From: Ahimsa Porter Sumchai MD PD
<ahimsaportersumchaimd@hunterspointcommunitybiomonitoring.net>

Sent: Monday, September 12, 2022 10:56 AM

To: Angel Bradley; Arieann Harrison

Cc: PrestonStaff (BOS); Preston, Dean (BOS); MandelmanStaff, [BOS]; ChanStaff (BOS); Somera, Alisa (BOS); Cabrera, Stephanie (BOS); Walton, Shamann (BOS); Board Of supervisors; James Dahlgren MD; Kathleen Dahlgren; editor@sfbayview.com

Subject: Important Documents - Board of Supervisors Audit & Oversight Committee Thursday, September 15, 2022 - Civil Grand Jury Report

Attachments: CivilGrandJuryCitizenComplaint.pdf; Declaration Regarding Health Risks to Hunters Point Residents.pdf; September-17-2019-Petition-to-Reestablish-the-Hunters-Point-Shipyard-Restoration-Advisory-Board.pdf; Final Addendum Parcel F HHRA.pdf; Radionuclides of Concern HPS HRA.jpeg; 48A3E679-4C86-4BAB-B549-16FFC2F2E15D_1_105_c.jpeg; D7F850E3-5116-46DD-8530-D392C29AC83B.jpeg; 33D77A1F-CEF8-4170-AB88-A9581F32B80B.png

Good morning,

I have attached important documents I am submitting to the Government Audit & Oversight Committee of the San Francisco Board of Supervisors in its review of the Civil Grand Jury Report. The documents include the formal complaint I submitted to the CGJ, the Exhibit included in the June 19, 2021 Proposition 65 Legal Injunction on Health Risks to Hunters Point Residents & Plaintiffs, the Formal Request to Reinstate the RAB, the National Response Center Incident Report and key documents from the Parcel A FOST and HRA identifying chemicals and radionuclides of concern known to be present at the Hunters Point Naval Shipyard.

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https://www.alignable.com/san-francisco-ca/hunters-point-community-biomonitoring-program

Citizen Complaint Form

City and County of San Francisco
Civil Grand Jury, Superior Court
400 McAllister St., Room 008
San Francisco, CA 94102 (FAX: 551-3601)

Person or Agency About Which Complaint is Made

Name or Agency: Mayor London Breed and Mayors Hunters Point Shipyard Citizens Advisory Committee UC Review of Radiological Soil Standa

Address: City Hall, Room 200 1 Dr. Carlton B. Goodlett Place San Francisco, Ca 94102

Telephone: (415) 554-6141

Nature of Complaint

Describe the events in the order they occurred and as concisely as possible:

On July 17, 2019 the Mayors Hunters Point Shipyard CAC hosted a meeting to introduce the UC led Review on Radiological Soil Standards at a meeting tha
The minutes of that meeting would later be determined to have been falsified following a whistleblower complaint and investigation. The meeting was capture
Particpants included scientists, doctors, attorneys, Hunters Point homeowners and community leaders and environmental activists. They were greeted in an
The meeting featured as keynote speaker UCSF Professor John Balmes, MD - who would later issue a public apology and admit he had been paid by the shi

In an audiotaped conference call with myself and UCSF MAA President Ramona Tascoe in August of 2019 John Balmes admits he was told by Mayor Breed not to speak to us.
He also admits the four "white male scientists" of the UC Review believed the soil standards and gamma scanning of the shipyard was inadequate and that Mayor Breed asked the

(attach additional sheet(s), if required)

Contacts

Which persons or agencies have you contacted about this problem?

Name or Agency	Address	Contact Date	Result
Mayor London Breed	City Hall, Room 200 1 Dr. Carlton B. Goodlett Place San Francisco, Ca 94102		Obstruction and Retaliation
Sunshine Ordinance Task Force	City Hall, Room 1 Dr. Carlton B. Goodlett Place San Francisco, Ca 94102		Obstruction and Censorship
Mayors Hunters Point Shipyard CAC	451 Galvez Avenue Suite 100 San Francisco 94124		Fraud, uncivil and unethical conduct
Attorney General Xavier Beccera	455 Golden Gate Avenue #11000 San Francisco 94102		Referral to City Attorney, UC President, DA and CGJ

Who do you believe the Grand Jury should contact about this matter?

Name or Agency	Address	Telephone
Mayor London Breed and Hank Heckel Compliance Officer for Office of Mayor	City Hall Room 200	(415) 554-6141
Micah Fobbs and Alise Vincent Administrators HPS CAC	451 Galvez Avenue S.F. 94124	info@hpscac.com

Action Requested

Describe the action you wish the Grand Jury to take:

Casey Hallinan on behalf of AG Xavier Beccera responded to a complaint that State and Local Open meeting violations occurred when Mayor London Breed required that four "wh
scientists" [term used by John Balmes MD in audiotaped conversation] meet in secret and prohibited them from speaking to key individuals including
two African American female doctors. The Sunshine Ordinance found no jurisdiction in this matter and failed to address the lack of a quorum and falsified mi
An email thread sent by Chronicle investigator Jason Fagone documents an exchange with John Balmes, Dr. Tascoe and myself in which Balmes admits
the report the four scientists submitted had been altered prior to its release and names key individuals in the health department and Mayors office who were
in a position to alter the final report. This is a matter of public health and safety. These are radioactive soils and this matter needs to be fully exposed.

Citizen Submitting Complaint

Name: Ahimsa Porter Sumchai, MD - PI & Medical Director Hunters Point Biomonitoring Program/Environmental Science Editor SF Bayview Newspape

Address: 236 West Portal Avenue #563 San Francisco, Ca 94127

Telephone (415) 859-5471

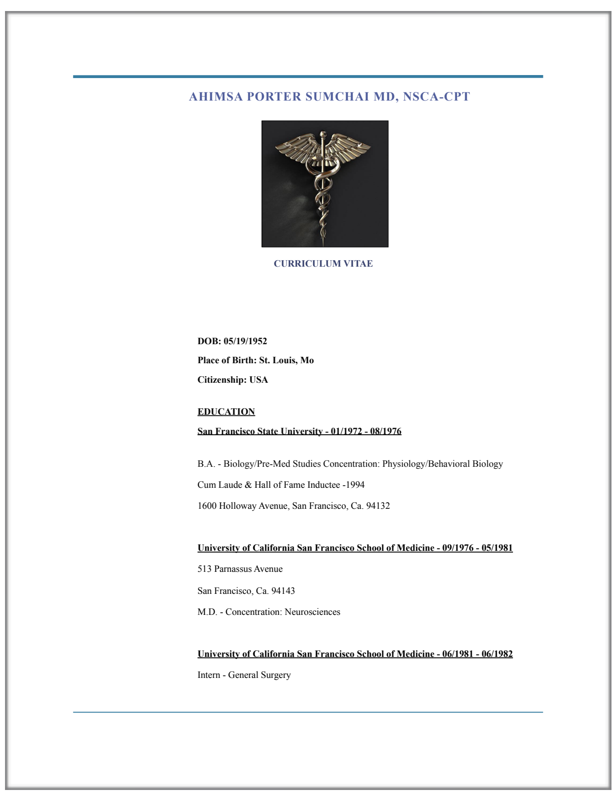
The information on this form is true, correct and complete to the best of my knowledge:

Ahimsa Porter Sumchai, MD — 08/17/21

Signature of Complainant — Date

Declaration Pursuant to Proposition 65 (Health & Safety Code, Section 25249.7 (d) (1)) Documenting Health Risks to Hunters Point Residents Due to Federal Superfund System Development Activities at the Hunters Point Naval Shipyard

Ahimsa Porter Sumchai, MD - Medical Director
Principal Investigator



AHIMSA PORTER SUMCHAI MD, NSCA-CPT

CURRICULUM VITAE

DOB: 05/19/1952
Place of Birth: St. Louis, Mo
Citizenship: USA

EDUCATION
San Francisco State University - 01/1972 - 08/1976

B.A. - Biology/Pre-Med Studies Concentration: Physiology/Behavioral Biology
Cum Laude & Hall of Fame Inductee -1994
1600 Holloway Avenue, San Francisco, Ca. 94132

University of California San Francisco School of Medicine - 09/1976 - 05/1981
513 Parnassus Avenue
San Francisco, Ca. 94143
M.D. - Concentration: Neurosciences

University of California San Francisco School of Medicine - 06/1981 - 06/1982
Intern - General Surgery

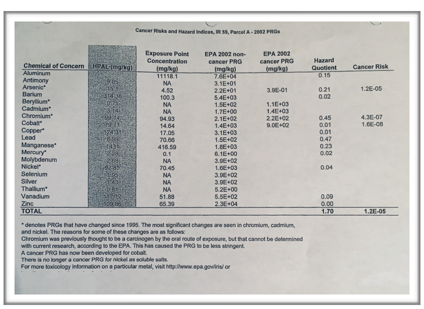
I, Ahimsa Porter Sumchai, MD, PD, declare:

1. Pursuant to the Proposition 65 requirement to submit to the Attorney General "factual information sufficient to establish the basis of a certificate of merit" for a civil action under Health & Safety Code, Section 25249.7 (d) (1), I submit the following Declaration:

2. I hold an unrestricted license issued by the Medical Board of California valid through May 31, 2022 and hold a certificate of completion of a Stanford Postdoctoral Clinical and Research Fellowship in the Department of Surgery/Division of Emergency Medicine on February 29, 1988. I was Board Certified in Emergency Medicine on March 17, 1992 and attended Medical Toxicology Grand Rounds at the San Francisco General Hospital as part of my fellowship learning requirements beginning in March of 1986.

3. I am the Medical Director and Principal Investigator for the Hunters Point Community Biomonitoring Program located at 5021 3rd Street at Palou. The Medical Screening Clinic is located within the affected region, less than one quarter of a mile from the federal Superfund system at HPNS, the Parcel E-2 landfill and Yosemite Slough. It was granted an MBC Fictitious Name Permit # 550759.

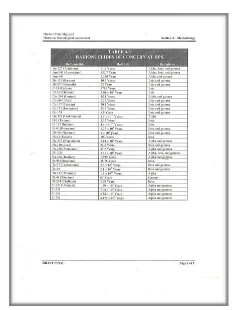
4. The purpose of this Declaration is to submit to the Attorney General factual information sufficient to establish the basis of the certificate of merit for a civil action under Health & Safety Code, Section 25249.7 (d)(1) based on documented exposures to airborne toxicants, epidemiological data demonstrating patterns of environmentally linked diseases in the 94124 zip code and valid human biomonitoring research documenting the presence of EPA designated chemicals of concern and radioactive elements of concern in urine screenings conducted on residents and workers within a one mile perimeter of the system of federal Superfund sites at the Hunters Point Naval Shipyard, with associated health effects. Those elements are documented here:



Cancer Risks and Hazard Indices, IR 59, Parcel A - 2002 PRGs

Chemical of Concern	HPAL (mg/kg)	Exposure Point Concentration (mg/kg)	EPA 2002 non-cancer PRG (mg/kg)	EPA 2002 cancer PRG (mg/kg)	Hazard Quotient	Cancer Risk
Aluminum		11118.1	7.6E+04		0.15	
Antimony	9.05	NA	3.1E+01			
Arsenic*	11.1	4.52	2.2E+01	3.9E-01	0.21	1.2E-05
Barium	314.36	100.3	5.4E+03		0.02	
Beryllium*	0.71	NA	1.5E+02	1.1E+03		
Cadmium*	3.14	NA	1.7E+00	1.4E+03		
Chromium*	99.14	94.93	2.1E+02	2.2E+02	0.45	4.3E-07
Cobalt*	19.11	14.64	1.4E+03	9.0E+02	0.01	1.6E-08
Copper*	124.31	17.05	3.1E+03		0.01	
Lead	8.99	70.66	1.5E+02		0.47	
Manganese*	1431	416.59	1.8E+03		0.23	
Mercury*	2.28	0.1	6.1E+00		0.02	
Molybdenum	2.68	NA	3.9E+02			
Nickel*	92.85	70.45	1.6E+03		0.04	
Selenium	1.95	NA	3.9E+02			
Silver	1.43	NA	3.9E+02			
Thallium*	0.81	NA	5.2E+00			
Vanadium	117.17	51.88	5.5E+02		0.09	
Zinc	109.86	65.39	2.3E+04		0.00	
TOTAL					1.70	1.2E-05

* denotes PRGs that have changed since 1995. The most significant changes are seen in chromium, cadmium, and nickel. The reasons for some of these changes are as follows:
Chromium was previously thought to be a carcinogen by the oral route of exposure, but that cannot be determined with current research, according to the EPA. This has caused the PRG to be less stringent.
A cancer PRG has now been developed for cobalt.
There is no longer a cancer PRG for nickel as soluble salts.
For more toxicology information on a particular metal, visit http://www.epa.gov/iris/ or



Hunters Point Shipyard
Historical Radiological Assessment
Section 4 – Methodology

TABLE 4-3
RADIONUCLIDES OF CONCERN AT HPS

Radionuclide	Half Life	Radiations
Ac-227 (Actinium)	21.8 Years	Alpha, beta, and gamma
Am-241 (Americium)	432.7 Years	Alpha, beta, and gamma
Am-243	7,370 Years	Alpha and gamma
Ba-133 (Barium)	10.5 Years	Beta and gamma
Bi-207 (Bismuth)	32 Years	Beta and gamma
C-14 (Carbon)	5715 Years	Beta
Cl-36 (Chlorine)	3.01×10^5 Years	Beta
Cm-244 (Curium)	18.1 Years	Alpha and gamma
Co-60 (Cobalt)	5.27 Years	Beta and gamma
Cs-137 (Cesium)	30.1 Years	Beta and gamma
Eu-152 (Europium)	13.5 Years	Beta and gamma
Eu-154	8.6 Years	Beta and gamma
Gd-152 (Gadolinium)	1.1×10^{14} Years	Alpha
H-3 (Tritium)	12.3 Years	Beta
In-115 (Indium)	4.4×10^{14} Years	Beta
K-40 (Potassium)	1.27×10^9 Years	Beta and gamma
Nb-94 (Niobium)	2×10^4 Years	Beta and gamma
Ni-63 (Nickel)	100 Years	Beta
Np-237 (Neptunium)	2.14×10^6 Years	Alpha and gamma
Pb-210 (Lead)	22.6 Years	Beta and gamma
Pu-238 (Plutonium)	87.7 Years	Alpha and gamma
PU-239	2.41×10^4 Years	Alpha, beta, and gamma
Ra-226 (Radium)	1,599 Years	Alpha and gamma
Sr-90 (Strontium)	28.78 Years	Beta
Tc-97 (Technetium)	2.6×10^6 Years	Beta and gamma
Tc-99	2.1×10^5 Years	Beta and gamma
Th-232 (Thorium)	1.4×10^{10} Years	Alpha
Ti-44 (Titanium)	67 Years	Gamma
Tl-204 (Thallium)	3.78 Years	Beta
U-233 (Uranium)	1.59×10^5 Years	Alpha and gamma
U-235	7.04×10^8 Years	Alpha and gamma
U-236	2.34×10^7 Years	Alpha and gamma
U-238	4.478×10^9 Years	Alpha and gamma

DRAFT FINAL
Page 1 of 1

5. This Declaration offers easily substantiated proof of health and safety risks faced by the most vulnerable residents and workers in the City & County of San Francisco due to documented exposure to known chemical and radioactive toxicants released by federal Superfund site development and soil excavation activities. These toxicants are numerous, dangerous, and are being detected in urinary screenings of nearby residents and workers as the direct result of airborne, waterborne, ingestion and dermal absorption. The majority of these elements are documented to be present in shipyard soils and landfills and present in Parcel A soils with calculated hazard risks by EPA 2002 PRGs. They include arsenic, cadmium, copper, manganese, nickel, thallium, vanadium and zinc. Elements with known radioisotopes are also detected using human biomonitoring urinary toxicology screenings and include, uranium, cesium, thallium, strontium, vanadium, gadolinium, rubidium and gamma emitting isotopes of manganese. Manganese has being detected in 100% of screenings. Naturally occurring manganese (25Mn) has twenty five radioisotopes, the most stable being 53Mn with a half life of 3.7 million years. 45Mn has an unknown half-life. The May 27, 2004 minutes of the HPNS Restoration Advisory Board documents the Navy/EPA decision to relax standards for clean up of manganese in shipyard soils. HPNS remediation tables document the elements most commonly detected on urinary toxicology screen- manganese, vanadium, arsenic and thallium -to be detected in soil analyses frequencies as high as 100%.

AR_N00217_004031
HUNTERS POINT
SSIC NO. 5090.3.A

Hunters Point Shipyard
Installation Restoration Program
Public Information Materials

27 May 2004
Public Meeting/Restoration Advisory Board Meeting
Held at Dago Mary's Restaurant
San Francisco, California

Materials/Handout Include:

- Agenda for 27 May 2004 RAB
- Meeting/Minutes from 22 April 2004 RAB Meeting
  - Includes: Action Items from 22 April 2004 RAB Meeting; and
  - Table 1, RAB Roll-Call Sheet
- Reporters Transcript from 27 May 2004 RAB Meeting
- PowerPoint Presentation, NAVSEA, HRA Update, 27 May 2004
- Monthly Progress Report, April 2004
- Meeting Minutes, HPS RAB, Economic Subcommittee, 04 May 2004 (w/attachment)
- Meeting Minutes, HPS RAB, Membership/Bylaws & Community Outreach Subcommittee, 12 May 2004 (w/attachment)
- Meeting Minutes, HPS RAB, Technical Review Subcommittee, 13 April 2004 and 18 May 2004 (w/attachment)
- Letter from ARC Ecology to Keith Forman, Draft Final Finding of Suitability to Transfer Parcel A, 24 May 2004
- Letter from ARC Ecology to Lynne Brown, Response to Lynne's e.mail regarding ARC Ecology's alleged conflict of interest, 26 May 2004
- Handout, Project Fact Sheet, Bayview Transportation Improvements Project
- Handout, Cancer Risks and Hazard Indices, IR 59-JAI, Parcel A -2002 PRGs
- Handout, Summary of Waste Consolidation at HPS, 27 May 2004
- Handout, Draft Revised Proposed RAB Rule, January 2004

Ms. Loizos also reported that she looked into the Parcel A risk assessment and the Parcel E radiological risk assessment, at the request of Ahimsa Sumchai, RAB member. She replied that some of the preliminary remediation goals (PRGs) from the EPA were revised and have become less stringent for manganese and nickel. Ms. Loizos also said that concerns of metals in the groundwater were more or less resolved since the regulatory agencies have determined the groundwater underneath the Shipyard to be non-beneficial and therefore unlikely to pose a health threat. Regarding a review of the Parcel E radiological risk assessment, Ms. Loizos said the comments were that there was not enough consideration of how materials might have gotten off the Shipyard, as well as the effects off-site migration might have had on the bay and the sediments in the bay. The review also questioned why radium was the only radionuclide of concern on Parcel E.

Mr. Tompkins objected to the Navy changing the PRGs for manganese and nickel, as well as the subcommittee's report that these new levels are safe. He asserted that African-Americans are more susceptible to certain environmental contaminants than a 35-year old white male -- the standard for standard risk assessment calculations. Ms. Loizos clarified her report and stated that the Navy did not change the PRGs, the EPA is the regulatory agency that sets the cleanup goals. Michael Work, US EPA, said he was unsure what variables were use for the PRGs for manganese but he would look into the question and report back.

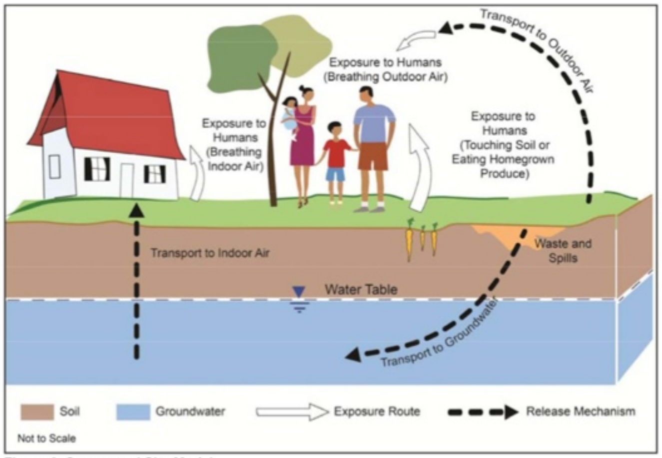


Figure 6. Conceptual Site Model

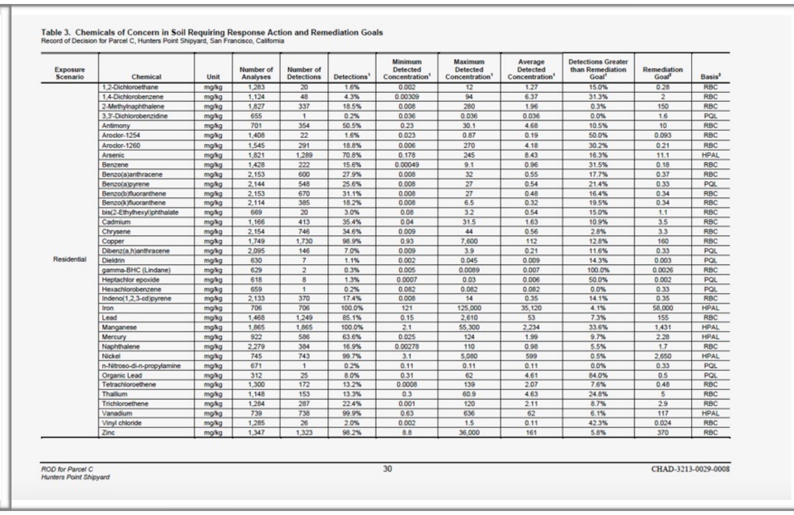


Table 3. Chemicals of Concern in Soil Requiring Response Action and Remediation Goals
Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California

Exposure Scenario	Chemical	Unit	Number of Analyses	Number of Detections	Detections[1]	Minimum Detected Concentration[1]	Maximum Detected Concentration[1]	Average Detected Concentration[1]	Detections Greater than Remediation Goal[1]	Remediation Goal[2]	Basis[2]
Residential	1,2-Dichloroethane	mg/kg	1,283	20	1.6%	0.002	12	1.27	15.0%	0.28	RBC
	1,4-Dichlorobenzene	mg/kg	1,124	48	4.3%	0.00309	94	6.37	31.3%	2	RBC
	2-Methylnaphthalene	mg/kg	1,827	337	18.5%	0.008	280	1.96	0.3%	150	RBC
	3,3'-Dichlorobenzidine	mg/kg	655	1	0.2%	0.036	0.036	0.036	0.0%	1.6	PQL
	Antimony	mg/kg	701	354	50.5%	0.23	30.1	4.68	10.5%	10	RBC
	Aroclor-1254	mg/kg	1,408	22	1.6%	0.023	0.87	0.19	50.0%	0.093	RBC
	Aroclor-1260	mg/kg	1,545	291	18.8%	0.006	270	4.18	30.2%	0.21	RBC
	Arsenic	mg/kg	1,821	1,289	70.8%	0.178	245	8.43	16.3%	11.1	HPAL
	Benzene	mg/kg	1,428	222	15.6%	0.00049	9.1	0.96	31.5%	0.18	RBC
	Benzo(a)anthracene	mg/kg	2,153	600	27.9%	0.008	32	0.55	17.7%	0.37	RBC
	Benzo(a)pyrene	mg/kg	2,144	548	25.6%	0.008	27	0.54	21.4%	0.33	PQL
	Benzo(b)fluoranthene	mg/kg	2,153	670	31.1%	0.008	27	0.48	16.4%	0.34	RBC
	Benzo(k)fluoranthene	mg/kg	2,114	385	18.2%	0.008	6.5	0.32	19.5%	0.34	RBC
	bis(2-Ethylhexyl)phthalate	mg/kg	669	20	3.0%	0.08	3.2	0.54	15.0%	1.1	RBC
	Cadmium	mg/kg	1,166	413	35.4%	0.04	31.5	1.63	10.9%	3.5	RBC
	Chrysene	mg/kg	2,154	746	34.6%	0.009	44	0.56	2.8%	3.3	RBC
	Copper	mg/kg	1,749	1,730	98.9%	0.93	7,600	112	12.8%	160	RBC
	Dibenz(a,h)anthracene	mg/kg	2,095	146	7.0%	0.009	3.9	0.21	11.6%	0.33	PQL
	Dieldrin	mg/kg	630	7	1.1%	0.002	0.045	0.009	14.3%	0.003	PQL
	gamma-BHC (Lindane)	mg/kg	629	2	0.3%	0.005	0.0089	0.007	100.0%	0.0026	RBC
	Heptachlor epoxide	mg/kg	618	8	1.3%	0.0007	0.03	0.006	50.0%	0.002	PQL
	Hexachlorobenzene	mg/kg	659	1	0.2%	0.082	0.082	0.082	0.0%	0.33	PQL
	Indeno(1,2,3-cd)pyrene	mg/kg	2,133	370	17.4%	0.008	14	0.35	14.1%	0.35	RBC
	Iron	mg/kg	706	706	100.0%	121	125,000	35,120	4.1%	58,000	HPAL
	Lead	mg/kg	1,468	1,249	85.1%	0.15	2,610	53	7.3%	155	RBC
	Manganese	mg/kg	1,865	1,865	100.0%	2.1	55,300	2,234	33.6%	1,431	HPAL
	Mercury	mg/kg	922	586	63.6%	0.025	124	1.99	9.7%	2.28	HPAL
	Naphthalene	mg/kg	2,279	384	16.9%	0.00278	110	0.98	5.5%	1.7	RBC
	Nickel	mg/kg	745	743	99.7%	3.1	5,080	599	0.5%	2,650	HPAL
	n-Nitroso-di-n-propylamine	mg/kg	671	1	0.2%	0.11	0.11	0.11	0.0%	0.33	PQL
	Organic Lead	mg/kg	312	25	8.0%	0.31	62	4.61	84.0%	0.5	PQL
	Tetrachloroethene	mg/kg	1,300	172	13.2%	0.0008	139	2.07	7.6%	0.48	RBC
	Thallium	mg/kg	1,148	153	13.3%	0.3	60.9	4.63	24.8%	5	RBC
	Trichloroethene	mg/kg	1,284	287	22.4%	0.001	120	2.11	8.7%	2.9	RBC
	Vanadium	mg/kg	739	738	99.9%	0.63	636	62	6.1%	117	HPAL
	Vinyl chloride	mg/kg	1,285	26	2.0%	0.002	1.5	0.11	42.3%	0.024	RBC
	Zinc	mg/kg	1,347	1,323	98.2%	8.8	36,000	161	5.8%	370	RBC

ROD for Parcel C
Hunters Point Shipyard
30
CHAD-3213-0029-0008

Table 3 Chemicals of Concern documents the detection frequency of soil elements at HPNS. The chemicals being detected most frequently in urinary toxicology screenings of residents and workers within a one mile radius of HPNS are detected in shipyard soils up to 100% of analyses for manganese and vanadium, 13.3% for thallium and 40% for arsenic.

Toxic Elements

Results in µg/g creatinine

Element	Result	Reference Range
Lead	0.4	<= 1.4
Mercury	<dl	<= 2.19
Aluminum	5.5	<= 22.3
Antimony	<dl	<= 0.149
Arsenic	9	<= 50
Barium	1.0	<= 6.7
Bismuth	<dl	<= 2.28
Cadmium	0.31	<= 0.64
Cesium	8.3	<= 10.5
Gadolinium	<dl	<= 0.019
Gallium	0.007	<= 0.028
Nickel	3.61	<= 3.88
Niobium	<dl	<= 0.084
Platinum	<dl	<= 0.033
Rubidium	3,207	<= 2,263
Thallium	0.533	<= 0.298
Thorium	<dl	<= 4.189
Tin	0.46	<= 2.04
Tungsten	0.120	<= 0.211
Uranium	<dl	<= 0.026

Nutrient Elements

Results in µg/g creatinine

Element	Result	Reference Range
Chromium	4.2	0.6-9.4
Cobalt	0.07	0.01-2.60
Copper	10.4	4.0-11.4
Iron	<dl	5-64
Lithium	121	9-129
Manganese	2.30	0.03-1.16
Molybdenum	88	15-175
Selenium	49	32-333
Strontium	60	47-346
Vanadium	2.7	0.1-3.2
Zinc	680	63-688

Results in mg/g creatinine

Element	Result	Reference Range
Calcium	29	37-313
Magnesium	35	41-267
Potassium	5,705	759-4,653
Sulfur	642	367-1,328

Creatinine Concentration

Urine Creatinine ♦ 29.08 23.00-205.00 mg/dL

Collection Information

Urine Total Volume (in milliliters): not given
Length of Collection: 0.0
Provocation Comment:
Information regarding pre- or post-provocation was not provided.

© Genova Diagnostics · A. L. Peace-Brewer, PhD, D(ABMLI), Lab Director · CLIA Lic #34D0655571 · Medicare Lic #34-8475

CUEPC RMS 314 Rev 7

The CUEP voluntarily obtained on a screening of a Hunters Point hilltop resident during an asthma attack detects concentrations above reference range for multiple HNPS COCs and ROCs including cesium, nickel, rubidium, thallium, copper, manganese, vanadium, zinc and potassium. The detection of lithium offers proof of exposure to airborne soil elements. Lithium is one of three elements created in the Big Bang and the 25th most abundant in the earths crust. The screening was conducted after the resident reported seeing dust in her environment.

INVESTIGATION CONCLUSION
ANOMALOUS SOIL SAMPLES
AT HUNTERS POINT NAVAL SHIPYARD
Revision 1

April 2014

HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

Prepared by:

TETRA TECH EC, INC.
1230 Columbia Street, Suite 750
San Diego, California 92101-8536

Erik Abkemeier, CHP, PE, CSP, CHMM
Radiation Safety Officer

Greg Joyce, ASQ CQM Quality Control
Program Manager

London N. Breed
Mayor

San Francisco Department of Public Health
Grant Colfax, MD
Director of Health

Tomás Aragón, MD, DrPH
Health Officer

Cover Summary

Date: March 6, 2019

From: Tomás Aragón, MD, DrPH, Health Officer

Re: Greater Bay Area Cancer Registry, University of California, San Francisco report: "Cancer Incidence Among Residents of the Bayview-Hunters Point Neighborhood, San Francisco, California, 2008—2012"

At the request of the San Francisco Department of Public Health, the Greater Bay Area Cancer Registry (GBACR) at the University of California, San Francisco conducted a cancer incidence analysis for Bayview Hunters Point (BVHP) neighborhood for the period 2008–2012, the latest period for which reliable population and cancer estimates are available. BVHP residents have expressed concerns about cancer rates in the neighborhood because of the Hunters Point Naval Shipyard (HPNS), a U.S. Environmental Protection Agency Superfund site undergoing clean up and restoration. The GBACR evaluated 12 cancer types that, according to the American Cancer Society [1], have been linked to radiation exposures. A similar BVHP cancer analysis was conducted in 1998 for the period 1993–1995 that found no elevated cancer rates [2].

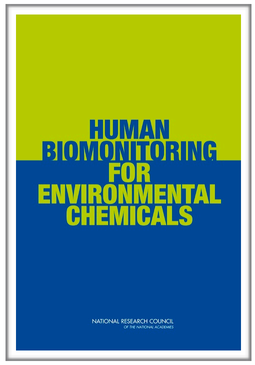
The current GBACR cancer incidence analysis compared the observed number of cancers in BVHP from 2008-2012 to the expected number of cancers if the BVHP neighborhood experienced the same cancer rates as similar neighborhoods in the Greater Bay Area nine-county region. The following cancers were evaluated for men and women: lung, colon, thyroid, myeloma, bladder, esophageal, stomach, liver, and lymphoma; and for women only: breast, uterine, and ovary.

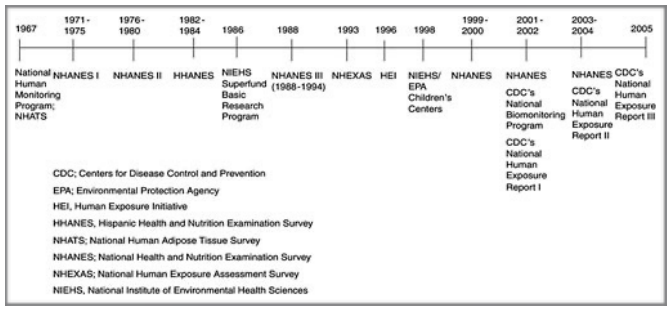
For all cancers combined, including both men and women, there was not an excess number of cases seen in BVHP. No excess number of cancers of any type was seen in women. There was an excess number of cases of one cancer—lung cancer—in men. There were no other significant findings in men. The analysis did not study causes or risk factors, and provides no evidence of any causes of the lung cancer among men.

The GBACR analysis identified a 31% increase in lung cancer cases among men. This finding was statistically significant. Because the most common cause of lung cancer is smoking, the GBACR evaluated whether smoking rates are elevated in BVHP. According to 2016 data from the Centers for Disease Control and Prevention "500 Cities Project: Local Data for Better Health," and included in the GBACR study, BVHP census tracts have increased smoking prevalence compared to other areas in San Francisco.

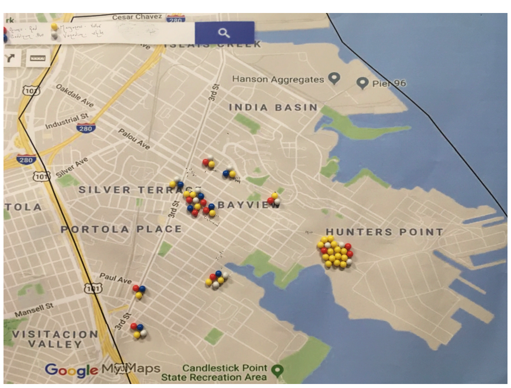
The Tetra Tech Internal Investigation detected 2,400 anomalous soil samples collected between the years 2008 and 2012 as established by Navy computers. In a letter to Mayor London Breed, Tomas Aragon, MD - Health Officer for CCSF documents a 31% increase in lung cancer in men in the 94124 zip code corresponding to the years 2008-2012

HUMAN BIOMONITORING IN ENVIRONMENTAL EXPOSURES





The National Human Monitoring Program was established in 1967. Human biomonitoring began in response to occupational exposures and grew out of the earliest work place exposures to radium (The Radium Girls) and lead. In 1993 the modern day era of human biomonitoring emerged that advanced the application of the nascent science to environmental exposures. For the first time NHEXAS offered aggregate analyses of multiple chemical toxicants analyzed using mass spectrometry. The Hunters Point Community Biomonitoring Program is the first human biomonitoring program that has detected an aggregate of multiple radioactive elements on multiple screenings. Combined with EPA recommended Geographic Information Systems or GIS, HP Biomonitoring has detected two distinct clusters of elements in screenings conducted on residents and workers within the one mile perimeter of the system of federal Superfund sites at HPNS:



Key to geospatial mapping: Left: red - arsenic, blue-gadolinium, yellow-manganese, white - vanadium

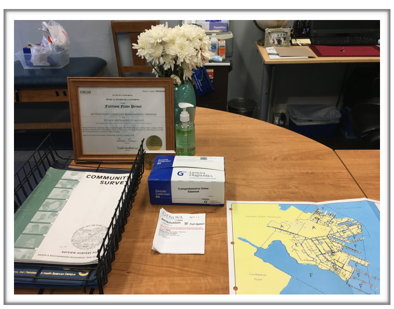
Right: yellow-uranium, green-cesium, black-thallium, red-rubidium, blue-gadolinium, white-strontium

FACTS ADDUCED SUPPORTED BY EVIDENCE

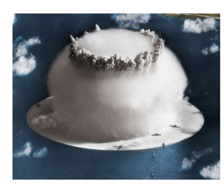
All of my opinions are rendered to a reasonable medical/scientific probability. The facts and conclusions of my opinions are based on over 20 years rigorous study of the Hunters Point Naval Shipyard remediation and development and my opinions are acceptable as true to a reasonable medical/scientific certainty. My uniquely qualifying personal and professional expertise is grounded in the following irrefutable facts:

1. **I was elected to the Hunters Point Shipyard Restoration (HPS) Advisory Board (RAB) in October 2000 in the aftermath of the Parcel E landfill fire that exposed residents and workers to products of combustion documented by ATSDR to include the known carcinogen benzene. I founded the HPS RAB Radiological Subcommittee and hosted it's first meeting in August 2001. I contributed to finalization of the HPS Historical Radiological Assessment and as a subcommittee chair and commenter, received all three hard copy iterations of the document.**

2. **I served as a physician specialist for the San Francisco Department of Public Health (SFDPH) as a UCSF resident in General and Neurological Surgery in 1982. In 1992, I founded "Hip Hop to Health" health care clinics in the Sunnydale Housing projects, Visitacion Valley community center and OMI. In 1997, I participated in the activities of the Bayview Hunters Point Health & Environmental Assessment, a community DPH partnership that produced a community survey I reference in the HP Biomonitoring screening clinic. In 1992, as a physician specialist with SFDPH I suffered the personal loss of my father, George Donald Porter, a career longshoreworker who died prematurely at age 58 from interstitial lung disease caused by occupational exposure to asbestosis.**



3. **I was appointed by Palo Alto VAH Medical Director Steven Osegi Okoye to head the Persian Gulf, Agent Orange, Ionizing Radiation Registry in 1997. I interviewed Atomic Veterans and survivors of Operation Crossroads nuclear testing conducted in 1946. Target and support ships from Shot Baker were hauled back to the Hunters Point Shipyard where radioactive sandblast from failed attempts to mitigate the high level radiation contamination was buried in landfills located on shipyard Parcels E and B.**



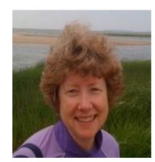
4. I was interviewed by the 2010-2011 and 2019/2020 Civil Grand Jury investigations documenting collusion between Lennar, SFDPH and EPA regulators in efforts to minimize and conceal community wide exposure to an estimated 1.2 million tons of asbestos, particulate and heavy metal containing serpentine rock from the Hunters Point hilltop.

CIVIL GRAND JURY
CITY AND COUNTY OF SAN FRANCISCO
2010-2011

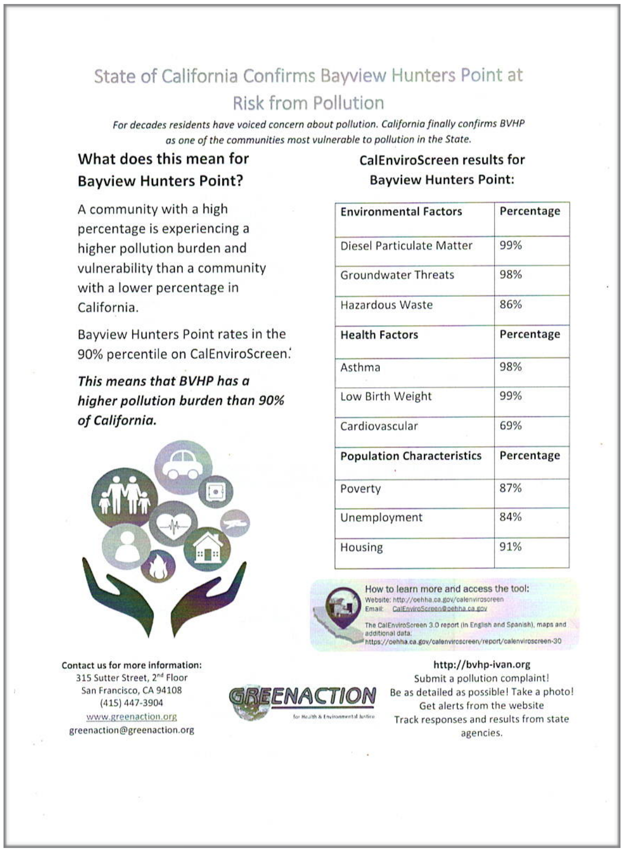
The SLAM Coalition of Bayview Hunters Point Community Organizations
Greenaction for Health and the Environment 703 Market St, Suite 501, San Francisco, CA 94102
Advocates for Environmental Human Rights. 650 Poydras Street, Suite 2523, New Orleans, Louisiana 70130

Emails Show Criminal Conspiracy by EPA, Region 9 and San Francisco Health Department Officials to Cover-up Dangers of the Lennar Corp.'s Development Project at the Hunters Point Naval Shipyard
Officials Suppress Data Showing Asbestos Exposures in the Bayview Hunters Point Community

Mark Ripperda, EPA Region 9
Remedial Project Manager



Amy Brownell, Environmental Engineer
San Francisco Department of Public Health



State of California Confirms Bayview Hunters Point at Risk from Pollution

For decades residents have voiced concern about pollution. California finally confirms BVHP as one of the communities most vulnerable to pollution in the State.

What does this mean for Bayview Hunters Point?

A community with a high percentage is experiencing a higher pollution burden and vulnerability than a community with a lower percentage in California.

Bayview Hunters Point rates in the 90% percentile on CalEnviroScreen.

This means that BVHP has a higher pollution burden than 90% of California.

CalEnviroScreen results for Bayview Hunters Point:

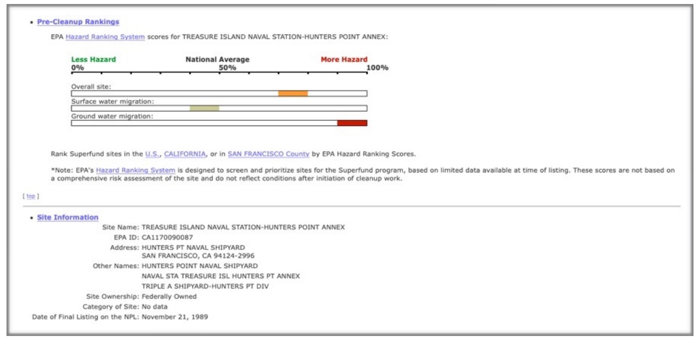
Environmental Factors	Percentage
Diesel Particulate Matter	99%
Groundwater Threats	98%
Hazardous Waste	86%
Health Factors	**Percentage**
Asthma	98%
Low Birth Weight	99%
Cardiovascular	69%
Population Characteristics	**Percentage**
Poverty	87%
Unemployment	84%
Housing	91%

How to learn more and access the tool:
Website: http://oehha.ca.gov/calenviroscreen
Email: CalEnviroScreen@oehha.ca.gov
The CalEnviroScreen 3.0 report (in English and Spanish), maps and additional data:
https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30

Contact us for more information:
315 Sutter Street, 2nd Floor
San Francisco, CA 94108
(415) 447-3904
www.greenaction.org
greenaction@greenaction.org

GREENACTION
for Health & Environmental Justice

http://bvhp-ivan.org
Submit a pollution complaint!
Be as detailed as possible! Take a photo!
Get alerts from the website
Track responses and results from state agencies.



- **Pre-Cleanup Rankings**

EPA Hazard Ranking System scores for TREASURE ISLAND NAVAL STATION-HUNTERS POINT ANNEX:

Less Hazard 0% | National Average 50% | More Hazard 100%

Overall site:
Surface water migration:
Ground water migration:

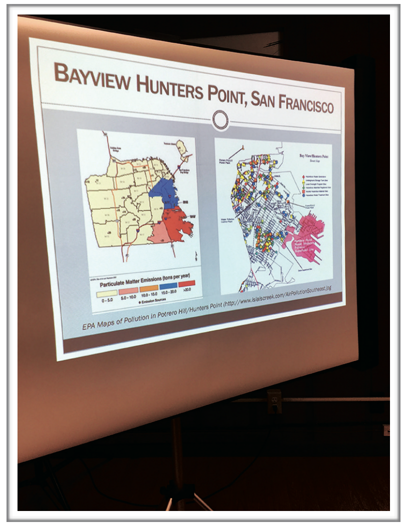
Rank Superfund sites in the U.S., CALIFORNIA, or in SAN FRANCISCO County by EPA Hazard Ranking Scores.

*Note: EPA's Hazard Ranking System is designed to screen and prioritize sites for the Superfund program, based on limited data available at time of listing. These scores are not based on a comprehensive risk assessment of the site and do not reflect conditions after initiation of cleanup work.

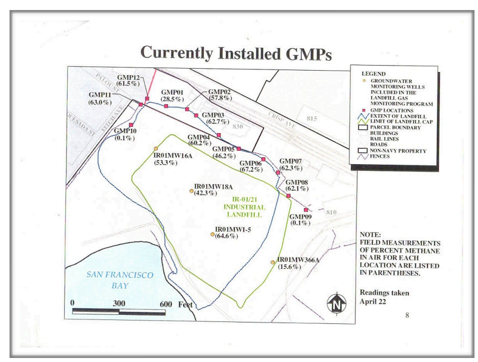
[top]

- **Site Information**

Site Name: TREASURE ISLAND NAVAL STATION-HUNTERS POINT ANNEX
EPA ID: CA1170090087
Address: HUNTERS PT NAVAL SHIPYARD
SAN FRANCISCO, CA 94124-2996
Other Names: HUNTERS POINT NAVAL SHIPYARD
NAVAL STA TREASURE ISL HUNTERS PT ANNEX
TRIPLE A SHIPYARD-HUNTERS PT DIV
Site Ownership: Federally Owned
Category of Site: No data
Date of Final Listing on the NPL: November 21, 1989

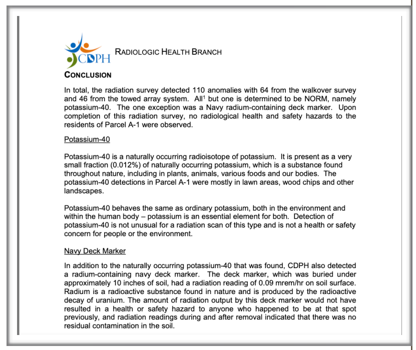


There exists protean epidemiological evidence demonstrating exposure to Bayview Hunters Point Residents from harmful chemicals, including radiation, generated by activities stemming from Lennar Corporations on-going excavation activities documented by recent videotaped evidence. Tetra Tech is no longer operational at HPNS and there is minimal evidence to support its role in soil fraud on Parcel A1 or Parcel A2. The entity most clearly linked to harmful on going exposures are remediation and excavations of the radiation contaminated Parcel E shoreline and the release of methane pockets from the Parcel E-2 landfill.



ENVIRONMENTAL EXPOSURES
FACTS, DATA FOR LOCATION AND SOURCE OF EXPOSURE

The Radiological Health Branch of the California Department of Public Health conducted a radiation survey that detected 110 above background anomalies from the walkover survey and towed array system conducted in 2018. The anomalies included a radium containing deck marker. The spectral analysis suggested the anomalies were due to naturally occurring radioactive materials or (NORM) and attributed to naturally occurring radioisotope of potassium K-40. The K-40 detections were primarily on lawn areas and residential streets.



CDPH RADIOLOGIC HEALTH BRANCH

CONCLUSION

In total, the radiation survey detected 110 anomalies with 64 from the walkover survey and 46 from the towed array system. All[1] but one is determined to be NORM, namely potassium-40. The one exception was a Navy radium-containing deck marker. Upon completion of this radiation survey, no radiological health and safety hazards to the residents of Parcel A-1 were observed.

Potassium-40

Potassium-40 is a naturally occurring radioisotope of potassium. It is present as a very small fraction (0.012%) of naturally occurring potassium, which is a substance found throughout nature, including in plants, animals, various foods and our bodies. The potassium-40 detections in Parcel A-1 were mostly in lawn areas, wood chips and other landscapes.

Potassium-40 behaves the same as ordinary potassium, both in the environment and within the human body – potassium is an essential element for both. Detection of potassium-40 is not unusual for a radiation scan of this type and is not a health or safety concern for people or the environment.

Navy Deck Marker

In addition to the naturally occurring potassium-40 that was found, CDPH also detected a radium-containing navy deck marker. The deck marker, which was buried under approximately 10 inches of soil, had a radiation reading of 0.09 mrem/hr on soil surface. Radium is a radioactive substance found in nature and is produced by the radioactive decay of uranium. The amount of radiation output by this deck marker would not have resulted in a health or safety hazard to anyone who happened to be at that spot previously, and radiation readings during and after removal indicated that there was no residual contamination in the soil.

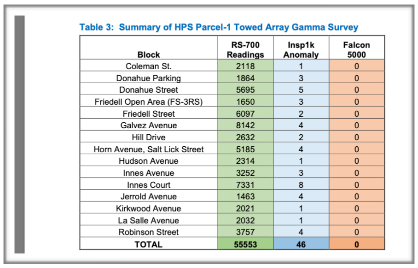


Table 3: Summary of HPS Parcel-1 Towed Array Gamma Survey

Block	RS-700 Readings	Insp1k Anomaly	Falcon 5000
Coleman St.	2118	1	0
Donahue Parking	1864	3	0
Donahue Street	5695	5	0
Friedell Open Area (FS-3RS)	1650	3	0
Friedell Street	6097	2	0
Galvez Avenue	8142	4	0
Hill Drive	2632	2	0
Horn Avenue, Salt Lick Street	5185	4	0
Hudson Avenue	2314	1	0
Innes Avenue	3252	3	0
Innes Court	7331	8	0
Jerrold Avenue	1463	4	0
Kirkwood Avenue	2021	1	0
La Salle Avenue	2032	1	0
Robinson Street	3757	4	0
TOTAL	**55553**	**46**	**0**

However, K-40 is identified as a radionuclide of concern by the shipyards Historical Radiological Assessment and was used in shipyard industry including photography, lithography and fireworks. The radiation survey does not include information about spectral analysis for Manganese and its gamma emitting isotopes. Manganese has a 100% detection rate in shipyard soils and has been detected in 100% of HP Biomonitoring's urinary screenings:

Toxic Elements

Results in µg/g creatinine

Element	Result	Reference Range
Lead	0.7	<= 1.4
Mercury	1.35	<= 2.19
Aluminum	7.1	<= 22.3
Antimony	0.107	<= 0.149
Arsenic	4	<= 50
Barium	4.1	<= 6.7
Bismuth	<dl	<= 2.28
Cadmium	0.21	<= 0.64
Cesium	6.5	<= 10.5
Gadolinium	<dl	<= 0.019
Gallium	<dl	<= 0.028
Nickel	6.84	<= 3.88
Niobium	<dl	<= 0.084
Platinum	<dl	<= 0.033
Rubidium	3,040	<= 2,263
Thallium	0.289	<= 0.298
Thorium	<dl	<= 4.189
Tin	0.49	<= 2.04
Tungsten	<dl	<= 0.211
Uranium	<dl	<= 0.026

Nutrient Elements

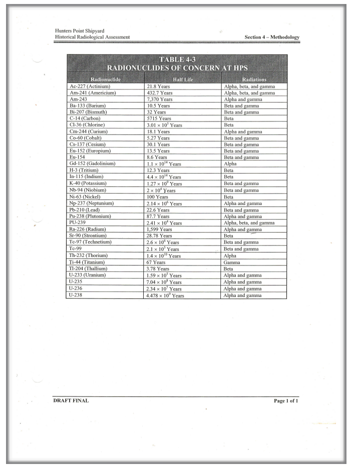
Results in µg/g creatinine

Element	Result	Reference Range
Chromium	3.2	0.6-9.4
Cobalt	<dl	0.01-2.60
Copper	9.1	4.0-11.4
Iron	<dl	5-64
Lithium	33	9-129
Manganese	3.12	0.03-1.16
Molybdenum	72	15-175
Selenium	48	32-333
Strontium	293	47-346
Vanadium	5.3	0.1-3.2
Zinc	328	63-688

Results in mg/g creatinine

Element	Result	Reference Range
Calcium	215	37-313
Magnesium	82	41-267
Potassium	5,233	759-4,653
Sulfur	576	367-1,328

Collection Information



Hunters Point Shipyard
Historical Radiological Assessment

Section 4 – Methodology

TABLE 4-3
RADIONUCLIDES OF CONCERN AT HPS

Radionuclide	Half Life	Radiations
Ac-227 (Actinium)	21.8 Years	Alpha, beta, and gamma
Am-241 (Americium)	432.7 Years	Alpha, beta, and gamma
Am-243	7,370 Years	Alpha and gamma
Ba-133 (Barium)	10.5 Years	Beta and gamma
Bi-207 (Bismuth)	32 Years	Beta and gamma
C-14 (Carbon)	5715 Years	Beta
Cl-36 (Chlorine)	3.01×10^5 Years	Beta
Cm-244 (Curium)	18.1 Years	Alpha and gamma
Co-60 (Cobalt)	5.27 Years	Beta and gamma
Cs-137 (Cesium)	30.1 Years	Beta and gamma
Eu-152 (Europium)	13.5 Years	Beta and gamma
Eu-154	8.6 Years	Beta and gamma
Gd-152 (Gadolinium)	1.1×10^{14} Years	Alpha
H-3 (Tritium)	12.3 Years	Beta
In-115 (Indium)	4.4×10^{14} Years	Beta
K-40 (Potassium)	1.27×10^9 Years	Beta and gamma
Nb-94 (Niobium)	2×10^4 Years	Beta and gamma
Ni-63 (Nickel)	100 Years	Beta
Np-237 (Neptunium)	2.14×10^6 Years	Alpha and gamma
Pb-210 (Lead)	22.6 Years	Beta and gamma
Pu-238 (Plutonium)	87.7 Years	Alpha and gamma
PU-239	2.41×10^4 Years	Alpha, beta, and gamma
Ra-226 (Radium)	1,599 Years	Alpha and gamma
Sr-90 (Strontium)	28.78 Years	Beta
Tc-97 (Technetium)	2.6×10^6 Years	Beta and gamma
Tc-99	2.1×10^5 Years	Beta and gamma
Th-232 (Thorium)	1.4×10^{10} Years	Alpha
Ti-44 (Titanium)	67 Years	Gamma
Tl-204 (Thallium)	3.78 Years	Beta
U-233 (Uranium)	1.59×10^5 Years	Alpha and gamma
U-235	7.04×10^8 Years	Alpha and gamma
U-236	2.34×10^7 Years	Alpha and gamma
U-238	4.478×10^9 Years	Alpha and gamma

DRAFT FINAL

Page 1 of 1

By Email

September 17, 2019

Laura Duchnak
BRAC PMO
33000 Nixie Way
Building 50, Suite 207
San Diego, CA 92147
(laura.duchnak@navy.mil)

Re: Request to Reestablish the Hunters Point Naval Shipyard Restoration Advisory Board

Dear Director Duchnak:

Greenaction for Health and Environmental Justice ("Greenaction"), the Bayview Hunters Point Mothers and Fathers Committee, Literacy for Environmental Justice, Bayview Hunters Point Community Advocates, and 240 members of the Bayview Hunters Point community, respectfully request that you, as the Installation Commander and for the reasons stated below, take the steps necessary to reestablish the Hunters Point Naval Shipyard ("Shipyard") Restoration Advisory Board ("RAB").

The RAB is intended to serve the following purposes to provide:

> (1) An opportunity for stakeholder involvement in the environmental restoration process at Department of Defense (DoD) installations. Stakeholders are those parties that may be affected by environmental restoration activities at the installation.
>
> (2) A forum for the early discussion and continued exchange of environmental restoration program information between DoD installations, regulatory agencies, tribes, and the community.
>
> (3) An opportunity for RAB members to review progress, participate in a dialogue with, and provide comments and advice to the installation's decision makers concerning environmental restoration matters. Installations shall give careful consideration to the comments provided by the RAB members.
>
> (4) A forum for addressing issues associated with environmental restoration activities under the Defense Environmental Restoration Program (DERP) at DoD installations, including activities conducted under the Military Munitions Response program (MMRP) to address unexploded ordnance, discarded military munitions, and the chemical constituents of munitions. Environmental groups or advisory boards that address issues other than environmental restoration activities are not governed by this regulation.[1]

[1] 32 C.F.R. § 202.1(b) (2006).

As further detailed below, the RAB should be reestablished because these purposes are important to the Bayview Hunters Point and the greater San Francisco community, which has a significant interest in the ongoing environmental restoration activities at the Shipyard. Community interest was strong when the RAB was dissolved in 2009, and community interest has only grown since then. Given that the community has demonstrated significant and sustained interest since the dissolution of the RAB, and because the circumstances that led the Navy to dissolve the RAB in 2009 no longer exist, the Navy should reestablish the RAB.

Initiating the establishment of the RAB is required by Department of Defense regulations, and is also a necessary first step in rebuilding trust and cooperation between the Navy and the community surrounding the Shipyard.

Sufficient and Sustained Community Interest

Sufficient community interest is a key factor that must be assessed for reestablishing the RAB.[2] Community interest in the Navy's environmental restoration activities, which has always existed, has only increased in recent years. The Navy is required to assess community interest regularly and should reestablish the RAB where that interest is "sufficient and sustained."[3] To evaluate whether "sufficient and sustained" community interest is present, the Navy must look to indicators including petitions from community members, media coverage, and consultation with local community members and government officials.[4]

We attach a petition signed by 240 local residents to demonstrate the overwhelming desire of the local community to have a more active role in the Navy's environmental restoration activities. The Petition, included as Attachment 1, provides evidence of sufficient and sustained community interest on its own.

Sufficient and sustained community interest is also demonstrated by the volume of longstanding and thorough media coverage related to the Navy's cleanup at the Shipyard. All major media outlets have reported on the cleanup repeatedly over the last few years. A list representing a small sample of coverage dating from the present back to 2016, included as Attachment 2, shows that media has been constant, and all media outlets such as TV, radio, and newspapers, both online and print, have covered issues related to the cleanup. A simple search on the internet reveals the abundance of reporting published in recent years.

Sufficient and sustained community interest is further demonstrated by the focus of elected officials and their constituents on the Navy's environmental restoration activities at the Shipyard. For example, over a year ago, while calling for the San Francisco Board of Supervisors to hold hearings on the Shipyard cleanup, local representative Malia Cohen said, "I have families reaching out with questions about air quality. I have people asking about how to get out of their

---

[2] *Id* § 202.10(c) ("When additional environmental restoration decisions have to be made resulting from subsequent action, such as long-term management and five-year reviews, the installation will reassess community interest for reestablishing the RAB. Where the reassessment finds sufficient and sustained community interest at previously adjourned or dissolved RABs, the Installation Commander should reestablish a RAB.").

[3] *Id.*

[4] *Id.* § 202.2; Department of Defense Restoration Advisory Boards, 71 Fed. Reg. 27612 (2006) ("In Section 202.2 of this rule… the Department has outlined several tools for Installation Commanders to use in the evaluation of 'sufficient and sustained community interest' including reviewing correspondence files and media coverage; consulting local community members and relevant government officials.").

leases because they are concerned about the lives and safety of their families."[5] Cohen also mentioned that the Navy "has done an exceptionally poor job [at] communicating with the public."[6] More recently, the Mayor convened an independent review of the Navy's environmental restoration plans. These examples clearly demonstrate that community interest is significant, and that it has persisted over a course of years.

The Circumstances Which Led the Navy to Dissolve the RAB No Longer Exist

Given the fact of sufficient and sustained community interest at the Shipyard, where restoration activities are still ongoing, not reestablishing a RAB can only be justified if the Installation Commander can demonstrate that the "same conditions exist" that required the original dissolution.[7] These conditions, purportedly relied upon by the Navy for dissolving the RAB, if indeed they existed, were internal to the RAB itself (i.e., a frustration with RAB members); the Navy can no longer rely on its purported rationale as that particular RAB has been disbanded.

The Navy's dissolution of the RAB was unacceptable at the time, and the regulations now require the Navy to re-engage with the community in a meaningful way and begin to repair the relationship.

Reestablishing the RAB Is Necessary for Rebuilding Trust with the Community

As stated above, among the purposes of a RAB are providing an "opportunity for stakeholder involvement," a "forum for addressing issues associated with environmental restoration" and "continued exchange" of information, and an opportunity for community members' comments to receive "careful consideration" by the Navy.[8] Dissolving the RAB undermined all of these processes, and the time is past due for the Navy to reestablish this cooperative forum with members of the community.

In fact, the Navy appears to be in violation of the regulatory requirement to "reassess community interest at least every 24 months."[9] This comes as no surprise to the community, given the Navy's track record of trying to dismiss and ignore the concerns of the local community.

The methods of community engagement the Navy has employed since 2009 are inadequate. In your Victim Impact Statement in *The Matter of U.S. v. Hubbard*, you noted that the Navy has lost its credibility with the community. You wrote that the community has a "total lack of confidence in the Navy's intentions and ability to conduct a proper cleanup."

If the Navy truly wants to start to rebuild the shattered trust of the community, reestablishing the RAB would be a positive step in the right direction.

---

[5] Laura Waxman, *City Supervisor Calls For Hearing On Hunters Point Cleanup*, San Francisco Examiner, April 18, 2018, http://www.sfexaminer.com/city-supervisor-calls-hearing-hunters-point-shipyard-cleanup/.
[6] *Id.*
[7] 32 C.F.R. § 202.10(c) ("If there is interest in reestablishment at a previously dissolved RAB, but the Installation Commander determines that the same conditions exist that required the original dissolution, he or she will request, through the chain-of-command to the Military Component's Deputy Assistant Secretary, an exception to reestablishing the RAB. If those conditions no longer exist at a previously dissolved RAB, and there is sufficient and sustained interest in reestablishment, the Installation Commander should recommend to the Deputy Assistant Secretary that the RAB be reestablished.").
[8] *Id.* § 202.1(b).
[9] *Id.* § 202.109(c).

We look forward to a prompt and positive response to this Petition to Reestablish the Restoration Advisory Board. Thank you for your attention to this matter.

Sincerely,

Greenaction for Health and Environmental Justice
Bradley Angel, Executive Director

Bayview Hunters Point Mothers and Fathers Committee
Leaotis Martin and Renay Jenkins, Co-Coordinators

Bayview Hunters Point Community Advocates
Michelle Pierce, Executive Director

Literacy for Environmental Justice
Patrick Rump, Executive Director

cc: By Email

Derek Robinson, Navy BRAC Environmental Coordinator (derek.j.robinson1@navy.mil)

Yolanda Sanchez, EPA Region 9 Community Involvement Coordinator (sanchez.yolanda@epa.gov)

Tyler Sullivan, Environmental Law and Justice Clinic, Golden Gate School of Law (tsullivan@ggu.edu)

Attachments:

- Petition signed by 240 Bayview Hunters Point residents
- Statement from Ahimsa Porter Sumchai, MD, Principle Investigator, Hunters Point Community Biomonitoring Program

Final

Addendum to the Feasibility Study Report for Parcel F

Hunters Point Naval Shipyard
San Francisco, California

Contract Number: N62473-09-D-2622
Contract Task Order: 0005
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Executive Summary

This report is an addendum to the final *Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California* (final FS report for Parcel F) (Barajas, 2008) to address radionuclides of concern (ROCs). The United States Department of the Navy (Navy) has identified six ROCs for Parcel F: cesium-137 (Cs-137), cobalt-60 (Co-60), plutonium-239/240 (Pu-239/240), radium-226 (Ra-226), strontium-90 (Sr-90), and uranium-235 (U-235) (NAVSEA, 2004). The intent of this addendum is to determine whether remedial actions are necessary to address the ROCs in Parcel F sediments, and if so, to present potential remedies.

Parcel F is located within Hunters Point Naval Shipyard (HPNS) in San Francisco, California. This parcel is the offshore area at HPNS and comprises 446 acres of underwater property. The final FS report for Parcel F evaluated potential remedial alternatives to address risks to human health and the environment from exposure to chemical contaminants (Barajas, 2008). After the FS report was finalized, radiological investigations of the offshore sediment at Parcel F were performed.

This document presents the following:

- Previously reported characterization data for ROCs at Parcel F
- Previously reported comparisons of the Parcel F data to the reference area data from the San Francisco Bay
- Results of previous statistical tests
- New information that quantifies the potential risk to future site users from exposure to ROCs
- An evaluation of potential cumulative human health risks from chemicals and ROCs
- An updated conceptual site model (CSM)
- The rationale for recommending that institutional controls (ICs) be placed on Parcel F sediments as the remedial alternative to manage future dredging activities, and to ensure the proper assessment of sediments and disposal of potential radiological devices at Parcel F

This FS addendum re-evaluates the entire historical dataset at Parcel F and provides new risk analysis in order to incorporate ROCs into the risk evaluation at Parcel F.

During extensive investigations performed throughout Parcel F, the Navy did not recover radioluminescent items such as dials, gauges, and deck markers from Parcel F sediments. Furthermore, no unacceptable risk from ROCs was identified during the risk evaluations. However, based on the CSM for HPNS activities that include the potential for inadvertent disposal of radioluminescent items, the Navy has decided that it is appropriate to place ICs on Parcel F sediments. ICs will allow for management of future dredging activities in light of the potential that low-level radiological objects such as radioluminescent dials, gauges, and deck markers could be encountered in dredge spoils.

A comprehensive history (from 1939 through June 2003) of radiological operations at HPNS, conducted by the Navy and Navy contractors and presented in the Historical Radiological Assessment (HRA), cited the principal areas of historical radiological operations at HPNS as follows:

- Repair, use, and disposal of radioluminescent items (such as dials, gauges, and deck markers)
- Gamma radiography for testing materials and calibration laboratory operations to ensure the accuracy of radiation survey equipment
- Decontamination of and scientific research on ships contaminated during atomic weapons testing during OPERATION CROSSROADS
- Use of various radionuclides for scientific research by the Naval Radiological Defense Laboratory and its predecessors

The HRA cited four potential release mechanisms to Parcel F: radioactive liquid waste discharged via the storm drains and sewers to Parcel F, OPERATION CROSSROADS decontamination activities, underwater experimentation, and accidental radioactive waste disposal activities from Navy ships. The HRA designated two general areas within Parcel F as impacted: “Underwater Areas” and “All Ships’ Berths.” The HRA did not provide boundaries for the Underwater Areas but described them as “underwater areas that encompass the property line of the shipyard, and waterways under ships’ docking and berthing areas” (NAVSEA, 2004). The assessment included an evaluation of media and migration pathways for five Parcel F ROCs (Cs-137, Pu-239/240, Ra-226, Sr-90, and U-235). Note that Co-60 was added as an ROC to Parcel F after the HRA, as described in the next paragraph. The HRA designated the potential for radiological contamination of sediment in Underwater Areas and All Ships’ Berths as “Low.”

The HRA designation for the underwater areas and ships’ berths as impacted was based on historical records and information. At the time the HRA was prepared, no radiological data had been collected from Parcel F sediments. To address the lack of information regarding the nature and extent of radionuclide activity within Parcel F, a two-phased data gap investigation was conducted. Phase 1 was a screening survey to characterize the nature and extent of ROC activity levels in sediment on a broad scale. The Phase 2 DGI was more focused and was split into two studies—Phase 2a conducted in 2011, followed by Phase 2b conducted in 2012. Phase 2a focused on locations within Parcel F where Phase 1 screening survey data indicated a potential for elevated radionuclide concentrations. Phase 2b was designed to cover the remaining Parcel F areas that were not covered in Phase 2a. Co-60 was also added as the sixth ROC for Parcel F during the data gap investigations because the radionuclide was used at the Experimental Ship Shielding Area adjacent to the South Basin in Parcel F. It is worth noting that the Phase I screening survey data that indicated a potential for elevated radionuclide concentrations was subsequently found to be biased high due to an onsite laboratory data interpretation issue that was later resolved through re-analysis at an offsite laboratory. This re-analysis showed that these results were approximately three times less than previous results for the ROC Ra-226 (ITSI Gilbane & SAIC, 2013).

The Phase 1, 2a, and 2b radiological data gap investigations conducted within Parcel F included the collection of environmental samples, laboratory analysis, assessment of risk to human health and the environment, calculation of screening criteria, and assessment of the data. The investigations included the advancement of over 300 sediment cores (247 Parcel F cores and 18 reference area cores for radionuclide analysis, and 42 cores for physical properties and quality assurance/quality control), which generated more than 1,058 sediment samples for laboratory analysis, 800 of which were analyzed for radionuclides.

The CSMs used to evaluate risk to humans and biota at Parcel F addressed two exposure scenarios: an intertidal component and a subtidal component (Battelle et.al., 2011). These CSMs differ in the way that receptors could be exposed to radionuclides in sediment as follows:

- The intertidal CSM is defined as areas within the Parcel F boundary from the high tide line (mean higher high water)[1] down in elevation to a water level of less than or equal to -3.0 feet mean lower low water.[2] Humans could be exposed through ingestion of contaminated shellfish and sediment, and external exposure to contaminated sediment. Biota could be directly exposed to contaminated sediments.
- The subtidal CSM is defined as areas within the Parcel F boundary with water levels greater than -3.0 feet mean lower low water. For the subtidal CSM, humans are assumed to be present in a boat over contaminated sediments. In this scenario, humans are assumed to be shielded by water from direct exposure to contaminated sediments but still could be exposed through ingestion of contaminated shellfish and sediment. Biota could be directly exposed to contaminated sediments.

Previous data gap investigations and the associated reports included discussion of a revetment wall CSM, which was defined as an area within the footprint of the revetment wall that had been planned for construction within and adjacent to Parcel B. Because the revetment wall is part of Parcel B, it is not relevant to Parcel F and, therefore, is not included within this report.

Risk assessments were completed for Parcel F to estimate risks associated with current and potential future exposure by human receptors and biota to radionuclides in sediment at Parcel F. Radionuclide risk evaluations for human health and biota were conducted during the Phase 2a and 2b investigations, using the sediment data collected during these and the Phase 1 investigations. The *Environmental Risk from Ionising Contaminants: Assessment and Management (ERICA) tool for biota risks* (Brown et al., 2008) to determine the potential environmental risk to biota. The ERICA tool models the transfer of radioactive material from sediment and water to organisms using a concentration factor approach.

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[1] The average of the higher high water height of each tidal day observed over the National Tidal Datum Epoch. Source NOAA/National Ocean Services.

[2] The average of the lower low water height of each tidal day observed over the National Tidal Datum Epoch. Source NOAA/National Ocean Services.

The Project Action Limits (PALs) estimated for biota were higher (less restrictive) than the PALs developed for protection of human health (Battelle and Sea Engineering, 2013). Therefore, for purposes of this addendum, only PALs for protection of human health were considered. Addressing potential risk to human health will also address potential risk to biota. The PALs developed for protection of human health were based on several model parameters that were established for human exposure to chemical contaminants in the Parcel F FS (Barajas, 2008) and the Final *Hunters Point Shipyard Parcel F Validation Study Report, San Francisco Bay, California* (Battelle et al., 2005). The previously established factors included consumption rates, exposure times, and other miscellaneous exposure parameters. PALs were developed for adult and child recreational users and for construction workers based on exposure via ingestion of contaminated shellfish and sediment and external exposure to contaminated sediment. The transfer of radioactive material from sediment to organisms to a human was modeled using a concentration factor approach similar to that used in the ERICA tool (Brown et al., 2008).

This FS addendum reassessed cancer risks for exposure to ROCs in sediment using 95 percent upper confidence limit (95 UCL) concentrations of ROCs measured during the Phase 1, 2a, and 2b radiological data gap investigations. Radiological risks were assessed for recreational users and were calculated as estimates of excess lifetime cancer risk. This FS addendum also updates human health risks for receptor exposure to nonradiological chemicals to reflect updated risk assessment methods, exposure assumptions, and toxicity criteria. This update incorporates 2014 HHRA Note 1. (DTSC, 2014) Combined cancer risks were calculated in this FS addendum to estimate the overall potential human health risk associated with recreational user exposure to both ROCs and chemicals in sediment at Parcel F. The combined risk for the recreational user is $4x10^{-4}$ for both the intertidal and subtidal CSM exposure scenarios. The combined risk for the intertidal and subtidal CSM exposure scenarios exceeds 10^{-4}, the upper end of the USEPA range of 10^{-4} to 10^{-6} for management of cancer risks. Chemical risks ($4x10^{-4}$ for both scenarios) contribute to the majority of the combined risk (99 percent for the intertidal scenario; nearly 100 percent for the subtidal scenario). Radiological risks ($4x10^{-6}$ for the intertidal scenario; $6x10^{-8}$ for the subtidal scenario) contribute minimally to the combined risk (1 percent for the intertidal scenario, negligibly for the subtidal scenario).

In addition, radiological risks associated with Parcel F are less than radiological risks associated with PAL + background levels. Radiological risks for the recreational user for the intertidal and subtidal scenarios ($4x10^{-6}$ and $6x10^{-8}$, respectively) are less than corresponding intertidal and subtidal radiological risks associated with PAL + background levels ($2x10^{-5}$ and $1x10^{-5}$, respectively). Chemical risks associated with Parcel F for the recreational user ($4x10^{-4}$) only slightly exceed ambient chemical risks associated with reference stations ($3x10^{-4}$).

A comprehensive analysis was performed to characterize the overall stability of the sediment bed in the Parcel F regions of interest. The study concluded that storm waves would resuspend only the top few centimeters of sediment and that substantial erosion from currents and waves is unlikely at the Berths North and Berths South sample locations. The results indicate it is unlikely that significant amounts of radiologically or chemically contaminated sediment historically would have been resuspended and transported from suspected source areas and deposited elsewhere.

The radiological data gap investigations concluded the following:

1. The Parcel F median radionuclide sediment concentrations were equal to or less than the median background concentrations for all six ROCs.
2. There is a highly statistically significant rejection of the null hypothesis that the median ROC concentration in Parcel F exceeds the median ROC concentration in the San Francisco Bay reference areas for the intertidal and subtidal exposure scenarios.
3. No individual sample had ROC concentrations exceeding the PAL + background.

The surveys at Parcel F are adequate for a scoping and characterization survey of a Class 3 site, and the sample densities are appropriate for the Wilcoxon Rank Sum test. A Class 3 survey unit is defined as an area having slight or no potential for residual radioactivity (USEPA, 2000). Sample results for all survey units were lower than the PAL, including background levels. The results for all three survey units were consistent with the background reference area when comparing the mean concentrations. The Wilcoxon Rank Sum test indicated that there was no significant difference between the subtidal, intertidal, and revetment wall, and the reference area sediment. The Navy has made reasonable effort to characterize Parcel F, and no radioactivity in excess of naturally occurring background levels has been identified. No additional radiological investigation or remediation for ROCs in Parcel F sediment is warranted.

However, low-level radiological objects or commodities such as radium dials and gauges from ship vessels may be present in Parcel F sediments, even though no items were discovered during the data gap investigations. Therefore, the Navy has decided that it is appropriate to place ICs on Parcel F sediments to manage future dredging activities and to ensure the proper assessment of sediments and disposal of potential radiological objects.

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Acronyms and Abbreviations

BCT	Base Realignment and Closure Cleanup Team
CDPH	California Department of Public Health
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	centimeter(s)
cm/year	centimeters per year
Co-60	cobalt-60
Cs-137	cesium-137
CSM	conceptual site model
DCGL	derived concentration guideline level
DGI	data gap investigation
DOD	United States Department of Defense
DOE	United States Department of Energy
DTSC	California Department of Toxic Substances Control
ELAP	Environmental Laboratory Accreditation Program
EPC	exposure point concentration
ERICA	Environmental Risk from Ionising Contaminants: Assessment and Management
FS	Feasibility Study
HHRA	human health risk assessment
HPNS	Hunters Point Naval Shipyard
HRA	Historical Radiological Assessment
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MLLW	mean lower low water
Navy	Department of the Navy
NRDL	Naval Radiological Defense Laboratory
NWT	New World Technology
pCi/g	picocurie(s) per gram
PAL	Project Action Limit
Pu-239/240	plutonium-239/240
QA/QC	quality assurance/quality control
Ra-226	radium-226
RI	Remedial Investigation
RME	reasonable maximum exposure

ROC	radionuclide of concern
ROD	Record of Decision
SFEI	San Francisco Estuary Institute
Sr-90	strontium-90
TCRA	time-critical removal action
U-235	uranium-235
UCL	upper confidence limit
USEPA	United States Environmental Protection Agency
Water Board	San Francisco Bay Regional Water Quality Control Board
WRS	Wilcoxon Rank Sum

1.0 Introduction

This report is an addendum to the *Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California* (final FS report for Parcel F) (Barajas, 2008) to address radionuclides of concern (ROCs). Parcel F is located at Hunters Point Naval Shipyard (HPNS) in San Francisco, California. The location of HPNS is shown on Figure 1-1 (figures are located at the end of this document), and the Parcel F boundary is shown on Figure 1-2. Parcel F is the offshore area at HPNS and comprises 446 acres of underwater property. The final FS report for Parcel F and this addendum are part of ongoing efforts by the United States Department of the Navy (Navy) to address hazardous substances at Parcel F in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The intent of this addendum is to determine whether remedial actions are necessary to address the ROCs in Parcel F sediments, and if so, to present potential remedies.

As the lead response agency, the Navy has authority over evaluation of remedial alternatives, selection of the preferred remedy, and overall public participation at HPNS. The Navy is coordinating efforts with the United States Environmental Protection Agency (USEPA) Region 9 (lead regulatory agency), the California Department of Toxic Substances Control (DTSC), and the San Francisco Bay Regional Water Quality Control Board (Water Board) in accordance with a Federal Facility Agreement that provides a procedural framework and schedule for the CERCLA cleanup process at HPNS (USEPA et al., 1991). The Navy, USEPA, DTSC, and Water Board representatives are collectively referred to as the Base Realignment and Closure Cleanup Team (BCT) for HPNS.

The final FS report for Parcel F focused on evaluating potential remedial options to address risks to human health and the environment from exposure to nonradioactive chemicals in sediment (Barajas, 2008). A human health risk assessment (HHRA) was completed as part of the Final Parcel F Validation Study (Battelle, Blasland, Bouck & Lee, Inc., and Neptune & Company, 2005) to estimate risks from exposure to nonradioactive chemicals in sediment and shellfish at Parcel F. Risks from exposure nonradioactive chemicals in shellfish were refined in the final FS report for Parcel F (Barajas, 2008). After the FS report was finalized, radiological investigations of the offshore sediment at Parcel F were performed.(Figure 3-1)

This document focuses on radionuclides and presents the following:

- Previously reported characterization data for ROCs at Parcel F
- Previously reported comparisons of the Parcel F data to the San Francisco Bay reference area data
- Results of previous statistical tests
- New information that quantifies the potential risk to future site users from exposure to ROCs
- An evaluation of potential cumulative human health risks from chemicals and ROCs

- An updated conceptual site model (CSM)
- The rationale for recommending that institutional controls (ICs) be placed on Parcel F sediments as the remedial alternative to manage future dredging activities, and to ensure the proper assessment of sediments and disposal of potential radiological devices at Parcel F

This FS addendum re-evaluates the entire historical dataset at Parcel F and provides new risk analysis to incorporate ROCs into the risk evaluation at Parcel F. While no unacceptable risk from ROCs was identified during the risk evaluations, the Navy has decided that it is appropriate to place ICs on Parcel F sediments. Placing ICs will allow for management of future dredging activities in light of the potential that low-level radiological objects such as radioluminescent dials, gauges, and deck markers could be encountered in dredge spoils.

This report was prepared in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (Title 40 of the *Code of Federal Regulations*, Part 300). USEPA guidance documents were used to prepare this report, including, but not limited to, the following:

- *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA, 1988)
- *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents* (USEPA, 1999)
- *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM; USEPA, 2000).

The data collected to date are sufficient to support risk-based decision making under CERCLA and are sufficient to support final status determinations following the general approach outlined in MARSSIM (USEPA, 2000).

1.1 Parcel F Study Areas

Two areas within Parcel F were identified in the Historical Radiological Assessment (HRA) (NAVSEA, 2004) as radiologically "impacted." These areas had two designations, "Underwater Areas" and "All Ships' Berths." The HRA did not provide the location of Underwater Areas in Parcel F on a figure but described it as "underwater areas that encompass the property line of the shipyard, and waterways under ships' docking and berthing areas" (NAVSEA, 2004). The locations of impacted sites as shown in the HRA are shown on Figure 1-2 and include the All Ships' Berths Area.

Subsequent to the HRA, the Phase 2b Technical Memorandum (ITSI, 2013) further subdivided Parcel F into smaller areas using various designations, including, but not limited to, the Submarine Area, Berth North Area, Berth South Area, South Basin, Submarine and Parcel B revetment wall, and the South Basin Experimental Ship Shielding Area (Figures 3-2 through 3-5). These designations were useful for conducting investigations. For the purposes of this addendum to the FS report, Parcel F site boundaries were taken as a whole and not subdivided. Structures such as the piers and berths within Parcel F are not part of this FS report because they were addressed as time-critical removal actions as specified in the Final Basewide Radiological Removal Action, Action Memorandum (Navy, 2006).

Because the revetment wall is part of Parcel B, it is not relevant to Parcel F and, therefore, is not included within this report.

1.2 Purpose and Scope

The purpose of the Remedial Investigation (RI)/FS process is a comparison of remedial strategies supported by valid site data and a risk assessment that allows decision makers to select ultimately the most appropriate remedy. During the FS process, remedial alternatives are developed, as needed, by incorporating medium-specific technologies into cleanup alternatives. However, as shown in this report, Parcel F does not have levels of ROCs that pose unacceptable risk to human health or the environment; therefore, remedial alternatives for ROCs are not presented or evaluated within this addendum.

1.3 Organization of Addendum

This addendum has been organized into the following sections:

- **Section 1: Introduction** – Identifies the Parcel F study areas; presents the purpose of the addendum, identifies the guidance documents used for its preparation; and summarizes the organization of the addendum.
- **Section 2: Site Description and Radiological History**– Presents a description of HPNS, its' radiological history and the HRA site designation for Parcel F.
- **Section 3: Radiological Investigations** – Summarizes the radiological investigations and data, CSMs, and Project Action Limits.
- **Section 4: Nature and Extent of Radionuclides –** Summarizes the previously reported data, results of statistical tests, and the nature and extent of radionuclides within Parcel F.
- **Section 5: Risk Assessment** – Summarizes previous human health risk evaluations for radionuclides, presents a re-assessment of radiological risks and new estimates of cumulative risk based on combined radiological and chemical risks, and summarizes the previous ecological risk assessment.
- **Section 6: Sediment Stability** – Summarizes results from sediment stability tests performed during the data gap investigations to estimate potential for sediment resuspension and the likelihood that ROC contaminated sediments were resuspended and transported elsewhere within Parcel F.
- **Section 7: Updated Conceptual Site Model –** Presents the updated CSM based upon results of the investigations and analysis presented in this addendum.
- **Section 8: Findings for No Action for Parcel F Sediment –** Presents the rationale and conclusions for no further action from radiological constituents in sediments.
- **Section 9: References** – Lists the documents and supporting information used to prepare this addendum.
- **Appendix A: Updated Human Health Risk Assessment – Chemical Contamination** – Provides an updated HHRA for exposure to nonradioactive chemicals in sediment and

shellfish at Parcel F to reflect revised methods for estimating exposure point concentrations (EPCs), revised assumptions for estimating exposure and chemical intake, changes to toxicity criteria, and updated risk characterization methods. The HHRA was updated as part of this addendum to incorporate the 2014 HHRA Note 1 (DTSC, 2014). The results of the updated HHRA for chemical contamination were used to estimate cumulative risks based on combined radiological and chemical risks (Section 5.0 of this report).

2.0 Site Description and Radiological History

This section presents a general description of HPNS and its physical characteristics, followed by a summary of the radiological history of Parcel F. Further details are presented in the various documents cited herein.

2.1 HPNS Background

HPNS is a former Navy installation situated on a peninsula in the southeastern corner of San Francisco, California (Figure 1-1). The peninsula is bounded on the north, east, and south by San Francisco Bay and on the west by the Bayview Hunters Point district. HPNS initially comprised approximately 934 acres, consisting of approximately 488 acres on land and approximately 446 acres of offshore sediments. The Navy acquired Hunters Point on December 29, 1939. From 1939 to 1944, Hunters Point was also known as United States Naval Drydocks Hunters Point. From 1945 to 1974, the Navy used HPNS predominantly for ship repair and maintenance. HPNS was deactivated in 1974 and remained relatively unused until 1976, when it was leased to Triple A Machine Shop, a private ship repair company. In 1986, the Navy resumed occupancy of HPNS. The shipyard was closed in 1991. HPNS has a current acreage of 859 (413 acres of land and 446 acres offshore) and is subdivided into 11 parcels (Parcels B, C, D-1, D-2, E, E-2, F, G, UC-1, UC-2, and UC-3). Former Parcel A was transferred to the City's redevelopment agency in 2004. The offshore portion of HPNS has been designated as Parcel F, which is the subject of this addendum.

Past shipyard operations left hazardous materials onsite; as a result, HPNS was included on the National Priorities List in 1989 as a Superfund site pursuant to CERCLA. In 1991, HPNS was designated for closure pursuant to the Defense Base Closure and Realignment Act of 1990.

2.2 Environmental Setting

This section briefly discusses the hydrodynamic setting of HPNS as it relates to Parcel F. Sediment stability is discussed separately in Section 6.0. HPNS has an irregular shoreline that trends generally in the north-south direction, with an east-west embayment on the south side of the peninsula referred to as the South Basin. The water depth along the northern shore of HPNS is generally less than 10 feet, increasing to more than 50 feet in the shipping channel east of HPNS. The water depths in the southern portion of the study area within the South Basin range from 6 feet to less than 2 feet.

2.3 Radiological History and Parcel F Site Designation

Sources of Radiation and Shipyard Activities

A comprehensive history (from 1939 through June 2003) of radiological operations conducted by the Navy and Navy contractors at HPNS is presented in the HRA (NAVSEA, 2004). Potential Radiological Operations at HPNS included three main activities: shipyard activities; decontamination of ships and research; and development activities at Naval

Radiological Defense Laboratory. While not all of these activities were performed off shore in Parcel F, they are important to evaluate in case a transport mechanism resulted in radiation reaching Parcel F. This section summarizes the key information and conclusions of the HRA. The following principal activities at HPNS were associated with historical radiological operations:

- Repair, use, and disposal of radioluminescent items (such as dials, gauges, and deck markers)
- Gamma radiography for testing materials and calibration laboratory operations to ensure the accuracy of radiation survey equipment
- Decontamination of and scientific research on ships contaminated during atomic weapons testing during OPERATION CROSSROADS
- Use of various radionuclides for scientific research by the Naval Radiological Defense Laboratory and its predecessors

Site Designations at Hunters Point Naval Shipyard

In addition to documenting the radiological history of HPNS, the Navy uses the HRA as a tool to assess the residual effect, if any, that radiological operations may have had on buildings, structures, or open areas. Assessments for the potential presence of radioactive materials result in designation of a site as "non-impacted" or "impacted." Non-impacted sites are considered to have no reasonable potential for residual radioactive contamination. A designation of impacted means the site has potential for radioactive contamination or is known to contain radioactive contamination. As described in the HRA, the following are impacted sites:

- Sites where radioactive materials were used or stored
- Sites where known spills, discharges, or other unusual occurrences involving radioactive materials have occurred, or may have occurred, that could have resulted in the release or spread of contamination
- Sites where radioactive materials might have been disposed of or buried

2.3.1 Potential Mechanisms for Radiological Release to Parcel F

The following section summarizes information from the HRA (NAVSEA, 2004). The HRA cited four potential release mechanisms to Parcel F; radioactive liquid waste discharged via the storm drains and sewers to Parcel F, OPERATION CROSSROADS decontamination activities, underwater experimentation, stormwater runoff from the Experimental Shielding area, and accidental radioactive waste disposal activities from Navy ships.

Liquid waste containing radium was commonly disposed of via building drain systems to sewers. Radium paint shops that repaired and maintained radioluminescent devices were likely located at HPNS, although no definitive locations have been established.

Radioluminescent devices came into wide use beginning in the late 1930s and continuing through the war years. Dials and surfaces that needed to be illuminated without using electricity were coated with a radioluminescent paint containing radium-226 (Ra-226). This mixture would glow, allowing personnel to locate controls, gauges, and walkways during ship operations or on dry docks and piers without the use of an external power source for light. Of the radionuclides used in radioluminescent devices, those of potential concern are Ra-226 and strontium-90 (Sr-90). Sr-90 was primarily used in deck markers onboard ships.

The ship berths were used to anchor the ships that came back from Operation Crossroads and the dry dock facilities were used for decontamination of the ships in the late 1940s and periodically through the 1950s and 1960s for the decontamination of ex-GRANVILLE S. HALL (Miscellaneous Auxiliary Service Craft [YAG]-39) and ex-GEORGE EASTMAN (YAG-40). YAG-39 and YAG-40 were ex-Liberty ships that provided support for research during weapons tests in the Pacific. Ship hulls were decontaminated in dry docks primarily using wet sandblast techniques. According to the HRA, while most of the decontamination material was collected and disposed at sea, some of it was discharged into the Bay.

The HRA recommended a final status survey at all ship berths before releasing them for unrestricted use because no records were found to show which berths were used for anchoring the ships. As previously noted, the berths are being addressed as part of the TCRA and not addressed in this report. The HRA also recommended that Bay sediments in the vicinity of all ship berths be investigated, which is the focus of this report.

No additional information is found regarding the nature of underwater experiments or the potential for accidental release of radiation from the ships.

2.3.2 Parcel F Impacted Site Designation

The HRA designated two general areas within Parcel F as impacted: Underwater Areas and All Ships’ Berths. The HRA did not provide boundaries for the Underwater Areas but described them as “underwater areas that encompass the property line of the shipyard, and waterways under ships’ docking and berthing areas” (NAVSEA, 2004). Figure 1-2 is the figure from the HRA that showed the radiologically impacted sites. The impacted site assessment was based on historical information indicating that there was potential for radiological contamination. The impacted designation was based on limited information and can be updated once additional information is collected. No radiological surveys or sampling activities had been conducted at Parcel F when the HRA was developed. The HRA identified the ROCs in the Underwater Areas as cesium-137 (Cs-137), plutonium-239 (Pu-239), Ra-226, Sr-90, and uranium-235 (U-235). The HRA identified the same ROCs for All Ships’ Berths with the exception of U-235. The Navy added cobalt-60 (Co-60) as an ROC for the South Basin area based on Co-60 use at the Experimental Shielding Area adjacent to the South Basin.

The HRA assessment included an evaluation of media and migration pathways for ROCs at Parcel F. The HRA designated environmental media’s potential for radiological contamination “None” or “Low.” A Low designation was defined as having the potential for contamination, and a designation of None was used when historical documentation of contamination in the specific medium or migration pathway had not been found. The HRA designated sediment in the Underwater Areas and All Ships’ Berths area as having a low potential for contamination and a low potential for serving as a migration pathway.

2.3.2.1 All Ships' Berths

Based on these determinations, the HRA recommended a review of the final status survey reports for completed berths and scoping surveys for the remaining areas. Scoping surveys and removal actions of the structures (i.e., surfaces of the berths and piers) are being performed as specified in the Final Basewide Radiological Removal Action, Action Memorandum (Navy, 2006) and are not discussed further in this addendum. Surveys of sediment in the vicinity of the ship berths and dry docks was included in the FS radiological investigations and is described in Section 3.0 of this addendum.

2.3.2.2 Underwater Areas

With respect to the remaining Underwater Areas, the HRA recommended scoping surveys in areas where OPERATION CROSSROADS decontamination activities were performed. Section 3.0 of this addendum further describes the sediment surveys that were performed radiological data gap investigations.

3.0 Radiological Investigations

This section summarizes the radiological investigations and the ecological and human health risk assessments that have been conducted for Parcel F.

3.1 Parcel F Radiological Investigations

The HRA concluded that six primary ROCs were related to operations potentially impacting Parcel F: Cs-137, Co-60, Pu-239/240, Ra-226, Sr-90, and U-235. However, at the time, the HRA was prepared and designations regarding impacted areas were made for the HPNS, no radiological data had been collected from Parcel F sediments. To address the data gaps regarding the nature and extent of radionuclide activity within Parcel F, a two-phased data gap investigation was conducted. Phase 1 was a screening survey to characterize the nature and extent of ROC concentrations in sediment on a broad scale. The Phase 2 data gap investigation was split into two studies—Phase 2a conducted in 2011, followed by Phase 2b conducted in 2012. The reference area locations from the San Francisco Bay that were used as part of the FS data gap investigation are shown on Figure 3-1. The sampling locations were spatially delineated into four areas: (1) the Submarine Base Area (Figure 3-2), (2) the Northern Berths Area (Figure 3-3), (3) the Southern Berths Area (Figure 3-4), and (4) South Basin (Figure 3-5). Phase 1, Phase 2a and Phase 2b sample locations are shown on Figures 3-2 through 3-5. The radiological investigations are summarized in Sections 3.1.1 through 3.1.3.

3.1.1 Phase 1 Radiological Screening Survey (2009)

The primary objective of the Phase 1 radiological investigation conducted in February 2009 was to provide an initial, broad-scope screening of activity levels in sediment for the six ROCs (Cs-137, Co-60, Pu-239/240, Ra-226, Sr-90, and U-235). No document was produced during Phase 1; however, the Phase 1 results were presented in the Phase 2a report (Battelle and Sea Engineering, 2013). Phase 1 screening locations were positioned to provide relatively even spatial coverage across Parcel F, with additional samples collected near storm drains and within dry docks, which were documented in the HRA as potential sources of radionuclides to Parcel F (Battelle and Sea Engineering, 2013). The Phase 1 screening survey results were used to develop the subsequent Phase 2 data gap investigation sampling approach—that is, Phase 2a and Phase 2b. It is worth noting that the Phase I screening survey data that indicated a potential for elevated radionuclide concentrations was subsequently found to be biased high due to an onsite laboratory data interpretation issue that was later resolved through re-analysis at an offsite laboratory that had United States Department of Defense Environmental Laboratory Accreditation and California National Environmental Laboratory Accreditation Certifications. This re-analysis showed that these results were approximately three times less than previous results for the ROC Ra-226 (ITSI Gilbane & SAIC, 2013). The re-analysis is explained further in Section 3.1.3.

3.1.2 Radiological Data Gap Investigation Phase 2a (2011)

The objectives of the Phase 2a data gap investigation included evaluation of the following: (1) ROC activity in sediment, (2) clam bioaccumulation exposure, (3) sediment stability, and (4) risks to human receptors and impacts to biota (Battelle and Sea Engineering, 2013). The Phase 2a report documents the results of the Phase 1 and Phase 2a sampling events. The sediment sampling activities conducted as part of Phase 2a were focused on the Submarine Area and the Berths North Area adjacent to the proposed Parcel B revetment walls (see Figures 3-2 through 3-5). Phase 2a work was initiated in the fall of 2011.

Sample locations for ROC activity in sediment were selected based on two primary considerations: (1) a greater sample density within areas of concern (locations originally suspected, in error, as having elevated Ra-226 levels) based on Phase 1 results), and (2) lower sample density for samples in areas where low ROC activity was measured during Phase 1.Additional sediment samples were collected at six reference areas within San Francisco Bay (Alameda Buoy, Alcatraz, Bay Farm, Red Rock, Oyster Point, and Paradise Cove) to establish background levels of ROC activity in the Bay.

Clams were deployed at four locations within Parcel F and in three reference areas. Locations in Parcel F were selected from those sampled during the Phase 1 screening survey; reference sites were selected to cover a range of particle sizes and geographic locations. At each deployment location, sediment was collected and placed into three cages with a sufficient number of clams (about 30 clams) to provide tissue analysis. Cages from two of the reference sites could not be recovered (Red Rock and Alameda Buoy [Figure 3-1]) because they became buried in the sediment, resulting in four clam tissue samples from Parcel F, one clam tissue reference sample, and one clam tissue control sample.

Two cores were collected for Sedflume analysis from the Parcel F Submarine Area and the Parcel B Revetment wall, shown on Figures 3-2 and 3-3, to characterize erosion rates and sediment stability with depth (i.e., to determine the critical shear stresses that represent the threshold for sediment resuspension). Particle size distribution and bulk density were also measured. This information was used to estimate the potential for resuspension of sediment under typical and extreme hydrodynamic conditions. Age dating data were also collected from two core locations. These samples were analyzed for beryllium-7, Cs-137, lead-210, Ra-226, and thorium-234 to estimate sediment age, accumulation rate, and information on the degree of surface sediment mixing. Age dating results confirmed the area as depositional and the Sedflume analysis confirmed that the sediment in this area will not likely be eroded (Battelle and Sea Engineering, 2013).

3.1.3 Radiological Data Gap Investigation Phase 2b (2013)

The final radiological data gap investigation, Phase 2b, was completed in February 2013 (ITSI Gilbane & SAIC, 2013). This work included investigating the remaining Parcel F areas that were not covered in Phase 2a, including portions of the Submarine Area (Figure 3-2), Berths North Area (Figure 3-3), Berths South Area (Figure 3-4), and South Basin Area (Figure 3-5). The Phase 2b sampling approach was designed to evaluate the same parameters as during Phase 2a: (1) ROC activity in sediments, (2) clam ROC exposure and bioaccumulation, and (3) sediment stability in these remaining areas. As a result, the Phase 2b samples included sediment cores, Sedflume, and age dating analysis, as well as clam deployments and associated sediment grabs used for bioaccumulation analysis.

Phase 2b also included confirmation sampling at additional locations in the South Basin Experimental Ship Shielding Area to delineate any potential Co-60 contamination. The HRA designated the Experimental Ship Shielding Area in Parcel E-2 as radiologically impacted with Co-60. Although the Experimental Ship Shielding Area is not part of Parcel F, Phase 2b collected additional samples in the South Basin adjacent to this area. Confirmation samples were also taken in the area of former Piers B and C, which were removed in 2011, to document the absence of radiological contamination.

In addition to the sediment sampling described above, the Phase 2b sediment ROC evaluation included a re-analysis of archived 2009 Phase 1 samples that were found to contain Ra-226 concentrations exceeding the applicable PAL (intertidal) for Ra-226 of 1.604 picocuries per gram (pCi/g) (1.0 pCi/g PAL with 0.6039 pCi/g background). The 15 individual Phase 1 samples identified as having Ra-226 exceedances were analyzed at the New World Technology (NWT) onsite radiological laboratory at HPNS (Battelle and Sea Engineering, 2013). Following the Phase 1 work plan, 10 percent of all Phase 1 samples were also analyzed by offsite by Test America, Inc. a United States Department of Defense Environmental Laboratory Accreditation and California National Environmental Laboratory Accreditation Certified laboratory, for QA confirmation. Comparative results showed that mean Ra-226 values from the NWT onsite radiological laboratory were approximately three times greater than mean values reported by Test America, Inc. It was suspected that peak overlap from U-235 was measured as part of the Ra-226 peak results at NWT, in turn causing the higher levels of Ra-226 recorded for the site samples. As a result of this uncertainty, archived Phase 1 samples were reanalyzed in 2013 at Test America, Inc. to confirm or reject these exceedances and assess the need for potential step-out sampling.

Only 11 of the 15 Phase 1 samples had sufficient archived volume for re-analysis. The reanalysis results indicated that none of the 11 Phase 1 samples were found to exceed the applicable PAL (intertidal) for Ra-226 of 1.604 pCi/g (1.0 pCi/g PAL with 0.6039 pCi/g background). Therefore, the original Phase 1 Ra-226 exceedances measured by the HPNS onsite radiological laboratory in 2009 were not confirmed, and no Ra-226 exceedances of the PAL were detected during the subsequent Phase 2b investigation. Further, 28 additional step-out samples associated with the Phase 1 locations that exceeded the PAL (SA05 and SB09) were collected, and all the laboratory results had low concentrations of Ra-226 (less than 0.7 pCi/g), all of which were less than the PAL for Ra-226. Details of the reanalysis are described in the Phase 2b report (ITSI Gilbane & SAIC, 2013). Re-analysis of the sediment samples that had Ra-226 concentrations less than PAL were not performed because it was assumed that the re-analysis results would be even less than those reported in Phase 1 and subsequently the concentrations would still be below the PAL. There is no required holding time for Ra-226 analysis in USEPA Method 901.1. Ra-226 has a half-life of 1,600 years; thus, the concentrations of the 2013 analysis should essentially be the same as those collected in 2009.

The Phase 2b report concluded that the median radionuclide concentrations in sediment in Parcel F are less than median background concentrations, the clam tissue analysis indicated no evidence of bioaccumulation at Parcel F, ROCs were not detected in clam tissue, and the level of stability of site sediments in the Underwater Area is high enough that they are not likely to be eroded.

3.2 Conceptual Site Models and Radionuclide Evaluation

The CSMs for Parcel F address two exposure scenarios: an intertidal component and a subtidal component, described as follows:

- The intertidal CSM is defined as areas within the Parcel F boundary from the high tide line (mean higher high water (MHHW)[3] down in elevation to a water level of less than or equal to -3.0 feet mean lower low water (MLLW).[4]
- The subtidal CSM is defined as areas within the Parcel F boundary with water levels greater than -3.0 feet MLLW.

During the data gap investigation, the footprint of the revetment wall within and adjacent to Parcel B contained sediment to which humans or biota could be exposed, so it was evaluated and the data were included in the statistical summaries. The revetment has since been constructed and an exposure pathway no longer exists. Because this area is not part of Parcel F, it has not been included in this report.

These CSMs differ in the way that receptors could be exposed to radionuclides in sediment, as follows:

- For the intertidal CSM, humans could be exposed through ingestion of contaminated shellfish and sediment, and external exposure to contaminated sediment. Biota could be directly exposed to contaminated sediments.
- For the subtidal CSM, humans are assumed to be present in a boat over contaminated sediments. In this scenario, humans are assumed to be shielded by water from direct exposure to contaminated sediments but still could be exposed through ingestion of contaminated shellfish and sediment. Biota could be directly exposed to contaminated sediments.

3.3 PALs and Background Reference Area

PALs were calculated for the radiological investigations based on the exposure pathways defined in the intertidal CSM (Figure 3-6) and the subtidal CSM (Figure 3-7). The PALs were calculated in the Phase 2a report and are defined as the radionuclide concentrations in sediment that correspond with specified lifetime risk levels, such as an excess lifetime cancer risk of 10^{-6} (Battelle, 2013). Radionuclide risk evaluations were conducted during Phase 2a and 2b using the PALs. Section 5.0 describes the historical development of the PALs in greater detail.

Background levels of U-235 and Ra-226 are present due to natural radioactivity present in the earth's crust. In addition, Cs-137, Sr-90, and Pu-239 are present in background environmental radioactivity from past atmospheric nuclear weapons testing. Co-60 was also detected in the background reference areas. Because background levels are not associated with activities at HPNS, Table 3-1 (tables are located at the end of this document) presents both the PALs and the PAL as increments above background levels (PAL + background levels)

[3] The average of the higher high water height of each tidal day observed over the National Tidal Datum Epoch. Source NOAA/National Ocean Services.

[4] The average of the lower low water height of each tidal day observed over the National Tidal Datum Epoch. Source NOAA/National Ocean Services.

4.0 Nature and Extent of Radionuclides in Sediment

The primary objectives of the radiological data gap investigation assessments (Phase 1, 2a, and 2b) were to (1) characterize the horizontal and vertical distribution of the six ROCs in Parcel F offshore sediments and (2) compare sample results to ambient levels in reference areas of the six ROCs in San Francisco Bay Reference Area sediments. Secondary objectives of the radiological data gap investigation assessments were to evaluate ROC tissue concentrations and sediment stability. The sediment and tissue data derived from the radiological investigations discussed in Section 3.1 were used to evaluate the nature and extent of ROCs at Parcel F. The sediment stability analysis is presented in Section 6.0.

The nature and extent summary presented in this section demonstrates that an adequate amount of data exists to support a human health risk assessment based on the current and planned future use of Parcel F and determine whether action is required at Parcel F to address radionuclides. Comparisons to PAL and background levels are also provided. Further details regarding the sampling and analytical methods can be found in the data gap investigation technical memoranda (Battelle and Sea Engineering, 2013 for Phase 2a; ITSI Gilbane & SAIC, 2013 for Phase 2b).

As summarized in the following sections, Parcel F sediment has not been impacted by radionuclides at levels that warrant remedial action. These findings confirm the initial assessment in the HRA, which concluded that there was a low potential for radioactive contamination in Parcel F sediments based on historical information and the remote migration pathway for sediments.

4.1 Summary of Parcel F Sediment Radionuclide Data

The Phase 1, 2a, and 2b radiological investigations conducted within Parcel F included advancement of over 300 sediment cores (247 Parcel F cores and 18 reference area cores for radionuclide analysis, and 42 cores for physical properties and quality assurance/quality control), which generated 1,058 sediment samples for laboratory analysis, 800 of which were analyzed for radionuclides. Sampling summaries for each of the investigations are presented in the following list:

- Phase 1 Activities:
  - Parcel F Submarine Area: 10 core locations, 28 sediment samples (Figure 3-2)
  - Parcel F Berth North Area: 34 core locations, 65 sediment samples (Figure 3-3)
  - Parcel F Berth South Area: 12 core locations, 58 sediment samples (Figure 3-4)
  - Parcel F South Basin: 10 core locations, 29 sediment samples (Figure 3-5)
  - Reference: 6 surface grab locations, 6 sediment samples (Figure 3-1)

- Phase 2a Activities:
  - Parcel F Submarine: 45 core locations, 169 sediment samples (Figure 3-2)
  - Reference: 18 core locations, 69 sediment samples (Figure 3-1)
  - In situ uptake into clam tissues: 4 locations in Parcel F and 1 reference site (Figures 3-2 and 3-3)
  - Sedflume analyses: 2 core locations in Parcel F for determination of sediment stability and erosion properties (Figures 3-2 and 3-3)
  - Age Dating: 2 core locations in Parcel F for determination of sediment age and deposition rates over time (Figures 3-2 and 3-3)
- Phase 2b Activities:
  - Parcel F Submarine Area: 14 core locations, 49 sediment samples (Figure 3-2)
  - Parcel F Berth North Area: 53 core locations, 159 sediment samples (Figure 3-3)
  - Parcel F Berth South Area: 30 core locations, 117 sediment samples (Figure 3-4)
  - Parcel F South Basin: 39 core locations, 143 sediment samples (Figure 3-5)
  - Geotechnical and QA/QC: 33 core locations in Parcel F, 166 sediment samples (Figures 3-3 and 3-4)
  - In situ uptake into clam tissues: 5 locations in Parcel F and 6 reference sites (Figures 3-3 and 3-4)
  - Sedflume analyses: 3 core locations in Parcel F for determination of sediment stability and erosion properties (Figures 3-3 and 3-4)
  - Geochronology: 2 core locations in Parcel F, sediment age and deposition rates over time (Figures 3-3 and 3-4)

4.1.1 Radionuclides in Sediment

ROC concentrations were measured in 247 (out of 300 total) sediment cores collected from Parcel F at the locations shown on Figures 3-2 through 3-5. Background ROC concentrations in the Bay were determined by measuring ROC concentrations in three sediment cores collected from each of the six reference areas shown on Figure 3-1.

4.1.2 Statistical Analysis of the Radionuclide Distribution

This section summarizes the statistical comparison of the Parcel F sediment ROC data to applicable reference data and PALs that was documented in Section 3.2.1 of the Phase 2a Report (Battelle and Sea Engineering, 2013) for Phase 1 and 2a data, and in Section 3.2.1 of the Phase 2b Report (ITSI Gilbane & SAIC, 2013) for Phase 2b data.

The statistical analysis was designed to compare the radionuclide activity levels within the sediment in Parcel F to background activity levels in non-impacted San Francisco Bay sediment. Background activity levels were defined as the combination of both natural and anthropogenic inputs in areas not affected or influenced by the HPNS. The background data was not separated into intertidal or subtidal zones. Specifically, Parcel F sediment data from all three phases were statistically compared to sediment data from the six reference areas to determine whether the radionuclide activity levels in HPNS Parcel F sediments were statistically greater than the background radionuclide activity levels in San Francisco Bay sediments concentrations by greater than the PALs (Table 3-1). The PALs, including the background values (PAL + background concentration), were used for comparison purposes, as discussed in Section 4.0. A more-comprehensive discussion of the statistical design and methods is provided in Appendix C of the Phase 2a and 2b reports.

To determine whether the radionuclide activity levels of the sediments in Parcel F were greater than the radionuclide activity levels of the sediments in the background reference area by more than the PAL, the Wilcoxon Rank Sum (WRS) test was conducted in the Phase 2a and Phase 2 reports following MARSSIM guidance (USEPA, 2000). The WRS test (also known as the Mann-Whitney test) is a two-sample, non-parametric statistical hypothesis test that assesses whether one dataset (e.g., Parcel F sediment) tends to have higher values than another dataset (e.g., reference area sediment). The WRS test can also be used to assess whether the values of one dataset are higher than the values of another dataset by more than a given constant (such as the PAL).

Separate WRS tests were performed for each ROC for the intertidal and subtidal CSM exposure scenarios for the Phase 1, 2a, and 2b datasets. The Phase 2a report included the Phase 1 and 2a datasets combined and the Phase 2b Report includes Phase 2b data only. Depending on the exposure scenario being evaluated, the intertidal and subtidal, the PAL for a given ROC was added to the ROC concentration for each of the reference area samples. The method detection limit was substituted for all reported non-detect results before any WRS calculations were performed.

In addition to a comparison between the reference area data and the PAL, a comparison was performed between the reference area background dataset and Parcel F sediment data collected from Phase 2b without the inclusion of the PAL (meaning a comparison to background). The Phase 2a report did not compare medians without the inclusion of the PAL and thus a comparison to background was not reported.

The historical dataset for the Parcel F radionuclides and background reference area and the results of the WRS test are included in the Phase 2a and Phase 2b Reports and are summarized in Section 4.1.3.

4.1.3 Summary of Analytical Results and Statistical Comparisons

This section summarizes the statistical comparison of Parcel F sediment ROC data to site-specific PALs. Analytical data for all sediment samples and corresponding laboratory reports have been taken from the Phase 2a and Phase 2b reports. Summary statistics for Parcel F and reference area sediment ROC data are provided in Table 4-1.

Statistical summaries of the number of samples, minimum, median, maximum, and WRS test results for each intertidal and subtidal ROC dataset presented in the Phase 2a and 2b reports as follows:

- Phase 1 – Phase 2a Report, Appendix B1, B3, B4

- Phase 2a – Phase 2a Report, Appendix B1, B5
- Phase 2b – Phase 2b Report, Appendix B1, B3

These results are summarized in Table 4-2.

Table 4-2 shows that all WRS tests have a p-value of <0.0001, which indicates a highly statistically significant rejection of the null hypothesis that the median ROC concentration in Parcel F exceeds the median ROC concentration, by more than the PAL, in the San Francisco Bay reference areas for intertidal and subtidal exposure scenarios. This means that the alternative hypothesis—that the median radionuclide concentration in Parcel F exceeds the median background concentration by *less* than the PAL or does not exceed the median background concentration— should be accepted.

In the Phase 2b Report, the data collected only during Phase 2b was compared to the background reference area data. Box plots comparing the Parcel F Phase 2b data to the reference dataset for each ROC are provided on Figure 4-1 for Cs-137, Co-60, Pu-239/240, and Ra-226 and Figure 4-2 for Sr-90 and U-235 Box Plots (ITSI Gilbane & SAIC, 2013). These box plots were reported to support the conclusion that Parcel F radionuclide concentrations are not attributable to site-specific conditions. The box plot results indicate that the median values of the Parcel F intertidal and subtidal Phase 2b datasets (represented by the horizontal line in the middle of the box in the figures) were less than the median value for the reference area datasets for Co-60, Ra-226, Sr-90, and U-235. Only the median value from the subtidal was more than the median value from the reference area dataset for Cs-137 and Pu-239/240. These median values for these two radionuclides do not exceed the background concentrations by more than the PAL as described above. Further, the median values for both the Phase 2b intertidal and subtidal datasets for all ROCs were substantially lower than the listed PALs. The Phase 2b Report concluded that these results indicate that Parcel F radionuclide levels are not attributable to site-specific conditions (ITSI Gilbane & SAIC, 2013).

The results of the WRS testing and the box plots support the alternative hypothesis that median Parcel F ROC levels do not exceed background levels by more than the PALs. In addition, the maximums of all individual data points from the Parcel F datasets were compared directly to the corresponding PAL. The results of this comparison, provided in Table 4-3, show that no individual Parcel F sediment sample had ROC concentrations exceeding any of the corresponding PALs. Therefore, no individual Parcel F sediment samples had ROC concentrations exceeding the PAL + background (i.e., no ROC concentrations presented a risk that exceeded the PAL at 10^{-6} above background).

In summary, the following conclusions for Parcel F presented in the Phase 2a and 2b reports describe the extent of radionuclides in sediment:

1. The Parcel F median radionuclide concentrations are equal to or less than the median background concentrations including the PALs for all six ROCs.
2. There is a highly statistically significant rejection of the null hypothesis that the median ROC concentration in Parcel F exceeds the median ROC concentration in the San Francisco Bay reference areas for the intertidal and subtidal exposure scenarios.
3. No individual sample had ROC concentrations exceeding the PAL + background.

4.1.4 Radionuclides in Clam Tissue

As part of the data gap investigation sampling activities, clams were deployed and recovered from a total of nine Parcel F locations and three reference areas. Tissue bioaccumulation results from the Phase 2a (Battelle and Sea Engineering, 2013) and Phase 2b (ITSI Gilbane & SAIC, 2013) data gap investigations are presented together with tissue ingestion PALs in Table 4-4.

4.1.4.1 Summary of Tissue Analytical Results

There was no evidence of bioaccumulation of the ROCs in tissues and no PAL exceedances for any of the ROCs. Analytical results indicated that ROCs were not detected in tissue at all clam sampling locations, except for two ROCs that were reported as detected at one location (Cs-137 and Ra-226 in clams deployed at SA-05). These two results were qualified as estimated values below the reporting limit. The tissue results suggest that ROC uptake by clams in Parcel F sediment was essentially negligible. As a result, it was not possible to develop a dose-response relationship between site sediment concentrations and clam tissue bioaccumulation, nor was it possible to calculate a sediment/tissue radionuclide concentration factor to support the evaluation of risk from ROC activity in Parcel F sediments. However, the analytical results indicate that bioaccumulation of ROCs in clam tissue does not pose risk to human health or the environment. The two results qualified as estimated concentrations below the reporting limit are 23 times (Ra-226 at SA-05) to 1,440 times (Cs-137 at SA-05) less than respective PALs, which are protective of human health and the environment. Maximum nondetected results for Parcel F samples range from 20 times (Ra-226 at BS09A) to 17,900 times (Co-60 at SB07A) less than respective PALs.

4.2 Parcel F Survey Data Evaluation

This section provides the following:

- Documents that the characterization work performed for Parcel F is sufficient to support the conclusion that radiation in Parcel F sediment is consistent with background (i.e., it is not significantly elevated with respect to the reference area), that the residual dose is low, and that the sediment does not require further action.
- Validates that the number of sediment samples used to make decisions are appropriate.
- Presents the net dose from sediment at the site.
- Compares the characterization survey data to the applicable reference area distribution.
- Provides conclusions that reasonable effort has been made to properly characterize the sediment and assess any possible residual dose.

To assess whether the amount of historical sediment data collected (sample densities) is sufficient to make decisions, the dataset was evaluated using available guidance that has been approved by multiple federal agencies, including USEPA, the Department of Defense, Department of Energy (DOE), and the Nuclear Regulatory Commission—namely, MARSSIM (USEPA, 2000). Section 5.2.2.2 of MARSSIM provides guidance on how to determine that the number of data points being used in statistical tests to make decisions are appropriate. The WRS test was used in the data gap investigations following MARSSIM guidance, namely in the Phase 2a and 2b report. MARSSIM provides guidance on how to evaluate sediment samples for surveys and radiological release. This flexible guidance is used in this FS Addendum as a reference for evaluating historical sample densities. This new evaluation is discussed below using the data collected to date and MARSSIM terminology to assist decision makers.

4.2.1 Survey Design

The Phase 2a and 2b reports describe the methodology for the samples collected within Parcel F. This section presents the information needed to confirm that the historical data collected were sufficient in quality and quantity to support decisions for release of the site.

The ROCs were identified in the HRA and data gap investigations and have been measured and evaluated within Parcel F during Phase 1, 2a, and 2b investigations. In order to determine that the quantity of data collected in the data gap investigations was sufficient, the flexible MARSSIM guidance has been used and retroactively applied to the sample density at Parcel F. A survey unit is a physical area consisting of a land area of specified size and shape for which a separate decision will be made as to whether or not that area exceeds the release criterion (MARSSIM Section 2.2). The intertidal and subtidal zones were renamed as survey units in this addendum and have been classified as Class 3 survey units following the flexible guidance contained in MARSSIM. A Class 3 survey unit is defined as an area having slight or no potential for residual radioactivity. Class 3 was assigned because the HRA identified contamination as potentially unlikely at Parcel F and historical data from the three phases of investigation confirm that no ROCs are greater than PAL plus background presented in Table 3-1. There is no size limitation for Class 3 survey units, so the size of this investigation area was consistent with its classification.

A total of 800 samples was analyzed for ROCs in a certified laboratory. The sampling design from the data gap investigation was based on professional judgment to include those depths that correlate to the time period when a release of radioactive material would have been possible, and was consistent with MARSSIM guidance for a Class 3 survey unit.

The limiting radionuclide for calculating sample densities is Ra -226 for intertidal based on the MARSSIM calculations. Ra-226 resulted in the highest number of samples required because of the values for the PAL, standard deviation, and factors presented in the following list that are inputs into the calculation. The following are the inputs used to sample density calculations for Ra-226:

- PAL including background = 1.6039 pCi/g. This value is conservative and consists of the background concentration (0.6039 pCi/g) added to the PAL (1 pCi/g).
- Lower Bound of the Gray Region (LBGR) = 1 pCi/g, which is equivalent to the PAL of 1 pCi/g.
- Derived Concentration Guideline Limit (DCGL) = 1.6039, which is equivalent to the PAL plus background.
- Standard deviation for background Ra-226 concentration in sediment = 0.1601 pCi/g and
- The WRS test (contaminants present in background).

The reference area data show that the ROCs are present in background, so the WRS test was used to determine whether survey unit data exceeded background. Using the data inputs above, the number of samples per survey unit was calculated at 48. This is significantly lower than the number of samples collected within Parcel F of 1,058 samples (with 800 analyzed for radionuclides) and confirms that the data collected were sufficient in quantity.

4.2.2 Data Quality

Appendix C in the Phase 2a report (Battelle and Sea Engineering, 2013) and in Appendix E of the Phase 2b report (ITSI Gilbane & SAIC, 2013) provide a thorough evaluation of the data gap investigation data quality. Test America St. Louis of Earth City, Missouri analyzed the radiological, geochronology, and tissue samples and currently holds a United States Department of Defense Environmental Laboratory Accreditation Certification and a California National Environmental Laboratory Accreditation Certification. Third party validation was performed by Validata Chemical Services of Duluth, Georgia and performed a manual USEPA Level III and Level IV review. These reports have been approved by the BCT and document that the data were sufficient in quality and quantity to make decisions regarding the suitability of the survey unit for release.

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5.0 Risk Assessment

Risk assessments were conducted to estimate risks associated with current and potential future exposure by human receptors and biota to radionuclides in sediment at Parcel F. The risk assessments provide a foundation for assessing the need for further response actions.

5.1 Radiological Risk Evaluation for Human Health

Radiological risk evaluations for human health were completed during the Phase 2a and 2b investigations using the sediment data collected during these and the Phase 1 investigations. In addition, the Phase 2a investigation established human health sediment PALs for ROCs at Parcel F for three CSM exposure scenarios (intertidal, subtidal, and revetment wall). The PALs were based on several model parameters that were established for human exposure to chemical contaminants in the final FS report for Parcel F (Barajas, 2008) and the Final *Hunters Point Shipyard Parcel F Validation Study Report, San Francisco Bay, California* (Battelle et al., 2005). The previously established factors included consumption rates, exposure times, and other miscellaneous exposure parameters.

PALs were developed for adult and child recreational users and for construction workers based on exposure from ingestion of contaminated shellfish and sediment and external exposure to contaminated sediment. In the final FS report for Parcel F (Barajas, 2008), the revised shellfish consumption rate of 0.00213 kilogram per day is based on the seafood consumption study completed by the San Francisco Estuary Institute (SFEI, 2000) and the study by Wong (1997). The SFEI (2001) study reported a value of 48 grams per day (90th percentile) for a reasonable maximum exposure (RME) scenario. The SFEI (2001) study was based on Wong (1997), which reported that shellfish typically make up only 5 percent of total seafood consumption among San Francisco Bay anglers. Adjusting the SFEI (2001) study seafood consumption rate by the shellfish-specific percentage reported by Wong (1997) resulted in a revised shellfish ingestion rate of 0.00213 kilogram per day.

The SFEI (2001) study encompassed the San Francisco Bay Area, and not specifically the Hunters Point area. Thirty-three percent of overall study respondents were of Asian ethnicity; however, this percentage includes respondents for all modes of fishing evaluated in the study: fishing, including pier, beach and bank, private boat, and party boat. For shore-based modes of fishing (i.e., pier, beach, and bank), more than 50 percent of study respondents interviewed at the Candlestick Point study location (just south of the Hunters Point area) were of Asian ethnicity (SFEI, 2001). In addition, 45 percent and 42 percent of overall study respondents who fished by pier, beach, or bank modes, respectively, were Asian (SFEI, 2000).

PALs were not developed for ingestion of contaminated sport fish through sport fishing because of the uncertainties associated with the fish consumption pathway, such as the difficulty in linking tissue concentrations in larger sport fish to site-specific sediment concentrations. The transfer of radioactive material from sediment to organisms to a human was modeled using a concentration factor approach similar to that used in the *Environmental*

Risk from Ionising Contaminants: Assessment and Management (ERICA) Tool for Biota Risks (Brown et al., 2008).

For adult and child recreational users, PALs were calculated for excess lifetime cancer risk levels of 10^{-4}, 10^{-5}, and 10^{-6}. Consistent with the Final *Basewide Radiological Removal Action, Action Memorandum-Revision 2006, Hunters Point Shipyard, San Francisco, California* (Navy, 2006), final PALs were based on an excess lifetime cancer risk of 10^{-6}. For construction workers, PALs represent the concentration in sediment that would yield a radiation dose of 0.1 millirem per year. PALs do not include background levels of radionuclides and therefore represent increments above background.

The following sections describe the human health exposure pathways associated with each of the CSM exposure scenarios and summarize the results of the previous human health risk evaluations for radionuclides in sediment. In addition, a re-assessment of radiological risks for recreational users is provided based on the combined results of the Phase 1, 2a, and 2b data gap investigations for radionuclides.

5.1.1 Conceptual Site Models

The following sections summarize and describe the receptors and potentially complete exposure pathways associated with the intertidal and subtidal CSMs. These exposure pathways form the basis of the sediment PALs that were developed for radionuclides for Parcel F. The revetment wall CSM, which was part of Parcel F when the human health sediment PALs for ROCs were established, is not described because it is now part of Parcel B.

5.1.1.1 Intertidal

For the intertidal CSM, adults were assumed to harvest shellfish recreationally. The recreational adult receptor was assumed to be externally exposed to contaminated sediments while harvesting shellfish, to ingest contaminated sediment incidentally while harvesting shellfish, and to eat the shellfish harvested. A similar scenario was evaluated for children. As presented in the Parcel F FS (Barajas, 2008), consumption of shellfish was not included for children because children under the age of 6 years are unlikely to consume shellfish (San Francisco Estuary Institute, 2000). However, children were assumed to be externally exposed to contaminated sediments and to ingest contaminated sediments incidentally, as they would be while playing on contaminated tidal flats or while accompanying their parents who were recreationally harvesting shellfish. Construction workers were assumed to be externally exposed to contaminated sediments and to ingest contaminated sediments incidentally while working. The exposed individual was assumed to stand directly on the sediments for each of the intertidal scenarios; water was assumed to not provide significant radiation shielding between the exposed individual and the sediments.

5.1.1.2 Subtidal

For the subtidal CSM, all receptors (adult recreational user, child recreational user, and construction worker) were assumed to be present in a boat over the contaminated sediments and to be externally exposed to contaminated sediments shielded by at least 3 feet of water. No shielding was assumed to be provided by the boat. Recreational users were also assumed to harvest and subsequently consume contaminated shellfish from the boat (adults only) and to incidentally ingest contaminated sediments associated with harvesting the shellfish (adults and children). The construction worker was also assumed to be present in a boat, and to ingest contaminated sediments incidentally while working.

5.1.2 Previous Risk Evaluations for ROCs in Sediment

Risk evaluations were conducted for the six ROCs in sediment (Cs-137, Co-60, Pu-239, Ra-226, Sr-90, and U-235) during the Phase 2a and 2b investigations. Results of these risk evaluations are summarized in Sections 5.1.2.1 and 5.1.2.2. In addition, an updated assessment of risks from exposure to ROCs in sediment is presented in Section 5.1.3, based on the combined Phase 1, 2a, and 2b investigation results.

5.1.2.1 Phase 1 and 2a Investigations

This section summarizes the methods and results of the risk evaluation for ROCs presented in the Phase 2a investigation (Battelle and Sea Engineering, 2013). A sum of fractions approach based on the DOE method for evaluating radiation doses to aquatic and terrestrial biota (DOE, 2002) was used to estimate health risks for sediment ROCs based on data collected during the Phase 1 and 2a investigations for the intertidal, subtidal, and revetment wall CSM exposure scenarios (Battelle and Sea Engineering, 2013). As noted in Section 5.1.1, the revetment wall exposure scenario is no longer applicable to Parcel F because it is now part of Parcel B.

The sum of fractions approach estimates the cumulative risk from exposure to the six ROCs by dividing the sample concentration by the respective PALs for each CSM exposure scenario and summing these fractions. Then, the summed fraction for each of the CSM exposure scenarios is summed to generate a cumulative summed fraction for all three scenarios. If the cumulative sum of fractions was less than 1.0, then the cumulative health risk from the six ROCs was deemed acceptable. Because the human health PALs are increments above background, mean concentrations for reference areas from the San Francisco Bay were subtracted from mean concentrations for each CSM exposure area to calculate the fraction of each PAL. For each CSM exposure area and ROC, the most conservative PAL for each of the three receptors (adult recreational user, child recreational user, construction worker) was used as the PAL for the sum of fractions risk evaluation. That is, the risk evaluation was not receptor-specific. Based on this approach, if the cumulative sum of fractions based on the most conservative PALs for each receptor was less than 1.0, then the cumulative health risks for each individual receptor were also deemed acceptable.

For the Phase 1 and 2a sediment samples, the cumulative sum of fraction results for the all three CSM exposure scenarios and all six ROCs was 0.16. This result is less than 1.0; therefore, the cumulative human health risk based on potential exposure to the six ROCs measured during the Phase 1 and 2a investigations was considered acceptable for each receptor. Calculations used for the cumulative sum are presented in Section 3.2.3 and Table 1 of the Battelle and Sea Engineering report (2013).

5.1.2.2 Phase 2b Investigations

This section summarizes the methods and results of the risk evaluation for ROCs presented in the Phase 2b investigation (ITSI Gilbane and SAIC, 2013)(Table 5-1). A sum of fractions approach was also used to estimate health risks for sediment ROC data obtained during the Phase 2b investigation for the intertidal and subtidal exposure scenarios (ITSI Gilbane and

SAIC, 2013). As discussed in Section 3.1.3, archived samples collected during the Phase 1 screening survey were re-analyzed during the Phase 2b investigation. The re-analysis results from Phase 2b replaced the results from Phase 1. Hence, phase 2b ROC data and re-analyzed Phase 1 ROC data composed the phase 2b dataset for ROCs.

The same method used to evaluate risks for the Phase 1 and Phase 2a investigation results was used for the Phase 2b risk evaluation. The sum of fractions from the Phase 2b data for the intertidal and subtidal exposure scenarios was -0.1399 and -0.0048, respectively. The cumulative sum of fractions for all six ROCs for the two CSM exposure scenarios investigated in Phase 2b was -0.1447. The negative sum of fractions results for the individual and combined CSM exposure scenarios indicates that ROC activity (concentrations) at the Phase 2b locations in Parcel F is less than the ROC activity (concentrations) at the reference areas in San Francisco Bay. Because these values were all less than 1.0, the cumulative health risk based on potential exposure to the six ROCs measured during the Phase 2b investigation was considered acceptable for all each receptor.

5.1.3 Re-assessment of Risks for Phase 1, 2a, and 2b Investigation Results

As discussed in Section 5.1.2, a sum of fractions approach was used to estimate risks based on data for sediment ROCs collected during the Phase 1, 2a, and 2b investigations. The sum of fractions approach does not provide cancer risks as estimates of excess lifetime cancer risk (e.g., 1×10^{-6}, or one additional cancer case in a population of one million people); therefore the results from the sum of fractions approach for ROCs cannot be combined with the excess lifetime cancer risks estimated for chemicals at Parcel F and cannot be compared with the USEPA (1991) range of 10^{-6} to 10^{-4} for managing excess cancer risks (i.e., the USEPA risk management range). In addition, the sum of fractions approach used was not receptor-specific.

For these reasons, risks based on data for sediment ROC-data collected during the Phase 1 (re-analyzed results only; see Section 3.1.3), 2a, and 2b investigations were re-assessed for the intertidal and subtidal scenarios as part of this addendum to the Parcel F FS. The re-assessment used an approach that provides receptor-specific estimates of cancer risk for each CSM exposure scenario, and provides risk results as estimates of excess lifetime cancer risks rather than summed fractions. The results of the re-assessment were combined with cancer risk estimates for chemicals to estimate overall health risks from radiological and chemical exposure (see Section 5.2 of this FS addendum). The re-assessment was limited to adult and child recreational users because the risk-based PALs developed for these receptors during the Phase 2a investigation (Battelle and Sea Engineering, 2013) were used to calculate cancer risks. PALs for the adult and child recreational user are concentrations based on an excess lifetime cancer risk level of 10^{-6}. Construction workers were not included in the assessment of radiological risks because the evaluation of exposure for this receptor is based on a radiation dose; likewise, PALs for this receptor are based on a radiation dose, rather than an excess cancer risk level.

The following four steps were used to re-assess ROC risks for the intertidal and subtidal scenarios:

Step 1: Calculate EPCs for each ROC and CSM exposure scenario
Step 2: Identify receptor-specific PALs
Step 3: Develop PAL + background concentrations for each ROC
Step 4: Calculate site radiological risks and PAL + background radiological risks for each ROC

These steps are detailed in Sections 5.1.3.1 through 5.1.3.4.

5.1.3.1 Step 1 – Calculate Exposure Point Concentrations for each ROC and CSM Exposure Scenario

The concentration of an ROC that a receptor (e.g., adult recreational user) may be exposed to is the EPC. The EPC for each ROC in sediment is represented by the 95 percent upper confidence limit (95 UCL) of the mean or the maximum detected concentration. USEPA considers the 95 UCL concentration as a conservative upper-bound estimate that is not likely to underestimate the mean concentration (USEPA, 1989; USEPA, 1992; USEPA, 2002).

95 UCLs were calculated for each ROC in intertidal and subtidal sediment using the stochastic methods in the USEPA ProUCL software (USEPA, 2013). Data from sediment samples collected from the Phase 2a and 2b investigations, and from archived samples collected during the Phase 1 screening survey that were re-analyzed during the Phase 2b investigation were used in the calculations.

The procedures in ProUCL identify the statistical distribution type (i.e., normal, lognormal, gamma, or nonparametric) for each chemical of potential concern and data grouping (e.g., intertidal sediment), and compute the corresponding 95 UCL for the identified distribution type. The 95 UCL is used as the EPC unless the calculated 95 UCL is greater than the maximum detected concentration or unless the number of samples or number of detected results in the data grouping is too small (fewer than five total results or fewer than four detected results) to permit estimation of a 95 UCL. If this occurs, then the maximum detected concentration is used as the EPC.

The EPCs calculated using ProUCL are summarized in Table 5-2. For each ROC, Table 5-2 shows the detection frequency, number of high censored results, arithmetic mean, distribution of the data determined by ProUCL (i.e., normal, lognormal, or gamma; data not fitting these distributions were treated as nonparametric), maximum detected concentration, and resulting EPC. Sufficient sediment data with sufficient detected results are available for Parcel F and calculated 95 UCLs did not exceed maximum concentrations; therefore, 95 UCLs were used as EPCs for all ROCs.

Table 5-2 also shows the number of negative results for each ROC. Negative results indicate that the background activity measured by laboratory instrumentation exceeded the sample activity measured by the laboratory. Negative results were replaced with one-half the sample-specific method detection limit for calculation of the 95 UCL. Although this approach increases the mean and decreases the variability for the sample population, it ensures that the resulting 95 UCL is non-negative.

5.1.3.2 Step 2 – Identify Receptor-Specific PALs

Receptor- and CSM exposure scenario (intertidal and subtidal)-specific PALs were used to re-assess ROC risks. The PALs are summarized in Table 5-3.

5.1.3.3 Step 3 – Develop PAL + Background Concentrations for Each ROC

The receptor-specific PALs for each CSM exposure scenario was added to the ROC-specific background concentration to develop "PAL + background" concentrations for each ROC. PALs represent increments above background and are based on an allowable excess cancer risk level of $1x10^{-6}$; the PAL + background concentration is the maximum allowable concentration for each ROC, based on exposure to naturally occurring ROC concentrations and an allowable increment of excess lifetime cancer risk ($1x10^{-6}$) above the risk associated with naturally occurring levels.

5.1.3.4 Step 4 – Calculate Site Radiological Risks and PAL + Background Radiological Risks for Each ROC

For each CSM scenario (intertidal, subtidal), radiological risks were calculated using a ratiometric ("risk ratio") approach for the following:

a. 95 UCL ROC concentrations (calculated in step 1)
b. PAL + background ROC concentrations (developed in step 2)

The ratiometric risk calculation approach used to reassess risks is consistent with the approach described in USEPA (2014) for estimating risks using pre-calculated, risk-based concentrations. For this evaluation, pre-calculated risk-based concentrations were represented by the receptor-specific PALs for each ROC. The PALs are based on a target excess lifetime cancer risk of 10^{-6}.

Cancer risks for each ROC were estimated using the following equations:

$$Cancer\ risk = (C_{sediment}/PAL_{sediment}) \times 10^{-6}$$

where:

$C_{sediment}$ = Concentration in sediment (picocuries per gram [pCi/g])
$PAL_{sediment}$ = Receptor-specific PAL for sediment based on $1x10^{-6}$ target excess lifetime cancer risk (pCi/g)

The cumulative risk from exposure to multiple ROCs for each CSM exposure scenario was calculated using the following equation:

$$Cumulative\ Risk_{exposure\ scenario} = 10^{-6} \times \{C_{sediment1}/PAL_{sediment1} + C_{sediment2}/PAL_{sediment2} + \ldots C_{sedimentn}/PAL_{sedimentn}\}$$

For each ROC, the risk estimated for the adult recreational user was added to the risk estimated for the child recreational user to calculate the total (adult plus child) risk for the recreational receptor. The adult and child risks were summed because cancer risk is cumulative over a lifetime of exposure.

Table 5-3 summarizes the 95 UCL ROC concentrations for each ROC (step 1), the receptor-specific PALs (step 2), and the PAL + background concentrations (step 3). For each ROC, Table 5-3 presents the site radiological risks based on 95 UCLs for Parcel F ROCs (step 4a) and the radiological risks based on PAL + background concentrations (step 4b).

Table 5-3 also sums the ROC-specific risks to calculate cumulative radiological risks for the intertidal and subtidal CSM exposure scenarios.

5.2 Combined Radiological and Chemical Risk

This section presents combined cancer risk estimates for Parcel F based on risks from exposure to both ROCs and chemical contaminants in sediment. The calculation of combined risk from radiological and chemical exposure was completed for this FS addendum to estimate the overall potential human health risk associated with the site (USEPA, 1989).

Chemical risks for Parcel F were evaluated as part of the HHRA completed for the Parcel F Validation Study (Battelle, Blasland, Bouck & Lee, Inc., and Neptune & Company, 2005) and were based on RMEs. RME chemical risks were calculated for a recreational shellfish harvesting scenario and for a construction worker scenario for the following five intertidal exposure areas (see Figure 1-2 of this FS addendum):

- India Basin (Area I)
- Point Avisadero Area (Area III)
- Eastern Wetland Area (Area VIII)
- Oil Reclamation Area (Area IX)
- South Basin Area (Area X)

Chemical exposure for the recreational shellfish harvesting scenario was based on adult shellfish consumption and direct contact with sediment (incidental ingestion and dermal contact) and child direct contact with sediment. Chemical exposure for the construction worker scenario was based on direct contact with sediment only.

For this FS addendum report, chemical risks for each of the five intertidal exposure areas (Areas I, III, VIII, IX, and X) were revised to reflect updated USEPA and California Environmental Protection Agency recommendations for EPCs, exposure assumptions, toxicity criteria, and mode of action. The updated chemical HHRA for Parcel F is presented in Appendix A. The maximum updated RME chemical risk for the five exposure areas was used to estimate combined radiological and chemical risks for both the intertidal and subtidal CSM scenarios (see Table 5-4). This approach was used because chemicals risks were evaluated for five separate intertidal exposure areas at Parcel F, while radiological risks were evaluated for all of Parcel F as a single exposure area. Selecting the highest risk from the five exposure areas evaluated for chemical risk results in the most conservative estimate of combined chemical and radiological risks for Parcel F.

Table 5-4 presents the combined radiological and chemical risks for Parcel F. Combined risks for Parcel F were calculated for the recreational user for the intertidal and subtidal CSM scenarios. Chemical cancer risks were assumed to be the same for intertidal and subtidal areas. Combined risks were not calculated for the construction worker because evaluation of exposure to ROCs for this receptor is based on a radiation dose, rather than estimates of excess cancer risk. Table 5-4 also summarizes RME cancer risks associated with PALs of ROCs combined with respective background levels, or “PAL + background” concentrations (i.e., Step 4b discussed in Section 5.1.3). The PALs do not include background levels of ROCs and represent an incremental level of risk above background. Therefore, the cancer risk associated with the "PAL + background" concentration is the risk associated with naturally occurring background levels plus an incremental concentration (corresponding to $1x10^{-6}$ excess cancer risk) above the background level. RME chemical risks associated with ambient levels (i.e., concentrations measured at reference stations, which are representative of ambient conditions and not influenced by sources associated with Parcel F) are also summarized on Table 5-4.

The combined risk for the recreational user is $4x10^{-4}$ for both the intertidal and subtidal CSM exposure scenarios (Table 5-4). The combined risk for the intertidal and subtidal scenarios exceeds 10^{-4}, the upper end of the USEPA management range for cancer risks. For both scenarios, the chemical risk ($4x10^{-4}$; Eastern Wetland Area [Area VIII]) contributes to the majority of the combined risk and likewise exceeds the upper end of the USEPA risk management range. Specifically, the chemical risk contributes to 99 percent of the combined risk for the intertidal CSM exposure scenario and to nearly 100 percent of the combined risk for the subtidal CSM exposure scenario. Conversely, ROCs contribute to 1 percent of the combined risk for the intertidal CSM exposure scenario and negligibly to the combined risk for the subtidal CSM exposure scenario.

In addition, radiological risks associated with Parcel F are less than radiological risks associated with PAL + background levels. As shown on Table 5-4, radiological risks for the intertidal and subtidal CSM exposure scenarios ($4x10^{-6}$ and $6x10^{-8}$, respectively) are less than corresponding intertidal and subtidal radiological risks associated with PAL + background levels ($2x10^{-5}$ and $1x10^{-5}$, respectively). Chemical risks associated with Parcel F for the recreational user ($4x10^{-4}$) only slightly exceed ambient chemical risks associated with reference stations ($3x10^{-4}$). Chemical risks associated with Parcel F for the construction worker ($6x10^{-6}$) are the same as ambient chemical risks associated with reference stations ($6x10^{-6}$).

These comparisons indicate that although combined radiological and chemical risks for the recreational user for the intertidal and subtidal CSM scenarios at Parcel F exceed the upper end of the USEPA management range for cancer risks, radiological risks at Parcel F do not exceed risks associated with PAL + background levels, and chemical risks only slightly exceed (recreational user) or are equivalent to (construction worker) risks associated with ambient (reference location) levels. As discussed in Section 5.1.3, the PAL + background concentration is the maximum allowable concentration for each ROC that has been established for Parcel F, and is based on the naturally occurring ROC concentration plus the concentration associated with an increment of excess lifetime cancer risk ($1x10^{-6}$) above naturally occurring levels.

Although assessment of risks for construction workers was limited to chemical risks (see Section 5.1.3), exclusion of radiological risk estimates for this receptor does not result in an underestimate of site-related (i.e., Parcel F-related) risks. Risks are directly proportional to chemical EPCs; therefore, because ROC concentrations at Parcel F are below PAL + background concentrations (the maximum allowable concentration for ROCs established for Parcel F), risks for ROC concentrations at Parcel F are below corresponding risks for PAL + background concentrations.

The final FS for Parcel F evaluates remedial alternatives to address chemical contamination found in sediments at Parcel F (Barajas, 2008). Additional chemical samples will be collected in the vicinity of the former Parcel B piers because these areas were not available for sampling previously. This work will be proposed in a separate work plan, and the results will be provided in an investigation summary report.

5.3 Environmental Risk

Environmental risk was assessed using the ERICA computer code (Brown et al., 2008) to determine the potential for impacts to biota. The ERICA tool models the transfer of radioactive material from sediment and water to organisms using a concentration factor approach. Based on the intertidal and subtidal CSMs for Hunters Point, radiation doses were estimated for four marine organisms:

- Marine birds, representative of the surf scoter
- Mollusks
- Benthic fish, representative of the green sturgeon
- *Polychaetes* (worms)

The PALs estimated for biota were higher (less restrictive) than the PALs developed for protection of human health (Battelle and Sea Engineering, 2013). Therefore, for purposes of this addendum, only PALs for protection of human health were considered. Addressing potential risk to human health will also address potential risk to the environment.

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6.0 Sediment Stability

Sediment stability evaluations were performed for the Phase 2a and 2b data gap investigations. These results were previously reported in Battelle and Sea Engineering (2013) and ITSI Gilbane & SAIC (2013). The material presented in this addendum is a summary of the earlier reports and does not represent any new investigations. A comprehensive analysis was performed to characterize the overall stability of the sediment bed in the Parcel F regions of interest. Further details regarding the field data collection and data analysis methods can be found in the data gap investigation technical memoranda (Battelle and Sea Engineering, 2013; ITSI Gilbane & SAIC, 2013).

Parcel F sediment samples for ROC analysis were collected at or near suspected radionuclide source areas. As discussed in Section 4.0, the sample results indicated that ROCs are not present in Parcel F sediments at levels of concern near the suspected source areas. The results of the sediment stability evaluation indicate it is unlikely that significant amounts of ROC-impacted sediments would have been resuspended, transported away from the suspected source areas, and deposited elsewhere.

Sediment erosion is initiated by bottom shear stress, which is the force exerted on the sediment bed by tidal currents, waves, or other forces, such as propeller wash. The critical shear stress for erosion is the shear stress at which a small but measurable amount of erosion occurs. As the bottom shear stress increases with increasing flow velocity, the erosion is more sustained, and particles from the sediment bed move into the overlying water column (Blake et al., 2007).

For the data gap investigations, the critical shear stress for erosion was determined for sediments at four locations in Parcel F using Sedflume analysis, as follows:

- Phase 2a – SA01 (Submarine Area) and BN304 (Parcel B Revetment Area)
- Phase 2b – BN312 (Berths North Area) and BS04 (Berths South Area)

Sedflume sample locations are shown on Figures 3-2, 3-3, and 3-4. Critical shear stresses were determined for five or six depth intervals in each core. The critical shear stresses generally increased with depth because of the consolidation of the sediment.

The bottom shear stresses in Parcel F from tidal currents and waves under typical and extreme (storm) conditions were estimated using information from the Parcel F validation study (Battelle et al., 2005) and the Parcel F FS data gap investigation (Battelle et al., 2007). Hydrodynamic measurements of waves and currents were collected for 1 month in the summer and 1 month in the winter at one location in the Parcel B Revetment Area (Point Avisadero) and one location in the South Basin as part of the validation study. These data were used to estimate bottom shear stresses in typical weather conditions. The SEDZLJ model (Jones and Lick, 2001) was used in the FS data gap investigation to determine the bottom shear stresses from storm waves in the South Basin for a 25-year storm. Extreme event analysis was based on the best available data, including 8 years of continuous wind data. Data for a 100-year storm are not available for the South Basin. The impact from storm events will be evaluated during the remedial design.

The Phase 2a data gap investigation found that the bottom shear stresses from tidal currents in the Submarine Area did not exceed the critical shear stresses determined from the Sedflume tests, and concluded that tidal currents were not sufficient to erode bottom sediments. The bottom shear stresses from waves periodically exceeded the critical shear stress for the surface sediment interval, but not for deeper sediment intervals tested in the Sedflume. The report concluded that storm waves would resuspend only the top few centimeters of sediment. The Phase 2b data gap investigation concluded that substantial erosion from currents and waves is unlikely at the Berths North and Berths South sample locations.

Sediment cores were also collected for geochronology using Cs-137 and Pb-210 in the Phase 2a and 2b data gap investigation. The age dating information can be used to estimate the net sediment accumulation rate if certain assumptions are met—the sediments have a uniform grain size; deposition has been continuous and uninterrupted; and the sediments have not been excessively mixed by bioturbation or other processes. The results for two of the cores (SA01 in the Submarine Area and BS04 in the Berths South Area) indicated a net sediment accumulation rate of about 2 centimeters per year (cm/year). The core from BN 312 in the Berths North Area was determined to be unsuitable for dating, and the core from BN304 in the Parcel B Revetment Area yielded a net sediment accumulation rate of 5.8 cm/year, which was considered to be anomalously high and inconsistent with field observations.

In summary, these results indicate it is unlikely that significant amounts of radiologically or chemically contaminated sediment historically would have been resuspended and transported from suspected source areas and deposited elsewhere.

7.0 Updated Conceptual Site Model

This section presents the updated CSM for Parcel F sediments, integrating results of the FS radiological investigations and Parcel F survey results described in Section 4.0. The updated CSM includes a summary of the potential sources of radiological contamination and contaminant transport pathways.

7.1 Potential Sources of Radionuclide Contamination to Parcel F Sediments

The HRA indicated that Parcel F sediments may have been historically impacted by OPERATION CROSSROADS decontamination operations, radioactive waste disposal accidents, contaminated water discharges, and storm and sewer discharge (NAVSEA, 2004). OPERATION CROSSROADS ships were decontaminated from 1946 to 1948 at dry docks 3, 4, and 6 and at various berths. The most effective decontamination method was sandblasting the contaminated surfaces of the vessels. The used (or spent) sandblast wastes were then accumulated in containers and disposed in the ocean. Other spent sandblast and decontamination materials were authorized for disposal to the Bay. After removal of the sand from each vessel, the floor was vigorously washed down and the water pumped out of the dry dock to the Bay. In addition, from the late 1940s through 1959, the NRDL and HPNS conducted radioactive waste disposal operations that involved consolidating waste from other military installations and educational institutions, research laboratories, and the Atomic Energy Commission. The waste was packaged for disposal in containers that were loaded onto barges for shipment to an ocean disposal site near the Farallon Islands. The HRA concluded that radiological waste could have been accidently released to Parcel F during these waste disposal operations. In addition, small amounts of low-level radioactive liquids were authorized for release via the site drainage or sanitary sewer systems into the Bay. Because these types of releases were allowed by the regulations of the time, the HRA assumed that NRDL most likely disposed of small amounts of low-level liquid effluents through the building drains.

Most of these potential sources of radionuclide contamination either no longer exist or have been surveyed and free-released, thereby preventing ongoing or potential future contamination of Parcel F sediments. Additionally, past operations at HPNS have not resulted in radionuclide contamination of Parcel F sediments in ship docking and berthing areas or in the vicinity of outfalls. The Parcel F radiological data gaps investigations demonstrated that the sediments do not present unacceptable risk to humans or the environment from the six ROCs, and radionuclides were not found at levels of concern in surface or subsurface sediments (Battelle and Sea Engineering, 2013; ITSI Gilbane and SAIC, 2013). These findings are consistent with the HRA conclusion that Parcel F sediment has a low potential for radionuclide contamination (NAVSEA, 2004).

Sediment core results provide further evidence that even during the most active period at the shipyard, radionuclide contamination of the sediment likely did not occur because data analysis shows that the sediments do not contain radionuclide concentrations in excess of the PAL including background. Age dating data from previous studies at Parcel F indicated an average sedimentation rate of about 1 cm/year (Battelle et al., 2007). This means that during the radiological investigations at Parcel F, a depth of approximately 65 cm (or a little over 2 feet) would represent the year 1946. To be conservative, the data gap investigations collected cores to double that depth to ensure capturing the sediment present in 1946 when the sources of radionuclides were most active at HPNS.

7.2 Contaminant Transport Pathways

The six ROCs addressed in the Parcel F radiological investigations tend to adsorb to sediment particles and if present, would have been transported with Parcel F sediment in the San Francisco Bay. The sediment transport environments differ on the south side of HPNS in South Basin, and in the areas offshore of the dry docks and berths. South Basin has restricted circulation with weak tidal currents. South Basin is an area of net sediment accumulation, and the primary source of sediment is suspended sediment from the San Francisco Bay. Previous studies have demonstrated that sediment bed in the South Basin is relatively stable (Battelle et al., 2007). Any historical release of radiological contamination to South Basin most likely would have been buried within the basin; however, the radiological data gaps sampling data do not indicate that this type of release occurred. The hydrodynamic environment offshore of the dry docks and ship berths is more energetic than in South Basin, although conditions are more quiescent within the berths. The age dating cores collected as part of the Parcel F data gap investigations indicate that these areas experience net sediment accumulation. Given the net depositional environment, some evidence of radiological contamination likely would have persisted near the dry docks and outfalls if it had occurred.

8.0 Findings for Institutional Controls for Parcel F Sediment

The HRA identified the Underwater Areas and All Ships' Berths as radiologically impacted and required scoping surveys in the areas of OPERATION CROSSROADS decontamination activities and site outfall discharges, a review of the final status survey reports for completed berths, and scoping surveys for the remainder of the berths. OPERATION CROSSROADS areas and outfall discharge locations were identified in Parcel F and investigated in phased investigations—Phase 1, Phase 2a, and Phase 2b. These investigations are described in Section 3.0 and meet the requirement of the required HRA scoping surveys.

The recommendations from the HRA have been implemented. Parcel F sediments have been adequately characterized and reasonable effort has been made to investigate the site. The Phase 1, 2a, and 2b radiological investigations conducted within Parcel F included advancement of more than 300 sediment cores, which generated more than 800 sediment samples for radionuclide analysis.

Cs-137, Co-60, Pu-230/240, Ra-226, Sr-90, and U-235 are the six ROCs in Parcel F. Through statistical evaluations, including the WRS test inspection of box plots, and comparisons of maximum concentrations to the PAL, the following conclusions were made:

1. The Parcel F median radionuclide sediment concentrations were equal to or less than the median background concentrations for all six ROCs.
2. There is a highly statistically significant rejection of the null hypothesis that the median ROC concentration in Parcel F exceeds the median ROC concentration in the San Francisco Bay reference areas for the intertidal and subtidal exposure scenarios.
3. No individual sample had ROC concentrations exceeding the PAL + background.
4. Parcel F radionuclide concentrations are not attributable to site-specific conditions and are not expected to be toxic.
5. The clam tissue results suggest that ROC uptake by clams in Parcel F sediment was essentially negligible.

The Navy has made reasonable effort to characterize Parcel F, and the results indicate that no radioactivity in excess of naturally occurring background levels has been identified. Therefore, the Navy has concluded that there is no risk to human health and the environment because of ROCs at HPNS.

During extensive investigations performed throughout Parcel F, the Navy has not recovered any radioluminescent items such as dials, gauges, and deck markers from Parcel F sediments. However, based on the CSM for HPNS activities, which include the potential for inadvertent disposal of radioluminescent items, the potential remains for these radioluminescent items to be present in Parcel F sediments where ships docked during

HPNS operations. Therefore, the Navy has decided that it is appropriate to place ICs on Parcel F sediments. ICs will allow for management of future dredging activities in light of the potential that low-level radiological objects could be encountered in dredge spoils, and will ensure the proper assessment of sediments and disposal of potential radiological devices.

9.0 References

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Tables

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TABLE 3-1
PALs and Background Reference Area Concentrations
Addendum to the Feasibility Study Report for Parcel F, Hunters Point Naval Shipyard, San Francisco, California

Radionuclide	CSM	Sediment PAL (pCi/g)	Background Concentration (pCi/g)	PAL + Background Concentration (pCi/g)
Cs-137	Intertidal	1.28	0.0747	1.355
	Subtidal	425		425.1
Co-60	Intertidal	0.364	0.0426	0.4066
	Subtidal	99.9		99.94
Pu-239/240	Intertidal	67.8	0.0173	67.82
	Subtidal	68.2		68.22
Ra-226	Intertidal	1	0.6039	1.604
	Subtidal	22.4		23.00
Sr-90	Intertidal	9.37	0.1747	9.545
	Subtidal	9.93		10.10
U-235	Intertidal	4.22	0.2342	4.454
	Subtidal	101		101.2

Notes:
Intertidal and Subtidal PALs from Phase 2b (ITSI Gilbane & SAIC, 2013). The PALs including the background values (PAL + background concentration) were used for comparison purposes, as discussed in Section 4.0.

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TABLE 4-1
Statistical Summary of Radionuclides in Sediment at Parcel F
Addendum to the Feasibility Study Report for Parcel F, Hunters Point Naval Shipyard, San Francisco, California

Radionuclide	CSM	No. of Samples	No. Detected	Percent Detected	Min (pCi/g)	Max Detected Concentration (pCi/g)	Area of Max	Station of Max
Cs-137	*Reference Area*	*69*	*31*	*45%*	*0.0214*	*0.213*	*Bay Farm*	*RB02*
	Intertidal	246	150	61%	0.0111	0.2480	Submarine Area	SA407
	Subtidal	440	424	96%	0.0128	0.2450	Submarine Area	SA210
Co-60	*Reference Area*	*69*	*4*	*6%*	*0.0081*	*0.1030*	*Paradise Cove*	*RP03*
	Intertidal	246	6	2%	0.0093	0.0452	South Basin Area	SB233
	Subtidal	440	24	5%	0.0070	0.0884	Submarine Area	SA202
Pu-239/240	*Reference Area*	*69*	*15*	*22%*	*0.0089*	*0.0527*	*Bay Farm*	*RB03*
	Intertidal	227	34	15%	0.0085	0.0422	Submarine Area	SA205
	Subtidal	431	112	26%	0.0085	0.7530	Berths North	BN222
Ra-226	*Reference Area*	*69*	*69*	*100%*	*0.2120*	*0.9940*	*Alameda Buoy*	*RA02*
	Intertidal	246	242	98%	0.1880	1.0600	Submarine Area	SA101
	Subtidal	440	419	95%	0.0570	1.3800	Submarine Area	SA201
Sr-90	*Reference Area*	*69*	*12*	*17%*	*0.1080*	*0.2990*	*Bay Farm*	*RB03*
	Intertidal	220	34	15%	0.0655	4.5600	Submarine Area	SA218
	Subtidal	416	58	14%	0.0981	0.7590	Berths North	BN204
U-235	*Reference Area*	*69*	*22*	*32%*	*0.1050*	*0.6220*	*Paradise Cove*	*RP01*
	Intertidal	246	115	47%	0.0443	0.6720	Submarine Area	SA106
	Subtidal	440	214	49%	0.0350	0.6970	Submarine Area	SA206

Note:
Data Source: Battelle and Sea Engineering, 2013, Table 3-4 (Intertidal and Subtidal) and Appendix B1-2, and ITSI Gilbane & SAIC, 2013 Table 3-4 (Intertidal and Subtidal), Table 3-5 (Reference Area) and Appendix B

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TABLE 4-2
Parcel F Sediment Radionuclide Data WRS Test Statistics – Phase 1, 2a, 2b Data
Addendum to the Feasibility Study Report for Parcel F, Hunters Point Naval Shipyard, San Francisco, California

Radionuclide	CSM	PAL + Background (pCi/g)	Phase 1 and Phase 2a					Phase 2b and Phase 1 Re-Analysis				
			No. of Samples	Min (pCi/g)	Median (pCi/g)	Max (pCi/g)	WRS Test P-value	No. of Samples	Min (pCi/g)	Median (pCi/g)	Max (pCi/g)	WRS Test P-value
Cs-137	*Reference Area*	*NA*	*69*	*0.0214*	*0.0507*	*0.2130*	*NA*	*69*	*0.0214*	*0.0507*	*0.2130*	*NA*
	Intertidal	1.355	103	0.0279	0.0764	0.2480	<0.0001	143	0.0111	0.0297	0.2410	<0.0001
	Subtidal	425.1	104	0.0355	0.1350	0.2450	<0.0001	336	0.0128	0.1145	0.1960	<0.0001
Co-60	*Reference Area*	*NA*	*69*	*0.0081*	*0.0404*	*0.1030*	*NA*	*69*	*0.0081*	*0.0404*	*0.1030*	*NA*
	Intertidal	0.4066	103	0.0099	0.0422	(0.0852)[a]	<0.0001	143	0.0093	0.0211	0.0452	<0.0001
	Subtidal	99.94	104	0.0092	0.0434	(0.1280)[a]	<0.0001	336	0.0070	0.0207	0.0576	<0.0001
Pu-239/240	*Reference Area*	*NA*	*69*	*0.0089*	*0.0176*	*0.0527*	*NA*	*69*	*0.0089*	*0.0176*	*0.0527*	*NA*
	Intertidal	67.82	84	0.0085	0.0189	0.0422	<0.0001	143	0.0086	0.0134	0.0327	<0.0001
	Subtidal	68.22	95	0.0091	0.0238	0.0547	<0.0001	336	0.0085	0.0199	0.7530	<0.0001
Ra-226	*Reference Area*	*NA*	*69*	*0.2120*	*0.6240*	*0.9940*	*NA*	*69*	*0.2120*	*0.6240*	*0.9940*	*NA*
	Intertidal	1.604	103	0.1880	0.6540	2.4894 [b]	<0.0001	143	0.3300	0.5570	0.7830	<0.0001
	Subtidal	23.00	104	0.0570	0.6910	1.8842 [b]	<0.0001	336	0.2440	0.5350	0.7850	<0.0001
Sr-90	*Reference Area*	*NA*	*69*	*0.1080*	*0.1730*	*0.2990*	*NA*	*69*	*0.1080*	*0.1730*	*0.2990*	*NA*
	Intertidal	9.545	84	0.1350	0.1955	4.5600	<0.0001	136	0.0655	0.1440	0.7540	<0.0001
	Subtidal	10.10	95	0.1120	0.1750	0.3100	<0.0001	321	0.0981	0.1430	0.7590	<0.0001
U-235	*Reference Area*	*NA*	*69*	*0.1050*	*0.2010*	*0.6220*	*NA*	*69*	*0.1050*	*0.2010*	*0.6220*	*NA*
	Intertidal	4.454	103	0.0443	0.2000	0.6720	<0.0001	143	0.0548	0.1220	0.3520	<0.0001
	Subtidal	101.2	104	0.0350	0.2255	0.6970	<0.0001	336	0.0676	0.1195	0.3270	<0.0001

Notes:

[a] Maximum concentration equals the method detection limit substituted for a non-detect value. Concentration in table was not detected.

[a] Maximum concentration was reanalyzed using an archived sample during the Phase 2b data gap investigation. The reanalysis result from Phase 2b replaced the result from Phase 1.

Data Source: Phase 1 and 2a: Battelle and Sea Engineering, 2013, Appendix B1-2 and Appendix C2 (Intertidal and Subtidal); and Reference Area and Phase 2b and Phase 1 Re-Analysis: ITSI Gilbane & SAIC, 2013 Appendix B1 and Table C-1 (Intertidal and Subtidal).

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TABLE 4-3
Summary of Individual Sediment Samples Compared to Their PALs Phase 1, 2a, 2b Data
Addendum to the Feasibility Study Report for Parcel F, Hunters Point Naval Shipyard, San Francisco, California

Radionuclide	CSM	Max Detected Concentration (pCi/g)	PAL (pCi/g)	Background Concentration (pCi/g)	PAL + Background Concentration (pCi/g)	No. of Exceedances of Pal +Background	Station(s) Exceeding PAL
Cs-137	Intertidal	0.2480	1.28	0.0747	1.355	0	NA
	Subtidal	0.2450	425		425.1	0	NA
Co-60	Intertidal	0.0452	0.364	0.0426	0.4066	0	NA
	Subtidal	0.0884	99.9		99.94	0	NA
Pu-239/240	Intertidal	0.0422	67.8	0.0173	67.82	0	NA
	Subtidal	0.7530	68.2		68.22	0	NA
Ra-226	Intertidal	1.0600	1	0.6039	1.604	0	NA
	Subtidal	1.3800	22.4		23.00	0	NA
Sr-90	Intertidal	4.5600	9.37	0.1747	9.545	0	NA
	Subtidal	0.7590	9.93		10.10	0	NA
U-235	Intertidal	0.6720	4.22	0.2342	4.454	0	NA
	Subtidal	0.6970	101		101.2	0	NA

Notes:
[a] Maximum concentration equals the method detection limit substituted for a non-detect value. Concentration in table was not detected.
[b] Maximum concentration was reanalyzed using an archived sample during the Phase 2b data gap investigation. The reanalysis result from Phase 2b replaced the result from Phase 1.
Data Source: Battelle and Sea Engineering, 2013, Table 3-4 (Intertidal and Subtidal), Table 3-8, and Appendix B1-2 and ITSI Gilbane & SAIC, 2013, Table 3-4 (Intertidal and Subtidal) and Appendix B1.

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TABLE 4-4
Tissue Bioaccumulation Results for *Macoma nasuta*
Addendum to the Feasibility Study Report for Parcel F, Hunters Point Naval Shipyard, San Francisco, California

Radionuclide	Location	Data Gap Investigation	Tissue Result (pCi/g)[a]	Tissue Qualifier[b]	Tissue PAL[c] (pCi/g)	Exceeds PAL?
Cs-137	BN-04	Phase 2a	0.0045	U	24.2	No
	SA-05	Phase 2a	0.0168	J		No
	SA-07	Phase 2a	-0.0002	U		No
	SA-08	Phase 2a	0.0178	U		No
	SB02A	Phase 2b	0.0132	U		No
	SB05A	Phase 2b	0.0127	U		No
	SB07A	Phase 2b	0.0151	U		No
	BS09A	Phase 2b	0.0165	U		No
	BN11A	Phase 2b	0.0153	U		No
	Bay Farm (Ref.)	Phase 2a	0.0054	U		No
	Paradise Cove (Ref.)	Phase 2b	0.0173	U		No
	Oyster Point (Ref.)	Phase 2b	0.0127	U		No
Co-60	BN-04	Phase 2a	0.0065	U	324	No
	SA-05	Phase 2a	-0.0044	U		No
	SA-07	Phase 2a	-0.0113	U		No
	SA-08	Phase 2a	-0.0015	U		No
	SB02A	Phase 2b	0.0156	U		No
	SB05A	Phase 2b	0.0156	U		No
	SB07A	Phase 2b	0.0181	U		No
	BS09A	Phase 2b	0.0180	U		No
	BN11A	Phase 2b	0.0172	U		No
	Bay Farm (Ref.)	Phase 2a	0.0063	U		No
	Paradise Cove (Ref.)	Phase 2b	0.0183	U		No
	Oyster Point (Ref.)	Phase 2b	0.0158	U		No
Pu-239/240	BN-04	Phase 2a	-0.0089	U	4.32	No
	SA-05	Phase 2a	0.0121	U		No
	SA-07	Phase 2a	-0.0028	U		No
	SA-08	Phase 2a	0.0000	U		No
	SB02A	Phase 2b	0.0284	U		No
	SB05A	Phase 2b	0.0290	U		No
	SB07A	Phase 2b	0.0316	U		No
	BS09A	Phase 2b	0.0417	U		No
	BN11A	Phase 2b	0.0258	U		No
	Bay Farm (Ref.)	Phase 2a	-0.0028	U		No
	Paradise Cove (Ref.)	Phase 2b	0.0310	U		No
	Oyster Point (Ref.)	Phase 2b	0.0398	U		No

TABLE 4-4
Tissue Bioaccumulation Results for *Macoma nasuta*
Addendum to the Feasibility Study Report for Parcel F, Hunters Point Naval Shipyard, San Francisco, California

Radionuclide	Location	Data Gap Investigation	Tissue Result (pCi/g)[a]	Tissue Qualifier[b]	Tissue PAL[c] (pCi/g)	Exceeds PAL?
Ra-226	BN-04	Phase 2a	-0.0161	U	2.53	No
	SA-05	Phase 2a	0.1100	J		No
	SA-07	Phase 2a	0.0167	U		No
	SA-08	Phase 2a	-0.0029	U		No
	SB02A	Phase 2b	0.0889	U		No
	SB05A	Phase 2b	0.0789	UJ		No
	SB07A	Phase 2b	0.0894	UJ		No
	BS09A	Phase 2b	0.1263	U		No
	BN11A	Phase 2b	0.1052	U		No
	Bay Farm (Ref.)	Phase 2a	0.0199	U		No
	Paradise Cove (Ref.)	Phase 2b	0.0993	U		No
	Oyster Point (Ref.)	Phase 2b	0.1001	U		No
Sr-90	BN-04	Phase 2a	0.0225	U	12.7	No
	SA-05	Phase 2a	-0.0070	U		No
	SA-07	Phase 2a	0.0436	U		No
	SA-08	Phase 2a	-0.0188	U		No
	SB02A	Phase 2b	0.0518	U		No
	SB05A	Phase 2b	0.0599	U		No
	SB07A	Phase 2b	0.0680	U		No
	BS09A	Phase 2b	0.0636	U		No
	BN11A	Phase 2b	0.0569	U		No
	Bay Farm (Ref.)	Phase 2a	-0.0086	U		No
	Paradise Cove (Ref.)	Phase 2b	0.0597	U		No
	Oyster Point (Ref.)	Phase 2b	0.0549	U		No
U-235	BN-04	Phase 2a	0.0345	U	11.3	No
	SA-05	Phase 2a	-0.0066	U		No
	SA-07	Phase 2a	-0.0298	U		No
	SA-08	Phase 2a	-0.0003	U		No
	SB02A	Phase 2b	0.0020	U		No
	SB05A	Phase 2b	0.0012	U		No
	SB07A	Phase 2b	0.0016	U		No
	BS09A	Phase 2b	0.0016	U		No
	BN11A	Phase 2b	0.0013	U		No
	Bay Farm (Ref.)	Phase 2a	-0.0451	U		No
	Paradise Cove (Ref.)	Phase 2b	0.0013	U		No
	Oyster Point (Ref.)	Phase 2b	0.0016	U		No

Notes:
[a] Radionuclide data are presented as measured minus the laboratory documented background concentration for each radionuclide. Therefore, negative values indicate samples were measured below the documented laboratory background for that radionuclide.
[b] Qualifiers: J = Estimated value detected below the reporting limit; U = Not detected; and UJ = Not detected at the estimated reporting limit.
[c] Tissue PAL = PALs for ingestion of contaminated shellfish. PAL represents the radionuclide concentrations in shellfish tissue that would yield a lifetime human health risk of 10^{-6}.

TABLE 5-1
Summary of Analytical Results for Radionuclides of Concern in Parcel F Intertidal and Subtidal Sediment from Phase 1, 2a, and 2B Data Gap Investigations
Addendum to the Feasibility Study Report for Parcel F, Hunters Point Naval Shipyard, San Francisco, California

Radionuclide of Concern	CSM Exposure Scenario	Phase 2a Data Gap Investigation[a]				Phase 2b Data Gap Investigation[b]				Re-Analysis during Phase 2b Data Gap Investigation of Phase 1 Samples Exceeding Intertidal CSM PAL for Ra-226[c]				Phase 1, 2b, and 2b Data Gap Investigations Combined					Human Health PAL (pCi/g)[e]	Background Concentration (pCi/g)	PAL + Background Concentration (pCi/g)	Number of Samples Exceeding PAL + Background Concentration
		Detection Frequency	Minimum Detected Concentration (pCi/g)	Maximum Detected Concentration (pCi/g)	Location of Maximum	Detection Frequency	Minimum Detected Concentration (pCi/g)	Maximum Detected Concentration (pCi/g)	Location of Maximum	Detection Frequency	Minimum Detected Concentration (pCi/g)	Maximum Detected Concentration (pCi/g)	Location of Maximum	Detection Frequency	Minimum Detected Concentration (pCi/g)	Maximum Detected Concentration (pCi/g)[d]	Location of Maximum	Investigation Associated with Maximum				
Cesium-137	Intertidal	54/79	0.0354 J	0.2480	SA407	76/132	-0.0133	0.2410	SB201	7/11	0.0488	0.1190	BN01	137 / 222	-0.0133	0.2480	SA407	Phase 2a	1.28	0.0747	1.355	0
	Subtidal	82/90	0.0471 J	0.2450	SA210	330/336	0.0184	0.1960	SA417	*not sampled*				412 / 426	0.0184	0.2450	SA210	Phase 2a	425		425.1	0
Cobalt-60	Intertidal	0/79	ND	ND	--	25/132	-0.0357	0.0452	SB233	0/11	ND	ND	--	25 / 222	-0.0357	0.0452	SB233	Phase 2b	0.364	0.0426	0.4066	0
	Subtidal	6/90	0.0334	0.0884	SA202	23/336	0.00291	0.0576	BN111	*not sampled*				29 / 426	0.00291	0.0884	SA202	Phase 2a	99.9		99.94	0
Plutonium-239/240	Intertidal	21/79	0.00872 J	0.0422 J	SA205	30/132	-0.00419	0.0327	SB216	0/11	ND	ND	--	51 / 222	-0.00419	0.0422 J	SA205	Phase 2a	67.8	0.0173	67.82	0
	Subtidal	23/90	0.0167 J	0.0547 J	SA408	91/336	-0.00208	0.0753	BN222	*not sampled*				114 / 426	-0.00208	0.0753	BN222	Phase 2b	68.2		68.22	0
Radium-226	Intertidal	79/79	0.188 J	1.0600	SA101	132/132	0.33	0.7590	SB245	11/11	0.398	0.7830	SB05	222 / 222	0.188 J	1.0600	SA101	Phase 2a	1[f]	0.6039	1.604	0
	Subtidal	90/90	0.32 J	1.3800	SA201	336/336	0.244	0.7850	BN203	*not sampled*				426 / 426	0.244	1.3800	SA201	Phase 2a	22.4		23	0
Strontium-90	Intertidal	26/79	0.177	4.5600	SA218	34/125	-0.0567	0.7540	SB204	0/11	ND	ND	--	60 / 215	-0.0567	4.5600	SA218	Phase 2a	9.37	0.1747	9.545	0
	Subtidal	17/90	0.14	0.3100	SA204	54/321	-0.0641	0.7590	BN204	*not sampled*				71 / 411	-0.0641	0.7590	BN204	Phase 2b	9.93		10.1	0
Uranium-235	Intertidal	15/79	0.14	0.6720	SA106	82/132	0.0664	0.3520 J	SB218	6/11	0.116	0.2840	SB05	103 / 222	0.0664	0.6720	SA106	Phase 2a	4.22	0.2342	4.454	0
	Subtidal	26/90	0.157	0.6970	SA206	179/336	0.0676	0.3270	BS108	*not sampled*				205 / 426	0.0676	0.6970	SA206	Phase 2a	101		101.2	0

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TABLE 5-2

Exposure Point Concentrations for Intertidal and Subtidal Sediment

Addendum to the Feasibility Study Report for Parcel F, Hunters Point Naval Shipyard, San Francisco, California

CSM Exposure Scenario	Radionuclide of Concern	Detection Frequency			Number of Negative Results (a)	Number of High Censored Results (b)	Units	Mean of Detected Results	95 UCL (Distribution) (c, d)		Maximum Concentration (Qualifier)		Exposure Point Concentration (e)		
													Value	Statistic	Method (f)
Intertidal	Cesium-137	137	/	222	34	0	pCi/g	9.27E-02	6.49E-02	NP	0.248		6.49E-02	95 UCL	(1)
	Cobalt-60	25	/	222	87	0	pCi/g	1.23E-02	4.85E-03	NP	0.0452		4.85E-03	95 UCL	(2)
	Plutonium-239/240	51	/	222	83	0	pCi/g	1.61E-02	5.22E-03	NP	0.0422	J	5.22E-03	95 UCL	(3)
	Radium-226	222	/	222	0	0	pCi/g	5.80E-01	5.93E-01	N	1.06		5.93E-01	95 UCL	(4)
	Strontium-90	60	/	215	50	0	pCi/g	3.00E-01	1.31E-01	NP	4.56		1.31E-01	95 UCL	(1)
	Uranium-235	103	/	222	11	0	pCi/g	1.74E-01	1.06E-01	NP	0.672		1.06E-01	95 UCL	(1)
Subtidal	Cesium-137	412	/	426	2	0	pCi/g	1.21E-01	1.30E-01	NP	0.245		1.30E-01	95 UCL	(2)
	Cobalt-60	29	/	426	135	0	pCi/g	3.35E-02	3.29E-03	NP	0.0884		3.29E-03	95 UCL	(1)
	Plutonium-239/240	114	/	426	108	0	pCi/g	2.77E-02	1.18E-02	NP	0.0753		1.18E-02	95 UCL	(2)
	Radium-226	426	/	426	0	0	pCi/g	5.73E-01	5.82E-01	N	1.38		5.82E-01	95 UCL	(4)
	Strontium-90	71	/	411	121	0	pCi/g	2.10E-01	4.60E-02	G	0.759		4.60E-02	95 UCL	(5)
	Uranium-235	205	/	426	8	0	pCi/g	1.70E-01	1.19E-01	NP	0.697		1.19E-01	95 UCL	(2)

Notes:

Data from Phase 2a data gap investigation samples, Phase 2b data gap investigation samples, and Phase 1 samples reanalyzed during the Phase 2b data gap investigation were used to calculate EPCs; see Table 5-1.
(a) A negative result indicates the background activity measured by laboratory instrumentation exceeded the sample activity.
(b) Number of censored (nondetect) results that exceeded the maximum detected concentration. These results are excluded from the statistical calculations.
(c) Negative results were replaced with one-half the sample-specific method detection limit for calculation of the 95 UCL. Although this approach increases the mean and decreases the variability for the sample population, it ensures that the resulting 95 UCL is non-negative.
(d) The three data distributions considered in ProUCL 5.0 include the normal, lognormal, and the gamma distributions. Shapiro-Wilk ($n \leq 50$) and Lilliefors ($n > 50$) test statistics are used to test for normality or lognormality of a dataset. A 5 percent level of significance was used in all tests.
Distribution tests were only conducted for samples with at least four detected results. Distributions not confirmed as normal, lognormal, or gamma, or not tested, were treated as nonparametric in all statistical calculations.
Distribution Codes: G = gamma, LN = lognormal, N = normal, NP = nonparametric
(e) The 95 UCL is not calculated when there are fewer than five total results or four detected results. If this occurs, then the maximum detected concentration is used as the EPC. The maximum concentration is also used as the EPC if the 95 UCL exceeds the maximum.
(f) All methods follow USEPA (2002, 2013).
Method (Statistic) Codes are defined as follows, and indicated the basis for the EPC:
(1) 95% KM (Percentile Bootstrap) UCL
(2) 97.5% KM Chebyshev UCL
(3) 95% KM (t) UCL
(4) 95% Student's-t UCL
(5) 95% Approximate Gamma KM-UCL
95 UCL = One-sided 95 percent upper confidence limit of the mean. Following USEPA (2002, 2013), this may be estimated by either a 95, 97.5, or 99 percent UCL depending on sample size, skewness, and degree of censorship.
EPC = exposure point concentration
J = estimated concentration below the laboratory reporting limit
KM = Kaplan-Meier
Max = maximum detected concentration
NA = not applicable
pCi/g = picocurie(s) per gram
UCL = upper confidence limit

References:

United States Environmental Protection Agency (USEPA). 2002. “Calculating Exposure Point Concentrations at Hazardous Waste Sites.” OSWER 9285.6-10. Office of Emergency and Remedial Response. Washington, DC. December.
United States Environmental Protection Agency (USEPA). 2013. “ProUCL Version 5.0.00 Technical Guide.” Prepared by Singh, A. and R. Maichle for USEPA Office of Research and Development. EPA/600/R-07/041. September.

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TABLE 5-3
Cancer Risks for Radionuclides of Concern in Sediment
Addendum to the Feasibility Study Report for Parcel F, Hunters Point Naval Shipyard, San Francisco, California

Radionuclide of Concern	CSM Exposure Scenario	Parcel F EPC[a]	PALs by Receptor, Target Cancer Risk=1E-06 (pCi/g)[b]		Background Concentration (pCi/g)	PAL + Background Concentration (pCi/g)		Radiological Risk Based on Parcel F EPC			Radiological Risk Based on PAL + Background Concentration		
			Adult Recreational User	Child Recreational User		Adult Recreational User	Child Recreational User	Adult Recreational User	Child Recreational User	Recreational User (Adult + Child)	Adult Recreational User	Child Recreational User	Recreational User (Adult + Child)
Cesium-137	Intertidal	6.49E-02	1.28	1.31	0.0747	1.355	1.385	5E-08	5E-08	1E-07	1E-06	1E-06	2E-06
	Subtidal	1.30E-01	425	633		425.07	633.07	3E-10	2E-10	5E-10	1E-06	1E-06	2E-06
Cobalt-60	Intertidal	4.85E-03	0.764	0.364	0.0426	0.8066	0.4066	6E-09	1E-08	2E-08	1E-06	1E-06	2E-06
	Subtidal	3.29E-03	237	99.9		237.04	99.94	1E-11	3E-11	5E-11	1E-06	1E-06	2E-06
Plutonium-239/240	Intertidal	5.22E-03	67.8	70.4	0.0173	67.82	70.42	8E-11	7E-11	2E-10	1E-06	1E-06	2E-06
	Subtidal	1.18E-02	68.2	70.7		68.22	70.72	2E-10	2E-10	3E-10	1E-06	1E-06	2E-06
Radium-226	Intertidal	5.93E-01	1 [0.277][c]	1 [0.362] [c]	0.6039	1.6039	1.6039	3E-06	2E-06	4E-06	7E-06	4E-06	1E-05
	Subtidal	5.82E-01	22.4	22.9		23.00	23.50	3E-08	3E-08	5E-08	1E-06	1E-06	2E-06
Strontium-90	Intertidal	1.31E-01	9.37	75.9	0.1747	9.54	76.07	1E-08	2E-09	2E-08	1E-06	1E-06	2E-06
	Subtidal	4.60E-02	9.93	136		10.10	136.17	5E-09	3E-10	5E-09	1E-06	1E-06	2E-06
Uranium-235	Intertidal	1.06E-01	4.22	54.2	0.2342	4.454	54.43	3E-08	2E-09	3E-08	1E-06	1E-06	2E-06
	Subtidal	1.19E-01	178	101		178.23	101.23	7E-10	1E-09	2E-09	1E-06	1E-06	2E-06
Cumulative Risk	Intertidal							3E-06	2E-06	4E-06	1E-05	1E-05	2E-05
	Subtidal							3E-08	3E-08	6E-08	6E-06	6E-06	1E-05

Notes:

[a] Exposure point concentrations (EPCs) for Parcel F ROCs are based on 95 percent upper confidence limit concentrations calculated from Phase 2a data gap investigation samples, Phase 2b data gap investigation samples, and Phase 1 samples reanalyzed during the Phase 2b data gap investigation; see Table 5-2.

[b] The PALs shown are receptor-specific, and are based on Tables 2-5 through 2-7 of ITSI & Gilbane (2013). PALs are based on exposure to sediment from shellfish ingestion, incidental ingestion, and external exposure for the adult recreational shellfish scenario. PALs are based on exposure to sediment from incidental ingestion and external exposure for the child recreational scenario. Except for Ra-226, the PAL represents the risk-based radionuclide concentration that would yield an excess lifetime cancer risk of $1x10^{-6}$. The PAL for Ra-226 is the terrestrial soil PAL of 1 pCi/g above background. The PALs do not include background and represent increments above background.

[c] The PAL for Ra-226 is the terrestrial soil PAL of 1 pCi/g above background (ITSI Gilbane and SAIC, 2013). The value shown in brackets is the risk-based concentrations for Ra-226 corresponding to an excess lifetime cancer risk level of $1x10^{-6}$ (0.227 pCi/g for adult recreational shellfish scenario; 0.362 pCi/g for child recreational shellfish scenario). The risk-based concentrations for Ra-226 were used in ratiometric equations to estimate radiological risks for Ra-226 based on the 95 UCL ROC concentration for Ra-226 and based on the PAL plus background concentration for Ra-226.

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TABLE 5-4

Combined Radiological and Chemical Cancer Risks

Addendum to the Feasibility Study Report for Parcel F, Hunters Point Naval Shipyard, San Francisco, California

CSM Exposure Scenario	Receptor	Parcel F Cancer Risk			Radiological Risk Associated with PALs Plus Background Levels[d]	Chemical Risk Associated with Ambient (Reference Stations) Levels[e]	Parcel F Radiological Risk Exceeds Risk Associated with PALs Plus Background Levels?	Parcel F Chemical Risk Exceeds Risk Associated with Ambient (Reference Station) Levels?
		Radiological Risk[a]	Chemical Risk[b]	Combined Risk[c]				
Intertidal	Recreational User (Adult+Child)	**4E-06**	**4E-04**	**4E-04**	**2E-05**	**3E-04**	No	Yes
	Construction Worker	NC	**6E-06**	NC[f]	NC	**6E-06**	--	No
Subtidal	Recreational User (Adult+Child)	6E-08	**4E-04**	**4E-04**	**1E-05**	**3E-04**	No	Yes
	Construction Worker	NC	**6E-06**	NC[f]	NC	**6E-06**	--	No

Notes:

[a] Radiological risks are calculated in Table 5-3 and are based on data from Phase 2a data gap investigation samples, Phase 2b data gap investigation samples, and Phase 1 data gap investigation samples re-analyzed during the Phase 2b data gap investigation.

[b] Chemical risks were assessed in BBL (2005); chemical risks were revised to reflect updated USEPA and California Environmental Protection Agency recommendations for EPCs, exposure assumptions, toxicity criteria, and mode of action (see Appendix A).The chemical risks shown are for RMEs, and are based on the maximum of the cumulative RME cancer risks calculated for each receptor for the five Parcel F exposure areas evaluated (Eastern Wetland Area [Area VIII], India Basin Area [Area I], Oil Reclamation Area [Area IX], Point Avisadero Area [Area III], and South Basin Area [Area X]). For the recreational receptor, the maximum chemical cancer risk is based on the Eastern Wetland Area (see Table A-18 of Appendix A). For the construction worker receptor, the maximum chemical cancer risk is the same for the following three of five exposure areas (see Table A-18 of Appendix A): Oil Reclamation Area (Area IX), Point Avisadero Area (Area III), and South Basin Area (Area X). Chemical cancer risks were assumed to be same for intertidal and subtidal areas.

[c] The combined risk is the sum of the radiological risk and the chemical risk.

[d] See Table 5-3.

[e] See note (d); chemical risks for reference stations were also revised to reflect updated USEPA and California Environmental Protection Agency recommendations for EPCs, exposure assumptions, toxicity criteria, and mode of action (see Appendix A).

[f] Combined risks for the intertidal and subtidal scenario were not calculated for the construction worker because radiological risks were not estimated for this receptor (see Section 5.1.3).

Cancer risks shown in boldface exceed 1E-06, the lower end of the USEPA risk management range for cancer risks of 1E-06 to 1E-04.

-- = Not applicable

Reference: Battelle, Blasland, Bouck & Lee, Inc. (BBL) and Neptune & Company. 2005. *Final Hunters Point Shipyard Parcel F, Validation Study Report, San Francisco Bay, California*. May 2.

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Figures

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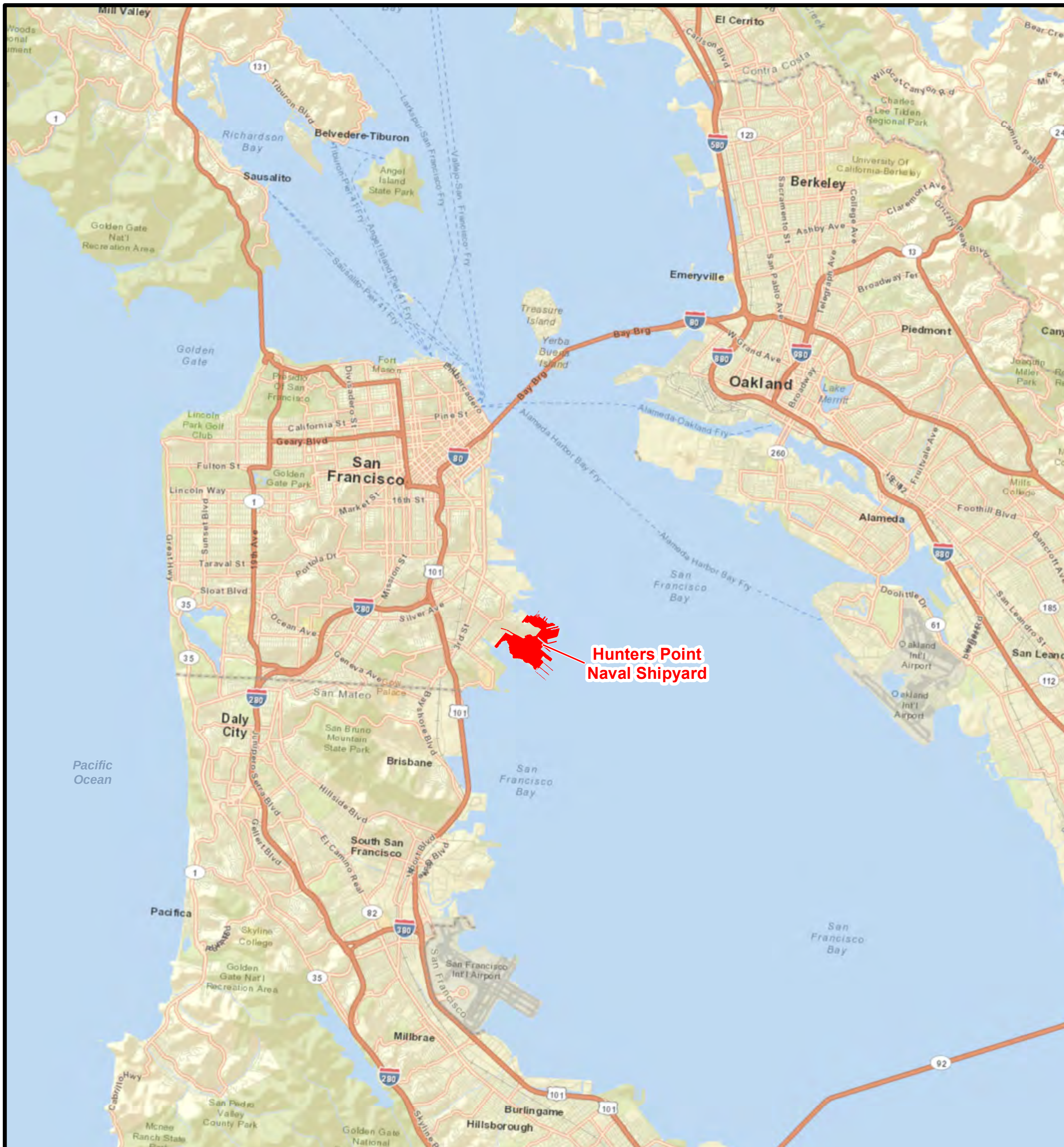

LEGEND

HUNTERS POINT NAVAL SHIPYARD

0 1.5 3 6
Miles

SOURCE:
ESRI ArcGIS Online Web Service, Streets

Regional Location

Addendum to the
Feasibility Study Report for Parcel F
Hunters Point Naval Shipyard San Francisco, California

N

FIGURE

1-1

Date: 6/2/2014 User: SWolfskill Path: C:\Users\swolfskill\Documents\GIS_PROJECTS\NAVY\HUNTERS_POINT\CTO_005\MXD\PAR_F_FS_RAD\005_2794.mxd

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Parcel F Boundaries and Impacted Areas as Reported in the HRA

Addendum to the Feasibility Study Report for Parcel F

N

FIGURE

1-2

ES041514084131BAO_Fig_1-2_Parcel_F-Boundaries-RadiologicallyAreas_v2.ai_lho_012015

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Figure was modified from ITSI Gilbane & SAIC, 2013

Reference Area Sampling Location Map

Addendum to the Feasibility Study Report for Parcel F

N

FIGURE

3-1

ES041514084131BAO_Ref_LocArea.ai_lho_012015

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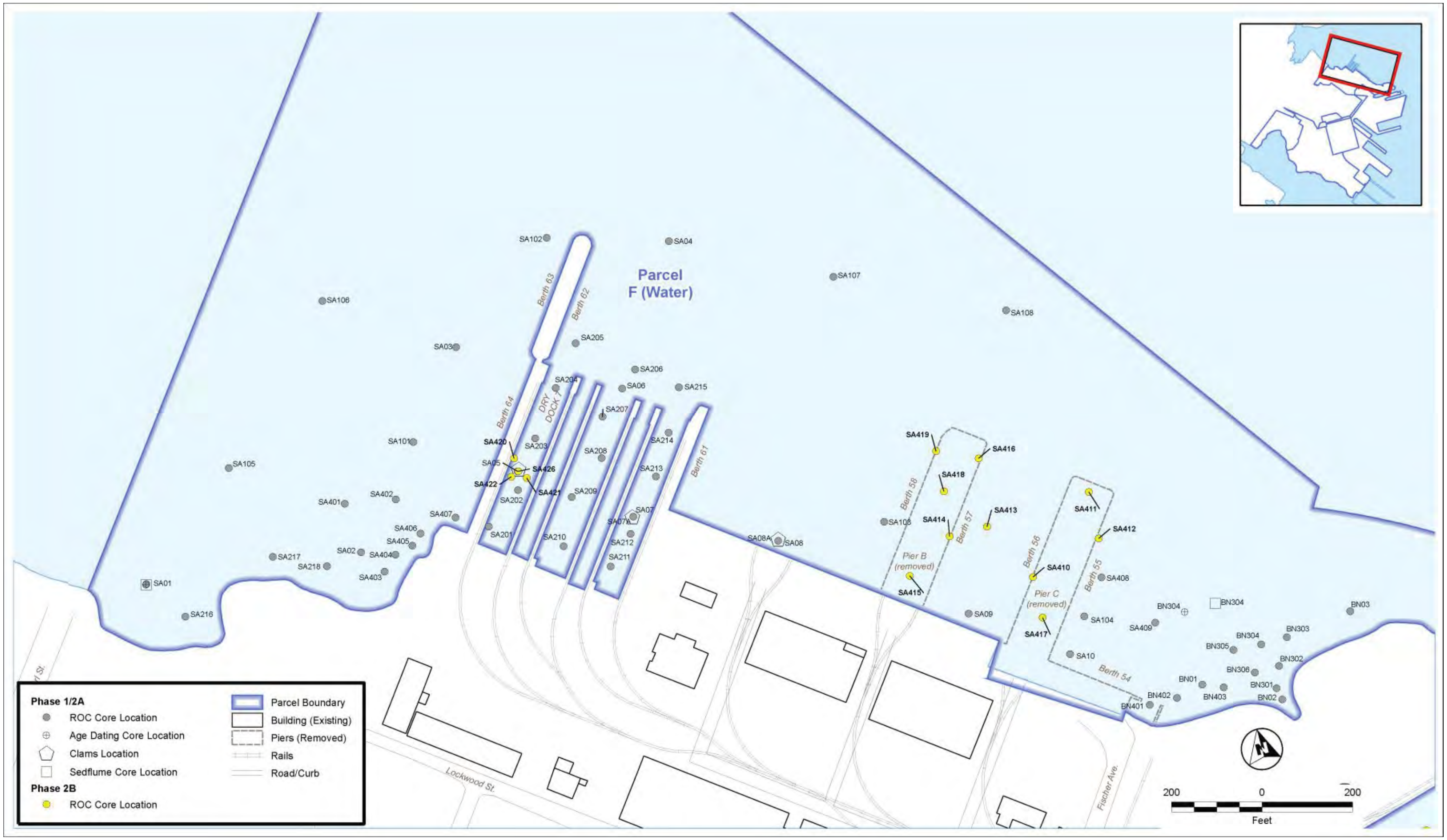

Parcel F Sediment Sampling Location Map for the Submarine Area

Addendum to the
Feasibility Study Report for Parcel F

FIGURE

3-2

Source: ITSI Gilbane & SAIC, 2013

ES041514084131BAO_Parcel_F-SubmarineArea.ai_lho_012015

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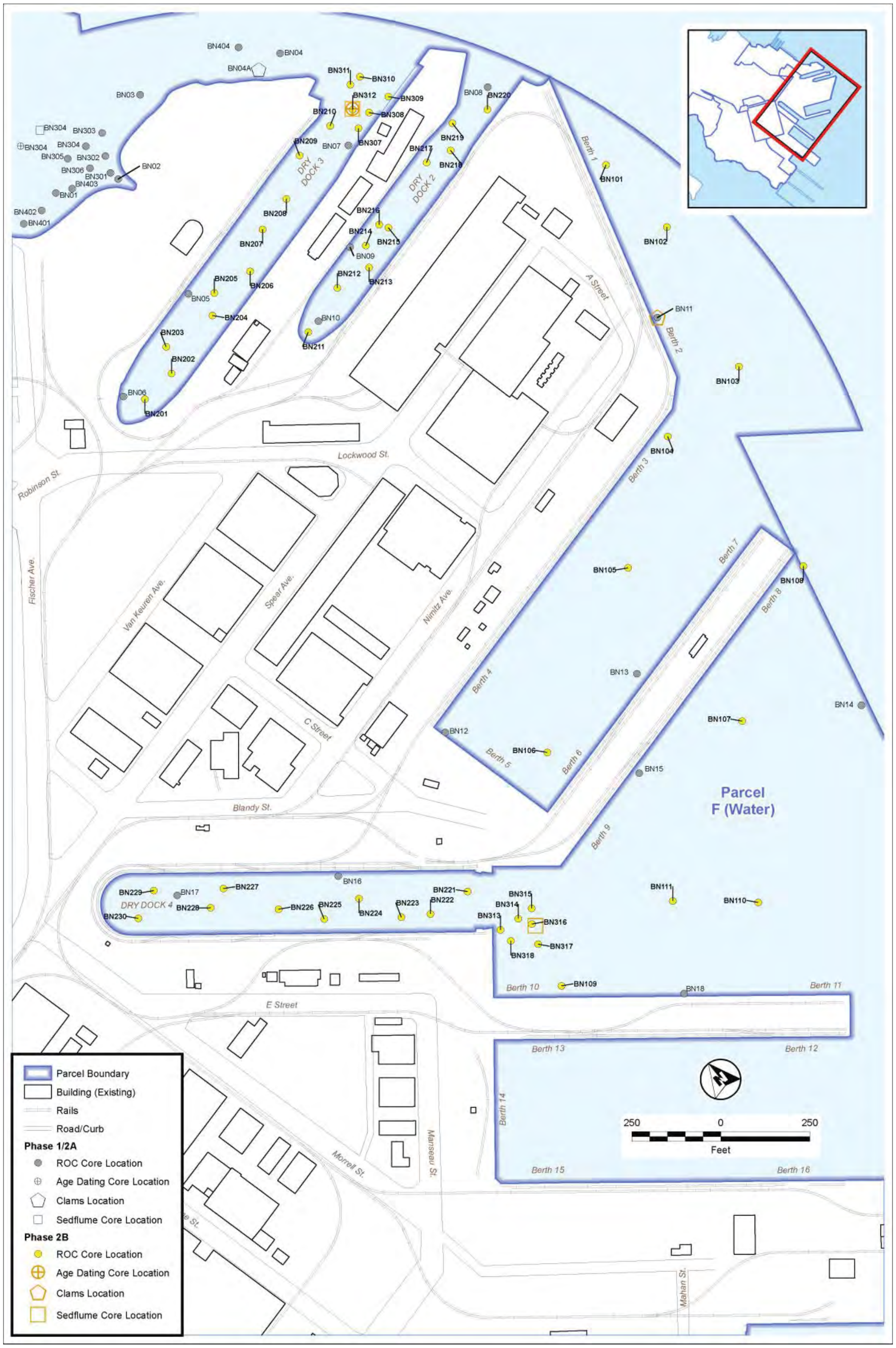

Source: ITSI Gilbane & SAIC, 2013

Parcel F Sediment Sampling Location Map for the Berths North Area

Addendum to the
Feasibility Study Report for Parcel F

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FIGURE

3-3

ES041514084131BAO_Parcel_F-BerthNorthArea.ai_lho_012015

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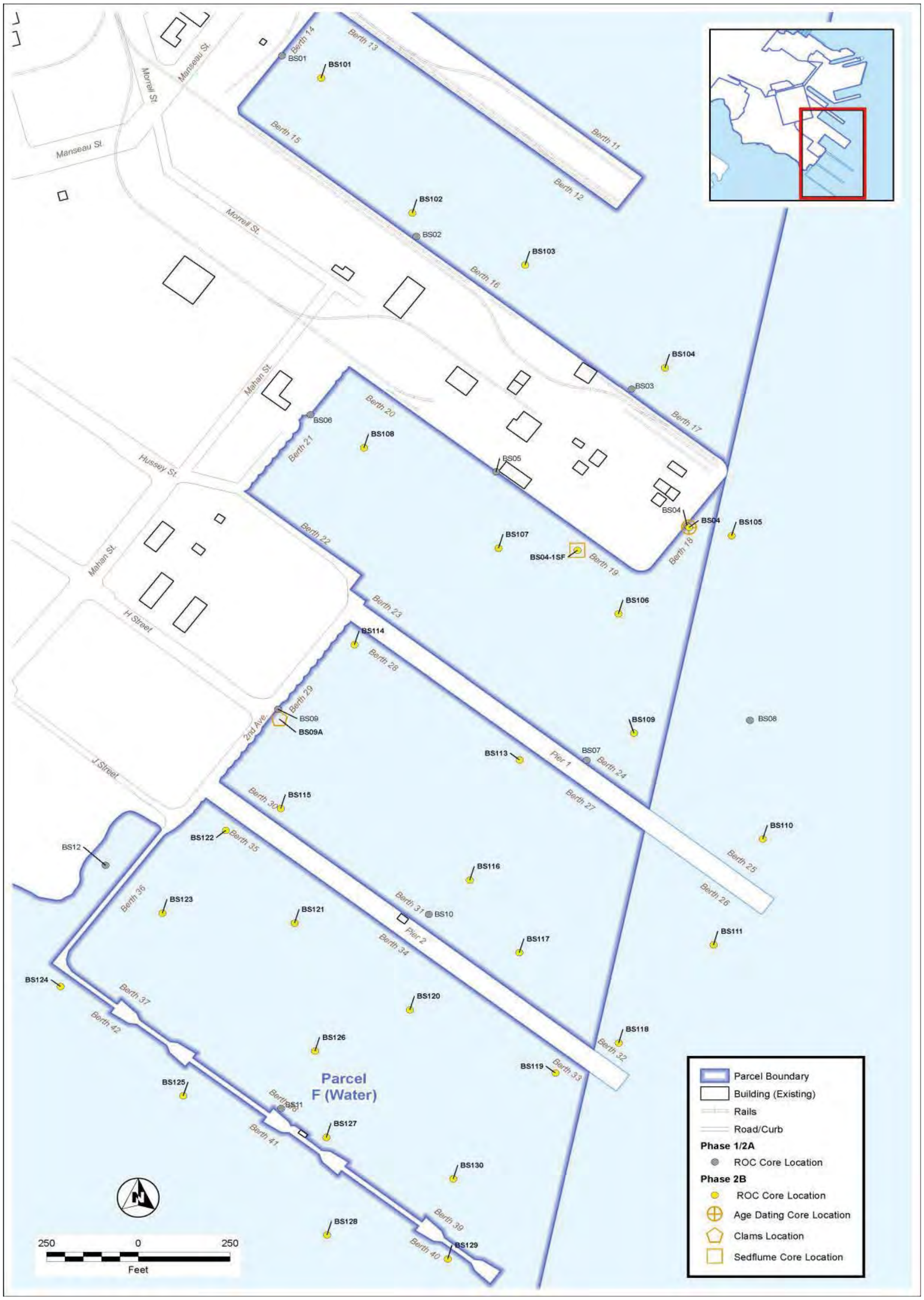

Parcel F DGI Phase 2b Sampling Location Map for the Berths South Area

Addendum to the
Feasibility Study Report for Parcel F

FIGURE

3-4

Source: ITSI Gilbane & SAIC, 2013

ES041514084131BAO_Parcel_F-DGI_Phase2b_BerthSouthArea.ai_lho_012015

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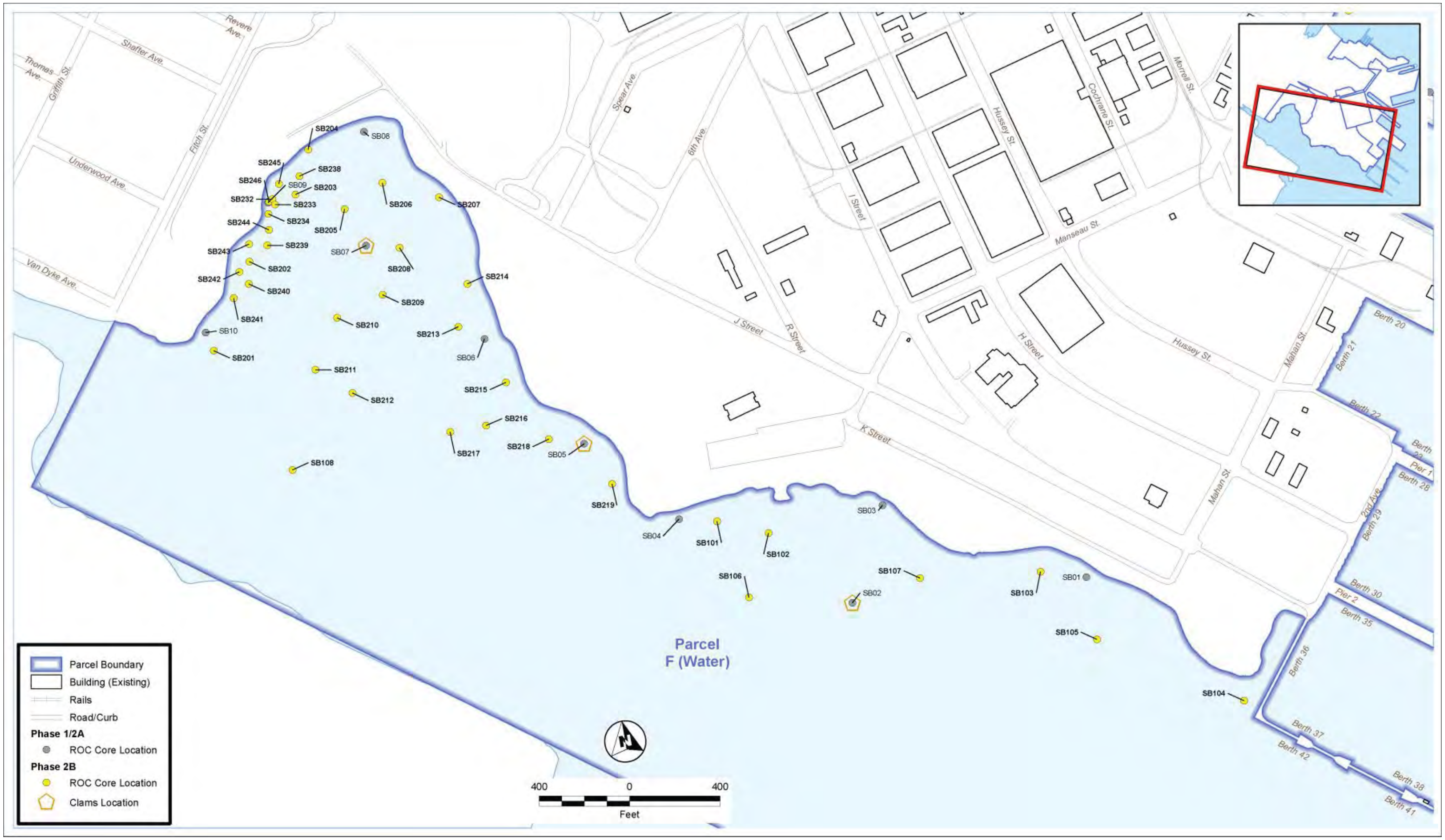

Source: ITSI Gilbane & SAIC, 2013

Parcel F Sediment Sampling Location Map for the South Basin Area

Addendum to the
Feasibility Study Report for Parcel F

FIGURE

3-5

ES041514084131BAO_Parcel_F-SouthBasinArea.ai_lho_012015

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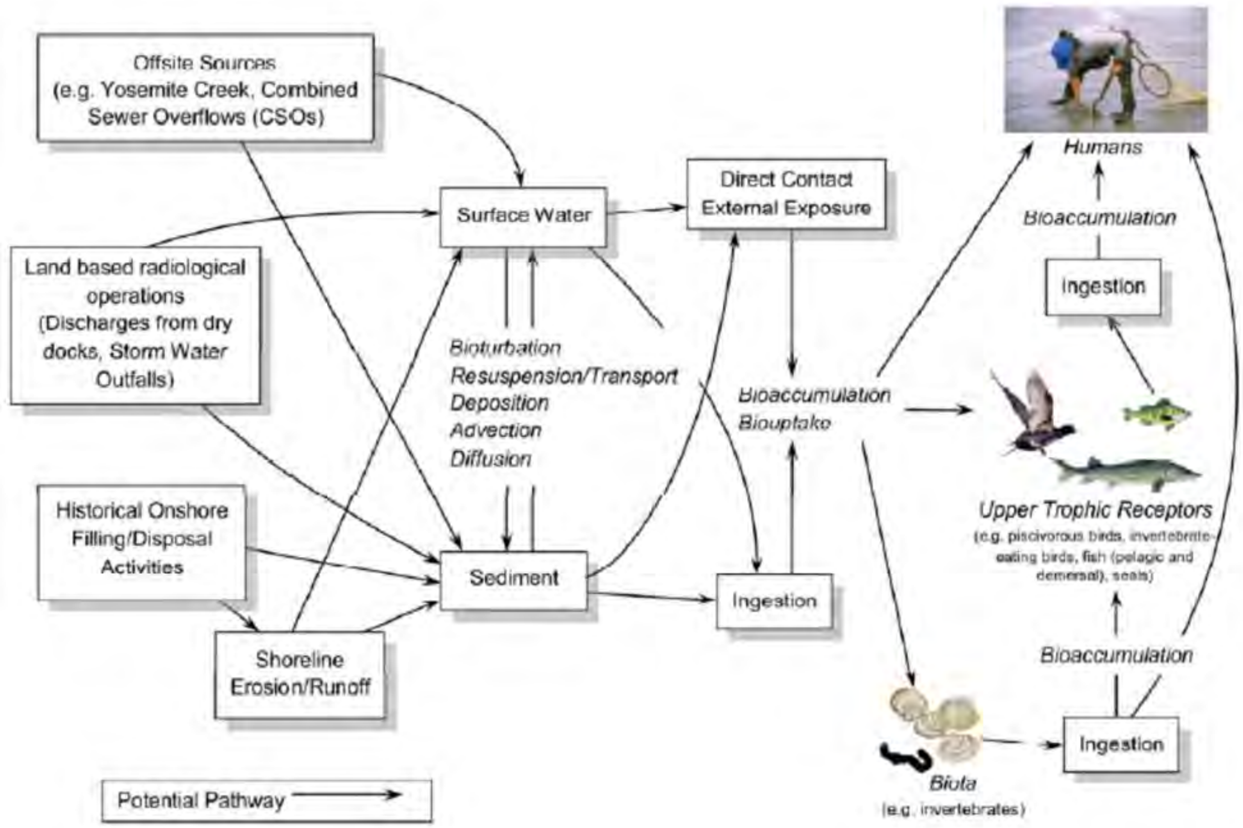

FIGURE 3-6
Intertidal CSM for Parcel F (high tide line to less than or equal to -3.0 feet MLLW)

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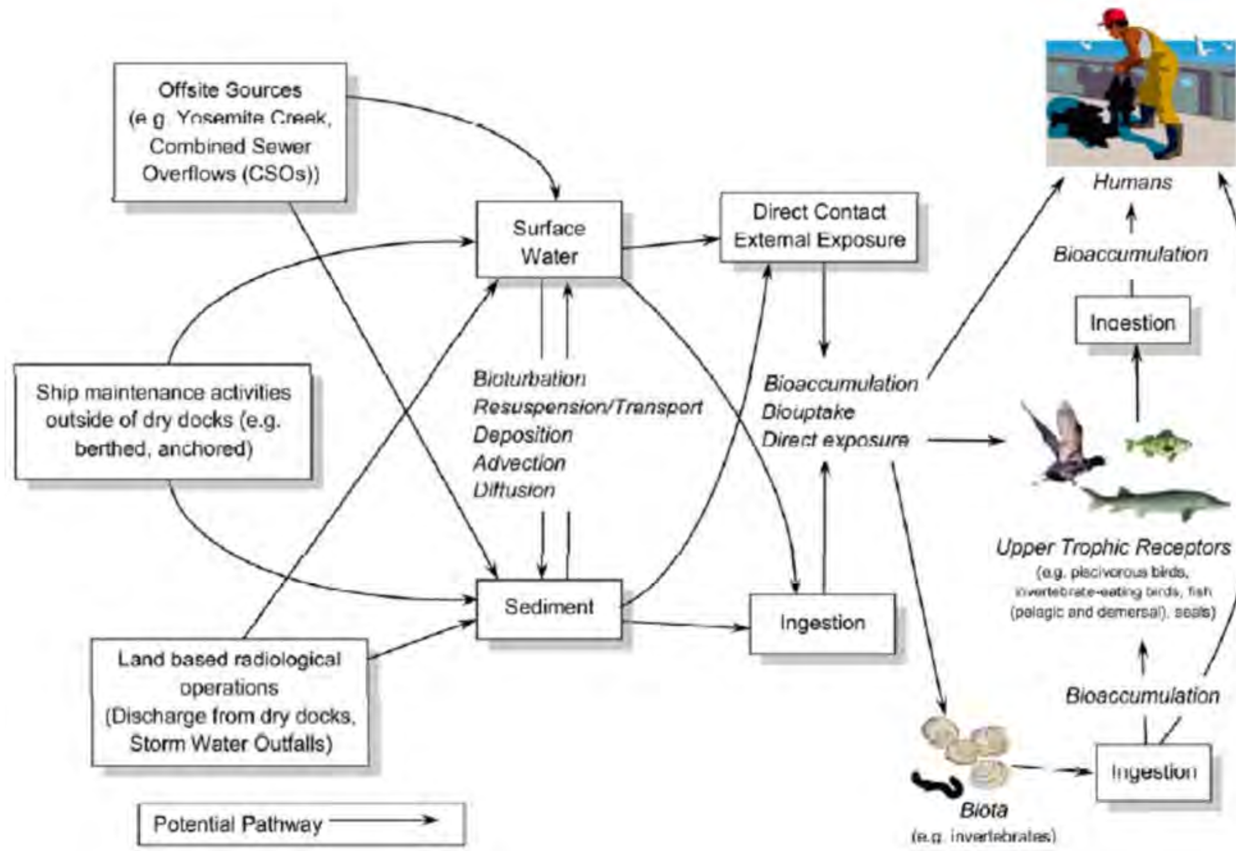

FIGURE 3-7
Subtidal CSM for Parcel F (greater than -3.0 feet MLLW)

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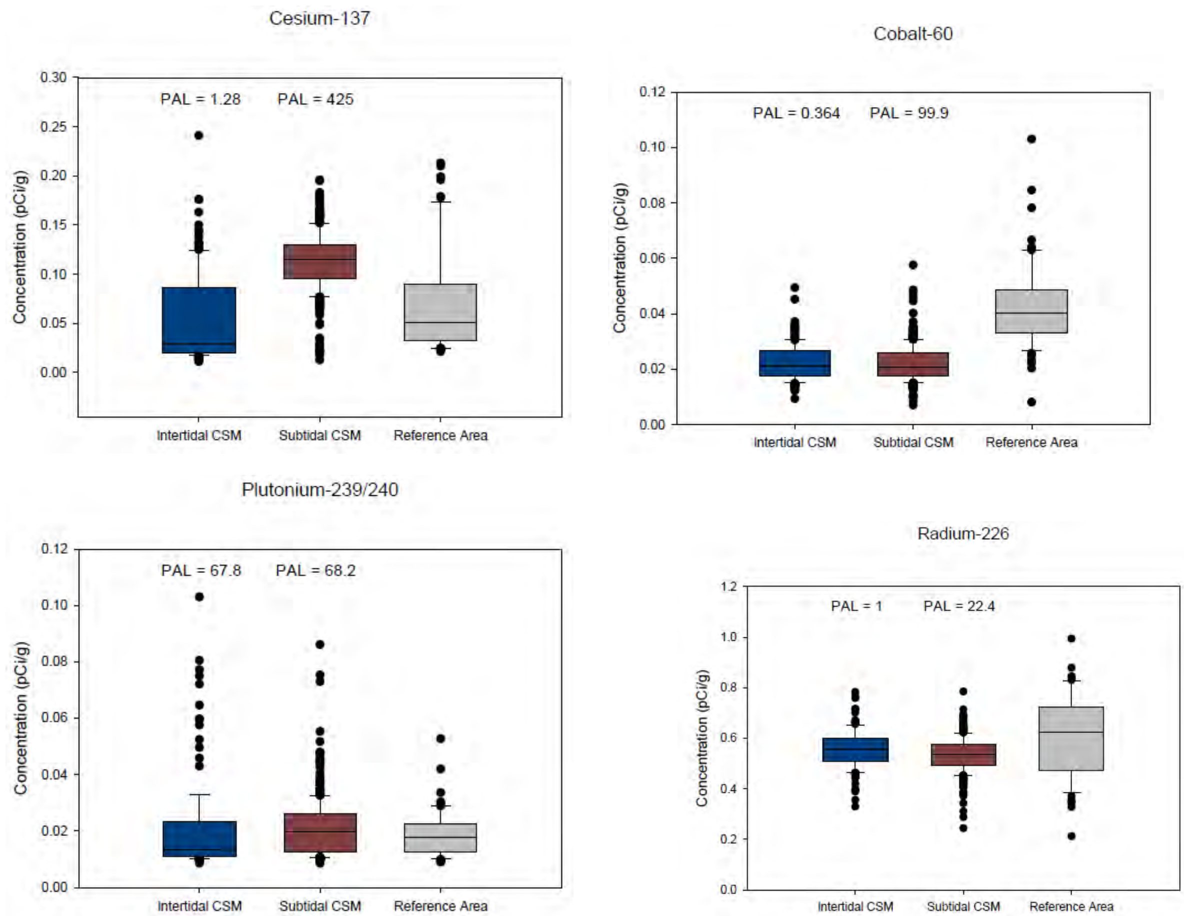

FIGURE 4-1
Cs-137, Co-60, Pu-239/240, and Ra-226 Box Plots for Phase 2b Dataset

Reference: Figure 3-6 through 3-9 (ITSI & Gilbane (2013).

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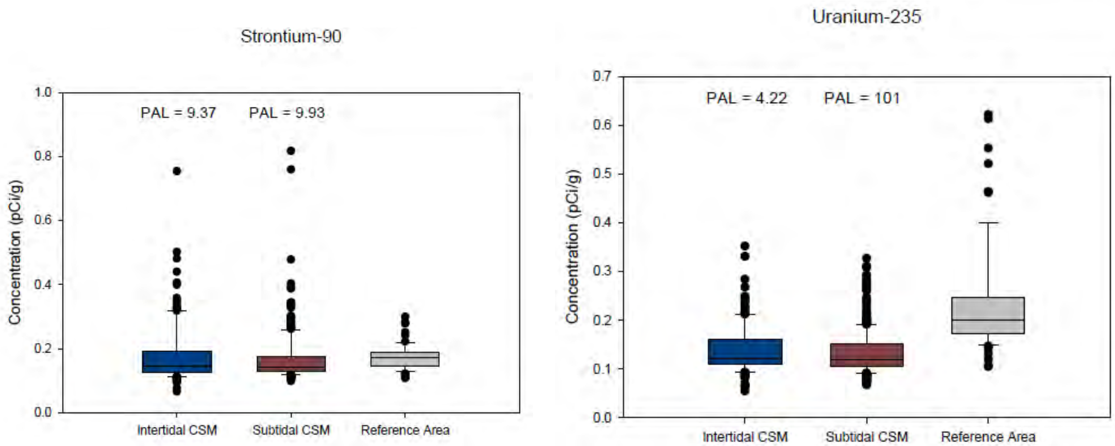

FIGURE 4-2
Sr-90 and U-235 Box Plots for Phase 2b Dataset

Reference: Figures 3-10 and 3-11 (ITSI & Gilbane (2013).

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Appendix A
Updated Human Health Risk Assessment – Chemical Contamination

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Appendix A

Updated Human Health Risk Assessment for Chemical Exposures

Addendum to the Feasibility Study Report for Parcel F

Hunters Point Naval Shipyard
San Francisco, California

Contract Number: N68711-05-C-6011
Contract Task Order Number: 0005
Document Control Number: KCH-2622-0005-0138

December 2016

Prepared for

Department of the Navy
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Contents

Tables

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Acronyms and Abbreviations

95UCL	95 percent upper confidence limit of the mean
ABS	dermal absorption
ADAF	age-dependent adjustment factor
Cal/EPA	California Environmental Protection Agency
COPC	chemical of potential concern
CTE	central tendency exposure
DTSC	(California) Department of Toxic Substances Control
EPC	exposure point concentration
FS	feasibility study
GI	gastrointestinal
HEAST	Health Effects Assessment Summary Tables
HHRA	human health risk assessment
HI	hazard index
IRIS	Integrated Risk Information System
kg/day	kilograms per day
mg/kg	milligrams per kilogram
OEHHA	Office of Environmental and Health Hazard Assessment
PCB	polychlorinated biphenyl
PPRTV	Provisional Peer-Reviewed Toxicity Values
PRG	preliminary remediation goal
RBA	relative bioavailability
RME	reasonable maximum exposure
RSL	regional screening level
TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
TEF	toxicity equivalency factor
TEQ	toxicity equivalent
USEPA	United States Environmental Protection Agency

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1.0 Introduction

This appendix presents the methods used to update the human health risk assessment (HHRA) for chemical exposures at Parcel F. Chemical risks for Parcel F were previously assessed as part of the HHRA completed for the Parcel F Validation Study (Battelle, Blasland, Bouck & Lee, Inc. and Neptune & Company, 2005), hereafter referred to as the 2005 HHRA. The 2005 HHRA estimated chemical risks for a recreational shellfish harvesting scenario and for a construction worker scenario for the following five exposure areas at Parcel F:

- Eastern Wetland Area
- India Basin Area I
- Oil Reclamation Area
- Point Avisadero Area
- South Basin Area X

In addition, risks were estimated based on exposure to reference station (i.e., background) concentrations. Risks to adult recreational users were based on exposure from shellfish consumption and direct contact with sediment (incidental ingestion and dermal contact). Risks to child recreational users and construction workers were based on direct contact with sediment. Further information regarding the potential human receptors, chemical transport mechanisms, and potentially complete exposure pathways for Parcel F is provided in the 2005 HHRA (Battelle, Blasland, Bouck & Lee, Inc. and Neptune & Company, 2005).

In this feasibility study (FS) addendum report, chemical risks are summed with radiological risks for Parcel F to estimate the overall potential for excess lifetime cancer risks from exposure to contaminated media. In the intervening years since the 2005 HHRA was completed, however, toxicity criteria for many of the chemicals of potential concern (COPC) at Parcel F have evolved based on additional scientific research. Toxicity criteria form the basis for evaluating risk and developing appropriate remedial goals to protect human health and the environment in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act. In addition, methods and assumptions recommended by the United States Environmental Protection Agency (USEPA) and California Department of Toxic Substances Control (DTSC) for estimating health risks have been updated.

Before they were summed with radiological risks, chemical risks for Parcel F were updated for the each of the five exposure areas and the reference stations to reflect updated USEPA and DTSC methodology for HHRAs. Both reasonable maximum exposure (RME) and central tendency exposure (CTE) risks were estimated in the 2005 HHRA; the updated HHRA was limited to estimation of RME risks. The maximum updated RME chemical risk for the five exposure areas was then used to estimate combined chemical and radiological risks for Parcel F (see Section 5.4 of the FS addendum report).

This appendix discusses the methods used to update the chemical HHRA for Parcel F. Approaches used to calculate risks that were unchanged from the 2005 HHRA completed for Parcel F are not described; details for these methods are provided in Section 9 and Appendices J and Q of the 2005 Parcel F Validation Study (Battelle, Blasland, Bouck & Lee, Inc., and Neptune & Company, 2005).

The updated chemical HHRA for Parcel F reflects revised methods for estimating exposure point concentrations (EPC), revised assumptions for estimating exposure and chemical intake, changes to toxicity criteria, and updated risk characterization methods. These revisions are discussed Sections 2.0 through 5.0. Results of the updated HHRA are provided in Section 6.0. References are listed in Section 7.0.

2.0 Exposure Point Concentrations

EPCs for each COPC identified in sediment and clam (*Macoma nasuta*) samples collected from the five exposure areas and the reference stations were revised to incorporate updated toxicity equivalency factors (TEFs) for dioxin/furan congeners and to incorporate updated methods for calculating 95 percent upper confidence limit of the mean (95UCL) concentrations. The updated EPCs are provided in Tables A-1 and A-2.

2.1 Toxicity Equivalency Factors

TEFs used in the updated HHRA to estimate 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) toxicity equivalent (TEQ) concentrations were revised based on TEFs provided by the USEPA (2010). The revised TCDD TEQ concentrations are referred to as total TEQ for dioxin/furan-like congeners, or “Total TEQ – TCDD DLC,” in the updated HHRA.

Total TEQ concentrations for the four coplanar polychlorinated biphenyl (PCBs) congeners (i.e., PCB-77, PCB 105, PCB 118, and PCB 126) were also calculated in the updated HHRA because of the availability of TEFs for these congeners. Evaluation of these PCB congeners was limited to total PCBs in the 2005 HHRA; however, these coplanar PCB congeners are also associated with dioxin-like toxicity. TEQ concentrations for the coplanar PCB congeners are referred to as total TEQ for dioxin-like PCB congeners, or “Total TEQ – PCB DLC” in the updated HHRA.

The chart below summarizes the dioxin/furan and PCB congener TEFs that were revised in the updated HHRA. Updated TEFs for congeners that were not analyzed in Parcel F samples are not listed.

Compound	2005 HHRA TEF (Van den Berg et al., 1998)	Updated HHRA TEF (USEPA, 2010)
1,2,3,7,8-Pentachlorinated dibenzofuran (1,2,3,7,8-PeCDF)	0.05	0.03
2,3,4,7,8-Pentachlorinated dibenzofuran (2,3,4,7,8-PeCDF)	0.5	0.3
PCB-105	0.0001	0.00003
PCB-118	0.0001	0.00003

2.2 95 Percent Upper Confidence Limit Concentrations

Although goodness-of-fit tests did not conclusively indicate a normal or lognormal distribution for exposure area-specific sampling results for COPCs, graphical analysis of the combined exposure area and reference data sets during the 2005 HHRA indicated a normal distribution (Battelle, Blasland, Bouck & Lee, Inc. and Neptune & Company, 2005).

Therefore, the 2005 HHRA calculated 95UCL concentrations for all COPCs using the Student's t-statistic and the USEPA (1992) method for normally distributed data.

95UCLs were recalculated for the updated HHRA using the stochastic methods in USEPA's ProUCL software (version 5.0.00) and technical guidance (USEPA, 2013). The procedures in ProUCL identify the COPC-specific statistical distribution type (e.g., normal, lognormal, gamma, or nonparametric) and compute the corresponding 95UCL for the identified distribution type. The 95UCL was used in the updated HHRA as the EPC unless the calculated 95UCL is greater than the maximum detected concentration or when the number of samples or number of detected results in the data grouping is too small (fewer than five total results or fewer than four detected results) to permit estimation of a 95UCL. If this occurs, then the maximum detected concentration was used as the EPC.

3.0 Exposure and Chemical Intake

The updated HHRA incorporates revised exposure assumptions, updated dermal absorption factors, and bioavailability for arsenic to estimate exposure and chemical intake.

3.1 Exposure Assumptions

Values used in the 2005 HHRA to estimate exposure were largely based on assumptions used by USEPA in 2002 to develop preliminary remediation goals (PRGs) for Region 9. The USEPA regional screening levels (RSLs) have replaced the USEPA Region 9 PRGs. The 2014 RSLs (USEPA, 2014a) incorporate revisions made in 2014 by USEPA (2014b) for several key exposure parameters, such as adult body weight, exposure skin surface area available for contact with soil and sediment, and residential exposure duration. In addition, DTSC (2014) has developed exposure assumption recommendations for soil and sediment contact. The updated HHRA uses the most conservative values between exposure assumptions used for the RSLs (USEPA, 2014a) and DTSC (2014) recommendations for exposure assumptions. For some exposure parameters (i.e., body weight and exposure duration) the DTSC (2014) recommendations are based on historical USEPA values that have since been replaced by newer USEPA (2014) values; the newer USEPA (2014) values are used for these parameters.

The site-specific ingestion rate for shellfish consumption of 0.048 kilograms per day (kg/day) used in the 2005 HHRA was revised in the updated HHRA to 0.00213 kg/day. The revised shellfish consumption rate reflects the approach established in the 2008 FS report for Parcel F to develop remediation goals for Parcel F (Barajas & Associates, Inc. 2008).

Table A-3 presents the updated exposure assumptions for direct contact with sediment and Table A-4 presents the updated exposure assumptions for shellfish consumption. The 2005 HHRA exposure assumptions are provided in these tables for comparison purposes; the tables also indicate which values were revised for the updated HHRA.

3.2 Dermal Absorption Factors

Dermal absorption (ABS) factors used in the 2005 HHRA to estimate chemical intake from exposure to COPCs in sediment were based on values used by USEPA in 2002 to develop the PRGs. The updated HHRA uses the most conservative ABS factor between those used by USEPA to develop the 2014 RSLs (USEPA, 2014a) and those recommended by DTSC in its 2013 preliminary endangerment assessment guidance (DTSC, 2013).

Table A-5 presents the ABS factors used in the updated HHRA. The 2005 HHRA ABS factors are provided in this table for comparison purposes; the table also indicates which factors were revised for the updated HHRA.

3.3 Arsenic Bioavailability

The 2005 HHRA assumed 100 percent relative bioavailability (RBA) of arsenic when exposure results from sediment ingestion. Recent guidance from USEPA (2012) recommends a default RBA value of 60 percent be used to adjust intake estimates for ingestion of arsenic in soil; this value is also incorporated in the derivation of the 2014 RSLs (USEPA, 2014a). Intake estimates for ingestion of arsenic were likewise adjusted in the updated HHRA to incorporate the default arsenic RBA of 60 percent.

4.0 Toxicity Criteria

The updated HHRA incorporates updated toxicity criteria, adjusts toxicity criteria for evaluating dermal exposures, uses toxicity criteria based on surrogate chemicals when chemical-specific toxicity criteria are not available, and makes changes to the assumed form of chromium present in sediment and clam tissue at Parcel F.

4.1 Toxicity Criteria

The 2005 HHRA used the following hierarchy as sources for toxicity criteria: (1) California Environmental Protection Agency's (Cal/EPA) Office of Health Hazard Assessment (OEHHA) criteria for carcinogens, (2) USEPA's Integrated Risk Information System (IRIS), and (3) USEPA's Health Effects Assessment Summary Tables (HEAST).

USEPA revised its recommendations for the hierarchy of toxicity criteria sources in 2003 (USEPA, 2003), and further refined its recommendations for the hierarchy of sources during subsequent development of the RSLs (USEPA, 2014a). USEPA (2014a) currently recommends the following three-tiered hierarchy of sources:

Tier 1: USEPA's IRIS

Tier 2: USEPA's Provisional Peer-Reviewed Toxicity Values (PPRTV) database.

Tier 3: Other toxicity values, from the following sources in the order in which they are listed:

a. Agency for Toxic Substances and Disease Registry minimal risk levels
b. Cal/EPA's OEHHA online database
c. USEPA PPRTV appendix screening toxicity values
d. USEPA's HEAST

The updated HHRA used this current (USEPA, 2014a) hierarchy to identify and update toxicity criteria, with one exception. The USEPA (2014a) hierarchy includes Cal/EPA-established criteria as third-tier sources. If the Cal/EPA toxicity criterion for carcinogens was more conservative than toxicity criterion for carcinogens from first- and second-tier sources, then the Cal/EPA criterion was used preferentially over the first- and second-tier source criterion. This approach provides a conservative estimate of health risks for carcinogens because Cal/EPA criteria for some chemicals are more conservative than toxicity criteria established by the other sources. This exception to the hierarchy was used to evaluate cancer effects only, as the Cal/EPA criteria for evaluation of noncancer effects have not undergone the same level of peer review as criteria for evaluation of cancer effects.

Table A-5 presents the toxicity criteria used in the updated HHRA. The 2005 HHRA toxicity criteria are provided in this table for comparison purposes; the table also indicates which factors were revised for the updated HHRA.

4.2 Toxicity Criteria – Dermal Exposure

Toxicity criteria are not available for the dermal exposure route. The 2005 HHRA used route-to-route extrapolations of oral toxicity criteria to evaluate dermal exposures. The gastrointestinal (GI) absorption fraction was assumed to be 100 percent for all COPCs; that is, oral toxicity criteria were not adjusted for GI absorption fraction in the 2005 HHRA to evaluate dermal exposures.

Current USEPA (2004) guidance recommends that oral toxicity criteria be adjusted for evaluation of dermal exposures so that criteria are based on an absorbed dose. Toxicity value adjustments are only needed when the GI absorption fraction is less than 50 percent (USEPA, 2004).

USEPA (2004)-recommended GI absorption fractions are summarized in Table A-5. These fractions were used in the updated HHRA to adjust oral toxicity criteria for evaluation of dermal exposures; the resulting dermal toxicity criteria are also shown on Table A-5. GI absorption fractions are not available for all COPCs. In the absence of information; the GI absorption fraction was assumed to be 1 (i.e., 100 percent) and oral toxicity criteria were not adjusted to evaluate dermal exposures.

4.3 Surrogate Chemicals

The 2005 HHRA did not estimate health risks for COPCs that did not have USEPA- or Cal/EPA-established toxicity criteria. The updated HHRA used chemical surrogates to address data gaps in the risk estimates resulting from lack of toxicity criteria for some COPCs. Chemical surrogates were selected based on structural similarity to the COPCs that lack toxicity criteria. The chemical surrogates used to identify toxicity criteria in the updated HHRA are listed in Table A-5.

4.4 Chromium

Chromium is a COPC in sediment and clam (*Macoma nasuta*) tissue. In the absence of speciation data, the 2005 HHRA assumed all chromium in sediment and clam tissue was present as hexavalent chromium for estimating health risks. Hexavalent chromium is considered a carcinogen (USEPA, 2014a). However, chromium in reducing or even mildly oxidizing conditions in aquatic environments is present primarily as trivalent chromium because these conditions do not provide stability for chromium in the hexavalent state (Rifkin, et. al., 2004). Under the anoxic conditions present in most sediments, hexavalent chromium is readily reduced to the trivalent form by a number of naturally-occurring chemical and microbial species. Natural chemical reductants include reduced iron and sulfur species as well as organic sediment constituents. Once formed, trivalent chromium has very low solubility at mid-range pH values due to the formation of $Cr(OH)_3$. Oxidation of trivalent to hexavalent chromium does not readily occur, even in the presence of possible oxidants such as oxygen or MnO_2, due to the general reductive capacity of the sediments (Sorensen, et al., 2010; Truex, et al., 2015). For this reason, the updated HHRA based toxicity criteria for chromium on trivalent chromium. Trivalent chromium is only associated with noncancer effects (USEPA, 2014a).

5.0 Risk Characterization

The updated HHRA incorporates mutagenic mode of action to estimate cancer risks, revises the methodology used to estimate cumulative cancer risks and noncancer hazards for recreational user contact with sediment, and confirms the approach for characterizing health effects for lead.

5.1 Mutagenic Mode of Action

Seven carcinogenic PAHs—benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene—were identified as COPCs. These cancer-causing chemicals operate by a mutagenic mode of action. It is believed that chemicals with a mutagenic mode of action may exhibit a greater effect in early life versus later-life exposure. Cancer risk to children from exposure includes early life exposures that may result in the occurrence of cancer during childhood or that may contribute to cancers later in life (USEPA, 2005). The following USEPA (2005) default age-dependent adjustment factors (ADAFs) are used to estimate cancer risks in the updated HHRA for mutagenic COPCs. USEPA (2005) equations for incorporating these ADAFs to estimate intake of mutagenic COPCs are shown in Table A-3.

- A 10-fold adjustment for ages 0 to less than 2 years
- A 3-fold adjustment for ages 2 to less than 16 years
- No adjustment for ages 16 years and older

Adjustment to cancer risks for mutagenic COPCs using ADAFs was not done in the 2005 HHRA.

5.2 Cumulative Cancer Risk Estimates

Cumulative cancer risks for direct contact with sediment for recreational users were estimated in the 2005 HHRA solely based on cancer risks for the adult recreational user. For the updated HHRA, cumulative cancer risks for recreational user direct contact with sediment were calculated by summing direct contact cancer risks for both the adult and child recreational users. This approach was used because cancer risks are cumulative over a lifetime of exposure (USEPA, 1989). This approach is also consistent with the method USEPA uses to develop residential RSLs, which include evaluation of adult and child exposures, for chemicals with cancer effects (USEPA, 2014a). Evaluation of construction worker exposure to sediment from direct contact was not affected by this change.

5.3 Cumulative Noncancer Hazard Estimates

The cumulative noncancer hazard for direct contact with sediment for recreational users was estimated in the 2005 HHRA based on the total noncancer hazard index (HI) for the adult recreational user. For the updated HHRA, the cumulative noncancer hazard for recreational users was based on the total HI for the child recreational user. This approach was used because intake of sediment from incidental ingestion and dermal contact per unit body mass is higher for children than for adults; thus, noncancer HIs for a child recreational user are always higher than noncancer HIs for an adult recreational user. This approach is also consistent with the method USEPA uses to develop residential RSLs, which is limited to evaluation of child exposures for chemicals with noncancer effects (USEPA, 2014a). Evaluation of construction worker exposure to sediment from direct contact was not affected by this change.

5.4 Lead

The 2005 HHRA evaluated the potential for health effects from exposure to lead in sediment and clam (*Macoma nasuta*) tissue by comparing the range of detected concentrations for lead with the USEPA 2002 residential PRG for lead in soil of 400 milligrams per kilogram (mg/kg). As discussed in Section 3.1, the USEPA PRGs have been replaced by USEPA RSLs; the current USEPA (2014) residential RSL for lead is the same as the 2002 PRG (400 mg/kg). However, as indicated in the 2005 HHRA, this screening concentration for lead is based on a target blood lead level concentration and lead uptake modeling for exposure to lead in soil, drinking water, homegrown produce, and respirable dust and air. The uptake modeling was not designed to predict blood lead levels associated with seafood consumption or from contact with sediment (Battelle, Blasland, Bouck & Lee, Inc. and Neptune & Company, 2005). Despite this difference, the 2005 HHRA found that concentrations of lead at Parcel F were lower than the health-protective concentration of 400 mg/kg and further evaluation of lead was therefore not warranted. For this reason, health effects from exposure to lead were not re-evaluated in the updated HHRA.

6.0 Risk Results

The updated cancer risk and noncancer HI results for the recreational user (direct contact with sediment, shellfish consumption) and construction worker (direct contact with sediment) scenarios are presented in the following tables:

- Eastern Wetland Area: Tables A-6A through A-7C
- India Basin Area I: Tables A-8A through A-9C
- Oil Reclamation Area: Tables A-10A through A-11C
- Point Avisadero Area: Tables A-12A through A-13C
- South Basin Area X: Tables A-14A through A-15C
- Reference Stations: Tables A-16A through A-17C

Table A-18 provides an overall summary of the updated cumulative cancer risk and noncancer HI results. Table A-19 compares the updated HHRA results with the results for the 2005 HHRA. The same format used for the summary tables in the 2005 HHRA was used for the comparison summary in Table A-19 for comparability.

Cumulative cancer risk and noncancer HI estimates in Table A-18 are presented to one significant figure in accordance with USEPA (1989) guidance. However, Tables A-6A through A-17C show chemical-specific risk and HI results to two significant figures to aid review of the risk calculations. Table A-19 shows both cumulative and chemical-specific risk and HI results to two significant figures for comparability with the results provided in the 2005 HHRA.

7.0 References

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Tables

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TABLE A-1

Exposure Point Concentration Summary for Sediment

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Current and Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Point	Area	Chemical of Potential Concern	CAS Number	Units	Detection Frequency	Number of High Censored Results (a)	Minimum Concentration	Arithmetic Mean (b)	95 UCL Distribution (c)		Maximum Detected Concentration	Exposure Point Concentration			
												Value	Units	Statistic (d)	Method (e)
Sediment	Eastern Wetland Area	**Metals**													
		Aluminum	7429-90-5	mg/kg	8 / 8	0	4.20E+04	5.51E+04	6.40E+04	N	7.49E+04	6.40E+04	mg/kg	95UCL	(2)
		Antimony	7440-36-0	mg/kg	8 / 8	0	6.42E-01	1.21E+00	2.77E+00	NP	3.64E+00	2.77E+00	mg/kg	95UCL	(4)
		Arsenic	7440-38-2	mg/kg	8 / 8	0	5.18E+00	8.12E+00	9.69E+00	N	1.11E+01	9.69E+00	mg/kg	95UCL	(2)
		Barium	7440-39-3	mg/kg	8 / 8	0	3.32E+02	3.92E+02	4.24E+02	N	4.58E+02	4.24E+02	mg/kg	95UCL	(2)
		Cadmium	7440-43-9	mg/kg	8 / 8	0	1.84E-01	2.34E-01	2.59E-01	N	2.71E-01	2.59E-01	mg/kg	95UCL	(2)
		Chromium	7440-47-3	mg/kg	8 / 8	0	1.58E+02	2.36E+02	2.90E+02	N	4.00E+02	2.90E+02	mg/kg	95UCL	(2)
		Cobalt	7440-48-4	mg/kg	8 / 8	0	1.27E+01	1.55E+01	1.74E+01	N	1.88E+01	1.74E+01	mg/kg	95UCL	(2)
		Copper	7440-50-8	mg/kg	8 / 8	0	1.20E+01	3.11E+01	4.11E+01	N	5.28E+01	4.11E+01	mg/kg	95UCL	(2)
		Iron	7439-89-6	mg/kg	8 / 8	0	2.21E+04	3.34E+04	3.94E+04	N	4.65E+04	3.94E+04	mg/kg	95UCL	(2)
		Lead	7439-92-1	mg/kg	8 / 8	0	1.57E+01	2.14E+01	2.47E+01	N	2.98E+01	2.47E+01	mg/kg	95UCL	(2)
		Manganese	7439-96-5	mg/kg	8 / 8	0	4.28E+02	4.95E+02	5.35E+02	N	5.79E+02	5.35E+02	mg/kg	95UCL	(2)
		Mercury	7439-97-6	mg/kg	8 / 8	0	8.08E-02	1.61E-01	2.18E-01	N	2.86E-01	2.18E-01	mg/kg	95UCL	(2)
		Molybdenum	7439-98-7	mg/kg	8 / 8	0	3.81E-01	7.38E-01	9.47E-01	N	1.17E+00	9.47E-01	mg/kg	95UCL	(2)
		Nickel	7440-02-0	mg/kg	8 / 8	0	5.96E+01	7.41E+01	8.53E+01	N	9.75E+01	8.53E+01	mg/kg	95UCL	(19)
		Selenium	7782-49-2	mg/kg	3 / 8	0	3.05E-01	3.94E-01	3.39E-01	NP	4.71E-01	3.39E-01	mg/kg	95UCL	(12)
		Silver	7440-22-4	mg/kg	7 / 8	0	7.32E-02	2.09E-01	2.81E-01	NP	3.97E-01	2.81E-01	mg/kg	95UCL	(12)
		Vanadium	7440-62-2	mg/kg	8 / 8	0	8.14E+01	1.15E+02	1.38E+02	N	1.62E+02	1.38E+02	mg/kg	95UCL	(2)
		Zinc	7440-66-6	mg/kg	8 / 8	0	4.70E+01	9.05E+01	1.09E+02	N	1.27E+02	1.09E+02	mg/kg	95UCL	(2)
		Pesticides													
		4,4'-DDD	72-54-8	mg/kg	6 / 8	0	2.10E-04	6.03E-04	7.43E-04	NP	1.03E-03	7.43E-04	mg/kg	95UCL	(12)
		4,4'-DDE	72-55-9	mg/kg	8 / 8	0	2.00E-04	5.89E-04	8.73E-04	N	1.19E-03	8.73E-04	mg/kg	95UCL	(2)
		4,4'-DDT	50-29-3	mg/kg	3 / 8	0	1.20E-04	3.23E-04	2.93E-04	NP	5.30E-04	2.93E-04	mg/kg	95UCL	(12)
		alpha-Chlordane	5103-71-9	mg/kg	3 / 8	0	1.10E-04	1.37E-04	1.18E-04	NP	1.50E-04	1.18E-04	mg/kg	95UCL	(12)
		gamma-Chlordane	5566-34-7	mg/kg	1 / 1	7	2.00E-05	2.00E-05	N/A	--	2.00E-05	2.00E-05	mg/kg	Max	(1)
		PAHs													
		2-Methylnaphthalene	91-57-6	mg/kg	8 / 8	0	1.59E-03	3.59E-03	4.89E-03	N	6.39E-03	4.89E-03	mg/kg	95UCL	(2)
		Acenaphthene	83-32-9	mg/kg	8 / 8	0	6.80E-04	2.77E-03	4.38E-03	N	6.24E-03	4.38E-03	mg/kg	95UCL	(2)
		Acenaphthylene	208-96-8	mg/kg	8 / 8	0	1.09E-03	4.57E-03	6.57E-03	N	8.54E-03	6.57E-03	mg/kg	95UCL	(2)
		Anthracene	120-12-7	mg/kg	8 / 8	0	2.91E-03	2.05E-02	3.19E-02	N	4.32E-02	3.19E-02	mg/kg	95UCL	(2)
		Fluorene	86-73-7	mg/kg	8 / 8	0	1.29E-03	4.32E-03	6.36E-03	N	8.61E-03	6.36E-03	mg/kg	95UCL	(2)
		Naphthalene	91-20-3	mg/kg	6 / 8	0	4.63E-03	1.01E-02	1.18E-02	NP	1.60E-02	1.18E-02	mg/kg	95UCL	(12)
		Phenanthrene	85-01-8	mg/kg	8 / 8	0	1.18E-02	5.77E-02	8.86E-02	N	1.33E-01	8.86E-02	mg/kg	95UCL	(2)
		Benzo(a)anthracene	56-55-3	mg/kg	8 / 8	0	1.09E-02	6.12E-02	9.32E-02	N	1.28E-01	9.32E-02	mg/kg	95UCL	(2)
		Benzo(a)pyrene	50-32-8	mg/kg	8 / 8	0	2.16E-02	9.64E-02	1.43E-01	N	1.97E-01	1.43E-01	mg/kg	95UCL	(2)
		Benzo(b)fluoranthene	205-99-2	mg/kg	8 / 8	0	1.36E-02	5.90E-02	8.84E-02	N	1.18E-01	8.84E-02	mg/kg	95UCL	(2)
		Benzo(g,h,i)perylene	191-24-2	mg/kg	8 / 8	0	2.11E-02	8.35E-02	1.24E-01	N	1.66E-01	1.24E-01	mg/kg	95UCL	(2)
		Benzo(k)fluoranthene	207-08-9	mg/kg	8 / 8	0	1.56E-02	6.30E-02	9.31E-02	N	1.29E-01	9.31E-02	mg/kg	95UCL	(2)
		Chrysene	218-01-9	mg/kg	8 / 8	0	1.64E-02	7.47E-02	1.13E-01	N	1.56E-01	1.13E-01	mg/kg	95UCL	(2)
		Dibenz(a,h)anthracene	53-70-3	mg/kg	8 / 8	0	1.49E-03	8.09E-03	1.22E-02	N	1.56E-02	1.22E-02	mg/kg	95UCL	(2)
		Fluoranthene	206-44-0	mg/kg	8 / 8	0	3.71E-02	1.35E-01	1.99E-01	N	2.76E-01	1.99E-01	mg/kg	95UCL	(2)
		Indeno(1,2,3-cd)pyrene	193-39-5	mg/kg	8 / 8	0	1.72E-02	7.45E-02	1.12E-01	N	1.50E-01	1.12E-01	mg/kg	95UCL	(2)
		Pyrene	129-00-0	mg/kg	8 / 8	0	4.64E-02	1.79E-01	2.62E-01	N	3.59E-01	2.62E-01	mg/kg	95UCL	(2)
		Butyltins													
		Dibutyltin	1002-53-5	mg/kg	3 / 8	0	3.80E-03	4.66E-03	3.91E-03	NP	5.36E-03	3.91E-03	mg/kg	95UCL	(12)
		Tributyltin	688-73-3	mg/kg	3 / 8	0	4.52E-03	5.87E-03	4.79E-03	NP	6.82E-03	4.79E-03	mg/kg	95UCL	(12)
		PCBs													
		Total PCB Congeners	1336-36-3	mg/kg	8 / 8	0	1.25E-02	2.32E-02	2.82E-02	N	3.31E-02	2.82E-02	mg/kg	95UCL	(2)
		Total TEQ – PCB DLC	--	mg/kg	8 / 8	0	4.51E-06	6.09E-06	7.52E-06	N	9.04E-06	7.52E-06	mg/kg	95UCL	(19)

TABLE A-1
Exposure Point Concentration Summary for Sediment
Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Current and Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Point	Area	Chemical of Potential Concern	CAS Number	Units	Detection Frequency	Number of High Censored Results (a)	Minimum Concentration	Arithmetic Mean (b)	95 UCL Distribution (c)		Maximum Detected Concentration	Exposure Point Concentration			
												Value	Units	Statistic (d)	Method (e)
	India Basin Area I	**Metals**													
		Aluminum	7429-90-5	mg/kg	6 / 6	0	6.35E+04	6.92E+04	7.21E+04	N	7.25E+04	7.21E+04	mg/kg	95UCL	(2)
		Antimony	7440-36-0	mg/kg	6 / 6	0	7.00E-01	9.09E-01	1.08E+00	N	1.24E+00	1.08E+00	mg/kg	95UCL	(2)
		Arsenic	7440-38-2	mg/kg	6 / 6	0	9.69E+00	1.05E+01	1.10E+01	N	1.14E+01	1.10E+01	mg/kg	95UCL	(2)
		Barium	7440-39-3	mg/kg	6 / 6	0	4.38E+02	4.69E+02	4.96E+02	N	5.33E+02	4.96E+02	mg/kg	95UCL	(2)
		Cadmium	7440-43-9	mg/kg	6 / 6	0	2.00E-01	2.25E-01	2.45E-01	N	2.64E-01	2.45E-01	mg/kg	95UCL	(2)
		Chromium	7440-47-3	mg/kg	6 / 6	0	1.56E+02	2.06E+02	2.66E+02	N	3.19E+02	2.66E+02	mg/kg	95UCL	(19)
		Cobalt	7440-48-4	mg/kg	6 / 6	0	1.53E+01	1.68E+01	1.87E+01	N	2.14E+01	1.87E+01	mg/kg	95UCL	(2)
		Copper	7440-50-8	mg/kg	6 / 6	0	4.00E+01	5.89E+01	8.35E+01	N	1.17E+02	8.35E+01	mg/kg	95UCL	(2)
		Iron	7439-89-6	mg/kg	6 / 6	0	3.98E+04	4.18E+04	4.30E+04	N	4.37E+04	4.30E+04	mg/kg	95UCL	(2)
		Lead	7439-92-1	mg/kg	6 / 6	0	2.16E+01	4.11E+01	1.15E+02	NP	1.26E+02	1.15E+02	mg/kg	95UCL	(4)
		Manganese	7439-96-5	mg/kg	6 / 6	0	4.11E+02	4.28E+02	4.40E+02	N	4.50E+02	4.40E+02	mg/kg	95UCL	(2)
		Mercury	7439-97-6	mg/kg	6 / 6	0	2.41E-01	3.12E-01	3.62E-01	N	4.07E-01	3.62E-01	mg/kg	95UCL	(2)
		Molybdenum	7439-98-7	mg/kg	6 / 6	0	7.63E-01	1.03E+00	1.29E+00	N	1.63E+00	1.29E+00	mg/kg	95UCL	(2)
		Nickel	7440-02-0	mg/kg	6 / 6	0	8.36E+01	1.26E+02	1.79E+02	N	2.32E+02	1.79E+02	mg/kg	95UCL	(19)
		Selenium	7782-49-2	mg/kg	6 / 6	0	2.73E-01	3.37E-01	3.87E-01	N	4.30E-01	3.87E-01	mg/kg	95UCL	(2)
		Silver	7440-22-4	mg/kg	6 / 6	0	2.53E-01	2.79E-01	3.00E-01	N	3.21E-01	3.00E-01	mg/kg	95UCL	(2)
		Vanadium	7440-62-2	mg/kg	6 / 6	0	1.21E+02	1.36E+02	1.43E+02	--	1.41E+02	1.41E+02	mg/kg	Max	(1)
		Zinc	7440-66-6	mg/kg	6 / 6	0	1.11E+02	1.22E+02	1.30E+02	N	1.36E+02	1.30E+02	mg/kg	95UCL	(2)
		Pesticides													
		4,4'-DDD	72-54-8	mg/kg	6 / 6	0	6.60E-04	1.19E-03	1.55E-03	N	1.92E-03	1.55E-03	mg/kg	95UCL	(2)
		4,4'-DDE	72-55-9	mg/kg	6 / 6	0	8.90E-04	1.27E-03	1.54E-03	N	1.84E-03	1.54E-03	mg/kg	95UCL	(2)
		4,4'-DDT	50-29-3	mg/kg	5 / 6	0	2.80E-04	5.56E-04	7.12E-04	NP	8.30E-04	7.12E-04	mg/kg	95UCL	(12)
		alpha-Chlordane	5103-71-9	mg/kg	6 / 6	0	7.00E-05	1.82E-04	3.23E-04	N	5.00E-04	3.23E-04	mg/kg	95UCL	(2)
		gamma-Chlordane	5566-34-7	mg/kg	1 / 6	0	1.40E-04	1.40E-04	N/A	--	1.40E-04	1.40E-04	mg/kg	Max	(1)
		PAHs													
		2-Methylnaphthalene	91-57-6	mg/kg	6 / 6	0	6.17E-03	8.00E-03	1.02E-02	N	1.30E-02	1.02E-02	mg/kg	95UCL	(2)
		Acenaphthene	83-32-9	mg/kg	6 / 6	0	4.92E-03	7.68E-03	9.72E-03	N	1.18E-02	9.72E-03	mg/kg	95UCL	(2)
		Acenaphthylene	208-96-8	mg/kg	6 / 6	0	7.36E-03	1.03E-02	1.22E-02	N	1.32E-02	1.22E-02	mg/kg	95UCL	(2)
		Anthracene	120-12-7	mg/kg	6 / 6	0	3.45E-02	7.79E-02	2.10E-01	NP	2.28E-01	2.10E-01	mg/kg	95UCL	(4)
		Fluorene	86-73-7	mg/kg	6 / 6	0	8.45E-03	1.46E-02	2.95E-02	G	3.27E-02	2.95E-02	mg/kg	95UCL	(11)
		Naphthalene	91-20-3	mg/kg	6 / 6	0	1.22E-02	1.42E-02	1.65E-02	N	1.93E-02	1.65E-02	mg/kg	95UCL	(2)
		Phenanthrene	85-01-8	mg/kg	6 / 6	0	7.88E-02	1.11E-01	1.37E-01	N	1.67E-01	1.37E-01	mg/kg	95UCL	(2)
		Benzo(a)anthracene	56-55-3	mg/kg	6 / 6	0	9.78E-02	1.34E-01	1.78E-01	N	2.36E-01	1.78E-01	mg/kg	95UCL	(2)
		Benzo(a)pyrene	50-32-8	mg/kg	6 / 6	0	1.70E-01	2.04E-01	2.45E-01	N	2.99E-01	2.45E-01	mg/kg	95UCL	(2)
		Benzo(b)fluoranthene	205-99-2	mg/kg	6 / 6	0	1.14E-01	1.52E-01	1.99E-01	N	2.65E-01	1.99E-01	mg/kg	95UCL	(2)
		Benzo(g,h,i)perylene	191-24-2	mg/kg	6 / 6	0	1.50E-01	1.70E-01	1.93E-01	N	2.21E-01	1.93E-01	mg/kg	95UCL	(2)
		Benzo(k)fluoranthene	207-08-9	mg/kg	6 / 6	0	1.05E-01	1.44E-01	1.91E-01	N	2.55E-01	1.91E-01	mg/kg	95UCL	(2)
		Chrysene	218-01-9	mg/kg	6 / 6	0	1.26E-01	1.87E-01	2.66E-01	N	3.75E-01	2.66E-01	mg/kg	95UCL	(2)
		Dibenz(a,h)anthracene	53-70-3	mg/kg	6 / 6	0	1.67E-02	2.41E-02	3.27E-02	N	4.28E-02	3.27E-02	mg/kg	95UCL	(2)
		Fluoranthene	206-44-0	mg/kg	6 / 6	0	2.18E-01	2.72E-01	3.34E-01	N	4.19E-01	3.34E-01	mg/kg	95UCL	(2)
		Indeno(1,2,3-cd)pyrene	193-39-5	mg/kg	6 / 6	0	1.36E-01	1.60E-01	1.88E-01	N	2.24E-01	1.88E-01	mg/kg	95UCL	(2)
		Pyrene	129-00-0	mg/kg	6 / 6	0	2.89E-01	3.32E-01	3.78E-01	N	4.37E-01	3.78E-01	mg/kg	95UCL	(2)
		Butyltins													
		Dibutyltin	1002-53-5	mg/kg	1 / 6	0	1.09E-02	1.09E-02	N/A	--	1.09E-02	1.09E-02	mg/kg	Max	(1)
		Tributyltin	688-73-3	mg/kg	1 / 6	0	1.77E-02	1.77E-02	N/A	--	1.77E-02	1.77E-02	mg/kg	Max	(1)
		PCBs													
		Total PCB Congeners	1336-36-3	mg/kg	6 / 6	0	1.32E-02	3.87E-02	1.01E-01	--	8.98E-02	8.98E-02	mg/kg	Max	(1)
		Total TEQ – PCB DLC	--	mg/kg	6 / 6	0	7.53E-06	7.96E-06	8.28E-06	N	8.57E-06	8.28E-06	mg/kg	95UCL	(2)

TABLE A-1
Exposure Point Concentration Summary for Sediment
Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Current and Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Point	Area	Chemical of Potential Concern	CAS Number	Units	Detection Frequency	Number of High Censored Results (a)	Minimum Concentration	Arithmetic Mean (b)	95 UCL Distribution (c)		Maximum Detected Concentration	Exposure Point Concentration			
												Value	Units	Statistic (d)	Method (e)
	Oil Reclamation Area	**Metals**													
		Aluminum	7429-90-5	mg/kg	6 / 6	0	5.20E+04	6.48E+04	7.17E+04	N	7.30E+04	7.17E+04	mg/kg	95UCL	(2)
		Antimony	7440-36-0	mg/kg	6 / 6	0	5.87E-01	2.02E+00	2.76E+00	N	3.17E+00	2.76E+00	mg/kg	95UCL	(2)
		Arsenic	7440-38-2	mg/kg	6 / 6	0	8.90E+00	1.13E+01	1.27E+01	N	1.36E+01	1.27E+01	mg/kg	95UCL	(2)
		Barium	7440-39-3	mg/kg	6 / 6	0	2.93E+02	3.92E+02	4.42E+02	N	4.58E+02	4.42E+02	mg/kg	95UCL	(2)
		Cadmium	7440-43-9	mg/kg	6 / 6	0	2.23E-01	3.34E-01	3.87E-01	N	3.99E-01	3.87E-01	mg/kg	95UCL	(2)
		Chromium	7440-47-3	mg/kg	6 / 6	0	1.67E+02	3.20E+02	4.29E+02	N	4.64E+02	4.29E+02	mg/kg	95UCL	(2)
		Cobalt	7440-48-4	mg/kg	6 / 6	0	1.75E+01	1.93E+01	2.08E+01	N	2.26E+01	2.08E+01	mg/kg	95UCL	(2)
		Copper	7440-50-8	mg/kg	6 / 6	0	5.51E+01	6.94E+01	8.43E+01	N	9.75E+01	8.43E+01	mg/kg	95UCL	(2)
		Iron	7439-89-6	mg/kg	6 / 6	0	4.12E+04	4.49E+04	4.73E+04	N	4.87E+04	4.73E+04	mg/kg	95UCL	(2)
		Lead	7439-92-1	mg/kg	6 / 6	0	1.19E+01	4.05E+01	5.45E+01	N	6.01E+01	5.45E+01	mg/kg	95UCL	(2)
		Manganese	7439-96-5	mg/kg	6 / 6	0	3.86E+02	4.95E+02	5.71E+02	N	6.24E+02	5.71E+02	mg/kg	95UCL	(2)
		Mercury	7439-97-6	mg/kg	6 / 6	0	3.03E-01	4.32E-01	5.18E-01	N	6.02E-01	5.18E-01	mg/kg	95UCL	(2)
		Molybdenum	7439-98-7	mg/kg	6 / 6	0	8.30E-01	1.35E+00	1.63E+00	N	1.71E+00	1.63E+00	mg/kg	95UCL	(2)
		Nickel	7440-02-0	mg/kg	6 / 6	0	9.49E+01	1.15E+02	1.35E+02	N	1.60E+02	1.35E+02	mg/kg	95UCL	(2)
		Selenium	7782-49-2	mg/kg	6 / 6	0	2.33E-01	3.21E-01	3.78E-01	N	4.06E-01	3.78E-01	mg/kg	95UCL	(2)
		Silver	7440-22-4	mg/kg	6 / 6	0	1.20E-01	3.25E-01	4.28E-01	N	4.35E-01	4.28E-01	mg/kg	95UCL	(2)
		Vanadium	7440-62-2	mg/kg	6 / 6	0	1.34E+02	1.52E+02	1.63E+02	N	1.71E+02	1.63E+02	mg/kg	95UCL	(2)
		Zinc	7440-66-6	mg/kg	6 / 6	0	1.14E+02	1.43E+02	1.62E+02	N	1.79E+02	1.62E+02	mg/kg	95UCL	(2)
		Pesticides													
		4,4'-DDD	72-54-8	mg/kg	6 / 6	0	9.10E-04	1.89E-03	2.66E-03	N	3.08E-03	2.66E-03	mg/kg	95UCL	(2)
		4,4'-DDE	72-55-9	mg/kg	6 / 6	0	3.30E-04	9.82E-04	1.31E-03	N	1.50E-03	1.31E-03	mg/kg	95UCL	(2)
		4,4'-DDT	50-29-3	mg/kg	5 / 6	0	1.20E-04	4.62E-04	6.58E-04	NP	7.80E-04	6.58E-04	mg/kg	95UCL	(12)
		alpha-Chlordane	5103-71-9	mg/kg	6 / 6	0	1.40E-04	2.70E-04	3.62E-04	N	4.10E-04	3.62E-04	mg/kg	95UCL	(2)
		Dieldrin	60-57-1	mg/kg	1 / 6	0	4.40E-04	4.40E-04	N/A	--	4.40E-04	4.40E-04	mg/kg	Max	(1)
		gamma-Chlordane	5566-34-7	mg/kg	5 / 6	0	8.00E-05	2.70E-04	3.80E-04	NP	4.20E-04	3.80E-04	mg/kg	95UCL	(12)
		PAHs													
		2-Methylnaphthalene	91-57-6	mg/kg	6 / 6	0	5.23E-03	7.32E-03	8.65E-03	N	9.85E-03	8.65E-03	mg/kg	95UCL	(2)
		Acenaphthene	83-32-9	mg/kg	6 / 6	0	2.13E-03	4.06E-03	5.76E-03	N	7.62E-03	5.76E-03	mg/kg	95UCL	(2)
		Acenaphthylene	208-96-8	mg/kg	6 / 6	0	4.71E-03	7.28E-03	9.07E-03	N	1.02E-02	9.07E-03	mg/kg	95UCL	(2)
		Anthracene	120-12-7	mg/kg	6 / 6	0	1.14E-02	2.81E-02	4.24E-02	N	6.09E-02	4.24E-02	mg/kg	95UCL	(2)
		Fluorene	86-73-7	mg/kg	6 / 6	0	3.27E-03	6.65E-03	8.93E-03	N	1.13E-02	8.93E-03	mg/kg	95UCL	(2)
		Naphthalene	91-20-3	mg/kg	6 / 6	0	1.04E-02	1.34E-02	1.52E-02	N	1.59E-02	1.52E-02	mg/kg	95UCL	(2)
		Phenanthrene	85-01-8	mg/kg	6 / 6	0	4.04E-02	7.54E-02	1.03E-01	N	1.35E-01	1.03E-01	mg/kg	95UCL	(2)
		Benzo(a)anthracene	56-55-3	mg/kg	6 / 6	0	5.13E-02	9.10E-02	1.20E-01	N	1.51E-01	1.20E-01	mg/kg	95UCL	(2)
		Benzo(a)pyrene	50-32-8	mg/kg	6 / 6	0	1.09E-01	1.58E-01	1.96E-01	N	2.04E-01	1.96E-01	mg/kg	95UCL	(2)
		Benzo(b)fluoranthene	205-99-2	mg/kg	6 / 6	0	6.83E-02	1.07E-01	1.34E-01	N	1.49E-01	1.34E-01	mg/kg	95UCL	(2)
		Benzo(g,h,i)perylene	191-24-2	mg/kg	6 / 6	0	1.13E-01	1.50E-01	1.80E-01	N	1.93E-01	1.80E-01	mg/kg	95UCL	(2)
		Benzo(k)fluoranthene	207-08-9	mg/kg	6 / 6	0	7.30E-02	1.12E-01	1.41E-01	N	1.69E-01	1.41E-01	mg/kg	95UCL	(2)
		Chrysene	218-01-9	mg/kg	6 / 6	0	7.07E-02	1.39E-01	1.95E-01	N	2.62E-01	1.95E-01	mg/kg	95UCL	(2)
		Dibenz(a,h)anthracene	53-70-3	mg/kg	6 / 6	0	8.82E-03	1.61E-02	2.10E-02	N	2.48E-02	2.10E-02	mg/kg	95UCL	(2)
		Fluoranthene	206-44-0	mg/kg	6 / 6	0	1.32E-01	1.89E-01	2.39E-01	N	2.91E-01	2.39E-01	mg/kg	95UCL	(2)
		Indeno(1,2,3-cd)pyrene	193-39-5	mg/kg	6 / 6	0	8.99E-02	1.30E-01	1.63E-01	N	1.81E-01	1.63E-01	mg/kg	95UCL	(2)
		Pyrene	129-00-0	mg/kg	6 / 6	0	1.71E-01	2.41E-01	2.99E-01	N	3.28E-01	2.99E-01	mg/kg	95UCL	(2)
		Butyltins													
		Monobutyltin	78763-54-9	mg/kg	1 / 6	0	2.69E-03	2.69E-03	N/A	--	2.69E-03	2.69E-03	mg/kg	Max	(1)
		Dibutyltin	1002-53-5	mg/kg	6 / 6	0	2.69E-03	1.03E-02	1.61E-02	N	2.08E-02	1.61E-02	mg/kg	95UCL	(2)
		Tributyltin	688-73-3	mg/kg	6 / 6	0	3.30E-03	2.16E-02	4.07E-02	N	6.59E-02	4.07E-02	mg/kg	95UCL	(2)
		PCBs													
		Total PCB Congeners	1336-36-3	mg/kg	6 / 6	0	8.78E-02	2.27E-01	3.39E-01	N	4.25E-01	3.39E-01	mg/kg	95UCL	(2)
		Total TEQ – PCB DLC	--	mg/kg	6 / 6	0	6.09E-06	7.63E-06	8.49E-06	N	8.59E-06	8.49E-06	mg/kg	95UCL	(2)

TABLE A-1
Exposure Point Concentration Summary for Sediment
Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Current and Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Point	Area	Chemical of Potential Concern	CAS Number	Units	Detection Frequency	Number of High Censored Results (a)	Minimum Concentration	Arithmetic Mean (b)	95 UCL Distribution (c)		Maximum Detected Concentration	Exposure Point Concentration			
												Value	Units	Statistic (d)	Method (e)
	Point Avisadero Area	**Metals**													
		Aluminum	7429-90-5	mg/kg	19 / 19	0	5.91E+04	6.69E+04	6.85E+04	N	7.20E+04	6.85E+04	mg/kg	95UCL	(2)
		Antimony	7440-36-0	mg/kg	19 / 19	0	5.54E-01	1.78E+00	5.44E+00	NP	1.68E+01	5.44E+00	mg/kg	95UCL	(4)
		Arsenic	7440-38-2	mg/kg	19 / 19	0	8.74E+00	1.17E+01	1.25E+01	N	1.82E+01	1.25E+01	mg/kg	95UCL	(2)
		Barium	7440-39-3	mg/kg	19 / 19	0	4.04E+02	4.63E+02	4.78E+02	N	5.68E+02	4.78E+02	mg/kg	95UCL	(2)
		Cadmium	7440-43-9	mg/kg	19 / 19	0	1.85E-01	2.76E-01	3.23E-01	G	7.60E-01	3.23E-01	mg/kg	95UCL	(11)
		Chromium	7440-47-3	mg/kg	19 / 19	0	1.62E+02	2.26E+02	2.57E+02	N	3.91E+02	2.57E+02	mg/kg	95UCL	(19)
		Cobalt	7440-48-4	mg/kg	19 / 19	0	1.40E+01	1.74E+01	1.81E+01	N	2.16E+01	1.81E+01	mg/kg	95UCL	(2)
		Copper	7440-50-8	mg/kg	19 / 19	0	3.27E+01	1.72E+02	4.25E+02	NP	1.05E+03	4.25E+02	mg/kg	95UCL	(4)
		Iron	7439-89-6	mg/kg	19 / 19	0	3.87E+04	4.12E+04	4.19E+04	N	4.65E+04	4.19E+04	mg/kg	95UCL	(2)
		Lead	7439-92-1	mg/kg	19 / 19	0	1.81E+01	4.38E+01	1.04E+02	NP	2.75E+02	1.04E+02	mg/kg	95UCL	(4)
		Manganese	7439-96-5	mg/kg	19 / 19	0	4.23E+02	4.99E+02	5.17E+02	N	6.15E+02	5.17E+02	mg/kg	95UCL	(2)
		Mercury	7439-97-6	mg/kg	19 / 19	0	1.45E-01	9.04E-01	2.53E+00	NP	7.47E+00	2.53E+00	mg/kg	95UCL	(4)
		Molybdenum	7439-98-7	mg/kg	19 / 19	0	6.11E-01	9.50E-01	1.03E+00	N	1.47E+00	1.03E+00	mg/kg	95UCL	(2)
		Nickel	7440-02-0	mg/kg	19 / 19	0	8.40E+01	1.09E+02	1.30E+02	N	2.50E+02	1.30E+02	mg/kg	95UCL	(19)
		Selenium	7782-49-2	mg/kg	19 / 19	0	2.22E-01	3.70E-01	4.29E-01	N	8.55E-01	4.29E-01	mg/kg	95UCL	(19)
		Silver	7440-22-4	mg/kg	19 / 19	0	1.77E-01	2.74E-01	2.95E-01	N	4.34E-01	2.95E-01	mg/kg	95UCL	(2)
		Vanadium	7440-62-2	mg/kg	19 / 19	0	1.08E+02	1.33E+02	1.38E+02	N	1.57E+02	1.38E+02	mg/kg	95UCL	(2)
		Zinc	7440-66-6	mg/kg	19 / 19	0	9.08E+01	1.25E+02	1.48E+02	N	3.22E+02	1.48E+02	mg/kg	95UCL	(19)
		Pesticides													
		2,4'-DDD	53-19-0	mg/kg	1 / 19	0	8.40E-04	8.40E-04	N/A	--	8.40E-04	8.40E-04	mg/kg	Max	(1)
		4,4'-DDD	72-54-8	mg/kg	19 / 19	0	5.70E-04	1.13E-03	1.27E-03	N	1.74E-03	1.27E-03	mg/kg	95UCL	(2)
		4,4'-DDE	72-55-9	mg/kg	19 / 19	0	4.80E-04	1.07E-03	1.20E-03	N	1.54E-03	1.20E-03	mg/kg	95UCL	(2)
		4,4'-DDT	50-29-3	mg/kg	11 / 19	0	1.40E-04	3.93E-04	3.55E-04	NP	8.40E-04	3.55E-04	mg/kg	95UCL	(12)
		alpha-Chlordane	5103-71-9	mg/kg	13 / 19	0	3.00E-05	1.49E-04	1.49E-04	LN	3.70E-04	1.49E-04	mg/kg	95UCL	(16)
		PAHs													
		2-Methylnaphthalene	91-57-6	mg/kg	19 / 19	0	4.13E-03	1.02E-02	1.21E-02	N	2.04E-02	1.21E-02	mg/kg	95UCL	(2)
		Acenaphthene	83-32-9	mg/kg	19 / 19	0	4.44E-03	2.95E-02	4.52E-02	G	1.82E-01	4.52E-02	mg/kg	95UCL	(11)
		Acenaphthylene	208-96-8	mg/kg	19 / 19	0	6.98E-03	2.23E-02	3.12E-02	LN	5.81E-02	3.12E-02	mg/kg	95UCL	(3)
		Anthracene	120-12-7	mg/kg	19 / 19	0	3.63E-02	1.32E-01	1.79E-01	G	4.89E-01	1.79E-01	mg/kg	95UCL	(11)
		Fluorene	86-73-7	mg/kg	19 / 19	0	8.20E-03	3.09E-02	3.98E-02	N	9.24E-02	3.98E-02	mg/kg	95UCL	(2)
		Naphthalene	91-20-3	mg/kg	19 / 19	0	7.72E-03	2.11E-02	2.51E-02	N	4.57E-02	2.51E-02	mg/kg	95UCL	(2)
		Phenanthrene	85-01-8	mg/kg	19 / 19	0	7.28E-02	3.25E-01	4.11E-01	N	7.63E-01	4.11E-01	mg/kg	95UCL	(2)
		Benzo(a)anthracene	56-55-3	mg/kg	19 / 19	0	8.13E-02	3.00E-01	3.64E-01	N	6.01E-01	3.64E-01	mg/kg	95UCL	(2)
		Benzo(a)pyrene	50-32-8	mg/kg	19 / 19	0	1.24E-01	4.03E-01	4.82E-01	N	7.54E-01	4.82E-01	mg/kg	95UCL	(2)
		Benzo(b)fluoranthene	205-99-2	mg/kg	19 / 19	0	8.58E-02	2.73E-01	3.26E-01	N	5.50E-01	3.26E-01	mg/kg	95UCL	(2)
		Benzo(g,h,i)perylene	191-24-2	mg/kg	19 / 19	0	1.07E-01	3.01E-01	3.58E-01	N	5.52E-01	3.58E-01	mg/kg	95UCL	(2)
		Benzo(k)fluoranthene	207-08-9	mg/kg	19 / 19	0	8.34E-02	2.75E-01	3.28E-01	N	5.46E-01	3.28E-01	mg/kg	95UCL	(2)
		Chrysene	218-01-9	mg/kg	19 / 19	0	1.04E-01	3.51E-01	4.24E-01	N	7.15E-01	4.24E-01	mg/kg	95UCL	(2)
		Dibenz(a,h)anthracene	53-70-3	mg/kg	19 / 19	0	1.22E-02	4.71E-02	5.72E-02	N	9.48E-02	5.72E-02	mg/kg	95UCL	(2)
		Fluoranthene	206-44-0	mg/kg	19 / 19	0	1.86E-01	6.27E-01	7.50E-01	N	1.21E+00	7.50E-01	mg/kg	95UCL	(2)
		Indeno(1,2,3-cd)pyrene	193-39-5	mg/kg	19 / 19	0	9.98E-02	2.96E-01	3.52E-01	N	5.36E-01	3.52E-01	mg/kg	95UCL	(2)
		Pyrene	129-00-0	mg/kg	19 / 19	0	2.25E-01	7.39E-01	8.90E-01	N	1.47E+00	8.90E-01	mg/kg	95UCL	(2)
		Butyltins													
		Dibutyltin	1002-53-5	mg/kg	11 / 19	0	1.30E-02	2.86E-02	2.40E-02	NP	5.74E-02	2.40E-02	mg/kg	95UCL	(12)
		Tributyltin	688-73-3	mg/kg	12 / 19	0	1.47E-02	9.11E-02	8.24E-02	NP	2.08E-01	8.24E-02	mg/kg	95UCL	(12)
		PCBs													
		Total PCB Congeners	1336-36-3	mg/kg	19 / 19	0	1.20E-02	3.23E-01	1.70E+00	NP	2.46E+00	1.70E+00	mg/kg	95UCL	(4)
		Total TEQ – PCB DLC	1336-36-3	mg/kg	19 / 19	0	6.52E-06	7.19E-06	7.43E-06	N	8.52E-06	7.43E-06	mg/kg	95UCL	(2)

TABLE A-1
Exposure Point Concentration Summary for Sediment
Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Current and Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Point	Area	Chemical of Potential Concern	CAS Number	Units	Detection Frequency	Number of High Censored Results (a)	Minimum Concentration	Arithmetic Mean (b)	95 UCL Distribution (c)		Maximum Detected Concentration	Exposure Point Concentration			
												Value	Units	Statistic (d)	Method (e)
	South Basin Area X	**Metals**													
		Aluminum	7429-90-5	mg/kg	23 / 23	0	3.91E+04	6.44E+04	6.82E+04	N	7.41E+04	6.82E+04	mg/kg	95UCL	(2)
		Antimony	7440-36-0	mg/kg	23 / 23	0	4.85E-01	3.16E+00	4.28E+00	G	1.06E+01	4.28E+00	mg/kg	95UCL	(11)
		Arsenic	7440-38-2	mg/kg	23 / 23	0	5.86E+00	1.07E+01	1.14E+01	N	1.43E+01	1.14E+01	mg/kg	95UCL	(2)
		Barium	7440-39-3	mg/kg	23 / 23	0	4.00E+02	5.12E+02	5.57E+02	N	8.93E+02	5.57E+02	mg/kg	95UCL	(19)
		Cadmium	7440-43-9	mg/kg	23 / 23	0	2.19E-01	4.55E-01	5.15E-01	N	8.45E-01	5.15E-01	mg/kg	95UCL	(2)
		Chromium	7440-47-3	mg/kg	23 / 23	0	1.67E+02	2.28E+02	2.52E+02	N	4.51E+02	2.52E+02	mg/kg	95UCL	(19)
		Cobalt	7440-48-4	mg/kg	23 / 23	0	1.05E+01	1.69E+01	1.80E+01	N	2.19E+01	1.80E+01	mg/kg	95UCL	(2)
		Copper	7440-50-8	mg/kg	23 / 23	0	6.61E+01	1.21E+02	1.49E+02	N	3.19E+02	1.49E+02	mg/kg	95UCL	(19)
		Iron	7439-89-6	mg/kg	23 / 23	0	1.57E+04	4.02E+04	4.34E+04	N	4.78E+04	4.34E+04	mg/kg	95UCL	(2)
		Lead	7439-92-1	mg/kg	23 / 23	0	1.10E+01	8.52E+01	9.80E+01	N	1.42E+02	9.80E+01	mg/kg	95UCL	(2)
		Manganese	7439-96-5	mg/kg	23 / 23	0	2.71E+02	4.32E+02	4.53E+02	N	5.80E+02	4.53E+02	mg/kg	95UCL	(2)
		Mercury	7439-97-6	mg/kg	23 / 23	0	2.32E-01	7.07E-01	8.21E-01	N	1.47E+00	8.21E-01	mg/kg	95UCL	(2)
		Molybdenum	7439-98-7	mg/kg	23 / 23	0	7.04E-01	1.14E+00	1.23E+00	N	1.83E+00	1.23E+00	mg/kg	95UCL	(2)
		Nickel	7440-02-0	mg/kg	23 / 23	0	7.25E+01	1.13E+02	1.24E+02	N	1.99E+02	1.24E+02	mg/kg	95UCL	(19)
		Selenium	7782-49-2	mg/kg	22 / 23	0	1.51E-01	3.34E-01	3.59E-01	NP	4.57E-01	3.59E-01	mg/kg	95UCL	(12)
		Silver	7440-22-4	mg/kg	23 / 23	0	1.39E-01	5.80E-01	1.04E+00	NP	2.80E+00	1.04E+00	mg/kg	95UCL	(4)
		Vanadium	7440-62-2	mg/kg	23 / 23	0	5.09E+01	1.32E+02	1.42E+02	N	1.72E+02	1.42E+02	mg/kg	95UCL	(2)
		Zinc	7440-66-6	mg/kg	23 / 23	0	1.64E+02	2.02E+02	2.13E+02	N	2.97E+02	2.13E+02	mg/kg	95UCL	(2)
		Pesticides													
		2,4'-DDD	53-19-0	mg/kg	1 / 16	6	1.20E-04	1.20E-04	N/A	--	1.20E-04	1.20E-04	mg/kg	Max	(1)
		4,4'-DDD	72-54-8	mg/kg	23 / 23	0	9.70E-04	8.16E-03	1.81E-02	NP	4.36E-02	1.81E-02	mg/kg	95UCL	(4)
		4,4'-DDE	72-55-9	mg/kg	21 / 22	0	1.06E-03	6.10E-03	7.39E-03	NP	1.84E-02	7.39E-03	mg/kg	95UCL	(12)
		4,4'-DDT	50-29-3	mg/kg	20 / 23	0	2.60E-04	1.13E-03	3.59E-03	G	3.60E-03	3.59E-03	mg/kg	95UCL	(11)
		alpha-Chlordane	5103-71-9	mg/kg	23 / 23	0	2.00E-04	1.43E-03	2.12E-03	LN	5.47E-03	2.12E-03	mg/kg	95UCL	(3)
		Dieldrin	60-57-1	mg/kg	15 / 22	0	7.50E-04	2.47E-03	7.18E-03	G	1.04E-02	7.18E-03	mg/kg	95UCL	(11)
		gamma-Chlordane	5566-34-7	mg/kg	23 / 23	0	1.70E-04	2.27E-03	3.33E-03	G	1.05E-02	3.33E-03	mg/kg	95UCL	(11)
		Heptachlor	76-44-8	mg/kg	1 / 22	0	2.13E-03	2.13E-03	N/A	--	2.13E-03	2.13E-03	mg/kg	Max	(1)
		PAHs													
		2-Methylnaphthalene	91-57-6	mg/kg	23 / 23	0	3.70E-03	1.82E-02	2.15E-02	N	4.90E-02	2.15E-02	mg/kg	95UCL	(2)
		Acenaphthene	83-32-9	mg/kg	23 / 23	0	1.08E-03	7.59E-03	9.10E-03	N	2.13E-02	9.10E-03	mg/kg	95UCL	(2)
		Acenaphthylene	208-96-8	mg/kg	23 / 23	0	2.26E-03	1.19E-02	1.99E-02	NP	4.37E-02	1.99E-02	mg/kg	95UCL	(4)
		Anthracene	120-12-7	mg/kg	23 / 23	0	6.99E-03	5.18E-02	1.01E-01	NP	2.34E-01	1.01E-01	mg/kg	95UCL	(4)
		Fluorene	86-73-7	mg/kg	23 / 23	0	2.02E-03	1.47E-02	3.03E-02	NP	8.15E-02	3.03E-02	mg/kg	95UCL	(4)
		Naphthalene	91-20-3	mg/kg	22 / 23	0	8.27E-03	3.07E-02	3.45E-02	NP	5.87E-02	3.45E-02	mg/kg	95UCL	(12)
		Phenanthrene	85-01-8	mg/kg	23 / 23	0	2.20E-02	1.49E-01	2.78E-01	NP	6.68E-01	2.78E-01	mg/kg	95UCL	(4)
		Benzo(a)anthracene	56-55-3	mg/kg	23 / 23	0	2.58E-02	1.81E-01	2.36E-01	G	6.29E-01	2.36E-01	mg/kg	95UCL	(11)
		Benzo(a)pyrene	50-32-8	mg/kg	23 / 23	0	5.32E-02	2.69E-01	3.14E-01	N	6.32E-01	3.14E-01	mg/kg	95UCL	(2)
		Benzo(b)fluoranthene	205-99-2	mg/kg	23 / 23	0	3.47E-02	2.01E-01	2.36E-01	N	4.84E-01	2.36E-01	mg/kg	95UCL	(2)
		Benzo(g,h,i)perylene	191-24-2	mg/kg	23 / 23	0	5.54E-02	2.39E-01	2.69E-01	N	3.84E-01	2.69E-01	mg/kg	95UCL	(2)
		Benzo(k)fluoranthene	207-08-9	mg/kg	23 / 23	0	4.08E-02	2.07E-01	2.44E-01	N	5.00E-01	2.44E-01	mg/kg	95UCL	(2)
		Chrysene	218-01-9	mg/kg	23 / 23	0	3.94E-02	2.45E-01	3.15E-01	G	7.44E-01	3.15E-01	mg/kg	95UCL	(11)
		Dibenz(a,h)anthracene	53-70-3	mg/kg	23 / 23	0	4.03E-03	3.62E-02	4.41E-02	N	1.04E-01	4.41E-02	mg/kg	95UCL	(2)
		Fluoranthene	206-44-0	mg/kg	23 / 23	0	5.97E-02	3.25E-01	3.94E-01	N	9.53E-01	3.94E-01	mg/kg	95UCL	(2)
		Indeno(1,2,3-cd)pyrene	193-39-5	mg/kg	23 / 23	0	4.39E-02	2.17E-01	2.47E-01	N	4.13E-01	2.47E-01	mg/kg	95UCL	(2)
		Pyrene	129-00-0	mg/kg	23 / 23	0	7.98E-02	3.90E-01	4.63E-01	N	1.07E+00	4.63E-01	mg/kg	95UCL	(2)
		Butyltins													
		Monobutyltin	78763-54-9	mg/kg	3 / 22	0	1.17E-03	2.18E-03	1.16E-03	NP	3.30E-03	1.16E-03	mg/kg	95UCL	(12)
		Dibutyltin	1002-53-5	mg/kg	23 / 23	0	2.72E-03	1.63E-02	2.15E-02	G	5.12E-02	2.15E-02	mg/kg	95UCL	(11)
		Tributyltin	688-73-3	mg/kg	23 / 23	0	3.08E-03	2.38E-02	4.85E-02	NP	1.29E-01	4.85E-02	mg/kg	95UCL	(4)
		PCBs													
		Total PCB Congeners	1336-36-3	mg/kg	23 / 23	0	1.13E-01	1.16E+00	1.70E+00	G	5.19E+00	1.70E+00	mg/kg	95UCL	(11)
		Total TEQ – PCB DLC	--	mg/kg	23 / 23	0	4.92E-06	1.21E-05	2.98E-05	NP	1.01E-04	2.98E-05	mg/kg	95UCL	(4)

TABLE A-1
Exposure Point Concentration Summary for Sediment
Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Current and Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Point	Area	Chemical of Potential Concern	CAS Number	Units	Detection Frequency	Number of High Censored Results (a)	Minimum Concentration	Arithmetic Mean (b)	95 UCL Distribution (c)		Maximum Detected Concentration	Exposure Point Concentration			
												Value	Units	Statistic (d)	Method (e)
	Reference Sediment Area	**Metals**													
		Aluminum	7429-90-5	mg/kg	5 / 5	0	4.43E+04	6.43E+04	7.65E+04	N	7.59E+04	7.59E+04	mg/kg	Max	(1)
		Antimony	7440-36-0	mg/kg	5 / 5	0	3.61E-01	6.63E-01	9.16E-01	N	9.29E-01	9.16E-01	mg/kg	95UCL	(2)
		Arsenic	7440-38-2	mg/kg	5 / 5	0	6.69E+00	1.02E+01	1.22E+01	N	1.21E+01	1.21E+01	mg/kg	Max	(1)
		Barium	7440-39-3	mg/kg	5 / 5	0	4.05E+02	4.45E+02	4.83E+02	N	5.01E+02	4.83E+02	mg/kg	95UCL	(2)
		Cadmium	7440-43-9	mg/kg	5 / 5	0	1.56E-01	3.63E-01	6.42E-01	N	8.41E-01	6.42E-01	mg/kg	95UCL	(2)
		Chromium	7440-47-3	mg/kg	5 / 5	0	1.03E+02	1.54E+02	1.82E+02	N	1.76E+02	1.76E+02	mg/kg	Max	(1)
		Cobalt	7440-48-4	mg/kg	5 / 5	0	1.03E+01	1.73E+01	2.15E+01	N	2.26E+01	2.15E+01	mg/kg	95UCL	(2)
		Copper	7440-50-8	mg/kg	5 / 5	0	1.65E+01	3.33E+01	4.70E+01	N	4.79E+01	4.70E+01	mg/kg	95UCL	(2)
		Iron	7439-89-6	mg/kg	5 / 5	0	2.06E+04	3.89E+04	4.92E+04	N	4.95E+04	4.92E+04	mg/kg	95UCL	(2)
		Lead	7439-92-1	mg/kg	5 / 5	0	1.23E+01	2.15E+01	2.86E+01	N	2.97E+01	2.86E+01	mg/kg	95UCL	(2)
		Manganese	7439-96-5	mg/kg	5 / 5	0	3.90E+02	5.21E+02	6.15E+02	N	6.34E+02	6.15E+02	mg/kg	95UCL	(2)
		Mercury	7439-97-6	mg/kg	5 / 5	0	2.52E-02	2.15E-01	3.64E-01	N	3.84E-01	3.64E-01	mg/kg	95UCL	(2)
		Molybdenum	7439-98-7	mg/kg	5 / 5	0	2.93E-01	6.42E-01	8.80E-01	--	8.51E-01	8.51E-01	mg/kg	Max	(1)
		Nickel	7440-02-0	mg/kg	5 / 5	0	3.98E+01	7.84E+01	1.00E+02	N	1.01E+02	1.00E+02	mg/kg	95UCL	(2)
		Selenium	7782-49-2	mg/kg	4 / 5	0	1.24E-01	3.32E-01	4.56E-01	NP	4.98E-01	4.56E-01	mg/kg	95UCL	(12)
		Silver	7440-22-4	mg/kg	4 / 5	0	1.23E-01	3.11E-01	4.47E-01	NP	5.38E-01	4.47E-01	mg/kg	95UCL	(12)
		Vanadium	7440-62-2	mg/kg	5 / 5	0	6.27E+01	1.30E+02	1.67E+02	N	1.59E+02	1.59E+02	mg/kg	Max	(1)
		Zinc	7440-66-6	mg/kg	5 / 5	0	4.25E+01	9.48E+01	1.27E+02	N	1.30E+02	1.27E+02	mg/kg	95UCL	(2)
		Pesticides													
		4,4'-DDD	72-54-8	mg/kg	4 / 5	0	4.10E-04	1.51E-03	2.41E-03	NP	3.11E-03	2.41E-03	mg/kg	95UCL	(12)
		4,4'-DDE	72-55-9	mg/kg	4 / 5	0	3.10E-04	6.83E-04	9.13E-04	NP	9.30E-04	9.13E-04	mg/kg	95UCL	(12)
		4,4'-DDT	50-29-3	mg/kg	1 / 5	0	1.65E-03	1.65E-03	N/A	--	1.65E-03	1.65E-03	mg/kg	Max	(1)
		alpha-Chlordane	5103-71-9	mg/kg	2 / 5	0	2.00E-05	7.00E-05	N/A	--	1.20E-04	1.20E-04	mg/kg	Max	(1)
		PAHs													
		2-Methylnaphthalene	91-57-6	mg/kg	5 / 5	0	1.17E-03	3.85E-03	6.43E-03	N	7.15E-03	6.43E-03	mg/kg	95UCL	(2)
		Acenaphthene	83-32-9	mg/kg	5 / 5	0	1.04E-03	4.04E-03	2.53E-02	G	1.24E-02	1.24E-02	mg/kg	Max	(1)
		Acenaphthylene	208-96-8	mg/kg	5 / 5	0	1.02E-03	5.49E-03	9.31E-03	N	1.20E-02	9.31E-03	mg/kg	95UCL	(2)
		Anthracene	120-12-7	mg/kg	5 / 5	0	2.73E-03	1.70E-02	3.13E-02	N	4.25E-02	3.13E-02	mg/kg	95UCL	(2)
		Fluorene	86-73-7	mg/kg	5 / 5	0	1.06E-03	4.76E-03	8.36E-03	N	1.09E-02	8.36E-03	mg/kg	95UCL	(2)
		Naphthalene	91-20-3	mg/kg	4 / 5	0	3.68E-03	1.01E-02	1.43E-02	NP	1.65E-02	1.43E-02	mg/kg	95UCL	(12)
		Phenanthrene	85-01-8	mg/kg	5 / 5	0	1.42E-02	5.74E-02	1.05E-01	N	1.42E-01	1.05E-01	mg/kg	95UCL	(2)
		Benzo(a)anthracene	56-55-3	mg/kg	5 / 5	0	1.25E-02	5.48E-02	9.49E-02	N	1.25E-01	9.49E-02	mg/kg	95UCL	(2)
		Benzo(a)pyrene	50-32-8	mg/kg	5 / 5	0	2.33E-02	1.07E-01	1.86E-01	N	2.40E-01	1.86E-01	mg/kg	95UCL	(2)
		Benzo(b)fluoranthene	205-99-2	mg/kg	5 / 5	0	1.67E-02	6.78E-02	1.17E-01	N	1.47E-01	1.17E-01	mg/kg	95UCL	(2)
		Benzo(g,h,i)perylene	191-24-2	mg/kg	5 / 5	0	2.09E-02	1.01E-01	1.78E-01	N	2.21E-01	1.78E-01	mg/kg	95UCL	(2)
		Benzo(k)fluoranthene	207-08-9	mg/kg	5 / 5	0	1.45E-02	6.60E-02	1.13E-01	N	1.45E-01	1.13E-01	mg/kg	95UCL	(2)
		Chrysene	218-01-9	mg/kg	5 / 5	0	1.54E-02	6.93E-02	1.12E-01	N	1.40E-01	1.12E-01	mg/kg	95UCL	(2)
		Dibenz(a,h)anthracene	53-70-3	mg/kg	5 / 5	0	2.06E-03	1.03E-02	1.87E-02	N	2.45E-02	1.87E-02	mg/kg	95UCL	(2)
		Fluoranthene	206-44-0	mg/kg	5 / 5	0	3.42E-02	1.35E-01	2.33E-01	N	3.06E-01	2.33E-01	mg/kg	95UCL	(2)
		Indeno(1,2,3-cd)pyrene	193-39-5	mg/kg	5 / 5	0	2.10E-02	9.05E-02	1.59E-01	N	2.00E-01	1.59E-01	mg/kg	95UCL	(2)
		Pyrene	129-00-0	mg/kg	5 / 5	0	4.49E-02	1.75E-01	2.94E-01	N	3.83E-01	2.94E-01	mg/kg	95UCL	(2)
		Butyltins													
		Dibutyltin	1002-53-5	mg/kg	1 / 1	4	1.32E-03	1.32E-03	N/A	--	1.32E-03	1.32E-03	mg/kg	Max	(1)
		Tributyltin	688-73-3	mg/kg	1 / 5	0	4.04E-03	4.04E-03	N/A	--	4.04E-03	4.04E-03	mg/kg	Max	(1)
		PCBs													
		Total PCB Congeners	1336-36-3	mg/kg	5 / 5	0	1.54E-03	1.42E-02	3.04E-02	N	4.32E-02	3.04E-02	mg/kg	95UCL	(2)
		Total TEQ – PCB DLC	--	mg/kg	5 / 5	0	4.51E-06	6.73E-06	8.66E-06	N	9.53E-06	8.66E-06	mg/kg	95UCL	(2)

TABLE A-1
Exposure Point Concentration Summary for Sediment
Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Current and Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Point	Area	Chemical of Potential Concern	CAS Number	Units	Detection Frequency	Number of High Censored Results (a)	Minimum Concentration	Arithmetic Mean (b)	95 UCL Distribution (c)	Maximum Detected Concentration	Exposure Point Concentration			
											Value	Units	Statistic (d)	Method (e)

Notes:

--	Not applicable
95UCL	A 95% upper confidence limit, the upper boundary (or limit) of a confidence interval of a parameter of interest such as the population mean
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DLC	Dioxin-like Congeners
EPC	Exposure point concentration
KM	Kaplan-Meier product limit estimator
Max	Maximum detected concentration
mg/kg	Milligram per kilogram
N/A	Not applicable, no estimate provided because there were fewer than five total results and four distinct detected results.
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated biphenyl
TCDD	Tetrachlorodibenzo-p-dioxin
TEQ	Toxic Equivalents
USEPA	United States Environmental Protection Agency
a	Number of censored (nondetect) results that exceeded the maximum detected concentration. The nondetected results are based on the sample-specific detection limits. These results were excluded from the statistical calculations.
b	Arithmetic mean based on detected data only.
c	The three data distributions considered in ProUCL 5.0.00 include the normal, lognormal, and the gamma distributions. Shapiro-Wilk ($n \leq 50$) and Lilliefors ($n > 50$) test statistics are used to test for normality or lognormality of a data set. A five percent level of significance was used in all tests. Distribution tests were only conducted for samples with at least 4 detected results. Distributions not confirmed as normal, lognormal, or gamma, or not tested, were treated as nonparametric in all statistical calculations.
	Distribution Codes: G= gamma, LN= lognormal, N= normal, NP= nonparametric
d	The EPC is the lesser of the UCL and the maximum detected result. The maximum detected result is the default when there are fewer than 5 total results or fewer than 4 detected results.
e	All methods follow USEPA (2002, 2013).
	Method (Statistic) Codes are defined as follows:
(1)	Maximum detected concentration
(2)	95 percent UCL calculated using Student's t distribution
(3)	95 percent UCL calculated using Land's H statistic
(4), (5), (6)	95, 97.5, or 99 percent UCL, respectively, calculated using the nonparametric Chebyshev method
(7), (8), (9)	95, 97.5, or 99 percent UCL, respectively, calculated using the MVUE Chebyshev method
(10)	95 percent UCL calculated using the approximate gamma method
(11)	95 percent UCL calculated using the adjusted gamma method
(12)	95 percent UCL calculated using the KM mean and Student's t cuttoff for the UCL
(13), (14), (15)	95, 97.5, or 99 percent UCL, respectively, calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL
(16)	95 percent UCL calculated using the KM mean and a percentile bootstrap to estimate the UCL
(17)	95 percent UCL calculated using the KM mean and a BCA bootstrap to estimate the UCL
(18)	Hall's bootstrap
(19)	95 percent UCL calculated using Modified t distribution
(20)	95 percent UCL calculated using the adjusted gamma KM statistic

References:

United States Environmental Protection Agency (USEPA). 2002. “Calculating Exposure Point Concentrations at Hazardous Waste Sites.” OSWER 9285.6-10. Office of Emergency and Remedial Response. December.
United States Environmental Protection Agency (USEPA). 2013. “ProUCL Version 5.0.00 Technical Guide.” Prepared by Singh, A., Armbya, N. and Singh, A.K. EPA/600/R-07/041. 2013.

TABLE A-2
Exposure Point Concentration Summary for Macoma
Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Current and Future
Medium:	Macoma
Exposure Medium:	Tissue

Exposure Point	Area	Chemical of Potential Concern	CAS Number	Units	Detection Frequency	Number of High Censored Results (a)	Minimum Concentration	Arithmetic Mean (b)	95 UCL	Distribution (c)	Maximum Detected Concentration	Exposure Point Concentration Value	Units	Statistic (d)	Method (e)
Macoma Tissue	Eastern Wetland Area	**Metals**													
		Aluminum	7429-90-5	mg/kg	8 / 8	0	1.18E+02	2.09E+02	2.59E+02	N	3.26E+02	2.59E+02	mg/kg	95UCL	(2)
		Antimony	7440-36-0	mg/kg	8 / 8	0	1.62E-02	2.98E-02	3.89E-02	N	4.98E-02	3.89E-02	mg/kg	95UCL	(2)
		Arsenic	7440-38-2	mg/kg	8 / 8	0	3.02E+00	3.81E+00	4.29E+00	N	5.02E+00	4.29E+00	mg/kg	95UCL	(2)
		Barium	7440-39-3	mg/kg	8 / 8	0	1.25E+00	1.99E+00	2.41E+00	N	3.08E+00	2.41E+00	mg/kg	95UCL	(2)
		Cadmium	7440-43-9	mg/kg	8 / 8	0	3.38E-02	7.24E-02	1.77E-01	NP	2.32E-01	1.77E-01	mg/kg	95UCL	(4)
		Chromium	7440-47-3	mg/kg	8 / 8	0	1.28E+00	2.21E+00	2.74E+00	N	3.75E+00	2.74E+00	mg/kg	95UCL	(2)
		Cobalt	7440-48-4	mg/kg	8 / 8	0	2.54E-01	3.54E-01	4.00E-01	N	4.80E-01	4.00E-01	mg/kg	95UCL	(2)
		Copper	7440-50-8	mg/kg	8 / 8	0	1.53E+00	2.83E+00	3.75E+00	N	5.02E+00	3.75E+00	mg/kg	95UCL	(2)
		Iron	7439-89-6	mg/kg	8 / 8	0	2.06E+02	3.16E+02	3.64E+02	N	4.15E+02	3.64E+02	mg/kg	95UCL	(2)
		Lead	7439-92-1	mg/kg	8 / 8	0	2.97E-01	5.46E-01	7.15E-01	N	8.98E-01	7.15E-01	mg/kg	95UCL	(2)
		Manganese	7439-96-5	mg/kg	8 / 8	0	2.83E+00	4.61E+00	5.23E+00	N	5.71E+00	5.23E+00	mg/kg	95UCL	(2)
		Mercury	7439-97-6	mg/kg	4 / 7	1	1.50E-02	2.29E-02	2.61E-02	NP	3.11E-02	2.61E-02	mg/kg	95UCL	(12)
		Molybdenum	7439-98-7	mg/kg	8 / 8	0	3.44E-01	5.00E-01	5.97E-01	N	7.82E-01	5.97E-01	mg/kg	95UCL	(2)
		Nickel	7440-02-0	mg/kg	8 / 8	0	7.83E-01	1.18E+00	1.38E+00	N	1.60E+00	1.38E+00	mg/kg	95UCL	(2)
		Selenium	7782-49-2	mg/kg	8 / 8	0	6.70E-01	8.00E-01	8.68E-01	N	9.44E-01	8.68E-01	mg/kg	95UCL	(2)
		Silver	7440-22-4	mg/kg	4 / 8	0	1.65E-02	3.41E-02	3.94E-02	NP	6.00E-02	3.94E-02	mg/kg	95UCL	(12)
		Vanadium	7440-62-2	mg/kg	8 / 8	0	7.91E-01	1.17E+00	1.32E+00	N	1.55E+00	1.32E+00	mg/kg	95UCL	(2)
		Zinc	7440-66-6	mg/kg	8 / 8	0	1.25E+01	1.84E+01	2.13E+01	N	2.63E+01	2.13E+01	mg/kg	95UCL	(2)
		Pesticides													
		4,4'-DDD	72-54-8	mg/kg	8 / 8	0	9.00E-05	4.94E-04	6.18E-04	N	7.20E-04	6.18E-04	mg/kg	95UCL	(2)
		4,4'-DDE	72-55-9	mg/kg	8 / 8	0	2.50E-04	1.09E-03	1.36E-03	N	1.45E-03	1.36E-03	mg/kg	95UCL	(2)
		alpha-Chlordane	5103-71-9	mg/kg	8 / 8	0	3.00E-05	1.39E-04	1.78E-04	N	2.20E-04	1.78E-04	mg/kg	95UCL	(2)
		Dieldrin	60-57-1	mg/kg	8 / 8	0	3.00E-05	2.30E-04	3.22E-04	N	4.50E-04	3.22E-04	mg/kg	95UCL	(2)
		gamma-Chlordane	5566-34-7	mg/kg	8 / 8	0	4.00E-05	1.40E-04	1.75E-04	N	2.20E-04	1.75E-04	mg/kg	95UCL	(2)
		PAHs													
		Acenaphthene	83-32-9	mg/kg	6 / 8	0	1.40E-04	2.06E-04	2.31E-04	NP	2.80E-04	2.31E-04	mg/kg	95UCL	(12)
		Acenaphthylene	208-96-8	mg/kg	6 / 8	0	2.10E-04	2.86E-04	3.18E-04	NP	4.11E-04	3.18E-04	mg/kg	95UCL	(12)
		Anthracene	120-12-7	mg/kg	7 / 8	0	9.61E-04	1.62E-03	2.04E-03	NP	3.19E-03	2.04E-03	mg/kg	95UCL	(12)
		Fluorene	86-73-7	mg/kg	6 / 8	0	2.25E-04	3.43E-04	3.74E-04	NP	4.00E-04	3.74E-04	mg/kg	95UCL	(12)
		Phenanthrene	85-01-8	mg/kg	7 / 8	0	1.08E-03	2.14E-03	2.50E-03	NP	3.14E-03	2.50E-03	mg/kg	95UCL	(12)
		Benzo(a)anthracene	56-55-3	mg/kg	7 / 8	0	2.15E-03	3.39E-03	4.00E-03	NP	5.51E-03	4.00E-03	mg/kg	95UCL	(12)
		Benzo(a)pyrene	50-32-8	mg/kg	8 / 8	0	6.20E-04	3.25E-03	4.05E-03	N	4.47E-03	4.05E-03	mg/kg	95UCL	(2)
		Benzo(b)fluoranthene	205-99-2	mg/kg	8 / 8	0	5.74E-04	4.00E-03	5.04E-03	N	5.25E-03	5.04E-03	mg/kg	95UCL	(2)
		Benzo(g,h,i)perylene	191-24-2	mg/kg	7 / 8	0	2.09E-03	3.16E-03	3.67E-03	NP	4.37E-03	3.67E-03	mg/kg	95UCL	(12)
		Benzo(k)fluoranthene	207-08-9	mg/kg	8 / 8	0	8.77E-04	3.90E-03	4.84E-03	N	5.05E-03	4.84E-03	mg/kg	95UCL	(2)
		Chrysene	218-01-9	mg/kg	8 / 8	0	7.95E-04	4.68E-03	6.15E-03	N	8.44E-03	6.15E-03	mg/kg	95UCL	(2)
		Dibenz(a,h)anthracene	53-70-3	mg/kg	6 / 8	0	1.50E-04	1.97E-04	2.13E-04	NP	2.41E-04	2.13E-04	mg/kg	95UCL	(12)
		Fluoranthene	206-44-0	mg/kg	8 / 8	0	2.29E-03	1.13E-02	1.50E-02	N	2.05E-02	1.50E-02	mg/kg	95UCL	(2)
		Indeno(1,2,3-cd)pyrene	193-39-5	mg/kg	7 / 8	0	1.04E-03	1.69E-03	1.95E-03	NP	2.30E-03	1.95E-03	mg/kg	95UCL	(12)
		Pyrene	129-00-0	mg/kg	8 / 8	0	2.39E-03	1.16E-02	1.46E-02	N	1.64E-02	1.46E-02	mg/kg	95UCL	(2)
		Butyltins													
		Monobutyltin	78763-54-9	mg/kg	1 / 1	7	8.74E-04	8.74E-04	N/A	--	8.74E-04	8.74E-04	mg/kg	Max	(1)
		Dibutyltin	1002-53-5	mg/kg	8 / 8	0	1.02E-03	1.39E-03	1.51E-03	N	1.66E-03	1.51E-03	mg/kg	95UCL	(2)
		Tributyltin	688-73-3	mg/kg	8 / 8	0	2.86E-03	4.13E-03	4.58E-03	N	4.89E-03	4.58E-03	mg/kg	95UCL	(2)
		PCBs													
		Total PCB Congeners	1336-36-3	mg/kg	8 / 8	0	4.72E-03	3.44E-02	4.77E-02	N	6.53E-02	4.77E-02	mg/kg	95UCL	(2)
		Total TEQ – PCB DLC	--	mg/kg	8 / 8	0	4.01E-06	9.47E-06	1.92E-05	NP	1.85E-05	1.85E-05	mg/kg	Max	(1)
		Dioxins													
		Total TEQ – TCDD DLC	--	mg/kg	2 / 2	0	4.75E-07	4.80E-07	N/A	--	4.86E-07	4.86E-07	mg/kg	Max	(1)

TABLE A-2
Exposure Point Concentration Summary for Macoma
Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Current and Future
Medium:	Macoma
Exposure Medium:	Tissue

Exposure Point	Area	Chemical of Potential Concern	CAS Number	Units	Detection Frequency	Number of High Censored Results (a)	Minimum Concentration	Arithmetic Mean (b)	95 UCL Distribution (c)		Maximum Detected Concentration	Exposure Point Concentration			
												Value	Units	Statistic (d)	Method (e)
	India Basin Area I	**Metals**													
		Aluminum	7429-90-5	mg/kg	6 / 6	0	1.02E+02	2.35E+02	3.22E+02	N	3.55E+02	3.22E+02	mg/kg	95UCL	(2)
		Antimony	7440-36-0	mg/kg	6 / 6	0	1.60E-02	2.02E-02	2.40E-02	LN	2.81E-02	2.40E-02	mg/kg	95UCL	(3)
		Arsenic	7440-38-2	mg/kg	6 / 6	0	2.92E+00	3.23E+00	3.47E+00	N	3.63E+00	3.47E+00	mg/kg	95UCL	(2)
		Barium	7440-39-3	mg/kg	6 / 6	0	1.23E+00	2.24E+00	2.99E+00	N	3.72E+00	2.99E+00	mg/kg	95UCL	(2)
		Cadmium	7440-43-9	mg/kg	6 / 6	0	3.10E-02	3.98E-02	4.75E-02	N	5.62E-02	4.75E-02	mg/kg	95UCL	(2)
		Chromium	7440-47-3	mg/kg	6 / 6	0	8.04E-01	1.30E+00	1.61E+00	N	1.89E+00	1.61E+00	mg/kg	95UCL	(2)
		Cobalt	7440-48-4	mg/kg	6 / 6	0	2.28E-01	3.19E-01	3.73E-01	N	3.86E-01	3.73E-01	mg/kg	95UCL	(2)
		Copper	7440-50-8	mg/kg	6 / 6	0	1.47E+00	2.09E+00	2.42E+00	N	2.50E+00	2.42E+00	mg/kg	95UCL	(2)
		Iron	7439-89-6	mg/kg	6 / 6	0	1.93E+02	2.92E+02	3.57E+02	N	4.09E+02	3.57E+02	mg/kg	95UCL	(2)
		Lead	7439-92-1	mg/kg	6 / 6	0	3.01E-01	3.74E-01	4.18E-01	N	4.46E-01	4.18E-01	mg/kg	95UCL	(2)
		Manganese	7439-96-5	mg/kg	6 / 6	0	2.35E+00	3.53E+00	4.47E+00	N	5.37E+00	4.47E+00	mg/kg	95UCL	(2)
		Mercury	7439-97-6	mg/kg	3 / 5	1	1.87E-02	1.99E-02	2.09E-02	NP	2.15E-02	2.09E-02	mg/kg	95UCL	(12)
		Molybdenum	7439-98-7	mg/kg	6 / 6	0	3.63E-01	4.20E-01	4.55E-01	N	4.69E-01	4.55E-01	mg/kg	95UCL	(2)
		Nickel	7440-02-0	mg/kg	6 / 6	0	8.43E-01	1.33E+00	2.00E+00	N	2.86E+00	2.00E+00	mg/kg	95UCL	(19)
		Selenium	7782-49-2	mg/kg	6 / 6	0	4.82E-01	6.71E-01	7.91E-01	N	8.24E-01	7.91E-01	mg/kg	95UCL	(2)
		Silver	7440-22-4	mg/kg	3 / 6	0	2.08E-02	9.13E-02	1.33E-01	NP	2.21E-01	1.33E-01	mg/kg	95UCL	(12)
		Vanadium	7440-62-2	mg/kg	6 / 6	0	6.96E-01	1.03E+00	1.25E+00	N	1.43E+00	1.25E+00	mg/kg	95UCL	(2)
		Zinc	7440-66-6	mg/kg	6 / 6	0	1.05E+01	1.49E+01	1.76E+01	N	2.00E+01	1.76E+01	mg/kg	95UCL	(2)
		Pesticides													
		4,4'-DDD	72-54-8	mg/kg	6 / 6	0	4.50E-04	6.27E-04	7.67E-04	N	8.40E-04	7.67E-04	mg/kg	95UCL	(2)
		4,4'-DDE	72-55-9	mg/kg	6 / 6	0	9.60E-04	1.20E-03	1.36E-03	N	1.45E-03	1.36E-03	mg/kg	95UCL	(2)
		alpha-Chlordane	5103-71-9	mg/kg	5 / 6	0	1.10E-04	2.00E-04	2.55E-04	NP	3.00E-04	2.55E-04	mg/kg	95UCL	(12)
		Dieldrin	60-57-1	mg/kg	6 / 6	0	1.30E-04	2.30E-04	3.48E-04	N	5.10E-04	3.48E-04	mg/kg	95UCL	(2)
		gamma-Chlordane	5566-34-7	mg/kg	6 / 6	0	6.00E-05	1.45E-04	2.10E-04	N	2.90E-04	2.10E-04	mg/kg	95UCL	(2)
		PAHs													
		Acenaphthene	83-32-9	mg/kg	4 / 6	0	2.68E-04	3.40E-04	3.79E-04	NP	4.30E-04	3.79E-04	mg/kg	95UCL	(12)
		Acenaphthylene	208-96-8	mg/kg	4 / 6	0	4.10E-04	6.19E-04	7.07E-04	NP	8.70E-04	7.07E-04	mg/kg	95UCL	(12)
		Anthracene	120-12-7	mg/kg	6 / 6	0	1.46E-03	3.99E-03	6.61E-03	N	1.01E-02	6.61E-03	mg/kg	95UCL	(2)
		Fluorene	86-73-7	mg/kg	4 / 6	0	3.00E-04	4.45E-04	5.11E-04	NP	6.20E-04	5.11E-04	mg/kg	95UCL	(12)
		Phenanthrene	85-01-8	mg/kg	6 / 6	0	1.22E-03	2.43E-03	3.39E-03	N	4.45E-03	3.39E-03	mg/kg	95UCL	(2)
		Benzo(a)anthracene	56-55-3	mg/kg	6 / 6	0	2.94E-03	7.30E-03	1.18E-02	N	1.81E-02	1.18E-02	mg/kg	95UCL	(2)
		Benzo(a)pyrene	50-32-8	mg/kg	6 / 6	0	3.08E-03	5.64E-03	7.85E-03	N	1.02E-02	7.85E-03	mg/kg	95UCL	(2)
		Benzo(b)fluoranthene	205-99-2	mg/kg	6 / 6	0	3.20E-03	6.92E-03	9.98E-03	N	1.40E-02	9.98E-03	mg/kg	95UCL	(2)
		Benzo(g,h,i)perylene	191-24-2	mg/kg	6 / 6	0	1.85E-03	3.21E-03	4.05E-03	N	4.83E-03	4.05E-03	mg/kg	95UCL	(2)
		Benzo(k)fluoranthene	207-08-9	mg/kg	6 / 6	0	4.03E-03	6.77E-03	9.72E-03	N	1.36E-02	9.72E-03	mg/kg	95UCL	(2)
		Chrysene	218-01-9	mg/kg	6 / 6	0	4.74E-03	9.80E-03	1.56E-02	N	2.37E-02	1.56E-02	mg/kg	95UCL	(2)
		Dibenz(a,h)anthracene	53-70-3	mg/kg	3 / 6	0	2.36E-04	3.52E-04	3.63E-04	NP	4.20E-04	3.63E-04	mg/kg	95UCL	(12)
		Fluoranthene	206-44-0	mg/kg	6 / 6	0	1.03E-02	2.43E-02	3.96E-02	N	6.10E-02	3.96E-02	mg/kg	95UCL	(2)
		Indeno(1,2,3-cd)pyrene	193-39-5	mg/kg	6 / 6	0	8.29E-04	1.99E-03	2.65E-03	N	3.20E-03	2.65E-03	mg/kg	95UCL	(2)
		Pyrene	129-00-0	mg/kg	6 / 6	0	1.30E-02	2.77E-02	4.41E-02	N	6.71E-02	4.41E-02	mg/kg	95UCL	(2)
		Butyltins													
		Dibutyltin	1002-53-5	mg/kg	6 / 6	0	9.19E-04	1.44E-03	1.79E-03	N	2.04E-03	1.79E-03	mg/kg	95UCL	(2)
		Tributyltin	688-73-3	mg/kg	6 / 6	0	2.89E-03	5.18E-03	7.23E-03	N	9.97E-03	7.23E-03	mg/kg	95UCL	(2)
		PCBs													
		Total PCB Congeners	1336-36-3	mg/kg	6 / 6	0	9.42E-03	1.36E-02	1.79E-02	N	2.06E-02	1.79E-02	mg/kg	95UCL	(2)
		Dioxins													
		Total TEQ – PCB DLC	--	mg/kg	6 / 6	0	4.52E-06	8.85E-06	1.34E-05	N	1.60E-05	1.34E-05	mg/kg	95UCL	(2)

TABLE A-2
Exposure Point Concentration Summary for Macoma
Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Current and Future
Medium:	Macoma
Exposure Medium:	Tissue

Exposure Point	Area	Chemical of Potential Concern	CAS Number	Units	Detection Frequency	Number of High Censored Results (a)	Minimum Concentration	Arithmetic Mean (b)	95 UCL	Distribution (c)	Maximum Detected Concentration	Exposure Point Concentration Value	Units	Statistic (d)	Method (e)
	Oil Reclamation Area	**Metals**													
		Aluminum	7429-90-5	mg/kg	6 / 6	0	1.71E+02	3.18E+02	4.34E+02	N	5.84E+02	4.34E+02	mg/kg	95UCL	(2)
		Antimony	7440-36-0	mg/kg	6 / 6	0	2.31E-02	3.33E-02	4.43E-02	N	5.75E-02	4.43E-02	mg/kg	95UCL	(2)
		Arsenic	7440-38-2	mg/kg	6 / 6	0	3.07E+00	3.53E+00	3.90E+00	N	4.09E+00	3.90E+00	mg/kg	95UCL	(2)
		Barium	7440-39-3	mg/kg	6 / 6	0	1.33E+00	2.72E+00	3.67E+00	N	4.72E+00	3.67E+00	mg/kg	95UCL	(2)
		Cadmium	7440-43-9	mg/kg	6 / 6	0	3.43E-02	1.15E-01	2.00E-01	N	2.91E-01	2.00E-01	mg/kg	95UCL	(2)
		Chromium	7440-47-3	mg/kg	6 / 6	0	8.63E-01	3.21E+00	4.69E+00	N	5.54E+00	4.69E+00	mg/kg	95UCL	(2)
		Cobalt	7440-48-4	mg/kg	6 / 6	0	2.35E-01	3.64E-01	4.55E-01	N	5.45E-01	4.55E-01	mg/kg	95UCL	(2)
		Copper	7440-50-8	mg/kg	6 / 6	0	2.23E+00	2.97E+00	3.64E+00	N	4.39E+00	3.64E+00	mg/kg	95UCL	(2)
		Iron	7439-89-6	mg/kg	6 / 6	0	2.23E+02	4.55E+02	5.98E+02	N	7.39E+02	5.98E+02	mg/kg	95UCL	(2)
		Lead	7439-92-1	mg/kg	6 / 6	0	3.82E-01	7.60E-01	1.06E+00	N	1.43E+00	1.06E+00	mg/kg	95UCL	(2)
		Manganese	7439-96-5	mg/kg	6 / 6	0	2.29E+00	5.74E+00	8.02E+00	N	9.00E+00	8.02E+00	mg/kg	95UCL	(2)
		Mercury	7439-97-6	mg/kg	5 / 6	0	1.63E-02	2.10E-02	2.46E-02	NP	2.91E-02	2.46E-02	mg/kg	95UCL	(12)
		Molybdenum	7439-98-7	mg/kg	6 / 6	0	3.70E-01	4.50E-01	5.08E-01	N	5.39E-01	5.08E-01	mg/kg	95UCL	(2)
		Nickel	7440-02-0	mg/kg	6 / 6	0	8.36E-01	1.47E+00	1.93E+00	N	2.47E+00	1.93E+00	mg/kg	95UCL	(2)
		Selenium	7782-49-2	mg/kg	6 / 6	0	6.92E-01	7.88E-01	8.68E-01	N	9.26E-01	8.68E-01	mg/kg	95UCL	(2)
		Silver	7440-22-4	mg/kg	1 / 3	3	3.71E-02	3.71E-02	N/A	--	3.71E-02	3.71E-02	mg/kg	Max	(1)
		Vanadium	7440-62-2	mg/kg	6 / 6	0	6.60E-01	1.51E+00	1.99E+00	N	2.43E+00	1.99E+00	mg/kg	95UCL	(2)
		Zinc	7440-66-6	mg/kg	6 / 6	0	1.38E+01	1.67E+01	1.88E+01	N	2.05E+01	1.88E+01	mg/kg	95UCL	(2)
		Pesticides													
		4,4'-DDD	72-54-8	mg/kg	6 / 6	0	5.30E-04	9.35E-04	1.16E-03	N	1.33E-03	1.16E-03	mg/kg	95UCL	(2)
		4,4'-DDE	72-55-9	mg/kg	6 / 6	0	1.52E-03	1.99E-03	2.21E-03	N	2.22E-03	2.21E-03	mg/kg	95UCL	(2)
		4,4'-DDT	50-29-3	mg/kg	1 / 6	0	7.00E-05	7.00E-05	N/A	--	7.00E-05	7.00E-05	mg/kg	Max	(1)
		alpha-Chlordane	5103-71-9	mg/kg	6 / 6	0	1.40E-04	2.35E-04	2.77E-04	N	2.80E-04	2.77E-04	mg/kg	95UCL	(2)
		Dieldrin	60-57-1	mg/kg	6 / 6	0	1.70E-04	2.22E-04	2.61E-04	N	3.10E-04	2.61E-04	mg/kg	95UCL	(2)
		gamma-Chlordane	5566-34-7	mg/kg	6 / 6	0	1.60E-04	2.80E-04	3.34E-04	N	3.40E-04	3.34E-04	mg/kg	95UCL	(2)
		PAHs													
		Acenaphthene	83-32-9	mg/kg	4 / 5	1	1.00E-04	1.38E-04	1.73E-04	NP	2.00E-04	1.73E-04	mg/kg	95UCL	(12)
		Acenaphthylene	208-96-8	mg/kg	5 / 6	0	2.30E-04	3.50E-04	4.32E-04	NP	5.42E-04	4.32E-04	mg/kg	95UCL	(12)
		Anthracene	120-12-7	mg/kg	6 / 6	0	6.90E-04	1.11E-03	1.37E-03	N	1.51E-03	1.37E-03	mg/kg	95UCL	(2)
		Fluorene	86-73-7	mg/kg	4 / 6	0	1.80E-04	2.28E-04	2.59E-04	NP	3.00E-04	2.59E-04	mg/kg	95UCL	(12)
		Phenanthrene	85-01-8	mg/kg	6 / 6	0	1.12E-03	2.03E-03	2.58E-03	N	2.88E-03	2.58E-03	mg/kg	95UCL	(2)
		Benzo(a)anthracene	56-55-3	mg/kg	6 / 6	0	2.09E-03	3.66E-03	4.78E-03	N	5.37E-03	4.78E-03	mg/kg	95UCL	(2)
		Benzo(a)pyrene	50-32-8	mg/kg	6 / 6	0	3.63E-03	5.08E-03	6.56E-03	N	8.00E-03	6.56E-03	mg/kg	95UCL	(2)
		Benzo(b)fluoranthene	205-99-2	mg/kg	6 / 6	0	3.38E-03	5.39E-03	6.75E-03	N	7.66E-03	6.75E-03	mg/kg	95UCL	(2)
		Benzo(g,h,i)perylene	191-24-2	mg/kg	6 / 6	0	1.99E-03	3.37E-03	4.50E-03	N	5.62E-03	4.50E-03	mg/kg	95UCL	(2)
		Benzo(k)fluoranthene	207-08-9	mg/kg	6 / 6	0	4.86E-03	6.49E-03	8.27E-03	N	9.83E-03	8.27E-03	mg/kg	95UCL	(2)
		Chrysene	218-01-9	mg/kg	6 / 6	0	3.59E-03	6.46E-03	9.05E-03	N	1.21E-02	9.05E-03	mg/kg	95UCL	(2)
		Dibenz(a,h)anthracene	53-70-3	mg/kg	4 / 6	0	1.40E-04	2.33E-04	2.79E-04	NP	3.49E-04	2.79E-04	mg/kg	95UCL	(12)
		Fluoranthene	206-44-0	mg/kg	6 / 6	0	7.32E-03	1.26E-02	1.74E-02	N	2.33E-02	1.74E-02	mg/kg	95UCL	(2)
		Indeno(1,2,3-cd)pyrene	193-39-5	mg/kg	6 / 6	0	1.12E-03	2.05E-03	2.65E-03	N	3.12E-03	2.65E-03	mg/kg	95UCL	(2)
		Pyrene	129-00-0	mg/kg	6 / 6	0	9.63E-03	1.52E-02	1.97E-02	N	2.43E-02	1.97E-02	mg/kg	95UCL	(2)
		Butyltins													
		Dibutyltin	1002-53-5	mg/kg	6 / 6	0	1.43E-03	2.56E-03	3.72E-03	N	5.31E-03	3.72E-03	mg/kg	95UCL	(2)
		Tributyltin	688-73-3	mg/kg	6 / 6	0	4.10E-03	1.69E-02	3.21E-02	N	5.28E-02	3.21E-02	mg/kg	95UCL	(2)
		PCBs													
		Total PCB Congeners	1336-36-3	mg/kg	6 / 6	0	5.37E-02	1.28E-01	1.71E-01	N	2.04E-01	1.71E-01	mg/kg	95UCL	(2)
		Total TEQ – PCB DLC	--	mg/kg	6 / 6	0	4.59E-06	5.27E-06	5.60E-06	N	5.61E-06	5.60E-06	mg/kg	95UCL	(2)
		Dioxins													
		Total TEQ – TCDD DLC	--	mg/kg	2 / 2	0	4.55E-07	6.17E-07	N/A	--	7.79E-07	7.79E-07	mg/kg	Max	(1)

TABLE A-2
Exposure Point Concentration Summary for Macoma
Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Current and Future
Medium:	Macoma
Exposure Medium:	Tissue

Exposure Point	Area	Chemical of Potential Concern	CAS Number	Units	Detection Frequency	Number of High Censored Results (a)	Minimum Concentration	Arithmetic Mean (b)	95 UCL Distribution (c)		Maximum Detected Concentration	Exposure Point Concentration			
												Value	Units	Statistic (d)	Method (e)
	Point Avisadero Area	**Metals**													
		Aluminum	7429-90-5	mg/kg	16 / 16	0	1.94E+02	2.83E+02	3.15E+02	N	4.48E+02	3.15E+02	mg/kg	95UCL	(2)
		Antimony	7440-36-0	mg/kg	16 / 16	0	1.65E-02	2.34E-02	2.59E-02	N	3.79E-02	2.59E-02	mg/kg	95UCL	(2)
		Arsenic	7440-38-2	mg/kg	16 / 16	0	2.61E+00	3.38E+00	3.53E+00	N	3.89E+00	3.53E+00	mg/kg	95UCL	(2)
		Barium	7440-39-3	mg/kg	16 / 16	0	1.93E+00	2.91E+00	3.32E+00	N	4.87E+00	3.32E+00	mg/kg	95UCL	(2)
		Cadmium	7440-43-9	mg/kg	16 / 16	0	3.05E-02	4.60E-02	4.98E-02	N	6.30E-02	4.98E-02	mg/kg	95UCL	(2)
		Chromium	7440-47-3	mg/kg	16 / 16	0	8.33E-01	2.67E+00	3.30E+00	N	5.28E+00	3.30E+00	mg/kg	95UCL	(2)
		Cobalt	7440-48-4	mg/kg	16 / 16	0	2.97E-01	4.01E-01	4.24E-01	N	4.87E-01	4.24E-01	mg/kg	95UCL	(2)
		Copper	7440-50-8	mg/kg	16 / 16	0	1.71E+00	6.58E+00	1.51E+01	NP	3.21E+01	1.51E+01	mg/kg	95UCL	(4)
		Iron	7439-89-6	mg/kg	16 / 16	0	2.84E+02	4.35E+02	4.85E+02	N	6.33E+02	4.85E+02	mg/kg	95UCL	(2)
		Lead	7439-92-1	mg/kg	16 / 16	0	2.91E-01	4.74E-01	5.46E-01	N	9.26E-01	5.46E-01	mg/kg	95UCL	(2)
		Manganese	7439-96-5	mg/kg	16 / 16	0	3.49E+00	6.52E+00	7.50E+00	N	1.00E+01	7.50E+00	mg/kg	95UCL	(2)
		Mercury	7439-97-6	mg/kg	13 / 16	0	1.66E-02	1.05E-01	3.48E-01	NP	6.63E-01	3.48E-01	mg/kg	95UCL	(14)
		Molybdenum	7439-98-7	mg/kg	16 / 16	0	3.22E-01	4.29E-01	4.55E-01	N	5.48E-01	4.55E-01	mg/kg	95UCL	(2)
		Nickel	7440-02-0	mg/kg	16 / 16	0	1.01E+00	1.38E+00	1.53E+00	N	2.25E+00	1.53E+00	mg/kg	95UCL	(2)
		Selenium	7782-49-2	mg/kg	16 / 16	0	4.32E-01	6.48E-01	7.12E-01	N	9.22E-01	7.12E-01	mg/kg	95UCL	(2)
		Silver	7440-22-4	mg/kg	3 / 16	0	2.16E-02	2.98E-02	2.59E-02	NP	4.53E-02	2.59E-02	mg/kg	95UCL	(12)
		Vanadium	7440-62-2	mg/kg	16 / 16	0	8.83E-01	1.39E+00	1.54E+00	N	1.95E+00	1.54E+00	mg/kg	95UCL	(2)
		Zinc	7440-66-6	mg/kg	16 / 16	0	1.21E+01	1.69E+01	1.80E+01	N	2.12E+01	1.80E+01	mg/kg	95UCL	(2)
		Pesticides													
		4,4'-DDD	72-54-8	mg/kg	16 / 16	0	3.40E-04	4.95E-04	5.35E-04	N	6.40E-04	5.35E-04	mg/kg	95UCL	(2)
		4,4'-DDE	72-55-9	mg/kg	16 / 16	0	7.20E-04	9.83E-04	1.06E-03	N	1.31E-03	1.06E-03	mg/kg	95UCL	(2)
		4,4'-DDT	50-29-3	mg/kg	1 / 16	0	2.60E-04	2.60E-04	N/A	--	2.60E-04	2.60E-04	mg/kg	Max	(1)
		alpha-Chlordane	5103-71-9	mg/kg	15 / 16	0	7.00E-05	1.13E-04	1.23E-04	NP	1.60E-04	1.23E-04	mg/kg	95UCL	(12)
		Dieldrin	60-57-1	mg/kg	12 / 16	0	1.00E-04	1.56E-04	1.60E-04	NP	3.00E-04	1.60E-04	mg/kg	95UCL	(12)
		gamma-Chlordane	5566-34-7	mg/kg	14 / 16	0	4.00E-05	1.19E-04	1.31E-04	NP	1.90E-04	1.31E-04	mg/kg	95UCL	(12)
		PAHs													
		Acenaphthene	83-32-9	mg/kg	15 / 16	0	1.90E-04	2.73E-04	3.01E-04	NP	4.90E-04	3.01E-04	mg/kg	95UCL	(12)
		Acenaphthylene	208-96-8	mg/kg	15 / 16	0	2.50E-04	4.77E-04	5.21E-04	NP	6.90E-04	5.21E-04	mg/kg	95UCL	(12)
		Anthracene	120-12-7	mg/kg	16 / 16	0	1.06E-03	2.65E-03	3.19E-03	N	5.02E-03	3.19E-03	mg/kg	95UCL	(2)
		Fluorene	86-73-7	mg/kg	15 / 16	0	2.00E-04	4.05E-04	4.51E-04	NP	7.00E-04	4.51E-04	mg/kg	95UCL	(12)
		Phenanthrene	85-01-8	mg/kg	15 / 16	0	1.28E-03	2.86E-03	3.29E-03	NP	5.87E-03	3.29E-03	mg/kg	95UCL	(12)
		Benzo(a)anthracene	56-55-3	mg/kg	16 / 16	0	1.78E-03	4.86E-03	6.08E-03	G	9.81E-03	6.08E-03	mg/kg	95UCL	(11)
		Benzo(a)pyrene	50-32-8	mg/kg	16 / 16	0	1.92E-03	4.84E-03	5.43E-03	N	7.10E-03	5.43E-03	mg/kg	95UCL	(2)
		Benzo(b)fluoranthene	205-99-2	mg/kg	16 / 16	0	2.01E-03	4.72E-03	5.29E-03	N	7.07E-03	5.29E-03	mg/kg	95UCL	(2)
		Benzo(g,h,i)perylene	191-24-2	mg/kg	16 / 16	0	1.19E-03	2.73E-03	3.14E-03	N	4.63E-03	3.14E-03	mg/kg	95UCL	(2)
		Benzo(k)fluoranthene	207-08-9	mg/kg	16 / 16	0	2.69E-03	5.57E-03	6.25E-03	N	8.25E-03	6.25E-03	mg/kg	95UCL	(2)
		Chrysene	218-01-9	mg/kg	16 / 16	0	2.60E-03	6.67E-03	7.84E-03	N	1.25E-02	7.84E-03	mg/kg	95UCL	(2)
		Dibenz(a,h)anthracene	53-70-3	mg/kg	14 / 16	0	1.30E-04	2.02E-04	2.15E-04	NP	3.10E-04	2.15E-04	mg/kg	95UCL	(12)
		Fluoranthene	206-44-0	mg/kg	16 / 16	0	7.20E-03	1.74E-02	2.02E-02	N	3.08E-02	2.02E-02	mg/kg	95UCL	(2)
		Indeno(1,2,3-cd)pyrene	193-39-5	mg/kg	16 / 16	0	6.00E-04	1.70E-03	2.07E-03	N	3.66E-03	2.07E-03	mg/kg	95UCL	(2)
		Pyrene	129-00-0	mg/kg	15 / 16	0	8.79E-03	2.16E-02	2.48E-02	NP	3.81E-02	2.48E-02	mg/kg	95UCL	(12)
		Butyltins													
		Monobutyltin	78763-54-9	mg/kg	2 / 2	14	1.34E-03	1.47E-03	N/A	--	1.60E-03	1.60E-03	mg/kg	Max	(1)
		Dibutyltin	1002-53-5	mg/kg	16 / 16	0	1.20E-03	5.83E-03	8.17E-03	N	2.00E-02	8.17E-03	mg/kg	95UCL	(2)
		Tributyltin	688-73-3	mg/kg	16 / 16	0	4.80E-03	5.59E-02	8.07E-02	N	2.09E-01	8.07E-02	mg/kg	95UCL	(2)
		PCBs													
		Total PCB Congeners	1336-36-3	mg/kg	16 / 16	0	8.11E-03	1.99E-02	2.80E-02	G	6.63E-02	2.80E-02	mg/kg	95UCL	(11)
		Dioxins													
		Total TEQ – PCB DLC	--	mg/kg	16 / 16	0	3.52E-06	6.30E-06	8.17E-06	N	1.65E-05	8.17E-06	mg/kg	95UCL	(19)

TABLE A-2
Exposure Point Concentration Summary for Macoma
Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Current and Future
Medium:	Macoma
Exposure Medium:	Tissue

Exposure Point	Area	Chemical of Potential Concern	CAS Number	Units	Detection Frequency	Number of High Censored Results (a)	Minimum Concentration	Arithmetic Mean (b)	95 UCL Distribution (c)		Maximum Detected Concentration	Exposure Point Concentration			
												Value	Units	Statistic (d)	Method (e)
	South Basin Area X	**Metals**													
		Aluminum	7429-90-5	mg/kg	23 / 23	0	3.14E+01	2.54E+02	2.88E+02	N	4.59E+02	2.88E+02	mg/kg	95UCL	(2)
		Antimony	7440-36-0	mg/kg	23 / 23	0	1.92E-02	4.42E-02	8.36E-02	NP	2.31E-01	8.36E-02	mg/kg	95UCL	(4)
		Arsenic	7440-38-2	mg/kg	23 / 23	0	2.00E+00	3.24E+00	3.42E+00	N	3.97E+00	3.42E+00	mg/kg	95UCL	(2)
		Barium	7440-39-3	mg/kg	23 / 23	0	4.67E-01	2.62E+00	3.03E+00	N	6.04E+00	3.03E+00	mg/kg	95UCL	(2)
		Cadmium	7440-43-9	mg/kg	23 / 23	0	2.51E-02	4.45E-02	4.99E-02	N	8.40E-02	4.99E-02	mg/kg	95UCL	(2)
		Chromium	7440-47-3	mg/kg	23 / 23	0	4.60E-01	1.74E+00	2.00E+00	N	3.52E+00	2.00E+00	mg/kg	95UCL	(2)
		Cobalt	7440-48-4	mg/kg	23 / 23	0	1.47E-01	3.25E-01	3.54E-01	N	4.80E-01	3.54E-01	mg/kg	95UCL	(2)
		Copper	7440-50-8	mg/kg	23 / 23	0	2.07E+00	3.20E+00	3.44E+00	N	4.43E+00	3.44E+00	mg/kg	95UCL	(2)
		Iron	7439-89-6	mg/kg	23 / 23	0	1.07E+02	3.43E+02	3.82E+02	N	6.28E+02	3.82E+02	mg/kg	95UCL	(2)
		Lead	7439-92-1	mg/kg	23 / 23	0	3.76E-01	1.15E+00	1.31E+00	N	2.35E+00	1.31E+00	mg/kg	95UCL	(2)
		Manganese	7439-96-5	mg/kg	23 / 23	0	2.20E+00	3.92E+00	4.37E+00	N	6.72E+00	4.37E+00	mg/kg	95UCL	(2)
		Mercury	7439-97-6	mg/kg	19 / 23	0	1.69E-02	2.32E-02	2.45E-02	NP	3.13E-02	2.45E-02	mg/kg	95UCL	(12)
		Molybdenum	7439-98-7	mg/kg	23 / 23	0	3.04E-01	4.35E-01	4.59E-01	N	5.63E-01	4.59E-01	mg/kg	95UCL	(2)
		Nickel	7440-02-0	mg/kg	23 / 23	0	3.51E-01	1.21E+00	1.34E+00	N	1.84E+00	1.34E+00	mg/kg	95UCL	(2)
		Selenium	7782-49-2	mg/kg	23 / 23	0	3.47E-01	6.88E-01	7.45E-01	N	9.33E-01	7.45E-01	mg/kg	95UCL	(2)
		Silver	7440-22-4	mg/kg	4 / 16	7	3.88E-02	3.95E-02	2.48E-02	NP	4.09E-02	2.48E-02	mg/kg	95UCL	(12)
		Vanadium	7440-62-2	mg/kg	23 / 23	0	4.05E-01	1.08E+00	1.20E+00	N	1.84E+00	1.20E+00	mg/kg	95UCL	(2)
		Zinc	7440-66-6	mg/kg	23 / 23	0	9.91E+00	1.69E+01	1.84E+01	N	2.40E+01	1.84E+01	mg/kg	95UCL	(2)
		Pesticides													
		4,4'-DDD	72-54-8	mg/kg	23 / 23	0	5.10E-04	1.62E-03	1.86E-03	N	3.94E-03	1.86E-03	mg/kg	95UCL	(2)
		4,4'-DDE	72-55-9	mg/kg	23 / 23	0	4.70E-04	5.20E-03	6.10E-03	N	1.07E-02	6.10E-03	mg/kg	95UCL	(2)
		4,4'-DDT	50-29-3	mg/kg	7 / 23	0	6.00E-05	2.34E-04	1.32E-04	NP	3.80E-04	1.32E-04	mg/kg	95UCL	(16)
		alpha-Chlordane	5103-71-9	mg/kg	23 / 23	0	9.00E-05	6.12E-04	1.08E-03	NP	2.69E-03	1.08E-03	mg/kg	95UCL	(4)
		Dieldrin	60-57-1	mg/kg	21 / 23	0	3.40E-04	1.03E-03	1.82E-03	NP	4.69E-03	1.82E-03	mg/kg	95UCL	(13)
		gamma-Chlordane	5566-34-7	mg/kg	23 / 23	0	9.00E-05	8.50E-04	1.52E-03	NP	3.74E-03	1.52E-03	mg/kg	95UCL	(4)
		PAHs													
		2-Methylnaphthalene	91-57-6	mg/kg	2 / 23	0	4.02E-04	5.26E-04	3.30E-04	NP	6.50E-04	3.30E-04	mg/kg	95UCL	(12)
		Acenaphthene	83-32-9	mg/kg	16 / 23	0	9.00E-05	2.77E-04	3.28E-04	NP	1.01E-03	3.28E-04	mg/kg	95UCL	(17)
		Acenaphthylene	208-96-8	mg/kg	17 / 23	0	1.10E-04	4.89E-04	4.91E-04	NP	9.00E-04	4.91E-04	mg/kg	95UCL	(16)
		Anthracene	120-12-7	mg/kg	23 / 23	0	4.70E-04	1.61E-03	1.91E-03	N	3.40E-03	1.91E-03	mg/kg	95UCL	(2)
		Fluorene	86-73-7	mg/kg	18 / 23	0	1.30E-04	3.54E-04	3.69E-04	NP	6.50E-04	3.69E-04	mg/kg	95UCL	(12)
		Naphthalene	91-20-3	mg/kg	1 / 23	0	1.98E-03	1.98E-03	N/A	--	1.98E-03	1.98E-03	mg/kg	Max	(1)
		Phenanthrene	85-01-8	mg/kg	21 / 23	0	9.70E-04	2.66E-03	3.91E-03	NP	6.50E-03	3.91E-03	mg/kg	95UCL	(13)
		Benzo(a)anthracene	56-55-3	mg/kg	23 / 23	0	3.90E-04	4.55E-03	5.25E-03	N	8.13E-03	5.25E-03	mg/kg	95UCL	(2)
		Benzo(a)pyrene	50-32-8	mg/kg	23 / 23	0	4.40E-04	6.75E-03	7.83E-03	N	1.65E-02	7.83E-03	mg/kg	95UCL	(2)
		Benzo(b)fluoranthene	205-99-2	mg/kg	23 / 23	0	6.30E-04	7.81E-03	8.90E-03	N	1.55E-02	8.90E-03	mg/kg	95UCL	(2)
		Benzo(g,h,i)perylene	191-24-2	mg/kg	23 / 23	0	4.30E-04	4.75E-03	5.42E-03	N	9.65E-03	5.42E-03	mg/kg	95UCL	(2)
		Benzo(k)fluoranthene	207-08-9	mg/kg	23 / 23	0	6.20E-04	8.66E-03	1.16E-02	NP	1.65E-02	1.16E-02	mg/kg	95UCL	(4)
		Chrysene	218-01-9	mg/kg	23 / 23	0	1.95E-03	7.48E-03	8.81E-03	N	1.66E-02	8.81E-03	mg/kg	95UCL	(2)
		Dibenz(a,h)anthracene	53-70-3	mg/kg	20 / 23	0	2.30E-04	3.86E-04	5.36E-04	NP	9.40E-04	5.36E-04	mg/kg	95UCL	(13)
		Fluoranthene	206-44-0	mg/kg	23 / 23	0	3.25E-03	1.79E-02	2.35E-02	G	5.39E-02	2.35E-02	mg/kg	95UCL	(11)
		Indeno(1,2,3-cd)pyrene	193-39-5	mg/kg	23 / 23	0	1.90E-04	3.10E-03	3.66E-03	N	7.30E-03	3.66E-03	mg/kg	95UCL	(2)
		Pyrene	129-00-0	mg/kg	21 / 23	0	2.80E-03	2.36E-02	3.02E-02	G	8.08E-02	3.02E-02	mg/kg	95UCL	(20)
		Butyltins													
		Dibutyltin	1002-53-5	mg/kg	21 / 21	2	1.03E-03	2.12E-03	2.46E-03	N	4.30E-03	2.46E-03	mg/kg	95UCL	(19)
		Tributyltin	688-73-3	mg/kg	23 / 23	0	2.11E-03	9.00E-03	1.22E-02	G	3.41E-02	1.22E-02	mg/kg	95UCL	(11)
		PCBs													
		Total PCB Congeners	1336-36-3	mg/kg	23 / 23	0	1.01E-01	2.68E-01	3.30E-01	G	6.62E-01	3.30E-01	mg/kg	95UCL	(11)
		Total TEQ – PCB DLC	--	mg/kg	23 / 23	0	3.76E-06	6.32E-06	7.67E-06	N	1.73E-05	7.67E-06	mg/kg	95UCL	(19)
		Dioxins													
		Total TEQ – TCDD DLC	--	mg/kg	2 / 2	0	5.40E-07	7.10E-07	N/A	--	8.80E-07	8.80E-07	mg/kg	Max	(1)

TABLE A-2
Exposure Point Concentration Summary for Macoma
Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Current and Future
Medium:	Macoma
Exposure Medium:	Tissue

Exposure Point	Area	Chemical of Potential Concern	CAS Number	Units	Detection Frequency	Number of High Censored Results (a)	Minimum Concentration	Arithmetic Mean (b)	95 UCL Distribution (c)		Maximum Detected Concentration	Exposure Point Concentration			
												Value	Units	Statistic (d)	Method (e)
	Reference Area	**Metals**													
		Aluminum	7429-90-5	mg/kg	25 / 25	0	4.96E+01	2.46E+02	2.79E+02	N	4.56E+02	2.79E+02	mg/kg	95UCL	(2)
		Antimony	7440-36-0	mg/kg	24 / 25	0	1.42E-02	2.48E-02	2.67E-02	NP	4.25E-02	2.67E-02	mg/kg	95UCL	(12)
		Arsenic	7440-38-2	mg/kg	25 / 25	0	2.72E+00	3.50E+00	3.78E+00	N	6.47E+00	3.78E+00	mg/kg	95UCL	(19)
		Barium	7440-39-3	mg/kg	25 / 25	0	8.08E-01	2.60E+00	2.94E+00	N	5.36E+00	2.94E+00	mg/kg	95UCL	(2)
		Cadmium	7440-43-9	mg/kg	25 / 25	0	3.38E-02	8.12E-02	1.45E-01	NP	3.53E-01	1.45E-01	mg/kg	95UCL	(4)
		Chromium	7440-47-3	mg/kg	25 / 25	0	6.70E-01	2.21E+00	2.82E+00	LN	8.31E+00	2.82E+00	mg/kg	95UCL	(3)
		Cobalt	7440-48-4	mg/kg	25 / 25	0	2.89E-01	4.70E-01	5.09E-01	N	7.56E-01	5.09E-01	mg/kg	95UCL	(2)
		Copper	7440-50-8	mg/kg	25 / 25	0	1.61E+00	2.26E+00	2.49E+00	N	4.93E+00	2.49E+00	mg/kg	95UCL	(19)
		Iron	7439-89-6	mg/kg	25 / 25	0	1.24E+02	3.45E+02	3.92E+02	N	6.92E+02	3.92E+02	mg/kg	95UCL	(2)
		Lead	7439-92-1	mg/kg	25 / 25	0	2.10E-01	4.33E-01	4.90E-01	N	8.80E-01	4.90E-01	mg/kg	95UCL	(2)
		Manganese	7439-96-5	mg/kg	25 / 25	0	4.08E+00	7.17E+00	7.93E+00	N	1.25E+01	7.93E+00	mg/kg	95UCL	(2)
		Mercury	7439-97-6	mg/kg	16 / 25	0	1.63E-02	2.42E-02	2.54E-02	NP	5.44E-02	2.54E-02	mg/kg	95UCL	(17)
		Molybdenum	7439-98-7	mg/kg	25 / 25	0	3.66E-01	4.55E-01	4.92E-01	N	8.95E-01	4.92E-01	mg/kg	95UCL	(19)
		Nickel	7440-02-0	mg/kg	25 / 25	0	7.52E-01	1.24E+00	1.36E+00	N	2.13E+00	1.36E+00	mg/kg	95UCL	(2)
		Selenium	7782-49-2	mg/kg	25 / 25	0	4.66E-01	7.31E-01	7.87E-01	N	1.15E+00	7.87E-01	mg/kg	95UCL	(2)
		Silver	7440-22-4	mg/kg	9 / 23	2	1.92E-02	2.81E-02	2.76E-02	NP	4.25E-02	2.76E-02	mg/kg	95UCL	(12)
		Vanadium	7440-62-2	mg/kg	25 / 25	0	5.84E-01	1.32E+00	1.52E+00	G	2.50E+00	1.52E+00	mg/kg	95UCL	(11)
		Zinc	7440-66-6	mg/kg	25 / 25	0	1.26E+01	1.68E+01	1.83E+01	N	3.17E+01	1.83E+01	mg/kg	95UCL	(19)
		Pesticides													
		4,4'-DDD	72-54-8	mg/kg	25 / 25	0	1.70E-04	4.60E-04	5.06E-04	N	7.50E-04	5.06E-04	mg/kg	95UCL	(2)
		4,4'-DDE	72-55-9	mg/kg	25 / 25	0	4.20E-04	7.93E-04	8.73E-04	N	1.29E-03	8.73E-04	mg/kg	95UCL	(2)
		4,4'-DDT	50-29-3	mg/kg	1 / 25	0	3.70E-04	3.70E-04	N/A	--	3.70E-04	3.70E-04	mg/kg	Max	(1)
		alpha-Chlordane	5103-71-9	mg/kg	22 / 25	0	5.00E-05	1.08E-04	1.18E-04	NP	2.00E-04	1.18E-04	mg/kg	95UCL	(12)
		Dieldrin	60-57-1	mg/kg	19 / 25	0	8.00E-05	1.58E-04	1.60E-04	NP	3.60E-04	1.60E-04	mg/kg	95UCL	(17)
		gamma-Chlordane	5566-34-7	mg/kg	21 / 25	0	2.00E-05	8.71E-05	9.69E-05	G	1.60E-04	9.69E-05	mg/kg	95UCL	(20)
		PAHs													
		Acenaphthene	83-32-9	mg/kg	20 / 25	0	9.00E-05	1.74E-04	1.85E-04	NP	2.70E-04	1.85E-04	mg/kg	95UCL	(12)
		Acenaphthylene	208-96-8	mg/kg	20 / 25	0	1.40E-04	2.94E-04	3.12E-04	NP	5.40E-04	3.12E-04	mg/kg	95UCL	(12)
		Anthracene	120-12-7	mg/kg	25 / 25	0	3.20E-04	1.01E-03	1.22E-03	G	2.21E-03	1.22E-03	mg/kg	95UCL	(11)
		Fluorene	86-73-7	mg/kg	20 / 25	0	1.50E-04	2.50E-04	2.67E-04	NP	4.40E-04	2.67E-04	mg/kg	95UCL	(16)
		Phenanthrene	85-01-8	mg/kg	20 / 25	0	8.40E-04	2.33E-03	2.53E-03	NP	4.62E-03	2.53E-03	mg/kg	95UCL	(17)
		Benzo(a)anthracene	56-55-3	mg/kg	25 / 25	0	1.07E-03	2.20E-03	2.49E-03	N	4.19E-03	2.49E-03	mg/kg	95UCL	(2)
		Benzo(a)pyrene	50-32-8	mg/kg	25 / 25	0	1.75E-03	3.37E-03	3.78E-03	N	5.68E-03	3.78E-03	mg/kg	95UCL	(2)
		Benzo(b)fluoranthene	205-99-2	mg/kg	25 / 25	0	1.30E-03	3.09E-03	3.49E-03	N	5.09E-03	3.49E-03	mg/kg	95UCL	(2)
		Benzo(g,h,i)perylene	191-24-2	mg/kg	25 / 25	0	8.00E-04	2.61E-03	3.03E-03	N	4.78E-03	3.03E-03	mg/kg	95UCL	(2)
		Benzo(k)fluoranthene	207-08-9	mg/kg	25 / 25	0	1.76E-03	3.58E-03	3.99E-03	N	6.33E-03	3.99E-03	mg/kg	95UCL	(2)
		Chrysene	218-01-9	mg/kg	25 / 25	0	1.77E-03	3.77E-03	4.35E-03	N	7.95E-03	4.35E-03	mg/kg	95UCL	(2)
		Dibenz(a,h)anthracene	53-70-3	mg/kg	14 / 25	0	1.10E-04	1.81E-04	1.41E-04	NP	3.15E-04	1.41E-04	mg/kg	95UCL	(12)
		Fluoranthene	206-44-0	mg/kg	25 / 25	0	3.86E-03	8.52E-03	1.01E-02	G	1.72E-02	1.01E-02	mg/kg	95UCL	(11)
		Indeno(1,2,3-cd)pyrene	193-39-5	mg/kg	25 / 25	0	4.70E-04	1.56E-03	1.83E-03	N	2.87E-03	1.83E-03	mg/kg	95UCL	(2)
		Pyrene	129-00-0	mg/kg	20 / 25	0	4.11E-03	1.11E-02	1.21E-02	NP	2.25E-02	1.21E-02	mg/kg	95UCL	(12)
		Butyltins													
		Dibutyltin	1002-53-5	mg/kg	23 / 23	1	1.05E-03	1.46E-03	1.60E-03	G	2.52E-03	1.60E-03	mg/kg	95UCL	(11)
		Tributyltin	688-73-3	mg/kg	24 / 24	0	2.02E-03	3.88E-03	4.78E-03	N	1.24E-02	4.78E-03	mg/kg	95UCL	(19)
		PCBs													
		Total PCB Congeners	1336-36-3	mg/kg	25 / 25	0	5.55E-03	1.01E-02	1.19E-02	N	2.25E-02	1.19E-02	mg/kg	95UCL	(19)
		Total TEQ – PCB DLC	--	mg/kg	25 / 25	0	3.51E-06	5.94E-06	7.17E-06	N	1.65E-05	7.17E-06	mg/kg	95UCL	(19)
		Dioxins													
		Total TEQ – TCDD DLC	--	mg/kg	5 / 5	0	3.64E-07	3.76E-07	3.87E-07	N	3.90E-07	3.87E-07	mg/kg	95UCL	(2)

TABLE A-2
Exposure Point Concentration Summary for Macoma
Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Current and Future
Medium:	Macoma
Exposure Medium:	Tissue

Exposure Point	Area	Chemical of Potential Concern	CAS Number	Units	Detection Frequency	Number of High Censored Results (a)	Minimum Concentration	Arithmetic Mean (b)	95 UCL Distribution (c)	Maximum Detected Concentration	Exposure Point Concentration			
											Value	Units	Statistic (d)	Method (e)

Notes:

--	Not applicable
95UCL	A 95% upper confidence limit, the upper boundary (or limit) of a confidence interval of a parameter of interest such as the population mean
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DLC	Dioxin-like Congeners
EPC	Exposure point concentration
KM	Kaplan-Meier product limit estimator
Max	Maximum detected concentration
mg/kg	Milligram per kilogram
N/A	Not applicable, no estimate provided because there were fewer than five total results and four distinct detected results.
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated biphenyl
TCDD	Tetrachlorodibenzo-p-dioxin
TEQ	Toxic Equivalents
USEPA	United States Environmental Protection Agency
a	Number of censored (nondetect) results that exceeded the maximum detected concentration. The nondetected results are based on the sample-specific detection limits. These results were excluded from the statistical calculations.
	The three data distributions considered in ProUCL 5.0.00 include the normal, lognormal, and the gamma distributions. Shapiro-Wilk (n ≤ 50) and Lilliefors (n > 50) test statistics are used to test for normality or lognormality of a data set. A five percent level of significance was used in all tests. Distribution tests were only conducted for samples with at least 4 detected results. Distributions not confirmed as normal, lognormal, or gamma, or not tested, were treated as nonparametric in all statistical calculations.
b	Arithmetic mean based on detected data only.
	Distribution Codes: G= gamma, LN= lognormal, N= normal, NP= nonparametric
d	The EPC is the lesser of the UCL and the maximum detected result. The maximum detected result is the default when there are fewer than 5 total results or fewer than 4 detected results.
e	All methods follow USEPA (2002, 2013).
	Method (Statistic) Codes are defined as follows:
(1)	Maximum detected concentration
(2)	95 percent UCL calculated using Student's t distribution
(3)	95 percent UCL calculated using Land's H statistic
(4), (5), (6)	95, 97.5, or 99 percent UCL, respectively, calculated using the nonparametric Chebyshev method
(7), (8), (9)	95, 97.5, or 99 percent UCL, respectively, calculated using the MVUE Chebyshev method
(10)	95 percent UCL calculated using the approximate gamma method
(11)	95 percent UCL calculated using the adjusted gamma method
(12)	95 percent UCL calculated using the KM mean and Student's t cuttoff for the UCL
(13), (14), (15)	95, 97.5, or 99 percent UCL, respectively, calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL
(16)	95 percent UCL calculated using the KM mean and a percentile bootstrap to estimate the UCL
(17)	95 percent UCL calculated using the KM mean and a BCA bootstrap to estimate the UCL
(18)	Hall's bootstrap
(19)	95 percent UCL calculated using Modified t distribution
(20)	95 percent UCL calculated using the adjusted gamma KM statistic

References:

United States Environmental Protection Agency (USEPA). 2002. “Calculating Exposure Point Concentrations at Hazardous Waste Sites.” OSWER 9285.6-10. Office of Emergency and Remedial Response. December.
United States Environmental Protection Agency (USEPA). 2013. “ProUCL Version 5.0.00 Technical Guide.” Prepared by Singh, A., Armbya, N. and Singh, A.K. EPA/600/R-07/041. 2013.

TABLE A-3

Values Used for Daily Intake, Sediment Exposure

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timef	Current/Future
Medium:	Sediment
Exposure Mediu	Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter	Parameter Definition	2005 HHRA RME Value[a]	RME Value Used for Updated HHRA	Units	RME Exposure Value Revised for Updated HHRA?	Reference for RME Value Used for Updated HHRA	Intake Equation[b]
Ingestion	Construction Worker	Adult	Parcel F	CS	Chemical Concentration in Sediment	Chemical-specific	Chemical-specific	mg/kg		See Table A-1.	Intake (mg/kg-day) = (CS x FI x IRS x EF x ED x MCF) / (BW x AT)
				IRS	Ingestion Rate – Sediment	100	330	mg/day	Yes	USEPA, 2002; DTSC, 2014. Soil ingestion rate assumed for sediment ingestion rate.	
				FI	Fraction Ingested	1	1	unitless		BBL, 2005	
				RBA	Relative bioavailability (arsenic)	--	0.6	unitless	Yes	USEPA, 2014	Arsenic Intake (mg/kg-day) = (CS x FI x IRS x RBA x EF x ED x MCF) / (BW x AT)
				EF	Exposure Frequency	120	250	days/year	Yes	USEPA, 2002; DTSC, 2014. Soil exposure frequency assumed for sediment exposure frequency.	
				ED	Exposure Duration	1	1	years		USEPA, 2002; DTSC, 2014	
				MCF	Mass Conversion Factor	1E-06	1E-06	kg/mg		Not applicable	
				BW	Body Weight	70	80	kg	Yes	USEPA, 2014	
				AT-C	Averaging Time – Cancer	25,550	25,550	days		USEPA, 2002; DTSC, 2014	
				AT-NC	Averaging Time – Noncancer	365	365	days		USEPA, 2002; DTSC, 2014	
	Recreational User	Adult	Parcel F	CS	Chemical Concentration in Sediment	Chemical-specific	Chemical-specific	mg/kg		See Table A-1.	Intake (mg/kg-day) = (CS x FI x IRS x EF x ED x MCF) / (BW x AT)
				IRS	Ingestion Rate – Sediment	100	100	mg/day		USEPA, 2014; DTSC 2014. Soil ingestion rate assumed for sediment ingestion rate.	
				FI	Fraction Ingested	1	1	unitless		BBL, 2005	See note c for recreational user intake equation for mutagenic chemicals.
				RBA	Relative bioavailability (arsenic)	--	0.6	unitless	Yes	USEPA, 2014	Arsenic Intake (mg/kg-day) = (CS x FI x IRS x RBA x EF x ED x MCF) / (BW x AT)
				EF	Exposure Frequency	26	26	days/year		BBL, 2005	
				ED	Exposure Duration	30	20	years	Yes	USEPA, 2014; DTSC, 2014. Soil exposure duration assumed for sediment exposure duration.	
				MCF	Mass Conversion Factor	1E-06	1E-06	kg/mg		Not applicable	
				BW	Body Weight	70	80	kg	Yes	USEPA, 2014	
				AT-C	Averaging Time – Cancer	25,550	25,550	days		USEPA, 2014; DTSC, 2014	
				AT-NC	Averaging Time – Noncancer	10,950	7,300	days	Yes	USEPA, 2014	
		Child	Parcel F	CS	Chemical Concentration in Sediment	Chemical-specific	Chemical-specific	mg/kg		See Table A-1.	Intake (mg/kg-day) = (CS x FI x IRS x EF x ED x MCF) / (BW x AT)
				IRS	Ingestion Rate – Sediment	100	200	mg/day	Yes	USEPA, 2013; DTSC 2014. Soil ingestion rate assumed for sediment ingestion rate.	
				FI	Fraction Ingested	1	1	unitless		BBL, 2005	See note b for intake equation for mutagenic chemicals.
				RBA	Relative bioavailability (arsenic)	--	0.6	unitless	Yes	USEPA, 2014	Arsenic Intake (mg/kg-day) = (CS x FI x IRS x RBA x EF x ED x MCF) / (BW x AT)
				EF	Exposure Frequency	26	26	days/year		BBL, 2005	
				ED	Exposure Duration	6	6	years		USEPA, 2014; DTSC, 2014. Soil exposure duration assumed for sediment exposure duration.	
				MCF	Mass Conversion Factor	1E-06	1E-06	kg/mg		Not applicable	
				BW	Body Weight	15	15	kg		USEPA, 2014; DTSC, 2014	
				AT-C	Averaging Time – Cancer	25,550	25,550	days		USEPA, 2014; DTSC, 2014	
				AT-NC	Averaging Time – Noncancer	2,190	2,190	days		USEPA, 2014; DTSC, 2014	
Dermal	Construction Worker	Adult	Parcel F	CS	Chemical Concentration in Sediment	Chemical-specific	Chemical-specific	mg/kg		See Table A-1.	Intake (mg/kg-day) = (CS x ABS x SA x AF x EF x ED x MCF) / (BW x AT)
				ABS	Dermal Absorption Factor	Chemical-specific	Chemical-specific	unitless		See Table A-5.	
				SA	Exposed Skin Surface Area	3,300	6,032	cm^2/day	Yes	DTSC, 2014. Soil exposed skin surface area assumed for sediment exposed skin surface area.	
				AF	Sediment to Skin Adherence	0.2	0.8	mg/cm^2	Yes	DTSC, 2014.	
				EF	Exposure Frequency	120	250	days/year	Yes	DTSC, 2014. Soil exposure frequency assumed for sediment exposure frequency.	
				ED	Exposure Duration	1	1	years		USEPA, 2002; DTSC, 2014	
				MCF	Mass Conversion Factor	1E-06	1E-06	kg/mg		Not applicable	
				BW	Body Weight	70	80	kg	Yes	USEPA, 2014	
				AT-C	Averaging Time – Cancer	25,550	25,550	days		USEPA, 2002; DTSC, 2014	
				AT-NC	Averaging Time – Noncancer	365	365	days		USEPA, 2014	

TABLE A-3

Values Used for Daily Intake, Sediment Exposure

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timef	Current/Future
Medium:	Sediment
Exposure Mediu	Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter	Parameter Definition	2005 HHRA RME Value[a]	RME Value Used for Updated HHRA	Units	RME Exposure Value Revised for Updated HHRA?	Reference for RME Value Used for Updated HHRA	Intake Equation[b]
Dermal (Continued)	Recreational User	Adult	Parcel F	CS	Chemical Concentration in Sediment	Chemical-specific	Chemical-specific	mg/kg		See Table A-1.	Intake (mg/kg-day) = (CS x ABS x SA x AF x EF x ED x MCF) / (BW x AT)
				ABS	Dermal Absorption Factor	Chemical-specific	Chemical-specific	unitless		See Table A-5.	
				SA	Exposed Skin Surface Area	5,700	6,032	cm^2/day	Yes	USEPA, 2014; DTSC, 2014. Soil exposed skin surface area assumed for sediment exposed skin	
				AF	Sediment to Skin Adherence	0.07	0.07	mg/cm^2		USEPA, 2014; DTSC, 2014	See note b for intake equation for mutagenic
				EF	Exposure Frequency	26	26	days/year		BBL, 2005	mutagenic chemicals.
				ED	Exposure Duration	30	20	years	Yes	USEPA, 2014; DTSC, 2014	
				MCF	Mass Conversion Factor	1E-06	1E-06	kg/mg		Not applicable	
				BW	Body Weight	70	80	kg	Yes	USEPA, 2014	
				AT-C	Averaging Time – Cancer	25,550	25,550	days		USEPA, 2014; DTSC, 2014	
				AT-NC	Averaging Time – Noncancer	10,950	7,300	days	Yes	USEPA, 2014	
		Child	Parcel F	CS	Chemical Concentration in Sediment	Chemical-specific	Chemical-specific	mg/kg		See Table A-1.	Intake (mg/kg-day) = (CS x ABS x SA x AF x EF x ED x MCF) / (BW x AT)
				ABS	Dermal Absorption Factor	Chemical-specific	Chemical-specific	unitless		See Table A-5.	
				SA	Exposed Skin Surface Area	2,800	2,900	cm^2/day	Yes	USEPA, 2014; DTSC, 2014. Soil exposed skin surface area assumed for sediment exposed skin	
				AF	Sediment to Skin Adherence	0.2	0.2	mg/cm^2		USEPA, 2014; DTSC 2014	See note b for intake equation for mutagenic
				EF	Exposure Frequency	26	26	days/year		BBL, 2005	mutagenic chemicals.
				ED	Exposure Duration	6	6	years		USEPA, 2014; DTSC, 2014	
				MCF	Mass Conversion Factor	1E-06	1E-06	kg/mg		Not applicable	
				BW	Body Weight	15	15	kg		USEPA, 2014; DTSC, 2014	
				AT-C	Averaging Time – Cancer	25,550	25,550	days		USEPA, 2014; DTSC, 2014	
				AT-NC	Averaging Time – Noncancer	2,190	2,190	days		USEPA, 2014; DTSC, 2014	

Notes:

[a] 2005 HHRA RME values from BBL and Neptune & Company (2005).

[b] Unless otherwise indicated, intake equations shown are for non-mutagenic chemicals.

[c] Consistent with USEPA (2014), intake of mutagenic chemicals in sediment was calculated using the following equations. Receptors exposed to carcinogens with a mutagenic mode of action (MMOA) are assumed to have increased early-life susceptibility; therefore, evaluation of MMOA is limited to the residential scenario. See Section 5.1 for discussion of the chemicals of potential concern identified as mutagens.

Sediment Ingestion

Intake (M) (mg/kg-day) = CS x FI x IRS (M) x EF x MCF / AT-C, where IRS (M) (mg-year/kg-day) =

[$ADAF_{0-2}$ (10) x ED_{0-2} (2 years) x IRS_{child} (200 mg/day) / BW_{child} (15 kg)] + [$ADAF_{2-6}$ (3) x (ED_{2-6} (4 years) x IRS_{child} (200 mg/day) / BW_{child} (15 kg)] + [$ADAF_{6-16}$ (3) x (ED_{6-16} (10 years) x IRS_{adult} (100 mg/day) / BW_{adult} (80 kg)] + [$ADAF_{16-26}$ (1) x (ED_{16-26} (10 years) x IRS_{adult} (100 mg/day) / BW_{adult} (80 kg)]

Dermal Contact with Sediment

Intake (M) (mg/kg-day) = CS x ABS x SA (M) x EF x MCF / AT-C, where SA (M) (mg-year/kg-day) =

[$ADAF_{0-2}$ (10) x ED_{0-2} (2 years) x SA_{child} (2,900 cm^2/day) x AF_{child} (0.2 mg/cm^2) / BW_{child} (15 kg)] + [$ADAF_{2-6}$ (3) x (ED_{2-6} (4 years) x SA_{child} (2,900 cm^2/day) x AF_{child} (0.2 mg/cm^2) / BW_{child} (15 kg)] + [$ADAF_{6-16}$ (3) x (ED_{6-16} (10 years) x SA_{adult} (5,700 cm^2/day) x AF_{adult} (0.07 mg/cm^2) / BW_{adult} (80 kg)] + [$ADAF_{16-26}$ (1) x (ED_{16-26} (10 years) x SA_{adult} (5,700 cm^2/day) x AF_{adult} (0.07 mg/cm^2) / BW_{adult} (80 kg)]

Acronyms/Abbreviations:

ADAF =	age-dependent adjustment factor
cm^2 =	square centimeter(s)
cm^2/day =	square centimeter(s) per day
kg =	kilogram(s)
kg/mg =	kilogram(s) per milligram
(M) =	mutagenic
mg/cm^2 =	milligram(s) per square centimeter
mg/day =	milligram(s) per day
mg/kg =	milligram(s) per kilogram
mg/kg-day =	milligram(s) per kilogram(s) per day
mg-year/kg-day =	milligram(s) per year per kilogram(s) per day
MMOA =	mutagenic mode of action
USEPA =	United States Environmental Protection Agency

References:

Battelle, Blasland, Bouck & Lee, Inc. (BBL), and Neptune & Company. 2005. “Final Hunter Point Shipyard Parcel F, Validation Study Report, San Francisco Bay, California.” May 2.

California Department of Toxic Substances Control (DTSC). 2014. Recommended DTSC Default Exposure Factors for Use in Risk Assessment at California Hazardous Waste Sites and Permitted Facilities. Office of Human and Ecological Risk (HERO). HERO HHRA Note Number 1. September 30.

United States Environmental Protection Agency (EPA). 2002. "Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, Interim Guidance." Office of Solid Waste and Emergency Response. OSWER 9355.4-24. December.

United States Environmental Protection Agency (USEPA). 2014. "Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites." May.

TABLE A-4

Values Used for Daily Intake, Macoma Exposure

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Current/Future
Medium:	Macoma
Exposure Medium:	Macoma

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter	Parameter Definition	2005 VS HHRA RME Value (a)	RME Value Used for Updated HHRA	Units	RME Exposure Value Revised for Updated HHRA?	Reference for RME Value Used for Updated HHRA	Intake Equation
Ingestion	Recreational User	Adult	Parcel F	CS	Chemical Concentration in shellfish	Chemical-specific	Chemical-specific	mg/kg		See Table A-2.	Intake (mg/kg-day) = (CS x FI x IRS x EF x ED) / (BW x AT)
				IRS	Ingestion Rate – shellfish	0.048	0.00213	kg/day	Yes	Barajas & Associates, Inc., 2008	
				FI	Fraction Ingested	1	1	unitless		Barajas & Associates, Inc., 2008	
				EF	Exposure Frequency	365	365	days/year		BBL, 2005	
				ED	Exposure Duration	30	20	years	Yes	USEPA, 2014	
				BW	Body Weight	70	80	kg	Yes	USEPA, 2014	
				AT-C	Averaging Time – Cancer	25,550	25,550	days		USEPA, 2014; DTSC, 2014	
				AT-NC	Averaging Time – Noncancer	10,950	7,300	days	Yes	USEPA, 2014	

Notes:

[a] Macoma tissue risk calculations are evaluated for the adult receptor only with the assumption there is no child ingestion of shellfish. Therefore, mutagenic mode of action (MMOA) was not evaluated for mutagenic COPCs for Macoma, because cancer risks are limited to adult exposures.

Acronyms/Abbreviations:

kg =	kilogram(s)
kg/day =	kilogram(s) per day
mg/kg =	milligram(s) per kilogram
mg/kg-day =	milligram(s) per kilogram(s) per day
mg-year/kg-day =	milligram(s) per year per kilogram(s) per day
USEPA =	United States Environmental Protection Agency

Sources:

Barajas & Associates, Inc. 2008. "Final Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California." April 30.

Battelle, Blasland, Bouck & Lee, Inc. (BBL), and Neptune & Company. 2005. “Final Hunter Point Shipyard Parcel F, Validation Study Report, San Francisco Bay, California.” May 2.

California Department of Toxic Substances Control (DTSC). 2014. Recommended DTSC Default Exposure Factors for Use in Risk Assessment at California Hazardous Waste Sites and Permitted Facilities. Office of Human and Ecological Risk (HERO). HERO HHRA Note Number 1. September 30.

United States Environmental Protection Agency (USEPA). 2014. Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites. May.

TABLE A-5

Cancer and Noncancer Toxicity Values Used for Risk Estimates

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Analyte	CAS Number	Mutagen (M)	Dermal ABS (unitless) (a)	2005 HHRA Dermal ABS (b)	Change in Dermal ABS?	GI Absorption Fraction (c)	Current Oral Slope Factor $(mg/kg\text{-}day)^{-1}$ (d)	Ref	Current Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$ (d)	Ref	2005 HHRA Oral Slope Factor $(mg/kg\text{-}day)^{-1}$ (b)	Change in Oral Slope Factor?	Oral Reference Dose (mg/kg-day)	Ref	Dermal Reference Dose (mg/kg-day)	Ref	2005 HHRA Oral Reference Dose (mg/kg-day) (b)	Change in Oral Reference Dose?	Notes
2,4'-DDD	53-19-0		0.05	0.03	Yes	1	0.24	I	0.24	I	0.24		0.0005	I	0.0005	I	--		4,4-DDD as surrogate for oral SF; 4,4-DDT as surrogate for oral RfD
2,4'-DDE	3424-82-6		0.05	0.03	Yes	1	0.34	I	0.34	I	0.34		0.0005	I	0.0005	I	--		4,4-DDE as surrogate for oral SF; 4,4-DDT as surrogate for oral RfD
2,4'-DDT	789-02-6		0.05	0.03	Yes	1	0.34	I	0.34	I	0.34		0.0005	I	0.0005	I	--	Yes	4,4-DDT as surrogate
2-Methylnaphthalene	91-57-6		0.15	--	Yes	1	--		--		--		0.004	I	0.004	I	--	Yes	
4,4'-DDD	72-54-8		0.05	0.03	Yes	1	0.24	I	0.24	I	0.24		0.0005	I	0.0005	I	--	Yes	4,4-DDT as surrogate for oral RfD
4,4'-DDE	72-55-9		0.05	0.03	Yes	1	0.34	I	0.34	I	0.34		0.0005	I	0.0005	I	--	Yes	4,4-DDT as surrogate for oral RfD
4,4'-DDT	50-29-3		0.05	0.03	Yes	1	0.34	I	0.34	I	0.34		0.0005	I	0.0005	I	--	Yes	
Acenaphthene	83-32-9		0.15	0.1	Yes	1	--		--		--		0.06	I	0.06	I	0.06		
Acenaphthylene	208-96-8		0.15	0.1	Yes	1	--		--		--		0.06	I	0.06	I	--	Yes	Acenaphthene as surrogate
alpha-Chlordane	5103-71-9		0.05	0.04	Yes	1	0.35	I	0.35	I	1.3	Yes	0.0005	I	0.0005	I	0.0005		Chlordane as surrogate
Aluminum	7429-90-5		0.01	0.01		1	--		--		--		1	P	1	P	--	Yes	
Anthracene	120-12-7		0.15	0.001	Yes	1	--		--		--		0.3	I	0.3	I	0.3		
Antimony	7440-36-0		0.01	0.01		0.15	--		--		--		0.0004	I	0.00006	I	0.0004		
Arsenic	7440-38-2		0.03	0.03		1	9.5	O	9.5	O	1.5	Yes	0.0003	I	0.0003	I	0.0003		
Barium	7440-39-3		0.01	0.01		0.07	--		--		--		0.2	I	0.014	I	--	Yes	
Benzo(a)anthracene	56-55-3	M	0.15	0.13	Yes	1	1.2	O	1.2	O	1.2		--		--		--		
Benzo(a)pyrene	50-32-8	M	0.15	0.13	Yes	1	7.3	I	7.3	I	12	Yes	--		--		--		
Benzo(b)fluoranthene	205-99-2	M	0.15	0.13	Yes	1	1.2	O	1.2	O	1.2		--		--		--		
Benzo(g,h,i)perylene	191-24-2		0.15	0.13	Yes	1	--		--		--		0.03	I	0.03	I	--	Yes	Pyrene as surrogate
Benzo(k)fluoranthene	207-08-9	M	0.15	0.13	Yes	1	1.2	O	1.2	O	1.2		--		--		--		
Cadmium	7440-43-9		0.001	0.01	Yes	0.025	15	O	600	O	0.38	Yes	0.001	I	0.000025	I	0.0005	Yes	
Chromium	7440-47-3		0.01	0.01		0.013	--		--		0.19	Yes	1.5	I	0.0195	I	0.003	Yes	Chromium III as surrogate for oral RfD
Chrysene	218-01-9	M	0.15	0.13	Yes	1	0.12	O	0.12	O	0.12		--		--		--		
Cobalt	7440-48-4		0.01	0.01		1	--		--		--		0.0003	P	0.0003	P	--	Yes	
Copper	7440-50-8		0.01	0.01		1	--		--		--		0.04	H	0.04	H	0.037	Yes	
Dibenz(a,h)anthracene	53-70-3	M	0.15	0.13	Yes	1	7.3	E	7.3	E	4.1	Yes	--		--		--		
Dibutyltin	1002-53-5		0.1	0.1		1	--		--		--		0.0003	A	0.0003	A	--	Yes	Tributyltin as surrogate
Dieldrin	60-57-1		0.1	0.1		1	16	I	16	I	16		0.00005	I	0.00005	I	0.00005		
Endosulfan II	33213-65-9		0.1	0.1		1	--		--		--		0.006	I	0.006	I	0.006		Endosulfan as surrogate
Endrin	72-20-8		0.1	0.1		1	--		--		--		0.0003	I	0.0003	I	0.0003		
Fluoranthene	206-44-0		0.15	0.13	Yes	1	--		--		--		0.04	I	0.04	I	0.04		
Fluorene	86-73-7		0.15	0.1	Yes	1	--		--		--		0.04	I	0.04	I	0.04		
gamma-Chlordane	5566-34-7		0.05	0.04	Yes	1	0.35	I	0.35	I	1.3	Yes	0.0005	I	0.0005	I	0.0005		Chlordane as surrogate
Heptachlor	76-44-8		0.1	0.1		1	4.5	I	4.5	I	4.1	Yes	0.0005	I	0.0005	I	0.0005		
Indeno(1,2,3-cd)pyrene	193-39-5	M	0.15	0.13	Yes	1	1.2	O	1.2	O	1.2		--		--		--		
Iron	7439-89-6		0.01	--	Yes	1	--		--		--		0.7	P	0.7	P	--	Yes	
Lead	7439-92-1		0.01	0.01		1	--		--		0.0085	Yes	--		--		--		
Manganese	7439-96-5		0.01	0.01		1	--		--		--		0.14	I	0.14	I	--	Yes	Manganese (diet)
Mercury	7439-97-6		0.01	0.01		1	--		--		--		0.0001	I	0.0001	I	0.0001		Methyl mercury as surrogate
Molybdenum	7439-98-7		0.01	0.1	Yes	1	--		--		--		0.005	I	0.005	I	--	Yes	
Monobutyltin	78763-54-9		0.1	0.1		1	--		--		--		0.0003	A	0.0003	A	--	Yes	Tributyltin as surrogate
Naphthalene	91-20-3		0.15	0.1	Yes	1	--		--		--		0.02	I	0.02	I	0.02		
Nickel	7440-02-0		0.01	0.01		0.04	--		--		--		0.02	I	0.0008	I	0.02		
Phenanthrene	85-01-8		0.15	0.1	Yes	1	--		--		--		0.3	I	0.3	I	--	Yes	Anthracene as surrogate
Pyrene	129-00-0		0.15	0.1	Yes	1	--		--		--		0.03	I	0.03	I	0.03		
Selenium	7782-49-2		0.01	0.01		1	--		--		--		0.005	I	0.005	I	0.005		

TABLE A-5

Cancer and Noncancer Toxicity Values Used for Risk Estimates

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Analyte	CAS Number	Mutagen (M)	Dermal ABS (unitless) (a)	2005 HHRA Dermal ABS (b)	Change in Dermal ABS?	GI Absorption Fraction (c)	Current Oral Slope Factor $(mg/kg\text{-}day)^{-1}$ (d)	Ref	Current Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$ (d)	Ref	2005 HHRA Oral Slope Factor $(mg/kg\text{-}day)^{-1}$ (b)	Change in Oral Slope Factor?	Oral Reference Dose (mg/kg-day)	Ref	Dermal Reference Dose (mg/kg-day)	Ref	2005 HHRA Oral Reference Dose (mg/kg-day) (b)	Change in Oral Reference Dose?	Notes
Silver	7440-22-4		0.01	0.01		0.04	--		--		--		0.005	I	0.0002	I	0.005		
Tetrabutyltin	1461-25-2		0.1	0.1		1	--		--		--		0.0003	A	0.0003	A	--	Yes	Tributyltin as surrogate
Total PCB Congeners	1336-36-3		0.15	0.14	Yes	1	2	I	2	I	5	Yes	0.00002	I	0.00002	I	--		Polychlorinated biphenyls (high risk); Aroclor-1254 as surrogate for oral RfD
Total TEQ – PCB DLC	--		0.03	0.03		1	130000	C	130000	C	130000		7E-10	I	7E-10	I	--	Yes	2,3,7,8-TCDD as surrogate
Total TEQ – TCDD DLC	--		0.03	0.03		1	130000	C	130000	C	130000		7E-10	I	7E-10	I	--	Yes	2,3,7,8-TCDD as surrogate
Tributyltin	688-73-3		0.1	0.1		1	--		--		--		0.0003	A	0.0003	A	--	Yes	
Vanadium	7440-62-2		0.01	0.01		0.026	--		--		--		0.005	I	0.00013	I	--	Yes	
Zinc	7440-66-6		0.01	0.01		1	--		--		--		0.3	I	0.3	I	0.3		

Notes:

(a) The dermal ABS is the most conservative between USEPA (2014) and DTSC (2013).

(b) Values from Battelle, BBL, and Nepture & Company (2005)

(c) Values from USEPA (2004)

(d) Values are based the most conservative value between oral SFs between USEPA (2014) and OEHHA (2014).

-- = not applicable or not available

A = ATSDR (as cited in EPA [2014])

C = California Environmental Protection Agencty (as cited in USEPA [2014]))

E = Environmental Criteria and Assessment Office (as cited in USEPA [2014])

H = Health Effects Assessment Summary Tables (as cited in USEPA [2014])

I = Integrated Risk Information System (as cited in USEPA [2014])

M = mutagen

O = Office of Enviornmental and Health Hazard Assessment (OEHHA, 2014)

P = Provisional Peer-Reviewed Toxicity Value (as cited in USEPA [2014])

V = volatile

ABS = absorption

CAS = Chemical Abstracts Service

DDD = dichlorodiphenyldichloroethane

DDE = dichlorodiphenyldichloroethylene

DDT = dichlorodiphenyltrichloroethane

GI = gastrointestinal

HHRA = human health risk assessment

mg/kg = milligram per kilogram

PCB = polychlorinated biphenyl

RfD = reference dose

SF = slope factor

TCDD = tetrachlorodibenzo-p-dioxin

References:

Battelle, Blasland, Bouck & Lee, Inc. (BBL), and Neptune & Company. 2005. “Final Hunter Point Shipyard Parcel F, Validation Study Report, San Francisco Bay, California.” May 2.

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United States Environmental Protection Agency (USEPA). 2004. "Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)." Final. Office of Superfund Remediation and Technology Innovation. EPA/540

United States Environmental Protection Agency (USEPA). 2014. Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites. May.

TABLE A-6A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Adult and Child Recreational User, Eastern Wetland Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern		EPC		Cancer Risk Calculations: Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Noncancer Hazard Quotient: Intake/Exposure Concentration		RfD / RfC		Hazard Quotient
						Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	Sediment	Ingestion	Aluminum		6.4E+04	mg/kg	6.8E-03	mg/kg-day	--	--	--	6.1E-02	mg/kg-day	1.0E+00	mg/kg-day	6.1E-02
				Antimony		2.8E+00	mg/kg	3.0E-07	mg/kg-day	--	--	--	2.6E-06	mg/kg-day	4.0E-04	mg/kg-day	6.6E-03
				Arsenic		9.7E+00	mg/kg	6.2E-07	mg/kg-day	9.5E+00	(mg/kg-day)-1	5.9E-06	5.5E-06	mg/kg-day	3.0E-04	mg/kg-day	1.8E-02
				Barium		4.2E+02	mg/kg	4.5E-05	mg/kg-day	--	--	--	4.0E-04	mg/kg-day	2.0E-01	mg/kg-day	2.0E-03
				Cadmium		2.6E-01	mg/kg	2.8E-08	mg/kg-day	1.5E+01	(mg/kg-day)-1	4.2E-07	2.5E-07	mg/kg-day	1.0E-03	mg/kg-day	2.5E-04
				Chromium		2.9E+02	mg/kg	3.1E-05	mg/kg-day	--	--	--	2.8E-04	mg/kg-day	1.5E+00	mg/kg-day	1.8E-04
				Cobalt		1.7E+01	mg/kg	1.9E-06	mg/kg-day	--	--	--	1.7E-05	mg/kg-day	3.0E-04	mg/kg-day	5.5E-02
				Copper		4.1E+01	mg/kg	4.4E-06	mg/kg-day	--	--	--	3.9E-05	mg/kg-day	4.0E-02	mg/kg-day	9.8E-04
				Iron		3.9E+04	mg/kg	4.2E-03	mg/kg-day	--	--	--	3.7E-02	mg/kg-day	7.0E-01	mg/kg-day	5.3E-02
				Lead		2.5E+01	mg/kg	2.6E-06	mg/kg-day	--	--	--	2.3E-05	mg/kg-day	--	--	--
				Manganese		5.3E+02	mg/kg	5.7E-05	mg/kg-day	--	--	--	5.1E-04	mg/kg-day	1.4E-01	mg/kg-day	3.6E-03
				Mercury		2.2E-01	mg/kg	2.3E-08	mg/kg-day	--	--	--	2.1E-07	mg/kg-day	1.0E-04	mg/kg-day	2.1E-03
				Molybdenum		9.5E-01	mg/kg	1.0E-07	mg/kg-day	--	--	--	9.0E-07	mg/kg-day	5.0E-03	mg/kg-day	1.8E-04
				Nickel		8.5E+01	mg/kg	9.1E-06	mg/kg-day	--	--	--	8.1E-05	mg/kg-day	2.0E-02	mg/kg-day	4.0E-03
				Selenium		3.4E-01	mg/kg	3.6E-08	mg/kg-day	--	--	--	3.2E-07	mg/kg-day	5.0E-03	mg/kg-day	6.4E-05
				Silver		2.8E-01	mg/kg	3.0E-08	mg/kg-day	--	--	--	2.7E-07	mg/kg-day	5.0E-03	mg/kg-day	5.3E-05
				Vanadium		1.4E+02	mg/kg	1.5E-05	mg/kg-day	--	--	--	1.3E-04	mg/kg-day	5.0E-03	mg/kg-day	2.6E-02
				Zinc		1.1E+02	mg/kg	1.2E-05	mg/kg-day	--	--	--	1.0E-04	mg/kg-day	3.0E-01	mg/kg-day	3.4E-04
				4,4'-DDD		7.4E-04	mg/kg	7.9E-11	mg/kg-day	2.4E-01	(mg/kg-day)-1	1.9E-11	7.1E-10	mg/kg-day	5.0E-04	mg/kg-day	1.4E-06
				4,4'-DDE		8.7E-04	mg/kg	9.3E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	3.2E-11	8.3E-10	mg/kg-day	5.0E-04	mg/kg-day	1.7E-06
				4,4'-DDT		2.9E-04	mg/kg	3.1E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	1.1E-11	2.8E-10	mg/kg-day	5.0E-04	mg/kg-day	5.6E-07
				alpha-Chlordane		1.2E-04	mg/kg	1.3E-11	mg/kg-day	3.5E-01	(mg/kg-day)-1	4.4E-12	1.1E-10	mg/kg-day	5.0E-04	mg/kg-day	2.2E-07
				gamma-Chlordane		2.0E-05	mg/kg	2.1E-12	mg/kg-day	3.5E-01	(mg/kg-day)-1	7.5E-13	1.9E-11	mg/kg-day	5.0E-04	mg/kg-day	3.8E-08
				2-Methylnaphthalene		4.9E-03	mg/kg	5.2E-10	mg/kg-day	--	--	--	4.6E-09	mg/kg-day	4.0E-03	mg/kg-day	1.2E-06
				Acenaphthene		4.4E-03	mg/kg	4.7E-10	mg/kg-day	--	--	--	4.2E-09	mg/kg-day	6.0E-02	mg/kg-day	6.9E-08
				Acenaphthylene		6.6E-03	mg/kg	7.0E-10	mg/kg-day	--	--	--	6.2E-09	mg/kg-day	6.0E-02	mg/kg-day	1.0E-07
				Anthracene		3.2E-02	mg/kg	3.4E-09	mg/kg-day	--	--	--	3.0E-08	mg/kg-day	3.0E-01	mg/kg-day	1.0E-07
				Fluorene		6.4E-03	mg/kg	6.8E-10	mg/kg-day	--	--	--	6.0E-09	mg/kg-day	4.0E-02	mg/kg-day	1.5E-07
				Naphthalene		1.2E-02	mg/kg	1.3E-09	mg/kg-day	--	--	--	1.1E-08	mg/kg-day	2.0E-02	mg/kg-day	5.6E-07
				Phenanthrene		8.9E-02	mg/kg	9.5E-09	mg/kg-day	--	--	--	8.4E-08	mg/kg-day	3.0E-01	mg/kg-day	2.8E-07
				Benzo(a)anthracene	M	9.3E-02	mg/kg	4.5E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	5.4E-08	8.9E-08	mg/kg-day	--	--	--
				Benzo(a)pyrene	M	1.4E-01	mg/kg	6.9E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	5.1E-07	1.4E-07	mg/kg-day	--	--	--
				Benzo(b)fluoranthene	M	8.8E-02	mg/kg	4.3E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	5.1E-08	8.4E-08	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene		1.2E-01	mg/kg	1.3E-08	mg/kg-day	--	--	--	1.2E-07	mg/kg-day	3.0E-02	mg/kg-day	3.9E-06
				Benzo(k)fluoranthene	M	9.3E-02	mg/kg	4.5E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	5.4E-08	8.8E-08	mg/kg-day	--	--	--
				Chrysene	M	1.1E-01	mg/kg	5.5E-08	mg/kg-day	1.2E-01	(mg/kg-day)-1	6.6E-09	1.1E-07	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene	M	1.2E-02	mg/kg	5.9E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	4.3E-08	1.2E-08	mg/kg-day	--	--	--
				Fluoranthene		2.0E-01	mg/kg	2.1E-08	mg/kg-day	--	--	--	1.9E-07	mg/kg-day	4.0E-02	mg/kg-day	4.7E-06
				Indeno(1,2,3-cd)pyrene	M	1.1E-01	mg/kg	5.4E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	6.5E-08	1.1E-07	mg/kg-day	--	--	--
				Pyrene		2.6E-01	mg/kg	2.8E-08	mg/kg-day	--	--	--	2.5E-07	mg/kg-day	3.0E-02	mg/kg-day	8.3E-06
				Dibutyltin		3.9E-03	mg/kg	4.2E-10	mg/kg-day	--	--	--	3.7E-09	mg/kg-day	3.0E-04	mg/kg-day	1.2E-05
				Tributyltin		4.8E-03	mg/kg	5.1E-10	mg/kg-day	--	--	--	4.5E-09	mg/kg-day	3.0E-04	mg/kg-day	1.5E-05
				Total PCB Congeners		2.8E-02	mg/kg	3.0E-09	mg/kg-day	2.0E+00	(mg/kg-day)-1	6.0E-09	2.7E-08	mg/kg-day	2.0E-05	mg/kg-day	1.3E-03
				Total TEQ – PCB DLC		7.5E-06	mg/kg	8.0E-13	mg/kg-day	1.3E+05	(mg/kg-day)-1	1.0E-07	7.1E-12	mg/kg-day	7.0E-10	mg/kg-day	1.0E-02
			Exp. Route Total									7.2E-06					2.5E-01
			Dermal	Aluminum		6.4E+04	mg/kg	2.2E-04	mg/kg-day	--	--	--	1.8E-03	mg/kg-day	1.0E+00	mg/kg-day	1.8E-03
				Antimony		2.8E+00	mg/kg	9.5E-09	mg/kg-day	--	--	--	7.6E-08	mg/kg-day	6.0E-05	mg/kg-day	1.3E-03
				Arsenic		9.7E+00	mg/kg	1.0E-07	mg/kg-day	9.5E+00	(mg/kg-day)-1	9.5E-07	8.0E-07	mg/kg-day	3.0E-04	mg/kg-day	2.7E-03
				Barium		4.2E+02	mg/kg	1.5E-06	mg/kg-day	--	--	--	1.2E-05	mg/kg-day	1.4E-02	mg/kg-day	8.3E-04
				Cadmium		2.6E-01	mg/kg	8.9E-11	mg/kg-day	6.0E+02	(mg/kg-day)-1	5.3E-08	7.1E-10	mg/kg-day	2.5E-05	mg/kg-day	2.9E-05
				Chromium		2.9E+02	mg/kg	1.0E-06	mg/kg-day	--	--	--	8.0E-06	mg/kg-day	2.0E-02	mg/kg-day	4.1E-04
				Cobalt		1.7E+01	mg/kg	6.0E-08	mg/kg-day	--	--	--	4.8E-07	mg/kg-day	3.0E-04	mg/kg-day	1.6E-03
				Copper		4.1E+01	mg/kg	1.4E-07	mg/kg-day	--	--	--	1.1E-06	mg/kg-day	4.0E-02	mg/kg-day	2.8E-05
				Iron		3.9E+04	mg/kg	1.4E-04	mg/kg-day	--	--	--	1.1E-03	mg/kg-day	7.0E-01	mg/kg-day	1.5E-03
				Lead		2.5E+01	mg/kg	8.5E-08	mg/kg-day	--	--	--	6.8E-07	mg/kg-day	--	--	--
				Manganese		5.3E+02	mg/kg	1.8E-06	mg/kg-day	--	--	--	1.5E-05	mg/kg-day	1.4E-01	mg/kg-day	1.1E-04
				Mercury		2.2E-01	mg/kg	7.5E-10	mg/kg-day	--	--	--	6.0E-09	mg/kg-day	1.0E-04	mg/kg-day	6.0E-05
				Molybdenum		9.5E-01	mg/kg	3.3E-09	mg/kg-day	--	--	--	2.6E-08	mg/kg-day	5.0E-03	mg/kg-day	5.2E-06
				Nickel		8.5E+01	mg/kg	2.9E-07	mg/kg-day	--	--	--	2.3E-06	mg/kg-day	8.0E-04	mg/kg-day	2.9E-03
				Selenium		3.4E-01	mg/kg	1.2E-09	mg/kg-day	--	--	--	9.3E-09	mg/kg-day	5.0E-03	mg/kg-day	1.9E-06
				Silver		2.8E-01	mg/kg	9.7E-10	mg/kg-day	--	--	--	7.7E-09	mg/kg-day	2.0E-04	mg/kg-day	3.9E-05

TABLE A-6A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Adult and Child Recreational User, Eastern Wetland Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

							Cancer Risk Calculations					Noncancer Hazard Quotient				
					EPC		Intake/Exposure Concentration		CSF / Unit Risk			Intake/Exposure Concentration		RfD / RfC		
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	Value	Units	Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
				Vanadium	1.4E+02	mg/kg	4.8E-07	mg/kg-day	--	--	--	3.8E-06	mg/kg-day	1.3E-04	mg/kg-day	2.9E-02
				Zinc	1.1E+02	mg/kg	3.7E-07	mg/kg-day	--	--	--	3.0E-06	mg/kg-day	3.0E-01	mg/kg-day	1.0E-05
				4,4'-DDD	7.4E-04	mg/kg	1.3E-11	mg/kg-day	2.4E-01	(mg/kg-day)-1	3.1E-12	1.0E-10	mg/kg-day	5.0E-04	mg/kg-day	2.0E-07
				4,4'-DDE	8.7E-04	mg/kg	1.5E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	5.1E-12	1.2E-10	mg/kg-day	5.0E-04	mg/kg-day	2.4E-07
				4,4'-DDT	2.9E-04	mg/kg	5.0E-12	mg/kg-day	3.4E-01	(mg/kg-day)-1	1.7E-12	4.0E-11	mg/kg-day	5.0E-04	mg/kg-day	8.1E-08
				alpha-Chlordane	1.2E-04	mg/kg	2.0E-12	mg/kg-day	3.5E-01	(mg/kg-day)-1	7.1E-13	1.6E-11	mg/kg-day	5.0E-04	mg/kg-day	3.3E-08
				gamma-Chlordane	2.0E-05	mg/kg	3.4E-13	mg/kg-day	3.5E-01	(mg/kg-day)-1	1.2E-13	2.8E-12	mg/kg-day	5.0E-04	mg/kg-day	5.5E-09
				2-Methylnaphthalene	4.9E-03	mg/kg	2.5E-10	mg/kg-day	--	--	--	2.0E-09	mg/kg-day	4.0E-03	mg/kg-day	5.1E-07
				Acenaphthene	4.4E-03	mg/kg	2.3E-10	mg/kg-day	--	--	--	1.8E-09	mg/kg-day	6.0E-02	mg/kg-day	3.0E-08
				Acenaphthylene	6.6E-03	mg/kg	3.4E-10	mg/kg-day	--	--	--	2.7E-09	mg/kg-day	6.0E-02	mg/kg-day	4.5E-08
				Anthracene	3.2E-02	mg/kg	1.6E-09	mg/kg-day	--	--	--	1.3E-08	mg/kg-day	3.0E-01	mg/kg-day	4.4E-08
				Fluorene	6.4E-03	mg/kg	3.3E-10	mg/kg-day	--	--	--	2.6E-09	mg/kg-day	4.0E-02	mg/kg-day	6.6E-08
				Naphthalene	1.2E-02	mg/kg	6.1E-10	mg/kg-day	--	--	--	4.9E-09	mg/kg-day	2.0E-02	mg/kg-day	2.4E-07
				Phenanthrene	8.9E-02	mg/kg	4.6E-09	mg/kg-day	--	--	--	3.7E-08	mg/kg-day	3.0E-01	mg/kg-day	1.2E-07
				Benzo(a)anthracene M	9.3E-02	mg/kg	2.1E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	2.5E-08	3.9E-08	mg/kg-day	--	--	--
				Benzo(a)pyrene M	1.4E-01	mg/kg	3.2E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	2.3E-07	5.9E-08	mg/kg-day	--	--	--
				Benzo(b)fluoranthene M	8.8E-02	mg/kg	2.0E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	2.3E-08	3.7E-08	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene	1.2E-01	mg/kg	6.4E-09	mg/kg-day	--	--	--	5.1E-08	mg/kg-day	3.0E-02	mg/kg-day	1.7E-06
				Benzo(k)fluoranthene M	9.3E-02	mg/kg	2.1E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	2.5E-08	3.8E-08	mg/kg-day	--	--	--
				Chrysene M	1.1E-01	mg/kg	2.5E-08	mg/kg-day	1.2E-01	(mg/kg-day)-1	3.0E-09	4.7E-08	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene M	1.2E-02	mg/kg	2.7E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	2.0E-08	5.0E-09	mg/kg-day	--	--	--
				Fluoranthene	2.0E-01	mg/kg	1.0E-08	mg/kg-day	--	--	--	8.2E-08	mg/kg-day	4.0E-02	mg/kg-day	2.1E-06
				Indeno(1,2,3-cd)pyrene M	1.1E-01	mg/kg	2.5E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	3.0E-08	4.6E-08	mg/kg-day	--	--	--
				Pyrene	2.6E-01	mg/kg	1.3E-08	mg/kg-day	--	--	--	1.1E-07	mg/kg-day	3.0E-02	mg/kg-day	3.6E-06
				Dibutyltin	3.9E-03	mg/kg	1.3E-10	mg/kg-day	--	--	--	1.1E-09	mg/kg-day	3.0E-04	mg/kg-day	3.6E-06
				Tributyltin	4.8E-03	mg/kg	1.6E-10	mg/kg-day	--	--	--	1.3E-09	mg/kg-day	3.0E-04	mg/kg-day	4.4E-06
				Total PCB Congeners	2.8E-02	mg/kg	1.5E-09	mg/kg-day	2.0E+00	(mg/kg-day)-1	2.9E-09	1.2E-08	mg/kg-day	2.0E-05	mg/kg-day	5.8E-04
				Total TEQ – PCB DLC	7.5E-06	mg/kg	7.8E-14	mg/kg-day	1.3E+05	(mg/kg-day)-1	1.0E-08	6.2E-13	mg/kg-day	7.0E-10	mg/kg-day	8.9E-04
			Exp. Route Total								1.4E-06					4.4E-02
		Exposure Point Total									8.6E-06					2.9E-01
	Exposure Medium Total										8.6E-06					2.9E-01
Medium Total											8.6E-06					2.9E-01
Macoma[a]	Macoma	Macoma	Ingestion	Aluminum	2.6E+02	mg/kg	2.0E-03	mg/kg-day	--	--	--	6.9E-03	mg/kg-day	1.0E+00	mg/kg-day	6.9E-03
				Antimony	3.9E-02	mg/kg	3.0E-07	mg/kg-day	--	--	--	1.0E-06	mg/kg-day	4.0E-04	mg/kg-day	2.6E-03
				Arsenic	4.3E+00	mg/kg	3.3E-05	mg/kg-day	9.5E+00	(mg/kg-day)-1	3.1E-04	1.1E-04	mg/kg-day	3.0E-04	mg/kg-day	3.8E-01
				Barium	2.4E+00	mg/kg	1.8E-05	mg/kg-day	--	--	--	6.4E-05	mg/kg-day	2.0E-01	mg/kg-day	3.2E-04
				Cadmium	1.8E-01	mg/kg	1.3E-06	mg/kg-day	1.5E+01	(mg/kg-day)-1	2.0E-05	4.7E-06	mg/kg-day	1.0E-03	mg/kg-day	4.7E-03
				Chromium	2.7E+00	mg/kg	2.1E-05	mg/kg-day	--	--	--	7.3E-05	mg/kg-day	1.5E+00	mg/kg-day	4.9E-05
				Cobalt	4.0E-01	mg/kg	3.0E-06	mg/kg-day	--	--	--	1.1E-05	mg/kg-day	3.0E-04	mg/kg-day	3.6E-02
				Copper	3.7E+00	mg/kg	2.8E-05	mg/kg-day	--	--	--	1.0E-04	mg/kg-day	4.0E-02	mg/kg-day	2.5E-03
				Iron	3.6E+02	mg/kg	2.8E-03	mg/kg-day	--	--	--	9.7E-03	mg/kg-day	7.0E-01	mg/kg-day	1.4E-02
				Lead	7.2E-01	mg/kg	5.4E-06	mg/kg-day	--	--	--	1.9E-05	mg/kg-day	--	--	--
				Manganese	5.2E+00	mg/kg	4.0E-05	mg/kg-day	--	--	--	1.4E-04	mg/kg-day	1.4E-01	mg/kg-day	9.9E-04
				Mercury	2.6E-02	mg/kg	2.0E-07	mg/kg-day	--	--	--	6.9E-07	mg/kg-day	1.0E-04	mg/kg-day	6.9E-03
				Molybdenum	6.0E-01	mg/kg	4.5E-06	mg/kg-day	--	--	--	1.6E-05	mg/kg-day	5.0E-03	mg/kg-day	3.2E-03
				Nickel	1.4E+00	mg/kg	1.0E-05	mg/kg-day	--	--	--	3.7E-05	mg/kg-day	2.0E-02	mg/kg-day	1.8E-03
				Selenium	8.7E-01	mg/kg	6.6E-06	mg/kg-day	--	--	--	2.3E-05	mg/kg-day	5.0E-03	mg/kg-day	4.6E-03
				Silver	3.9E-02	mg/kg	3.0E-07	mg/kg-day	--	--	--	1.0E-06	mg/kg-day	5.0E-03	mg/kg-day	2.1E-04
				Vanadium	1.3E+00	mg/kg	1.0E-05	mg/kg-day	--	--	--	3.5E-05	mg/kg-day	5.0E-03	mg/kg-day	7.0E-03
				Zinc	2.1E+01	mg/kg	1.6E-04	mg/kg-day	--	--	--	5.7E-04	mg/kg-day	3.0E-01	mg/kg-day	1.9E-03
				4,4'-DDD	6.2E-04	mg/kg	4.7E-09	mg/kg-day	2.4E-01	(mg/kg-day)-1	1.1E-09	1.6E-08	mg/kg-day	5.0E-04	mg/kg-day	3.3E-05
				4,4'-DDE	1.4E-03	mg/kg	1.0E-08	mg/kg-day	3.4E-01	(mg/kg-day)-1	3.5E-09	3.6E-08	mg/kg-day	5.0E-04	mg/kg-day	7.2E-05
				alpha-Chlordane	1.8E-04	mg/kg	1.4E-09	mg/kg-day	3.5E-01	(mg/kg-day)-1	4.7E-10	4.7E-09	mg/kg-day	5.0E-04	mg/kg-day	9.5E-06
				Dieldrin	3.2E-04	mg/kg	2.4E-09	mg/kg-day	1.6E+01	(mg/kg-day)-1	3.9E-08	8.6E-09	mg/kg-day	5.0E-05	mg/kg-day	1.7E-04
				gamma-Chlordane	1.7E-04	mg/kg	1.3E-09	mg/kg-day	3.5E-01	(mg/kg-day)-1	4.7E-10	4.7E-09	mg/kg-day	5.0E-04	mg/kg-day	9.3E-06
				Acenaphthene	2.3E-04	mg/kg	1.8E-09	mg/kg-day	--	--	--	6.2E-09	mg/kg-day	6.0E-02	mg/kg-day	1.0E-07
				Acenaphthylene	3.2E-04	mg/kg	2.4E-09	mg/kg-day	--	--	--	8.5E-09	mg/kg-day	6.0E-02	mg/kg-day	1.4E-07

TABLE A-6A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Adult and Child Recreational User, Eastern Wetland Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations: Intake/Exposure Concentration		Cancer Risk Calculations: CSF / Unit Risk		Cancer Risk	Noncancer Hazard Quotient: Intake/Exposure Concentration		Noncancer Hazard Quotient: RfD / RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
				Anthracene	2.0E-03	mg/kg	1.6E-08	mg/kg-day	--	--	--	5.4E-08	mg/kg-day	3.0E-01	mg/kg-day	1.8E-07
				Fluorene	3.7E-04	mg/kg	2.8E-09	mg/kg-day	--	--	--	1.0E-08	mg/kg-day	4.0E-02	mg/kg-day	2.5E-07
				Phenanthrene	2.5E-03	mg/kg	1.9E-08	mg/kg-day	--	--	--	6.7E-08	mg/kg-day	3.0E-01	mg/kg-day	2.2E-07
				Benzo(a)anthracene	4.0E-03	mg/kg	3.0E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	3.7E-08	1.1E-07	mg/kg-day	--	--	--
				Benzo(a)pyrene	4.1E-03	mg/kg	3.1E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	2.2E-07	1.1E-07	mg/kg-day	--	--	--
				Benzo(b)fluoranthene	5.0E-03	mg/kg	3.8E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	4.6E-08	1.3E-07	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene	3.7E-03	mg/kg	2.8E-08	mg/kg-day	--	--	--	9.8E-08	mg/kg-day	3.0E-02	mg/kg-day	3.3E-06
				Benzo(k)fluoranthene	4.8E-03	mg/kg	3.7E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	4.4E-08	1.3E-07	mg/kg-day	--	--	--
				Chrysene	6.2E-03	mg/kg	4.7E-08	mg/kg-day	1.2E-01	(mg/kg-day)-1	5.6E-09	1.6E-07	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene	2.1E-04	mg/kg	1.6E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	1.2E-08	5.7E-09	mg/kg-day	--	--	--
				Fluoranthene	1.5E-02	mg/kg	1.1E-07	mg/kg-day	--	--	--	4.0E-07	mg/kg-day	4.0E-02	mg/kg-day	1.0E-05
				Indeno(1,2,3-cd)pyrene	2.0E-03	mg/kg	1.5E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.8E-08	5.2E-08	mg/kg-day	--	--	--
				Pyrene	1.5E-02	mg/kg	1.1E-07	mg/kg-day	--	--	--	3.9E-07	mg/kg-day	3.0E-02	mg/kg-day	1.3E-05
				Monobutyltin	8.7E-04	mg/kg	6.7E-09	mg/kg-day	--	--	--	2.3E-08	mg/kg-day	3.0E-04	mg/kg-day	7.8E-05
				Dibutyltin	1.5E-03	mg/kg	1.1E-08	mg/kg-day	--	--	--	4.0E-08	mg/kg-day	3.0E-04	mg/kg-day	1.3E-04
				Tributyltin	4.6E-03	mg/kg	3.5E-08	mg/kg-day	--	--	--	1.2E-07	mg/kg-day	3.0E-04	mg/kg-day	4.1E-04
				Total PCB Congeners	4.8E-02	mg/kg	3.6E-07	mg/kg-day	2.0E+00	(mg/kg-day)-1	7.3E-07	1.3E-06	mg/kg-day	2.0E-05	mg/kg-day	6.4E-02
				Total TEQ – PCB DLC	1.9E-05	mg/kg	1.4E-10	mg/kg-day	1.3E+05	(mg/kg-day)-1	1.8E-05	4.9E-10	mg/kg-day	7.0E-10	mg/kg-day	7.1E-01
				Total TEQ – TCDD DLC	4.9E-07	mg/kg	3.7E-12	mg/kg-day	1.3E+05	(mg/kg-day)-1	4.8E-07	1.3E-11	mg/kg-day	7.0E-10	mg/kg-day	1.8E-02
			Exp. Route Total								3.5E-04					1.3E+00
		Exposure Point Total									3.5E-04					1.3E+00
	Exposure Medium Total										3.5E-04					1.3E+00
Medium Total											3.5E-04					1.3E+00
										Total of Receptor Risks across All Media	3.6E-04				Total of Receptor Hazards across All Media	1.6E+00

Notes:

[a] Macoma ingestion risks are evaluated for the adult receptor only.

Acronyms/Abbreviations:

-- = not available or not applicable

CSF = cancer slope factor

DDD = dichlorodiphenyldichloroethane

DDE = dichlorodiphenyldichloroethylene

DDT = dichlorodiphenyltrichloroethane

EPC = exposure point concentration

Exp. = exposure

M = lifetime exposure from birth, mutagenic endpoint

(mg/kg-day)-1 = 1/(milligram[s] per kilogram per day)

mg/kg = milligram(s) per kilogram

mg/kg-day = milligram(s) per kilogram per day

PCB = polychlorinated biphenyl

RfC = reference concentration

RfD = reference dose

RME = reasonable maximum exposure

TCDD = tetrachlorodibenzo-p-dioxin

TABLE A-6B

Summary of Receptor Risks and Hazards - Adult and Child Recreational User, Eastern Wetland Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

				Cancer Risk				Noncancer Hazard Quotient			
Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Ingestion	Inhalation	Dermal	Exposure Routes Total	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	Sediment	Aluminum	--	--	--	--	6.1E-02	--	1.8E-03	6.3E-02
			Antimony	--	--	--	--	6.6E-03	--	1.3E-03	7.9E-03
			Arsenic	5.9E-06	--	9.5E-07	6.8E-06	1.8E-02	--	2.7E-03	2.1E-02
			Barium	--	--	--	--	2.0E-03	--	8.3E-04	2.9E-03
			Cadmium	4.2E-07	--	5.3E-08	4.7E-07	2.5E-04	--	2.9E-05	2.7E-04
			Chromium	--	--	--	--	1.8E-04	--	4.1E-04	5.9E-04
			Cobalt	--	--	--	--	5.5E-02	--	1.6E-03	5.7E-02
			Copper	--	--	--	--	9.8E-04	--	2.8E-05	1.0E-03
			Iron	--	--	--	--	5.3E-02	--	1.5E-03	5.5E-02
			Lead	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	3.6E-03	--	1.1E-04	3.7E-03
			Mercury	--	--	--	--	2.1E-03	--	6.0E-05	2.1E-03
			Molybdenum	--	--	--	--	1.8E-04	--	5.2E-06	1.9E-04
			Nickel	--	--	--	--	4.0E-03	--	2.9E-03	7.0E-03
			Selenium	--	--	--	--	6.4E-05	--	1.9E-06	6.6E-05
			Silver	--	--	--	--	5.3E-05	--	3.9E-05	9.2E-05
			Vanadium	--	--	--	--	2.6E-02	--	2.9E-02	5.6E-02
			Zinc	--	--	--	--	3.4E-04	--	1.0E-05	3.5E-04
			4,4'-DDD	1.9E-11	--	3.1E-12	2.2E-11	1.4E-06	--	2.0E-07	1.6E-06
			4,4'-DDE	3.2E-11	--	5.1E-12	3.7E-11	1.7E-06	--	2.4E-07	1.9E-06
			4,4'-DDT	1.1E-11	--	1.7E-12	1.2E-11	5.6E-07	--	8.1E-08	6.4E-07
			alpha-Chlordane	4.4E-12	--	7.1E-13	5.1E-12	2.2E-07	--	3.3E-08	2.6E-07
			2-Methylnaphthalene	--	--	--	--	1.2E-06	--	5.1E-07	1.7E-06
			Acenaphthene	--	--	--	--	6.9E-08	--	3.0E-08	9.9E-08
			Acenaphthylene	--	--	--	--	1.0E-07	--	4.5E-08	1.5E-07
			Anthracene	--	--	--	--	1.0E-07	--	4.4E-08	1.4E-07
			Fluorene	--	--	--	--	1.5E-07	--	6.6E-08	2.2E-07
			Naphthalene	--	--	--	--	5.6E-07	--	2.4E-07	8.0E-07
			Phenanthrene	--	--	--	--	2.8E-07	--	1.2E-07	4.0E-07
			Benzo(a)anthracene	5.4E-08	--	2.5E-08	7.9E-08	--	--	--	--
			Benzo(a)pyrene	5.1E-07	--	2.3E-07	7.4E-07	--	--	--	--
			Benzo(b)fluoranthene	5.1E-08	--	2.3E-08	7.5E-08	--	--	--	--
			Benzo(g,h,i)perylene	--	--	--	--	3.9E-06	--	1.7E-06	5.6E-06
			Benzo(k)fluoranthene	5.4E-08	--	2.5E-08	7.9E-08	--	--	--	--
			Chrysene	6.6E-09	--	3.0E-09	9.6E-09	--	--	--	--
			Dibenz(a,h)anthracene	4.3E-08	--	2.0E-08	6.3E-08	--	--	--	--
			Fluoranthene	--	--	--	--	4.7E-06	--	2.1E-06	6.8E-06
			Indeno(1,2,3-cd)pyrene	6.5E-08	--	3.0E-08	9.5E-08	--	--	--	--
			Pyrene	--	--	--	--	8.3E-06	--	3.6E-06	1.2E-05
			Dibutyltin	--	--	--	--	1.2E-05	--	3.6E-06	1.6E-05
			Tributyltin	--	--	--	--	1.5E-05	--	4.4E-06	2.0E-05
			Total PCB Congeners	6.0E-09	--	2.9E-09	8.9E-09	1.3E-03	--	5.8E-04	1.9E-03
			Total TEQ – PCB DLC	1.0E-07	--	1.0E-08	1.1E-07	1.0E-02	--	8.9E-04	1.1E-02
			Total TEQ – PCB DLC	1.0E-07	--	1.0E-08	1.1E-07	1.0E-02	--	8.9E-04	1.1E-02
			Chemical Total	7.3E-06	--	1.4E-06	8.7E-06	2.6E-01	--	4.5E-02	3.0E-01
		Exposure Point Total					8.7E-06				3.0E-01
	Exposure Medium Total						8.7E-06				3.0E-01
Medium Total							8.7E-06				3.0E-01

TABLE A-6B

Summary of Receptor Risks and Hazards - Adult and Child Recreational User, Eastern Wetland Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient			
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Ingestion	Inhalation	Dermal	Exposure Routes Total
Macoma	Macoma	Macoma (ingestion)	Aluminum	--	--	--	--	6.9E-03	--	--	6.9E-03
			Antimony	--	--	--	--	2.6E-03	--	--	2.6E-03
			Arsenic	3.1E-04	--	--	3.1E-04	3.8E-01	--	--	3.8E-01
			Barium	--	--	--	--	3.2E-04	--	--	3.2E-04
			Cadmium	2.0E-05	--	--	2.0E-05	4.7E-03	--	--	4.7E-03
			Chromium	--	--	--	--	4.9E-05	--	--	4.9E-05
			Cobalt	--	--	--	--	3.6E-02	--	--	3.6E-02
			Copper	--	--	--	--	2.5E-03	--	--	2.5E-03
			Iron	--	--	--	--	1.4E-02	--	--	1.4E-02
			Lead	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	9.9E-04	--	--	9.9E-04
			Mercury	--	--	--	--	6.9E-03	--	--	6.9E-03
			Molybdenum	--	--	--	--	3.2E-03	--	--	3.2E-03
			Nickel	--	--	--	--	1.8E-03	--	--	1.8E-03
			Selenium	--	--	--	--	4.6E-03	--	--	4.6E-03
			Silver	--	--	--	--	2.1E-04	--	--	2.1E-04
			Vanadium	--	--	--	--	7.0E-03	--	--	7.0E-03
			Zinc	--	--	--	--	1.9E-03	--	--	1.9E-03
			4,4'-DDD	1.1E-09	--	--	1.1E-09	3.3E-05	--	--	3.3E-05
			4,4'-DDE	3.5E-09	--	--	3.5E-09	7.2E-05	--	--	7.2E-05
			alpha-Chlordane	4.7E-10	--	--	4.7E-10	9.5E-06	--	--	9.5E-06
			Dieldrin	3.9E-08	--	--	3.9E-08	1.7E-04	--	--	1.7E-04
			gamma-Chlordane	4.7E-10	--	--	4.7E-10	9.3E-06	--	--	9.3E-06
			Acenaphthene	--	--	--	--	1.0E-07	--	--	1.0E-07
			Acenaphthylene	--	--	--	--	1.4E-07	--	--	1.4E-07
			Anthracene	--	--	--	--	1.8E-07	--	--	1.8E-07
			Fluorene	--	--	--	--	2.5E-07	--	--	2.5E-07
			Phenanthrene	--	--	--	--	2.2E-07	--	--	2.2E-07
			Benzo(a)anthracene	3.7E-08	--	--	3.7E-08	--	--	--	--
			Benzo(a)pyrene	2.2E-07	--	--	2.2E-07	--	--	--	--
			Benzo(b)fluoranthene	4.6E-08	--	--	4.6E-08	--	--	--	--
			Benzo(g,h,i)perylene	--	--	--	--	3.3E-06	--	--	3.3E-06
			Benzo(k)fluoranthene	4.4E-08	--	--	4.4E-08	--	--	--	--
			Chrysene	5.6E-09	--	--	5.6E-09	--	--	--	--
			Dibenz(a,h)anthracene	1.2E-08	--	--	1.2E-08	--	--	--	--
			Fluoranthene	--	--	--	--	1.0E-05	--	--	1.0E-05
			Indeno(1,2,3-cd)pyrene	1.8E-08	--	--	1.8E-08	--	--	--	--
			Pyrene	--	--	--	--	1.3E-05	--	--	1.3E-05
			Monobutyltin	--	--	--	--	7.8E-05	--	--	7.8E-05
			Dibutyltin	--	--	--	--	1.3E-04	--	--	1.3E-04
			Tributyltin	--	--	--	--	4.1E-04	--	--	4.1E-04
			Total PCB Congeners	7.3E-07	--	--	7.3E-07	6.4E-02	--	--	6.4E-02
			Total TEQ – PCB DLC	1.8E-05	--	--	1.8E-05	7.1E-01	--	--	7.1E-01
			Total TEQ – TCDD DLC	4.8E-07	--	--	4.8E-07	1.8E-02	--	--	1.8E-02
			Chemical Total	3.5E-04	--	--	3.5E-04	1.3E+00	--	--	1.3E+00
		Exposure Point Total					3.5E-04				1.3E+00
	Exposure Medium Total						3.5E-04				1.3E+00
Medium Total							3.5E-04				1.3E+00
Receptor Total						Total Risk across All Media	3.6E-04			Total Hazard across All Media	1.6E+00

Acronyms/Abbreviations:

-- =	not available or not applicable		
EPA =	United States Environmental Protection Agency	DDT =	dichlorodiphenyltrichloroethane
DDD =	dichlorodiphenyldichloroethane	PCB =	polychlorinated biphenyl
DDE =	dichlorodiphenyldichloroethylene	TCDD =	tetrachlorodibenzo-p-dioxin

TABLE A-6C

Summary of Risk Drivers - Adult and Child Recreational User, Eastern Wetland Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient			
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	Sediment (Oral/Dermal)	BAP (EQ)*	7.4E-07	--	3.4E-07	1.1E-06	--	--	--	--
			Arsenic	5.9E-06	--	9.5E-07	6.8E-06	1.8E-02	--	2.7E-03	2.1E-02
			Chemical Total	6.6E-06	--	1.3E-06	7.9E-06	1.8E-02	--	2.7E-03	2.1E-02
		Exposure Point Total					7.9E-06				2.1E-02
	Exposure Medium Total						7.9E-06				2.1E-02
Medium Total							7.9E-06				2.1E-02
Macoma	Macoma	Macoma (Oral)	Arsenic	3.1E-04	--	--	3.1E-04	3.8E-01	--	--	3.8E-01
			Cadmium	2.0E-05	--	--	2.0E-05	4.7E-03	--	--	4.7E-03
			Total TEQ – PCB DLC	1.8E-05	--	--	1.8E-05	7.1E-01	--	--	7.1E-01
			Chemical Total	3.5E-04	--	--	3.5E-04	1.1E+00	--	--	1.1E+00
		Exposure Point Total					3.5E-04				1.1E+00
	Exposure Medium Total						3.5E-04				1.1E+00
Medium Total							3.5E-04				1.1E+00
Receptor Total						Total Risk across All Media	3.6E-04			Total Hazard across All Media	1.1E+00

Notes:

* Risk for benzo(a)pyrene equivalent (BAP [EQ]) is calculated by summing the risks for each of the individual potentially carcinogenic PAHs: benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene.

Acronyms/Abbreviations:

-- = not available or not applicable

BAP (EQ) = benzo(a)pyrene equivalent

PAH = polycyclic aromatic hydrocarbon

PCB = polychlorinated biphenyl

TABLE A-7A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Construction Worker, Eastern Wetland Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

							Cancer Risk Calculations					Noncancer Hazard Quotient				
					EPC		Intake/Exposure Concentration		CSF / Unit Risk			Intake/Exposure Concentration		RfD / RfC		
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	Value	Units	Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Sediment	Sediment	Sediment	Ingestion	Aluminum	6.4E+04	mg/kg	2.6E-03	mg/kg-day	--	--	--	1.8E-01	mg/kg-day	1.0E+00	mg/kg-day	1.8E-01
				Antimony	2.8E+00	mg/kg	1.1E-07	mg/kg-day	--	--	--	7.8E-06	mg/kg-day	4.0E-04	mg/kg-day	2.0E-02
				Arsenic	9.7E+00	mg/kg	2.3E-07	mg/kg-day	9.5E+00	(mg/kg-day)-1	2.2E-06	1.6E-05	mg/kg-day	3.0E-04	mg/kg-day	5.5E-02
				Barium	4.2E+02	mg/kg	1.7E-05	mg/kg-day	--	--	--	1.2E-03	mg/kg-day	2.0E-01	mg/kg-day	6.0E-03
				Cadmium	2.6E-01	mg/kg	1.0E-08	mg/kg-day	1.5E+01	(mg/kg-day)-1	1.6E-07	7.3E-07	mg/kg-day	1.0E-03	mg/kg-day	7.3E-04
				Chromium	2.9E+02	mg/kg	1.2E-05	mg/kg-day	--	--	--	8.2E-04	mg/kg-day	1.5E+00	mg/kg-day	5.5E-04
				Cobalt	1.7E+01	mg/kg	7.0E-07	mg/kg-day	--	--	--	4.9E-05	mg/kg-day	3.0E-04	mg/kg-day	1.6E-01
				Copper	4.1E+01	mg/kg	1.7E-06	mg/kg-day	--	--	--	1.2E-04	mg/kg-day	4.0E-02	mg/kg-day	2.9E-03
				Iron	3.9E+04	mg/kg	1.6E-03	mg/kg-day	--	--	--	1.1E-01	mg/kg-day	7.0E-01	mg/kg-day	1.6E-01
				Lead	2.5E+01	mg/kg	1.0E-06	mg/kg-day	--	--	--	7.0E-05	mg/kg-day	--	--	--
				Manganese	5.3E+02	mg/kg	2.2E-05	mg/kg-day	--	--	--	1.5E-03	mg/kg-day	1.4E-01	mg/kg-day	1.1E-02
				Mercury	2.2E-01	mg/kg	8.8E-09	mg/kg-day	--	--	--	6.2E-07	mg/kg-day	1.0E-04	mg/kg-day	6.2E-03
				Molybdenum	9.5E-01	mg/kg	3.8E-08	mg/kg-day	--	--	--	2.7E-06	mg/kg-day	5.0E-03	mg/kg-day	5.4E-04
				Nickel	8.5E+01	mg/kg	3.4E-06	mg/kg-day	--	--	--	2.4E-04	mg/kg-day	2.0E-02	mg/kg-day	1.2E-02
				Selenium	3.4E-01	mg/kg	1.4E-08	mg/kg-day	--	--	--	9.6E-07	mg/kg-day	5.0E-03	mg/kg-day	1.9E-04
				Silver	2.8E-01	mg/kg	1.1E-08	mg/kg-day	--	--	--	7.9E-07	mg/kg-day	5.0E-03	mg/kg-day	1.6E-04
				Vanadium	1.4E+02	mg/kg	5.6E-06	mg/kg-day	--	--	--	3.9E-04	mg/kg-day	5.0E-03	mg/kg-day	7.8E-02
				Zinc	1.1E+02	mg/kg	4.4E-06	mg/kg-day	--	--	--	3.1E-04	mg/kg-day	3.0E-01	mg/kg-day	1.0E-03
				4,4'-DDD	7.4E-04	mg/kg	3.0E-11	mg/kg-day	2.4E-01	(mg/kg-day)-1	7.2E-12	2.1E-09	mg/kg-day	5.0E-04	mg/kg-day	4.2E-06
				4,4'-DDE	8.7E-04	mg/kg	3.5E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	1.2E-11	2.5E-09	mg/kg-day	5.0E-04	mg/kg-day	4.9E-06
				4,4'-DDT	2.9E-04	mg/kg	1.2E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	4.0E-12	8.3E-10	mg/kg-day	5.0E-04	mg/kg-day	1.7E-06
				alpha-Chlordane	1.2E-04	mg/kg	4.8E-12	mg/kg-day	3.5E-01	(mg/kg-day)-1	1.7E-12	3.3E-10	mg/kg-day	5.0E-04	mg/kg-day	6.7E-07
				gamma-Chlordane	2.0E-05	mg/kg	8.1E-13	mg/kg-day	3.5E-01	(mg/kg-day)-1	2.8E-13	5.7E-11	mg/kg-day	5.0E-04	mg/kg-day	1.1E-07
				2-Methylnaphthalene	4.9E-03	mg/kg	2.0E-10	mg/kg-day	--	--	--	1.4E-08	mg/kg-day	4.0E-03	mg/kg-day	3.5E-06
				Acenaphthene	4.4E-03	mg/kg	1.8E-10	mg/kg-day	--	--	--	1.2E-08	mg/kg-day	6.0E-02	mg/kg-day	2.1E-07
				Acenaphthylene	6.6E-03	mg/kg	2.7E-10	mg/kg-day	--	--	--	1.9E-08	mg/kg-day	6.0E-02	mg/kg-day	3.1E-07
				Anthracene	3.2E-02	mg/kg	1.3E-09	mg/kg-day	--	--	--	9.0E-08	mg/kg-day	3.0E-01	mg/kg-day	3.0E-07
				Fluorene	6.4E-03	mg/kg	2.6E-10	mg/kg-day	--	--	--	1.8E-08	mg/kg-day	4.0E-02	mg/kg-day	4.5E-07
				Naphthalene	1.2E-02	mg/kg	4.8E-10	mg/kg-day	--	--	--	3.3E-08	mg/kg-day	2.0E-02	mg/kg-day	1.7E-06
				Phenanthrene	8.9E-02	mg/kg	3.6E-09	mg/kg-day	--	--	--	2.5E-07	mg/kg-day	3.0E-01	mg/kg-day	8.3E-07
				Benzo(a)anthracene	9.3E-02	mg/kg	3.8E-09	mg/kg-day	1.2E+00	(mg/kg-day)-1	4.5E-09	2.6E-07	mg/kg-day	--	--	--
				Benzo(a)pyrene	1.4E-01	mg/kg	5.8E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	4.2E-08	4.0E-07	mg/kg-day	--	--	--
				Benzo(b)fluoranthene	8.8E-02	mg/kg	3.6E-09	mg/kg-day	1.2E+00	(mg/kg-day)-1	4.3E-09	2.5E-07	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene	1.2E-01	mg/kg	5.0E-09	mg/kg-day	--	--	--	3.5E-07	mg/kg-day	3.0E-02	mg/kg-day	1.2E-05
				Benzo(k)fluoranthene	9.3E-02	mg/kg	3.8E-09	mg/kg-day	1.2E+00	(mg/kg-day)-1	4.5E-09	2.6E-07	mg/kg-day	--	--	--
				Chrysene	1.1E-01	mg/kg	4.6E-09	mg/kg-day	1.2E-01	(mg/kg-day)-1	5.5E-10	3.2E-07	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene	1.2E-02	mg/kg	4.9E-10	mg/kg-day	7.3E+00	(mg/kg-day)-1	3.6E-09	3.4E-08	mg/kg-day	--	--	--
				Fluoranthene	2.0E-01	mg/kg	8.0E-09	mg/kg-day	--	--	--	5.6E-07	mg/kg-day	4.0E-02	mg/kg-day	1.4E-05
				Indeno(1,2,3-cd)pyrene	1.1E-01	mg/kg	4.5E-09	mg/kg-day	1.2E+00	(mg/kg-day)-1	5.4E-09	3.2E-07	mg/kg-day	--	--	--
				Pyrene	2.6E-01	mg/kg	1.1E-08	mg/kg-day	--	--	--	7.4E-07	mg/kg-day	3.0E-02	mg/kg-day	2.5E-05
				Dibutyltin	3.9E-03	mg/kg	1.6E-10	mg/kg-day	--	--	--	1.1E-08	mg/kg-day	3.0E-04	mg/kg-day	3.7E-05
				Tributyltin	4.8E-03	mg/kg	1.9E-10	mg/kg-day	--	--	--	1.4E-08	mg/kg-day	3.0E-04	mg/kg-day	4.5E-05
				Total PCB Congeners	2.8E-02	mg/kg	1.1E-09	mg/kg-day	2.0E+00	(mg/kg-day)-1	2.3E-09	8.0E-08	mg/kg-day	2.0E-05	mg/kg-day	4.0E-03
				Total TEQ – PCB DLC	7.5E-06	mg/kg	3.0E-13	mg/kg-day	1.3E+05	(mg/kg-day)-1	3.9E-08	2.1E-11	mg/kg-day	7.0E-10	mg/kg-day	3.0E-02
			Exp. Route Total								2.5E-06					7.3E-01

TABLE A-7A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Construction Worker, Eastern Wetland Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations: Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Noncancer Hazard Quotient: Intake/Exposure Concentration		RfD / RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
			Dermal	Aluminum	6.4E+04	mg/kg	3.8E-04	mg/kg-day	--	--	--	2.6E-02	mg/kg-day	1.0E+00	mg/kg-day	2.6E-02
				Antimony	2.8E+00	mg/kg	1.6E-08	mg/kg-day	--	--	--	1.1E-06	mg/kg-day	6.0E-05	mg/kg-day	1.9E-02
				Arsenic	9.7E+00	mg/kg	1.7E-07	mg/kg-day	9.5E+00	(mg/kg-day)-1	1.6E-06	1.2E-05	mg/kg-day	3.0E-04	mg/kg-day	4.0E-02
				Barium	4.2E+02	mg/kg	2.5E-06	mg/kg-day	--	--	--	1.8E-04	mg/kg-day	1.4E-02	mg/kg-day	1.3E-02
				Cadmium	2.6E-01	mg/kg	1.5E-10	mg/kg-day	6.0E+02	(mg/kg-day)-1	9.2E-08	1.1E-08	mg/kg-day	2.5E-05	mg/kg-day	4.3E-04
				Chromium	2.9E+02	mg/kg	1.7E-06	mg/kg-day	--	--	--	1.2E-04	mg/kg-day	2.0E-02	mg/kg-day	6.1E-03
				Cobalt	1.7E+01	mg/kg	1.0E-07	mg/kg-day	--	--	--	7.2E-06	mg/kg-day	3.0E-04	mg/kg-day	2.4E-02
				Copper	4.1E+01	mg/kg	2.4E-07	mg/kg-day	--	--	--	1.7E-05	mg/kg-day	4.0E-02	mg/kg-day	4.2E-04
				Iron	3.9E+04	mg/kg	2.3E-04	mg/kg-day	--	--	--	1.6E-02	mg/kg-day	7.0E-01	mg/kg-day	2.3E-02
				Lead	2.5E+01	mg/kg	1.5E-07	mg/kg-day	--	--	--	1.0E-05	mg/kg-day	--	--	--
				Manganese	5.3E+02	mg/kg	3.2E-06	mg/kg-day	--	--	--	2.2E-04	mg/kg-day	1.4E-01	mg/kg-day	1.6E-03
				Mercury	2.2E-01	mg/kg	1.3E-09	mg/kg-day	--	--	--	9.0E-08	mg/kg-day	1.0E-04	mg/kg-day	9.0E-04
				Molybdenum	9.5E-01	mg/kg	5.6E-09	mg/kg-day	--	--	--	3.9E-07	mg/kg-day	5.0E-03	mg/kg-day	7.8E-05
				Nickel	8.5E+01	mg/kg	5.0E-07	mg/kg-day	--	--	--	3.5E-05	mg/kg-day	8.0E-04	mg/kg-day	4.4E-02
				Selenium	3.4E-01	mg/kg	2.0E-09	mg/kg-day	--	--	--	1.4E-07	mg/kg-day	5.0E-03	mg/kg-day	2.8E-05
				Silver	2.8E-01	mg/kg	1.7E-09	mg/kg-day	--	--	--	1.2E-07	mg/kg-day	2.0E-04	mg/kg-day	5.8E-04
				Vanadium	1.4E+02	mg/kg	8.2E-07	mg/kg-day	--	--	--	5.7E-05	mg/kg-day	1.3E-04	mg/kg-day	4.4E-01
				Zinc	1.1E+02	mg/kg	6.4E-07	mg/kg-day	--	--	--	4.5E-05	mg/kg-day	3.0E-01	mg/kg-day	1.5E-04
				4,4'-DDD	7.4E-04	mg/kg	2.2E-11	mg/kg-day	2.4E-01	(mg/kg-day)-1	5.3E-12	1.5E-09	mg/kg-day	5.0E-04	mg/kg-day	3.1E-06
				4,4'-DDE	8.7E-04	mg/kg	2.6E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	8.8E-12	1.8E-09	mg/kg-day	5.0E-04	mg/kg-day	3.6E-06
				4,4'-DDT	2.9E-04	mg/kg	8.6E-12	mg/kg-day	3.4E-01	(mg/kg-day)-1	2.9E-12	6.1E-10	mg/kg-day	5.0E-04	mg/kg-day	1.2E-06
				alpha-Chlordane	1.2E-04	mg/kg	3.5E-12	mg/kg-day	3.5E-01	(mg/kg-day)-1	1.2E-12	2.4E-10	mg/kg-day	5.0E-04	mg/kg-day	4.9E-07
				gamma-Chlordane	2.0E-05	mg/kg	5.9E-13	mg/kg-day	3.5E-01	(mg/kg-day)-1	2.1E-13	4.1E-11	mg/kg-day	5.0E-04	mg/kg-day	8.3E-08
				2-Methylnaphthalene	4.9E-03	mg/kg	4.3E-10	mg/kg-day	--	--	--	3.0E-08	mg/kg-day	4.0E-03	mg/kg-day	7.6E-06
				Acenaphthene	4.4E-03	mg/kg	3.9E-10	mg/kg-day	--	--	--	2.7E-08	mg/kg-day	6.0E-02	mg/kg-day	4.5E-07
				Acenaphthylene	6.6E-03	mg/kg	5.8E-10	mg/kg-day	--	--	--	4.1E-08	mg/kg-day	6.0E-02	mg/kg-day	6.8E-07
				Anthracene	3.2E-02	mg/kg	2.8E-09	mg/kg-day	--	--	--	2.0E-07	mg/kg-day	3.0E-01	mg/kg-day	6.6E-07
				Fluorene	6.4E-03	mg/kg	5.6E-10	mg/kg-day	--	--	--	3.9E-08	mg/kg-day	4.0E-02	mg/kg-day	9.9E-07
				Naphthalene	1.2E-02	mg/kg	1.0E-09	mg/kg-day	--	--	--	7.3E-08	mg/kg-day	2.0E-02	mg/kg-day	3.7E-06
				Phenanthrene	8.9E-02	mg/kg	7.8E-09	mg/kg-day	--	--	--	5.5E-07	mg/kg-day	3.0E-01	mg/kg-day	1.8E-06
				Benzo(a)anthracene	9.3E-02	mg/kg	8.3E-09	mg/kg-day	1.2E+00	(mg/kg-day)-1	9.9E-09	5.8E-07	mg/kg-day	--	--	--
				Benzo(a)pyrene	1.4E-01	mg/kg	1.3E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	9.2E-08	8.9E-07	mg/kg-day	--	--	--
				Benzo(b)fluoranthene	8.8E-02	mg/kg	7.8E-09	mg/kg-day	1.2E+00	(mg/kg-day)-1	9.4E-09	5.5E-07	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene	1.2E-01	mg/kg	1.1E-08	mg/kg-day	--	--	--	7.7E-07	mg/kg-day	3.0E-02	mg/kg-day	2.6E-05
				Benzo(k)fluoranthene	9.3E-02	mg/kg	8.2E-09	mg/kg-day	1.2E+00	(mg/kg-day)-1	9.9E-09	5.8E-07	mg/kg-day	--	--	--
				Chrysene	1.1E-01	mg/kg	1.0E-08	mg/kg-day	1.2E-01	(mg/kg-day)-1	1.2E-09	7.0E-07	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene	1.2E-02	mg/kg	1.1E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	7.9E-09	7.6E-08	mg/kg-day	--	--	--
				Fluoranthene	2.0E-01	mg/kg	1.8E-08	mg/kg-day	--	--	--	1.2E-06	mg/kg-day	4.0E-02	mg/kg-day	3.1E-05
				Indeno(1,2,3-cd)pyrene	1.1E-01	mg/kg	9.9E-09	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.2E-08	6.9E-07	mg/kg-day	--	--	--
				Pyrene	2.6E-01	mg/kg	2.3E-08	mg/kg-day	--	--	--	1.6E-06	mg/kg-day	3.0E-02	mg/kg-day	5.4E-05
				Dibutyltin	3.9E-03	mg/kg	2.3E-10	mg/kg-day	--	--	--	1.6E-08	mg/kg-day	3.0E-04	mg/kg-day	5.4E-05
				Tributyltin	4.8E-03	mg/kg	2.8E-10	mg/kg-day	--	--	--	2.0E-08	mg/kg-day	3.0E-04	mg/kg-day	6.6E-05
				Total PCB Congeners	2.8E-02	mg/kg	2.5E-09	mg/kg-day	2.0E+00	(mg/kg-day)-1	5.0E-09	1.7E-07	mg/kg-day	2.0E-05	mg/kg-day	8.7E-03
				Total TEQ – PCB DLC	7.5E-06	mg/kg	1.3E-13	mg/kg-day	1.3E+05	(mg/kg-day)-1	1.7E-08	9.3E-12	mg/kg-day	7.0E-10	mg/kg-day	1.3E-02
			Exp. Route Total								1.9E-06					6.6E-01
		Exposure Point Total									4.4E-06					1.4E+00
	Exposure Medium Total										4.4E-06					1.4E+00
Medium Total											4.4E-06					1.4E+00
										Total of Receptor Risks across All Media	4.4E-06				Total of Receptor Hazards across All Media	1.4E+00

Acronyms/Abbreviations:

-- = not available or not applicable
CSF = cancer slope factor
DDD = dichlorodiphenyldichloroethane
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
EPC = exposure point concentration
Exp. = exposure
M = lifetime exposure from birth, mutagenic endpoint

(mg/kg-day)- 1/(milligram[s] per kilogram per day)
mg/kg = milligram(s) per kilogram
mg/kg-day = milligram(s) per kilogram per day
PCB = polychlorinated biphenyl
RfC = reference concentration
RfD = reference dose
RME = reasonable maximum exposure
TCDD = tetrachlorodibenzo-p-dioxin

TABLE A-7B

Summary of Receptor Risks and Hazards - Construction Worker, Eastern Wetland Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient			
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	Sediment	Aluminum	--	--	--	--	1.8E-01	--	2.6E-02	2.1E-01
			Antimony	--	--	--	--	2.0E-02	--	1.9E-02	3.9E-02
			Arsenic	2.2E-06	--	1.6E-06	3.9E-06	5.5E-02	--	4.0E-02	9.5E-02
			Barium	--	--	--	--	6.0E-03	--	1.3E-02	1.9E-02
			Cadmium	1.6E-07	--	9.2E-08	2.5E-07	7.3E-04	--	4.3E-04	1.2E-03
			Chromium	--	--	--	--	5.5E-04	--	6.1E-03	6.7E-03
			Cobalt	--	--	--	--	1.6E-01	--	2.4E-02	1.9E-01
			Copper	--	--	--	--	2.9E-03	--	4.2E-04	3.3E-03
			Iron	--	--	--	--	1.6E-01	--	2.3E-02	1.8E-01
			Lead	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	1.1E-02	--	1.6E-03	1.2E-02
			Mercury	--	--	--	--	6.2E-03	--	9.0E-04	7.1E-03
			Molybdenum	--	--	--	--	5.4E-04	--	7.8E-05	6.1E-04
			Nickel	--	--	--	--	1.2E-02	--	4.4E-02	5.6E-02
			Selenium	--	--	--	--	1.9E-04	--	2.8E-05	2.2E-04
			Silver	--	--	--	--	1.6E-04	--	5.8E-04	7.4E-04
			Vanadium	--	--	--	--	7.8E-02	--	4.4E-01	5.2E-01
			Zinc	--	--	--	--	1.0E-03	--	1.5E-04	1.2E-03
			4,4'-DDE	1.2E-11	--	8.8E-12	2.1E-11	4.9E-06	--	3.6E-06	8.5E-06
			4,4'-DDT	4.0E-12	--	2.9E-12	7.0E-12	1.7E-06	--	1.2E-06	2.9E-06
			alpha-Chlordane	1.7E-12	--	1.2E-12	2.9E-12	6.7E-07	--	4.9E-07	1.2E-06
			gamma-Chlordane	2.8E-13	--	2.1E-13	4.9E-13	1.1E-07	--	8.3E-08	2.0E-07
			2-Methylnaphthalene	--	--	--	--	3.5E-06	--	7.6E-06	1.1E-05
			Acenaphthene	--	--	--	--	2.1E-07	--	4.5E-07	6.6E-07
			Acenaphthylene	--	--	--	--	3.1E-07	--	6.8E-07	9.9E-07
			Anthracene	--	--	--	--	3.0E-07	--	6.6E-07	9.6E-07
			Fluorene	--	--	--	--	4.5E-07	--	9.9E-07	1.4E-06
			Naphthalene	--	--	--	--	1.7E-06	--	3.7E-06	5.3E-06
			Phenanthrene	--	--	--	--	8.3E-07	--	1.8E-06	2.7E-06
			Benzo(a)anthracene	4.5E-09	--	9.9E-09	1.4E-08	--	--	--	--
			Benzo(a)pyrene	4.2E-08	--	9.2E-08	1.3E-07	--	--	--	--
			Benzo(b)fluoranthene	4.3E-09	--	9.4E-09	1.4E-08	--	--	--	--
			Benzo(g,h,i)perylene	--	--	--	--	1.2E-05	--	2.6E-05	3.7E-05
			Benzo(k)fluoranthene	4.5E-09	--	9.9E-09	1.4E-08	--	--	--	--
			Chrysene	5.5E-10	--	1.2E-09	1.7E-09	--	--	--	--
			Dibenz(a,h)anthracene	3.6E-09	--	7.9E-09	1.1E-08	--	--	--	--
			Fluoranthene	--	--	--	--	1.4E-05	--	3.1E-05	4.5E-05
			Indeno(1,2,3-cd)pyrene	5.4E-09	--	1.2E-08	1.7E-08	--	--	--	--
			Pyrene	--	--	--	--	2.5E-05	--	5.4E-05	7.9E-05
			Dibutyltin	--	--	--	--	3.7E-05	--	5.4E-05	9.1E-05
			Tributyltin	--	--	--	--	4.5E-05	--	6.6E-05	1.1E-04
			Total PCB Congeners	2.3E-09	--	5.0E-09	7.3E-09	4.0E-03	--	8.7E-03	1.3E-02
			Total TEQ – PCB DLC	3.9E-08	--	1.7E-08	5.7E-08	3.0E-02	--	1.3E-02	4.4E-02
			Chemical Total	2.5E-06	--	1.9E-06	4.4E-06	7.3E-01	--	6.6E-01	1.4E+00
		Exposure Point Total					4.4E-06				1.4E+00
	Exposure Medium Total						4.4E-06				1.4E+00
Medium Total							4.4E-06				1.4E+00
Receptor Total						Total Risk across All Media	4.4E-06			Total Hazard across All Media	1.4E+00

TABLE A-7B

Summary of Receptor Risks and Hazards - Construction Worker, Eastern Wetland Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient			
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Ingestion	Inhalation	Dermal	Exposure Routes Total

Acronyms/Abbreviations:

-- = not available or not applicable

DDD = dichlorodiphenyldichloroethane

DDE = dichlorodiphenyldichloroethylene

DDT = dichlorodiphenyltrichloroethane

PCB = polychlorinated biphenyl

TCDD = tetrachlorodibenzo-p-dioxin

TABLE A-7C

Summary of Risk Drivers - Construction Worker, Eastern Wetland Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient			
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	Sediment	Arsenic	2.2E-06	--	1.6E-06	3.9E-06	5.5E-02	--	4.0E-02	9.5E-02
			Chemical Total	--	--	--	3.9E-06	--	--	--	9.5E-02
		Exposure Point Total					3.9E-06				9.5E-02
	Exposure Medium Total						3.9E-06				9.5E-02
Medium Total							3.9E-06				9.5E-02
Receptor Total						Total Risk across All Media	3.9E-06			Total Hazard across All Media	9.5E-02

Acronyms/Abbreviations:

-- = not available or not applicable

TABLE A-8A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Adult and Child Recreational User, India Basin I

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern		EPC		Cancer Risk Calculations: Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Noncancer Hazard Quotient: Intake/Exposure Concentration		RfD / RfC		Hazard Quotient
						Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	Sediment	Ingestion	Aluminum		7.2E+04	mg/kg	7.7E-03	mg/kg-day	--	--	--	6.8E-02	mg/kg-day	1.0E+00	mg/kg-day	6.8E-02
				Antimony		1.1E+00	mg/kg	1.2E-07	mg/kg-day	--	--	--	1.0E-06	mg/kg-day	4.0E-04	mg/kg-day	2.6E-03
				Arsenic		1.1E+01	mg/kg	7.0E-07	mg/kg-day	9.5E+00	(mg/kg-day)-1	6.7E-06	6.3E-06	mg/kg-day	3.0E-04	mg/kg-day	2.1E-02
				Barium		5.0E+02	mg/kg	5.3E-05	mg/kg-day	--	--	--	4.7E-04	mg/kg-day	2.0E-01	mg/kg-day	2.4E-03
				Cadmium		2.5E-01	mg/kg	2.6E-08	mg/kg-day	1.5E+01	(mg/kg-day)-1	3.9E-07	2.3E-07	mg/kg-day	1.0E-03	mg/kg-day	2.3E-04
				Chromium		2.7E+02	mg/kg	2.8E-05	mg/kg-day	--	--	--	2.5E-04	mg/kg-day	1.5E+00	mg/kg-day	1.7E-04
				Cobalt		1.9E+01	mg/kg	2.0E-06	mg/kg-day	--	--	--	1.8E-05	mg/kg-day	3.0E-04	mg/kg-day	5.9E-02
				Copper		8.4E+01	mg/kg	8.9E-06	mg/kg-day	--	--	--	7.9E-05	mg/kg-day	4.0E-02	mg/kg-day	2.0E-03
				Iron		4.3E+04	mg/kg	4.6E-03	mg/kg-day	--	--	--	4.1E-02	mg/kg-day	7.0E-01	mg/kg-day	5.8E-02
				Lead		1.2E+02	mg/kg	1.2E-05	mg/kg-day	--	--	--	1.1E-04	mg/kg-day	--	--	--
				Manganese		4.4E+02	mg/kg	4.7E-05	mg/kg-day	--	--	--	4.2E-04	mg/kg-day	1.4E-01	mg/kg-day	3.0E-03
				Mercury		3.6E-01	mg/kg	3.9E-08	mg/kg-day	--	--	--	3.4E-07	mg/kg-day	1.0E-04	mg/kg-day	3.4E-03
				Molybdenum		1.3E+00	mg/kg	1.4E-07	mg/kg-day	--	--	--	1.2E-06	mg/kg-day	5.0E-03	mg/kg-day	2.5E-04
				Nickel		1.8E+02	mg/kg	1.9E-05	mg/kg-day	--	--	--	1.7E-04	mg/kg-day	2.0E-02	mg/kg-day	8.5E-03
				Selenium		3.9E-01	mg/kg	4.1E-08	mg/kg-day	--	--	--	3.7E-07	mg/kg-day	5.0E-03	mg/kg-day	7.4E-05
				Silver		3.0E-01	mg/kg	3.2E-08	mg/kg-day	--	--	--	2.8E-07	mg/kg-day	5.0E-03	mg/kg-day	5.7E-05
				Vanadium		1.4E+02	mg/kg	1.5E-05	mg/kg-day	--	--	--	1.3E-04	mg/kg-day	5.0E-03	mg/kg-day	2.7E-02
				Zinc		1.3E+02	mg/kg	1.4E-05	mg/kg-day	--	--	--	1.2E-04	mg/kg-day	3.0E-01	mg/kg-day	4.1E-04
				4,4'-DDD		1.6E-03	mg/kg	1.7E-10	mg/kg-day	2.4E-01	(mg/kg-day)-1	4.0E-11	1.5E-09	mg/kg-day	5.0E-04	mg/kg-day	2.9E-06
				4,4'-DDE		1.5E-03	mg/kg	1.6E-10	mg/kg-day	3.4E-01	(mg/kg-day)-1	5.6E-11	1.5E-09	mg/kg-day	5.0E-04	mg/kg-day	2.9E-06
				4,4'-DDT		7.1E-04	mg/kg	7.6E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	2.6E-11	6.8E-10	mg/kg-day	5.0E-04	mg/kg-day	1.4E-06
				alpha-Chlordane		3.2E-04	mg/kg	3.4E-11	mg/kg-day	3.5E-01	(mg/kg-day)-1	1.2E-11	3.1E-10	mg/kg-day	5.0E-04	mg/kg-day	6.1E-07
				gamma-Chlordane		1.4E-04	mg/kg	1.5E-11	mg/kg-day	3.5E-01	(mg/kg-day)-1	5.2E-12	1.3E-10	mg/kg-day	5.0E-04	mg/kg-day	2.7E-07
				2-Methylnaphthalene		1.0E-02	mg/kg	1.1E-09	mg/kg-day	--	--	--	9.7E-09	mg/kg-day	4.0E-03	mg/kg-day	2.4E-06
				Acenaphthene		9.7E-03	mg/kg	1.0E-09	mg/kg-day	--	--	--	9.2E-09	mg/kg-day	6.0E-02	mg/kg-day	1.5E-07
				Acenaphthylene		1.2E-02	mg/kg	1.3E-09	mg/kg-day	--	--	--	1.2E-08	mg/kg-day	6.0E-02	mg/kg-day	1.9E-07
				Anthracene		2.1E-01	mg/kg	2.2E-08	mg/kg-day	--	--	--	2.0E-07	mg/kg-day	3.0E-01	mg/kg-day	6.6E-07
				Fluorene		3.0E-02	mg/kg	3.2E-09	mg/kg-day	--	--	--	2.8E-08	mg/kg-day	4.0E-02	mg/kg-day	7.0E-07
				Naphthalene		1.7E-02	mg/kg	1.8E-09	mg/kg-day	--	--	--	1.6E-08	mg/kg-day	2.0E-02	mg/kg-day	7.8E-07
				Phenanthrene		1.4E-01	mg/kg	1.5E-08	mg/kg-day	--	--	--	1.3E-07	mg/kg-day	3.0E-01	mg/kg-day	4.3E-07
				Benzo(a)anthracene	M	1.8E-01	mg/kg	8.6E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.0E-07	1.7E-07	mg/kg-day	--	--	--
				Benzo(a)pyrene	M	2.5E-01	mg/kg	1.2E-07	mg/kg-day	7.3E+00	(mg/kg-day)-1	8.7E-07	2.3E-07	mg/kg-day	--	--	--
				Benzo(b)fluoranthene	M	2.0E-01	mg/kg	9.7E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.2E-07	1.9E-07	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene		1.9E-01	mg/kg	2.1E-08	mg/kg-day	--	--	--	1.8E-07	mg/kg-day	3.0E-02	mg/kg-day	6.1E-06
				Benzo(k)fluoranthene	M	1.9E-01	mg/kg	9.3E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.1E-07	1.8E-07	mg/kg-day	--	--	--
				Chrysene	M	2.7E-01	mg/kg	1.3E-07	mg/kg-day	1.2E-01	(mg/kg-day)-1	1.5E-08	2.5E-07	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene	M	3.3E-02	mg/kg	1.6E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	1.2E-07	3.1E-08	mg/kg-day	--	--	--
				Fluoranthene		3.3E-01	mg/kg	3.6E-08	mg/kg-day	--	--	--	3.2E-07	mg/kg-day	4.0E-02	mg/kg-day	7.9E-06
				Indeno(1,2,3-cd)pyrene	M	1.9E-01	mg/kg	9.1E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.1E-07	1.8E-07	mg/kg-day	--	--	--
				Pyrene		3.8E-01	mg/kg	4.0E-08	mg/kg-day	--	--	--	3.6E-07	mg/kg-day	3.0E-02	mg/kg-day	1.2E-05
				Dibutyltin		1.1E-02	mg/kg	1.2E-09	mg/kg-day	--	--	--	1.0E-08	mg/kg-day	3.0E-04	mg/kg-day	3.5E-05
				Tributyltin		1.8E-02	mg/kg	1.9E-09	mg/kg-day	--	--	--	1.7E-08	mg/kg-day	3.0E-04	mg/kg-day	5.6E-05
				Total PCB Congeners		9.0E-02	mg/kg	9.6E-09	mg/kg-day	2.0E+00	(mg/kg-day)-1	1.9E-08	8.5E-08	mg/kg-day	2.0E-05	mg/kg-day	4.3E-03
				Total TEQ – PCB DLC		8.3E-06	mg/kg	8.9E-13	mg/kg-day	1.3E+05	(mg/kg-day)-1	1.2E-07	7.9E-12	mg/kg-day	7.0E-10	mg/kg-day	1.1E-02
			Exp. Route Total									8.7E-06					2.7E-01

TABLE A-8A
Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Adult and Child Recreational User, India Basin I
Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern		EPC Value	EPC Units	Cancer Risk Calculations: Intake/Exposure Concentration Value	Intake/Exposure Concentration Units	CSF / Unit Risk Value	CSF / Unit Risk Units	Cancer Risk	Noncancer Hazard Quotient: Intake/Exposure Concentration Value	Intake/Exposure Concentration Units	RfD / RfC Value	RfD / RfC Units	Hazard Quotient
			Dermal	Aluminum		7.2E+04	mg/kg	2.5E-04	mg/kg-day	--	--	--	2.0E-03	mg/kg-day	1.0E+00	mg/kg-day	2.0E-03
				Antimony		1.1E+00	mg/kg	3.7E-09	mg/kg-day	--	--	--	3.0E-08	mg/kg-day	6.0E-05	mg/kg-day	5.0E-04
				Arsenic		1.1E+01	mg/kg	1.1E-07	mg/kg-day	9.5E+00	(mg/kg-day)-1	1.1E-06	9.1E-07	mg/kg-day	3.0E-04	mg/kg-day	3.0E-03
				Barium		5.0E+02	mg/kg	1.7E-06	mg/kg-day	--	--	--	1.4E-05	mg/kg-day	1.4E-02	mg/kg-day	9.8E-04
				Cadmium		2.5E-01	mg/kg	8.4E-11	mg/kg-day	6.0E+02	(mg/kg-day)-1	5.0E-08	6.7E-10	mg/kg-day	2.5E-05	mg/kg-day	2.7E-05
				Chromium		2.7E+02	mg/kg	9.1E-07	mg/kg-day	--	--	--	7.3E-06	mg/kg-day	2.0E-02	mg/kg-day	3.8E-04
				Cobalt		1.9E+01	mg/kg	6.4E-08	mg/kg-day	--	--	--	5.2E-07	mg/kg-day	3.0E-04	mg/kg-day	1.7E-03
				Copper		8.4E+01	mg/kg	2.9E-07	mg/kg-day	--	--	--	2.3E-06	mg/kg-day	4.0E-02	mg/kg-day	5.8E-05
				Iron		4.3E+04	mg/kg	1.5E-04	mg/kg-day	--	--	--	1.2E-03	mg/kg-day	7.0E-01	mg/kg-day	1.7E-03
				Lead		1.2E+02	mg/kg	4.0E-07	mg/kg-day	--	--	--	3.2E-06	mg/kg-day	--	--	--
				Manganese		4.4E+02	mg/kg	1.5E-06	mg/kg-day	--	--	--	1.2E-05	mg/kg-day	1.4E-01	mg/kg-day	8.7E-05
				Mercury		3.6E-01	mg/kg	1.2E-09	mg/kg-day	--	--	--	1.0E-08	mg/kg-day	1.0E-04	mg/kg-day	1.0E-04
				Molybdenum		1.3E+00	mg/kg	4.4E-09	mg/kg-day	--	--	--	3.6E-08	mg/kg-day	5.0E-03	mg/kg-day	7.1E-06
				Nickel		1.8E+02	mg/kg	6.2E-07	mg/kg-day	--	--	--	4.9E-06	mg/kg-day	8.0E-04	mg/kg-day	6.2E-03
				Selenium		3.9E-01	mg/kg	1.3E-09	mg/kg-day	--	--	--	1.1E-08	mg/kg-day	5.0E-03	mg/kg-day	2.1E-06
				Silver		3.0E-01	mg/kg	1.0E-09	mg/kg-day	--	--	--	8.3E-09	mg/kg-day	2.0E-04	mg/kg-day	4.1E-05
				Vanadium		1.4E+02	mg/kg	4.8E-07	mg/kg-day	--	--	--	3.9E-06	mg/kg-day	1.3E-04	mg/kg-day	3.0E-02
				Zinc		1.3E+02	mg/kg	4.5E-07	mg/kg-day	--	--	--	3.6E-06	mg/kg-day	3.0E-01	mg/kg-day	1.2E-05
				4,4'-DDD		1.6E-03	mg/kg	2.7E-11	mg/kg-day	2.4E-01	(mg/kg-day)-1	6.4E-12	2.1E-10	mg/kg-day	5.0E-04	mg/kg-day	4.3E-07
				4,4'-DDE		1.5E-03	mg/kg	2.6E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	9.0E-12	2.1E-10	mg/kg-day	5.0E-04	mg/kg-day	4.2E-07
				4,4'-DDT		7.1E-04	mg/kg	1.2E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	4.2E-12	9.8E-11	mg/kg-day	5.0E-04	mg/kg-day	2.0E-07
				alpha-Chlordane		3.2E-04	mg/kg	5.5E-12	mg/kg-day	3.5E-01	(mg/kg-day)-1	1.9E-12	4.4E-11	mg/kg-day	5.0E-04	mg/kg-day	8.9E-08
				gamma-Chlordane		1.4E-04	mg/kg	2.4E-12	mg/kg-day	3.5E-01	(mg/kg-day)-1	8.4E-13	1.9E-11	mg/kg-day	5.0E-04	mg/kg-day	3.9E-08
				2-Methylnaphthalene		1.0E-02	mg/kg	5.3E-10	mg/kg-day	--	--	--	4.2E-09	mg/kg-day	4.0E-03	mg/kg-day	1.1E-06
				Acenaphthene		9.7E-03	mg/kg	5.0E-10	mg/kg-day	--	--	--	4.0E-09	mg/kg-day	6.0E-02	mg/kg-day	6.7E-08
				Acenaphthylene		1.2E-02	mg/kg	6.3E-10	mg/kg-day	--	--	--	5.0E-09	mg/kg-day	6.0E-02	mg/kg-day	8.4E-08
				Anthracene		2.1E-01	mg/kg	1.1E-08	mg/kg-day	--	--	--	8.7E-08	mg/kg-day	3.0E-01	mg/kg-day	2.9E-07
				Fluorene		3.0E-02	mg/kg	1.5E-09	mg/kg-day	--	--	--	1.2E-08	mg/kg-day	4.0E-02	mg/kg-day	3.0E-07
				Naphthalene		1.7E-02	mg/kg	8.5E-10	mg/kg-day	--	--	--	6.8E-09	mg/kg-day	2.0E-02	mg/kg-day	3.4E-07
				Phenanthrene		1.4E-01	mg/kg	7.1E-09	mg/kg-day	--	--	--	5.7E-08	mg/kg-day	3.0E-01	mg/kg-day	1.9E-07
				Benzo(a)anthracene	M	1.8E-01	mg/kg	3.9E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	4.7E-08	7.4E-08	mg/kg-day	--	--	--
				Benzo(a)pyrene	M	2.5E-01	mg/kg	5.4E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	4.0E-07	1.0E-07	mg/kg-day	--	--	--
				Benzo(b)fluoranthene	M	2.0E-01	mg/kg	4.4E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	5.3E-08	8.2E-08	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene		1.9E-01	mg/kg	9.9E-09	mg/kg-day	--	--	--	8.0E-08	mg/kg-day	3.0E-02	mg/kg-day	2.7E-06
				Benzo(k)fluoranthene	M	1.9E-01	mg/kg	4.2E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	5.1E-08	7.9E-08	mg/kg-day	--	--	--
				Chrysene	M	2.7E-01	mg/kg	5.9E-08	mg/kg-day	1.2E-01	(mg/kg-day)-1	7.1E-09	1.1E-07	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene	M	3.3E-02	mg/kg	7.2E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	5.3E-08	1.4E-08	mg/kg-day	--	--	--
				Fluoranthene		3.3E-01	mg/kg	1.7E-08	mg/kg-day	--	--	--	1.4E-07	mg/kg-day	4.0E-02	mg/kg-day	3.4E-06
				Indeno(1,2,3-cd)pyrene	M	1.9E-01	mg/kg	4.2E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	5.0E-08	7.8E-08	mg/kg-day	--	--	--
				Pyrene		3.8E-01	mg/kg	1.9E-08	mg/kg-day	--	--	--	1.6E-07	mg/kg-day	3.0E-02	mg/kg-day	5.2E-06
				Dibutyltin		1.1E-02	mg/kg	3.7E-10	mg/kg-day	--	--	--	3.0E-09	mg/kg-day	3.0E-04	mg/kg-day	1.0E-05
				Tributyltin		1.8E-02	mg/kg	6.1E-10	mg/kg-day	--	--	--	4.9E-09	mg/kg-day	3.0E-04	mg/kg-day	1.6E-05
				Total PCB Congeners		9.0E-02	mg/kg	4.6E-09	mg/kg-day	2.0E+00	(mg/kg-day)-1	9.3E-09	3.7E-08	mg/kg-day	2.0E-05	mg/kg-day	1.9E-03
				Total TEQ – PCB DLC		8.3E-06	mg/kg	8.5E-14	mg/kg-day	1.3E+05	(mg/kg-day)-1	1.1E-08	6.8E-13	mg/kg-day	7.0E-10	mg/kg-day	9.8E-04
			Exp. Route Total									1.8E-06					5.0E-02
		Exposure Point Total										1.0E-05					3.2E-01
	Exposure Medium Total											1.0E-05					3.2E-01
Medium Total												1.0E-05					3.2E-01

TABLE A-8A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Adult and Child Recreational User, India Basin I

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations: Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Noncancer Hazard Quotient: Intake/Exposure Concentration		RfD / RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Macoma[a]	Macoma	Macoma	Ingestion	Aluminum	3.2E+02	mg/kg	2.5E-03	mg/kg-day	--	--	--	8.6E-03	mg/kg-day	1.0E+00	mg/kg-day	8.6E-03
				Antimony	2.4E-02	mg/kg	1.8E-07	mg/kg-day	--	--	--	6.4E-07	mg/kg-day	4.0E-04	mg/kg-day	1.6E-03
				Arsenic	3.5E+00	mg/kg	2.6E-05	mg/kg-day	9.5E+00	(mg/kg-day)-1	2.5E-04	9.2E-05	mg/kg-day	3.0E-04	mg/kg-day	3.1E-01
				Barium	3.0E+00	mg/kg	2.3E-05	mg/kg-day	--	--	--	8.0E-05	mg/kg-day	2.0E-01	mg/kg-day	4.0E-04
				Cadmium	4.8E-02	mg/kg	3.6E-07	mg/kg-day	1.5E+01	(mg/kg-day)-1	5.4E-06	1.3E-06	mg/kg-day	1.0E-03	mg/kg-day	1.3E-03
				Chromium	1.6E+00	mg/kg	1.2E-05	mg/kg-day	--	--	--	4.3E-05	mg/kg-day	1.5E+00	mg/kg-day	2.9E-05
				Cobalt	3.7E-01	mg/kg	2.8E-06	mg/kg-day	--	--	--	9.9E-06	mg/kg-day	3.0E-04	mg/kg-day	3.3E-02
				Copper	2.4E+00	mg/kg	1.8E-05	mg/kg-day	--	--	--	6.4E-05	mg/kg-day	4.0E-02	mg/kg-day	1.6E-03
				Iron	3.6E+02	mg/kg	2.7E-03	mg/kg-day	--	--	--	9.5E-03	mg/kg-day	7.0E-01	mg/kg-day	1.4E-02
				Lead	4.2E-01	mg/kg	3.2E-06	mg/kg-day	--	--	--	1.1E-05	mg/kg-day	--	--	--
				Manganese	4.5E+00	mg/kg	3.4E-05	mg/kg-day	--	--	--	1.2E-04	mg/kg-day	1.4E-01	mg/kg-day	8.5E-04
				Mercury	2.1E-02	mg/kg	1.6E-07	mg/kg-day	--	--	--	5.6E-07	mg/kg-day	1.0E-04	mg/kg-day	5.6E-03
				Molybdenum	4.6E-01	mg/kg	3.5E-06	mg/kg-day	--	--	--	1.2E-05	mg/kg-day	5.0E-03	mg/kg-day	2.4E-03
				Nickel	2.0E+00	mg/kg	1.5E-05	mg/kg-day	--	--	--	5.3E-05	mg/kg-day	2.0E-02	mg/kg-day	2.7E-03
				Selenium	7.9E-01	mg/kg	6.0E-06	mg/kg-day	--	--	--	2.1E-05	mg/kg-day	5.0E-03	mg/kg-day	4.2E-03
				Silver	1.3E-01	mg/kg	1.0E-06	mg/kg-day	--	--	--	3.5E-06	mg/kg-day	5.0E-03	mg/kg-day	7.1E-04
				Vanadium	1.2E+00	mg/kg	9.5E-06	mg/kg-day	--	--	--	3.3E-05	mg/kg-day	5.0E-03	mg/kg-day	6.6E-03
				Zinc	1.8E+01	mg/kg	1.3E-04	mg/kg-day	--	--	--	4.7E-04	mg/kg-day	3.0E-01	mg/kg-day	1.6E-03
				4,4'-DDD	7.7E-04	mg/kg	5.8E-09	mg/kg-day	2.4E-01	(mg/kg-day)-1	1.4E-09	2.0E-08	mg/kg-day	5.0E-04	mg/kg-day	4.1E-05
				4,4'-DDE	1.4E-03	mg/kg	1.0E-08	mg/kg-day	3.4E-01	(mg/kg-day)-1	3.5E-09	3.6E-08	mg/kg-day	5.0E-04	mg/kg-day	7.2E-05
				alpha-Chlordane	2.5E-04	mg/kg	1.9E-09	mg/kg-day	3.5E-01	(mg/kg-day)-1	6.8E-10	6.8E-09	mg/kg-day	5.0E-04	mg/kg-day	1.4E-05
				Dieldrin	3.5E-04	mg/kg	2.6E-09	mg/kg-day	1.6E+01	(mg/kg-day)-1	4.2E-08	9.3E-09	mg/kg-day	5.0E-05	mg/kg-day	1.9E-04
				gamma-Chlordane	2.1E-04	mg/kg	1.6E-09	mg/kg-day	3.5E-01	(mg/kg-day)-1	5.6E-10	5.6E-09	mg/kg-day	5.0E-04	mg/kg-day	1.1E-05
				Acenaphthene	3.8E-04	mg/kg	2.9E-09	mg/kg-day	--	--	--	1.0E-08	mg/kg-day	6.0E-02	mg/kg-day	1.7E-07
				Acenaphthylene	7.1E-04	mg/kg	5.4E-09	mg/kg-day	--	--	--	1.9E-08	mg/kg-day	6.0E-02	mg/kg-day	3.1E-07
				Anthracene	6.6E-03	mg/kg	5.0E-08	mg/kg-day	--	--	--	1.8E-07	mg/kg-day	3.0E-01	mg/kg-day	5.9E-07
				Fluorene	5.1E-04	mg/kg	3.9E-09	mg/kg-day	--	--	--	1.4E-08	mg/kg-day	4.0E-02	mg/kg-day	3.4E-07
				Phenanthrene	3.4E-03	mg/kg	2.6E-08	mg/kg-day	--	--	--	9.0E-08	mg/kg-day	3.0E-01	mg/kg-day	3.0E-07
				Benzo(a)anthracene	1.2E-02	mg/kg	9.0E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.1E-07	3.1E-07	mg/kg-day	--	--	--
				Benzo(a)pyrene	7.9E-03	mg/kg	6.0E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	4.4E-07	2.1E-07	mg/kg-day	--	--	--
				Benzo(b)fluoranthene	1.0E-02	mg/kg	7.6E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	9.1E-08	2.7E-07	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene	4.1E-03	mg/kg	3.1E-08	mg/kg-day	--	--	--	1.1E-07	mg/kg-day	3.0E-02	mg/kg-day	3.6E-06
				Benzo(k)fluoranthene	9.7E-03	mg/kg	7.4E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	8.9E-08	2.6E-07	mg/kg-day	--	--	--
				Chrysene	1.6E-02	mg/kg	1.2E-07	mg/kg-day	1.2E-01	(mg/kg-day)-1	1.4E-08	4.2E-07	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene	3.6E-04	mg/kg	2.8E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	2.0E-08	9.7E-09	mg/kg-day	--	--	--
				Fluoranthene	4.0E-02	mg/kg	3.0E-07	mg/kg-day	--	--	--	1.1E-06	mg/kg-day	4.0E-02	mg/kg-day	2.6E-05
				Indeno(1,2,3-cd)pyrene	2.7E-03	mg/kg	2.0E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	2.4E-08	7.1E-08	mg/kg-day	--	--	--
				Pyrene	4.4E-02	mg/kg	3.4E-07	mg/kg-day	--	--	--	1.2E-06	mg/kg-day	3.0E-02	mg/kg-day	3.9E-05
				Dibutyltin	1.8E-03	mg/kg	1.4E-08	mg/kg-day	--	--	--	4.8E-08	mg/kg-day	3.0E-04	mg/kg-day	1.6E-04
				Tributyltin	7.2E-03	mg/kg	5.5E-08	mg/kg-day	--	--	--	1.9E-07	mg/kg-day	3.0E-04	mg/kg-day	6.4E-04
				Total PCB Congeners	1.8E-02	mg/kg	1.4E-07	mg/kg-day	2.0E+00	(mg/kg-day)-1	2.7E-07	4.8E-07	mg/kg-day	2.0E-05	mg/kg-day	2.4E-02
				Total TEQ – PCB DLC	1.3E-05	mg/kg	1.0E-10	mg/kg-day	1.3E+05	(mg/kg-day)-1	1.3E-05	3.6E-10	mg/kg-day	7.0E-10	mg/kg-day	5.1E-01
			Exp. Route Total								2.7E-04					9.3E-01
		Exposure Point Total									2.7E-04					9.3E-01
	Exposure Medium Total										2.7E-04					9.3E-01
Medium Total											2.7E-04					9.3E-01
										Total of Receptor Risks across All Media	2.8E-04				Total of Receptor Hazards across All Media	1.3E+00

TABLE A-8A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Adult and Child Recreational User, India Basin I

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

							Cancer Risk Calculations					Noncancer Hazard Quotient				
					EPC		Intake/Exposure Concentration		CSF / Unit Risk			Intake/Exposure Concentration		RfD / RfC		
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	Value	Units	Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient

Notes:

[a] Macoma ingestion risks are evaluated for the adult receptor only.

Acronyms/Abbreviations:

-- =	not available or not applicable	(mg/kg-day)-1 =	1/(milligram[s] per kilogram per day)
CSF =	cancer slope factor	mg/kg =	milligram(s) per kilogram
DDD =	dichlorodiphenyldichloroethane	mg/kg-day =	milligram(s) per kilogram per day
DDE =	dichlorodiphenyldichloroethylene	PCB =	polychlorinated biphenyl
DDT =	dichlorodiphenyltrichloroethane	RfC =	reference concentration
EPC =	exposure point concentration	RfD =	reference dose
Exp. =	exposure	RME =	reasonable maximum exposure
M =	lifetime exposure from birth, mutagenic endpoint	TCDD =	tetrachlorodibenzo-p-dioxin

TABLE A-8B

Summary of Receptor Risks and Hazards - Adult and Child Recreational User, India Basin I

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

				Cancer Risk				Noncancer Hazard Quotient			
Medium	**Exposure Medium**	**Exposure Point**	**Chemical of Potential Concern**	**Ingestion**	**Inhalation**	**Dermal**	**Exposure Routes Total**	**Ingestion**	**Inhalation**	**Dermal**	**Exposure Routes Total**
Sediment	Sediment	Sediment	Aluminum	--	--	--	--	6.8E-02	--	2.0E-03	7.0E-02
			Antimony	--	--	--	--	2.6E-03	--	5.0E-04	3.1E-03
			Arsenic	6.7E-06	--	1.1E-06	7.8E-06	2.1E-02	--	3.0E-03	2.4E-02
			Barium	--	--	--	--	2.4E-03	--	9.8E-04	3.3E-03
			Cadmium	3.9E-07	--	5.0E-08	4.4E-07	2.3E-04	--	2.7E-05	2.6E-04
			Chromium	--	--	--	--	1.7E-04	--	3.8E-04	5.4E-04
			Cobalt	--	--	--	--	5.9E-02	--	1.7E-03	6.1E-02
			Copper	--	--	--	--	2.0E-03	--	5.8E-05	2.0E-03
			Iron	--	--	--	--	5.8E-02	--	1.7E-03	6.0E-02
			Lead	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	3.0E-03	--	8.7E-05	3.1E-03
			Mercury	--	--	--	--	3.4E-03	--	1.0E-04	3.5E-03
			Molybdenum	--	--	--	--	2.5E-04	--	7.1E-06	2.5E-04
			Nickel	--	--	--	--	8.5E-03	--	6.2E-03	1.5E-02
			Selenium	--	--	--	--	7.4E-05	--	2.1E-06	7.6E-05
			Silver	--	--	--	--	5.7E-05	--	4.1E-05	9.8E-05
			Vanadium	--	--	--	--	2.7E-02	--	3.0E-02	5.7E-02
			Zinc	--	--	--	--	4.1E-04	--	1.2E-05	4.2E-04
			4,4'-DDD	4.0E-11	--	6.4E-12	4.6E-11	2.9E-06	--	4.3E-07	3.4E-06
			4,4'-DDE	5.6E-11	--	9.0E-12	6.5E-11	2.9E-06	--	4.2E-07	3.3E-06
			4,4'-DDT	2.6E-11	--	4.2E-12	3.0E-11	1.4E-06	--	2.0E-07	1.5E-06
			alpha-Chlordane	1.2E-11	--	1.9E-12	1.4E-11	6.1E-07	--	8.9E-08	7.0E-07
			gamma-Chlordane	5.2E-12	--	8.4E-13	6.1E-12	2.7E-07	--	3.9E-08	3.0E-07
			2-Methylnaphthalene	--	--	--	--	2.4E-06	--	1.1E-06	3.5E-06
			Acenaphthene	--	--	--	--	1.5E-07	--	6.7E-08	2.2E-07
			Acenaphthylene	--	--	--	--	1.9E-07	--	8.4E-08	2.8E-07
			Anthracene	--	--	--	--	6.6E-07	--	2.9E-07	9.5E-07
			Fluorene	--	--	--	--	7.0E-07	--	3.0E-07	1.0E-06
			Naphthalene	--	--	--	--	7.8E-07	--	3.4E-07	1.1E-06
			Phenanthrene	--	--	--	--	4.3E-07	--	1.9E-07	6.2E-07
			Benzo(a)anthracene	1.0E-07	--	4.7E-08	1.5E-07	--	--	--	--
			Benzo(a)pyrene	8.7E-07	--	4.0E-07	1.3E-06	--	--	--	--
			Benzo(b)fluoranthene	1.2E-07	--	5.3E-08	1.7E-07	--	--	--	--
			Benzo(g,h,i)perylene	--	--	--	--	6.1E-06	--	2.7E-06	8.8E-06
			Benzo(k)fluoranthene	1.1E-07	--	5.1E-08	1.6E-07	--	--	--	--
			Chrysene	1.5E-08	--	7.1E-09	2.3E-08	--	--	--	--
			Dibenz(a,h)anthracene	1.2E-07	--	5.3E-08	1.7E-07	--	--	--	--
			Fluoranthene	--	--	--	--	7.9E-06	--	3.4E-06	1.1E-05
			Indeno(1,2,3-cd)pyrene	1.1E-07	--	5.0E-08	1.6E-07	--	--	--	--
			Pyrene	--	--	--	--	1.2E-05	--	5.2E-06	1.7E-05
			Dibutyltin	--	--	--	--	3.5E-05	--	1.0E-05	4.5E-05
			Tributyltin	--	--	--	--	5.6E-05	--	1.6E-05	7.2E-05
			Total PCB Congeners	1.9E-08	--	9.3E-09	2.8E-08	4.3E-03	--	1.9E-03	6.1E-03
			Total TEQ – PCB DLC	1.2E-07	--	1.1E-08	1.3E-07	1.1E-02	--	9.8E-04	1.2E-02
			Chemical Total	8.7E-06	--	1.8E-06	1.0E-05	2.7E-01	--	5.0E-02	3.2E-01
		Exposure Point Total					1.0E-05				3.2E-01
	Exposure Medium Total						1.0E-05				3.2E-01
Medium Total							1.0E-05				3.2E-01

TABLE A-8B

Summary of Receptor Risks and Hazards - Adult and Child Recreational User, India Basin I

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk Ingestion	Cancer Risk Inhalation	Cancer Risk Dermal	Cancer Risk Exposure Routes Total	Noncancer Hazard Quotient Ingestion	Noncancer Hazard Quotient Inhalation	Noncancer Hazard Quotient Dermal	Noncancer Hazard Quotient Exposure Routes Total
Macoma	Macoma	Macoma (ingestion)	Aluminum	--	--	--	--	8.6E-03	--	--	8.6E-03
			Antimony	--	--	--	--	1.6E-03	--	--	1.6E-03
			Arsenic	2.5E-04	--	--	2.5E-04	3.1E-01	--	--	3.1E-01
			Barium	--	--	--	--	4.0E-04	--	--	4.0E-04
			Cadmium	5.4E-06	--	--	5.4E-06	1.3E-03	--	--	1.3E-03
			Chromium	--	--	--	--	2.9E-05	--	--	2.9E-05
			Cobalt	--	--	--	--	3.3E-02	--	--	3.3E-02
			Copper	--	--	--	--	1.6E-03	--	--	1.6E-03
			Iron	--	--	--	--	1.4E-02	--	--	1.4E-02
			Lead	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	8.5E-04	--	--	8.5E-04
			Mercury	--	--	--	--	5.6E-03	--	--	5.6E-03
			Molybdenum	--	--	--	--	2.4E-03	--	--	2.4E-03
			Nickel	--	--	--	--	2.7E-03	--	--	2.7E-03
			Selenium	--	--	--	--	4.2E-03	--	--	4.2E-03
			Silver	--	--	--	--	7.1E-04	--	--	7.1E-04
			Vanadium	--	--	--	--	6.6E-03	--	--	6.6E-03
			Zinc	--	--	--	--	1.6E-03	--	--	1.6E-03
			4,4'-DDD	1.4E-09	--	--	1.4E-09	4.1E-05	--	--	4.1E-05
			4,4'-DDE	3.5E-09	--	--	3.5E-09	7.2E-05	--	--	7.2E-05
			alpha-Chlordane	6.8E-10	--	--	6.8E-10	1.4E-05	--	--	1.4E-05
			Dieldrin	4.2E-08	--	--	4.2E-08	1.9E-04	--	--	1.9E-04
			gamma-Chlordane	5.6E-10	--	--	5.6E-10	1.1E-05	--	--	1.1E-05
			Acenaphthene	--	--	--	--	1.7E-07	--	--	1.7E-07
			Acenaphthylene	--	--	--	--	3.1E-07	--	--	3.1E-07
			Anthracene	--	--	--	--	5.9E-07	--	--	5.9E-07
			Fluorene	--	--	--	--	3.4E-07	--	--	3.4E-07
			Phenanthrene	--	--	--	--	3.0E-07	--	--	3.0E-07
			Benzo(a)anthracene	1.1E-07	--	--	1.1E-07	--	--	--	--
			Benzo(a)pyrene	4.4E-07	--	--	4.4E-07	--	--	--	--
			Benzo(b)fluoranthene	9.1E-08	--	--	9.1E-08	--	--	--	--
			Benzo(g,h,i)perylene	--	--	--	--	3.6E-06	--	--	3.6E-06
			Benzo(k)fluoranthene	8.9E-08	--	--	8.9E-08	--	--	--	--
			Chrysene	1.4E-08	--	--	1.4E-08	--	--	--	--
			Dibenz(a,h)anthracene	2.0E-08	--	--	2.0E-08	--	--	--	--
			Fluoranthene	--	--	--	--	2.6E-05	--	--	2.6E-05
			Indeno(1,2,3-cd)pyrene	2.4E-08	--	--	2.4E-08	--	--	--	--
			Pyrene	--	--	--	--	3.9E-05	--	--	3.9E-05
			Dibutyltin	--	--	--	--	1.6E-04	--	--	1.6E-04
			Tributyltin	--	--	--	--	6.4E-04	--	--	6.4E-04
			Total PCB Congeners	2.7E-07	--	--	2.7E-07	2.4E-02	--	--	2.4E-02
			Total TEQ – PCB DLC	1.3E-05	--	--	1.3E-05	5.1E-01	--	--	5.1E-01
			Chemical Total	2.7E-04	--	--	2.7E-04	9.3E-01	--	--	9.3E-01
		Exposure Point Total					2.7E-04				9.3E-01
	Exposure Medium Total						2.7E-04				9.3E-01
Medium Total							2.7E-04				9.3E-01
Receptor Total						Total Risk across All Media	2.8E-04			Total Hazard across All Media	1.3E+00

Acronyms/Abbreviations:

-- = not available or not applicable

DDD = dichlorodiphenyldichloroethane

DDE = dichlorodiphenyldichloroethylene

DDT = dichlorodiphenyltrichloroethane

PCB = polychlorinated biphenyl

TCDD = tetrachlorodibenzo-p-dioxin

TABLE A-8C

Summary of Risk Drivers - Adult and Child Recreational User, India Basin I

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient			
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	Sediment (Oral/Dermal)	BAP (EQ)*	1.3E-06	--	6.0E-07	1.9E-06	--	--	--	--
			Arsenic	6.7E-06	--	1.1E-06	7.8E-06	2.1E-02	--	3.0E-03	2.4E-02
			Chemical Total	8.0E-06	--	1.7E-06	9.7E-06	2.1E-02	--	3.0E-03	2.4E-02
		Exposure Point Total					9.7E-06				2.4E-02
	Exposure Medium Total						9.7E-06				2.4E-02
Medium Total							9.7E-06				2.4E-02
Macoma	Macoma	Macoma (Oral)	Arsenic	2.5E-04	--	--	2.5E-04	3.1E-01	--	--	3.1E-01
			Cadmium	5.4E-06	--	--	5.4E-06	1.3E-03	--	--	1.3E-03
			Total TEQ – PCB DLC	1.3E-05	--	--	1.3E-05	5.1E-01	--	--	5.1E-01
			Chemical Total	2.7E-04	--	--	2.7E-04	8.2E-01	--	--	8.2E-01
		Exposure Point Total					2.7E-04				8.2E-01
	Exposure Medium Total						2.7E-04				8.2E-01
Medium Total							2.7E-04				8.2E-01
Receptor Total				Total Risk across All Media			2.8E-04	Total Hazard across All Media			8.4E-01

Notes:

* Risk for benzo(a)pyrene equivalent (BAP [EQ]) is calculated by summing the risks for each of the individual potentially carcinogenic PAHs: benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene.

Acronyms/Abbreviations:

-- = not available or not applicable

BAP (EQ) = benzo(a)pyrene equivalent

PAH = polycyclic aromatic hydrocarbon

PCB = polychlorinated biphenyl

TABLE A-9A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Construction Worker, India Basin I

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Noncancer Hazard Quotient				
							Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	Sediment	Ingestion	Aluminum	7.2E+04	mg/kg	2.9E-03	mg/kg-day	--	--	--	2.0E-01	mg/kg-day	1.0E+00	mg/kg-day	2.0E-01
				Antimony	1.1E+00	mg/kg	4.4E-08	mg/kg-day	--	--	--	3.1E-06	mg/kg-day	4.0E-04	mg/kg-day	7.6E-03
				Arsenic	1.1E+01	mg/kg	2.7E-07	mg/kg-day	9.5E+00	(mg/kg-day)-1	2.5E-06	1.9E-05	mg/kg-day	3.0E-04	mg/kg-day	6.2E-02
				Barium	5.0E+02	mg/kg	2.0E-05	mg/kg-day	--	--	--	1.4E-03	mg/kg-day	2.0E-01	mg/kg-day	7.0E-03
				Cadmium	2.5E-01	mg/kg	9.9E-09	mg/kg-day	1.5E+01	(mg/kg-day)-1	1.5E-07	6.9E-07	mg/kg-day	1.0E-03	mg/kg-day	6.9E-04
				Chromium	2.7E+02	mg/kg	1.1E-05	mg/kg-day	--	--	--	7.5E-04	mg/kg-day	1.5E+00	mg/kg-day	5.0E-04
				Cobalt	1.9E+01	mg/kg	7.6E-07	mg/kg-day	--	--	--	5.3E-05	mg/kg-day	3.0E-04	mg/kg-day	1.8E-01
				Copper	8.4E+01	mg/kg	3.4E-06	mg/kg-day	--	--	--	2.4E-04	mg/kg-day	4.0E-02	mg/kg-day	5.9E-03
				Iron	4.3E+04	mg/kg	1.7E-03	mg/kg-day	--	--	--	1.2E-01	mg/kg-day	7.0E-01	mg/kg-day	1.7E-01
				Lead	1.2E+02	mg/kg	4.6E-06	mg/kg-day	--	--	--	3.3E-04	mg/kg-day	--	--	--
				Manganese	4.4E+02	mg/kg	1.8E-05	mg/kg-day	--	--	--	1.2E-03	mg/kg-day	1.4E-01	mg/kg-day	8.9E-03
				Mercury	3.6E-01	mg/kg	1.5E-08	mg/kg-day	--	--	--	1.0E-06	mg/kg-day	1.0E-04	mg/kg-day	1.0E-02
				Molybdenum	1.3E+00	mg/kg	5.2E-08	mg/kg-day	--	--	--	3.7E-06	mg/kg-day	5.0E-03	mg/kg-day	7.3E-04
				Nickel	1.8E+02	mg/kg	7.2E-06	mg/kg-day	--	--	--	5.1E-04	mg/kg-day	2.0E-02	mg/kg-day	2.5E-02
				Selenium	3.9E-01	mg/kg	1.6E-08	mg/kg-day	--	--	--	1.1E-06	mg/kg-day	5.0E-03	mg/kg-day	2.2E-04
				Silver	3.0E-01	mg/kg	1.2E-08	mg/kg-day	--	--	--	8.5E-07	mg/kg-day	5.0E-03	mg/kg-day	1.7E-04
				Vanadium	1.4E+02	mg/kg	5.7E-06	mg/kg-day	--	--	--	4.0E-04	mg/kg-day	5.0E-03	mg/kg-day	8.0E-02
				Zinc	1.3E+02	mg/kg	5.2E-06	mg/kg-day	--	--	--	3.7E-04	mg/kg-day	3.0E-01	mg/kg-day	1.2E-03
				4,4'-DDD	1.6E-03	mg/kg	6.3E-11	mg/kg-day	2.4E-01	(mg/kg-day)-1	1.5E-11	4.4E-09	mg/kg-day	5.0E-04	mg/kg-day	8.8E-06
				4,4'-DDE	1.5E-03	mg/kg	6.2E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	2.1E-11	4.4E-09	mg/kg-day	5.0E-04	mg/kg-day	8.7E-06
				4,4'-DDT	7.1E-04	mg/kg	2.9E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	9.8E-12	2.0E-09	mg/kg-day	5.0E-04	mg/kg-day	4.0E-06
				alpha-Chlordane	3.2E-04	mg/kg	1.3E-11	mg/kg-day	3.5E-01	(mg/kg-day)-1	4.6E-12	9.1E-10	mg/kg-day	5.0E-04	mg/kg-day	1.8E-06
				gamma-Chlordane	1.4E-04	mg/kg	5.7E-12	mg/kg-day	3.5E-01	(mg/kg-day)-1	2.0E-12	4.0E-10	mg/kg-day	5.0E-04	mg/kg-day	7.9E-07
				2-Methylnaphthalene	1.0E-02	mg/kg	4.1E-10	mg/kg-day	--	--	--	2.9E-08	mg/kg-day	4.0E-03	mg/kg-day	7.2E-06
				Acenaphthene	9.7E-03	mg/kg	3.9E-10	mg/kg-day	--	--	--	2.7E-08	mg/kg-day	6.0E-02	mg/kg-day	4.6E-07
				Acenaphthylene	1.2E-02	mg/kg	4.9E-10	mg/kg-day	--	--	--	3.4E-08	mg/kg-day	6.0E-02	mg/kg-day	5.7E-07
				Anthracene	2.1E-01	mg/kg	8.5E-09	mg/kg-day	--	--	--	5.9E-07	mg/kg-day	3.0E-01	mg/kg-day	2.0E-06
				Fluorene	3.0E-02	mg/kg	1.2E-09	mg/kg-day	--	--	--	8.3E-08	mg/kg-day	4.0E-02	mg/kg-day	2.1E-06
				Naphthalene	1.7E-02	mg/kg	6.7E-10	mg/kg-day	--	--	--	4.7E-08	mg/kg-day	2.0E-02	mg/kg-day	2.3E-06
				Phenanthrene	1.4E-01	mg/kg	5.5E-09	mg/kg-day	--	--	--	3.9E-07	mg/kg-day	3.0E-01	mg/kg-day	1.3E-06
				Benzo(a)anthracene	1.8E-01	mg/kg	7.2E-09	mg/kg-day	1.2E+00	(mg/kg-day)-1	8.6E-09	5.0E-07	mg/kg-day	--	--	--
				Benzo(a)pyrene	2.5E-01	mg/kg	9.9E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	7.2E-08	6.9E-07	mg/kg-day	--	--	--
				Benzo(b)fluoranthene	2.0E-01	mg/kg	8.0E-09	mg/kg-day	1.2E+00	(mg/kg-day)-1	9.6E-09	5.6E-07	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene	1.9E-01	mg/kg	7.8E-09	mg/kg-day	--	--	--	5.5E-07	mg/kg-day	3.0E-02	mg/kg-day	1.8E-05
				Benzo(k)fluoranthene	1.9E-01	mg/kg	7.7E-09	mg/kg-day	1.2E+00	(mg/kg-day)-1	9.3E-09	5.4E-07	mg/kg-day	--	--	--
				Chrysene	2.7E-01	mg/kg	1.1E-08	mg/kg-day	1.2E-01	(mg/kg-day)-1	1.3E-09	7.5E-07	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene	3.3E-02	mg/kg	1.3E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	9.6E-09	9.2E-08	mg/kg-day	--	--	--
				Fluoranthene	3.3E-01	mg/kg	1.3E-08	mg/kg-day	--	--	--	9.4E-07	mg/kg-day	4.0E-02	mg/kg-day	2.4E-05
				Indeno(1,2,3-cd)pyrene	1.9E-01	mg/kg	7.6E-09	mg/kg-day	1.2E+00	(mg/kg-day)-1	9.1E-09	5.3E-07	mg/kg-day	--	--	--
				Pyrene	3.8E-01	mg/kg	1.5E-08	mg/kg-day	--	--	--	1.1E-06	mg/kg-day	3.0E-02	mg/kg-day	3.6E-05
				Dibutyltin	1.1E-02	mg/kg	4.4E-10	mg/kg-day	--	--	--	3.1E-08	mg/kg-day	3.0E-04	mg/kg-day	1.0E-04
				Tributyltin	1.8E-02	mg/kg	7.1E-10	mg/kg-day	--	--	--	5.0E-08	mg/kg-day	3.0E-04	mg/kg-day	1.7E-04
				Total PCB Congeners	9.0E-02	mg/kg	3.6E-09	mg/kg-day	2.0E+00	(mg/kg-day)-1	7.2E-09	2.5E-07	mg/kg-day	2.0E-05	mg/kg-day	1.3E-02
				Total TEQ – PCB DLC	8.3E-06	mg/kg	3.3E-13	mg/kg-day	1.3E+05	(mg/kg-day)-1	4.3E-08	2.3E-11	mg/kg-day	7.0E-10	mg/kg-day	3.3E-02
			Exp. Route Total								2.8E-06					8.1E-01

TABLE A-9A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Construction Worker, India Basin I

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Noncancer Hazard Quotient				
							Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
			Dermal	Aluminum	7.2E+04	mg/kg	4.3E-04	mg/kg-day	--	--	--	3.0E-02	mg/kg-day	1.0E+00	mg/kg-day	3.0E-02
				Antimony	1.1E+00	mg/kg	6.4E-09	mg/kg-day	--	--	--	4.5E-07	mg/kg-day	6.0E-05	mg/kg-day	7.5E-03
				Arsenic	1.1E+01	mg/kg	1.9E-07	mg/kg-day	9.5E+00	(mg/kg-day)-1	1.8E-06	1.4E-05	mg/kg-day	3.0E-04	mg/kg-day	4.5E-02
				Barium	5.0E+02	mg/kg	2.9E-06	mg/kg-day	--	--	--	2.1E-04	mg/kg-day	1.4E-02	mg/kg-day	1.5E-02
				Cadmium	2.5E-01	mg/kg	1.4E-10	mg/kg-day	6.0E+02	(mg/kg-day)-1	8.7E-08	1.0E-08	mg/kg-day	2.5E-05	mg/kg-day	4.0E-04
				Chromium	2.7E+02	mg/kg	1.6E-06	mg/kg-day	--	--	--	1.1E-04	mg/kg-day	2.0E-02	mg/kg-day	5.6E-03
				Cobalt	1.9E+01	mg/kg	1.1E-07	mg/kg-day	--	--	--	7.7E-06	mg/kg-day	3.0E-04	mg/kg-day	2.6E-02
				Copper	8.4E+01	mg/kg	4.9E-07	mg/kg-day	--	--	--	3.5E-05	mg/kg-day	4.0E-02	mg/kg-day	8.6E-04
				Iron	4.3E+04	mg/kg	2.5E-04	mg/kg-day	--	--	--	1.8E-02	mg/kg-day	7.0E-01	mg/kg-day	2.5E-02
				Lead	1.2E+02	mg/kg	6.8E-07	mg/kg-day	--	--	--	4.8E-05	mg/kg-day	--	--	--
				Manganese	4.4E+02	mg/kg	2.6E-06	mg/kg-day	--	--	--	1.8E-04	mg/kg-day	1.4E-01	mg/kg-day	1.3E-03
				Mercury	3.6E-01	mg/kg	2.1E-09	mg/kg-day	--	--	--	1.5E-07	mg/kg-day	1.0E-04	mg/kg-day	1.5E-03
				Molybdenum	1.3E+00	mg/kg	7.6E-09	mg/kg-day	--	--	--	5.3E-07	mg/kg-day	5.0E-03	mg/kg-day	1.1E-04
				Nickel	1.8E+02	mg/kg	1.1E-06	mg/kg-day	--	--	--	7.4E-05	mg/kg-day	8.0E-04	mg/kg-day	9.3E-02
				Selenium	3.9E-01	mg/kg	2.3E-09	mg/kg-day	--	--	--	1.6E-07	mg/kg-day	5.0E-03	mg/kg-day	3.2E-05
				Silver	3.0E-01	mg/kg	1.8E-09	mg/kg-day	--	--	--	1.2E-07	mg/kg-day	2.0E-04	mg/kg-day	6.2E-04
				Vanadium	1.4E+02	mg/kg	8.3E-07	mg/kg-day	--	--	--	5.8E-05	mg/kg-day	1.3E-04	mg/kg-day	4.5E-01
				Zinc	1.3E+02	mg/kg	7.7E-07	mg/kg-day	--	--	--	5.4E-05	mg/kg-day	3.0E-01	mg/kg-day	1.8E-04
				4,4'-DDD	1.6E-03	mg/kg	4.6E-11	mg/kg-day	2.4E-01	(mg/kg-day)-1	1.1E-11	3.2E-09	mg/kg-day	5.0E-04	mg/kg-day	6.4E-06
				4,4'-DDE	1.5E-03	mg/kg	4.5E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	1.5E-11	3.2E-09	mg/kg-day	5.0E-04	mg/kg-day	6.4E-06
				4,4'-DDT	7.1E-04	mg/kg	2.1E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	7.1E-12	1.5E-09	mg/kg-day	5.0E-04	mg/kg-day	2.9E-06
				alpha-Chlordane	3.2E-04	mg/kg	9.5E-12	mg/kg-day	3.5E-01	(mg/kg-day)-1	3.3E-12	6.7E-10	mg/kg-day	5.0E-04	mg/kg-day	1.3E-06
				gamma-Chlordane	1.4E-04	mg/kg	4.1E-12	mg/kg-day	3.5E-01	(mg/kg-day)-1	1.4E-12	2.9E-10	mg/kg-day	5.0E-04	mg/kg-day	5.8E-07
				2-Methylnaphthalene	1.0E-02	mg/kg	9.0E-10	mg/kg-day	--	--	--	6.3E-08	mg/kg-day	4.0E-03	mg/kg-day	1.6E-05
				Acenaphthene	9.7E-03	mg/kg	8.6E-10	mg/kg-day	--	--	--	6.0E-08	mg/kg-day	6.0E-02	mg/kg-day	1.0E-06
				Acenaphthylene	1.2E-02	mg/kg	1.1E-09	mg/kg-day	--	--	--	7.6E-08	mg/kg-day	6.0E-02	mg/kg-day	1.3E-06
				Anthracene	2.1E-01	mg/kg	1.9E-08	mg/kg-day	--	--	--	1.3E-06	mg/kg-day	3.0E-01	mg/kg-day	4.3E-06
				Fluorene	3.0E-02	mg/kg	2.6E-09	mg/kg-day	--	--	--	1.8E-07	mg/kg-day	4.0E-02	mg/kg-day	4.6E-06
				Naphthalene	1.7E-02	mg/kg	1.5E-09	mg/kg-day	--	--	--	1.0E-07	mg/kg-day	2.0E-02	mg/kg-day	5.1E-06
				Phenanthrene	1.4E-01	mg/kg	1.2E-08	mg/kg-day	--	--	--	8.5E-07	mg/kg-day	3.0E-01	mg/kg-day	2.8E-06
				Benzo(a)anthracene	1.8E-01	mg/kg	1.6E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.9E-08	1.1E-06	mg/kg-day	--	--	--
				Benzo(a)pyrene	2.5E-01	mg/kg	2.2E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	1.6E-07	1.5E-06	mg/kg-day	--	--	--
				Benzo(b)fluoranthene	2.0E-01	mg/kg	1.8E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	2.1E-08	1.2E-06	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene	1.9E-01	mg/kg	1.7E-08	mg/kg-day	--	--	--	1.2E-06	mg/kg-day	3.0E-02	mg/kg-day	4.0E-05
				Benzo(k)fluoranthene	1.9E-01	mg/kg	1.7E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	2.0E-08	1.2E-06	mg/kg-day	--	--	--
				Chrysene	2.7E-01	mg/kg	2.4E-08	mg/kg-day	1.2E-01	(mg/kg-day)-1	2.8E-09	1.6E-06	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene	3.3E-02	mg/kg	2.9E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	2.1E-08	2.0E-07	mg/kg-day	--	--	--
				Fluoranthene	3.3E-01	mg/kg	3.0E-08	mg/kg-day	--	--	--	2.1E-06	mg/kg-day	4.0E-02	mg/kg-day	5.2E-05
				Indeno(1,2,3-cd)pyrene	1.9E-01	mg/kg	1.7E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	2.0E-08	1.2E-06	mg/kg-day	--	--	--
				Pyrene	3.8E-01	mg/kg	3.3E-08	mg/kg-day	--	--	--	2.3E-06	mg/kg-day	3.0E-02	mg/kg-day	7.8E-05
				Dibutyltin	1.1E-02	mg/kg	6.4E-10	mg/kg-day	--	--	--	4.5E-08	mg/kg-day	3.0E-04	mg/kg-day	1.5E-04
				Tributyltin	1.8E-02	mg/kg	1.0E-09	mg/kg-day	--	--	--	7.3E-08	mg/kg-day	3.0E-04	mg/kg-day	2.4E-04
				Total PCB Congeners	9.0E-02	mg/kg	8.0E-09	mg/kg-day	2.0E+00	(mg/kg-day)-1	1.6E-08	5.6E-07	mg/kg-day	2.0E-05	mg/kg-day	2.8E-02
				Total TEQ – PCB DLC	8.3E-06	mg/kg	1.5E-13	mg/kg-day	1.3E+05	(mg/kg-day)-1	1.9E-08	1.0E-11	mg/kg-day	7.0E-10	mg/kg-day	1.5E-02
			Exp. Route Total								2.2E-06					7.4E-01
		Exposure Point Total									5.1E-06					1.6E+00
	Exposure Medium Total										5.1E-06					1.6E+00
Medium Total											5.1E-06					1.6E+00
										Total of Receptor Risks across All Media	5.1E-06				Total of Receptor Hazards across All Media	1.6E+00

Acronyms/Abbreviations:

-- =	not available or not applicable
CSF =	cancer slope factor
DDD =	dichlorodiphenyldichloroethane
DDE =	dichlorodiphenyldichloroethylene
DDT =	dichlorodiphenyltrichloroethane
EPC =	exposure point concentration
Exp. =	exposure
M =	lifetime exposure from birth, mutagenic endpoint
(mg/kg-day)-	1/(milligram[s] per kilogram per day)
mg/kg =	milligram(s) per kilogram
mg/kg-day =	milligram(s) per kilogram per day
PCB =	polychlorinated biphenyl
RfC =	reference concentration
RfD =	reference dose
RME =	reasonable maximum exposure
TCDD =	tetrachlorodibenzo-p-dioxin

TABLE A-9B
Summary of Receptor Risks and Hazards - Construction Worker, India Basin I
Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

				Cancer Risk				Noncancer Hazard Quotient			
Medium	**Exposure Medium**	**Exposure Point**	**Chemical of Potential Concern**	**Ingestion**	**Inhalation**	**Dermal**	**Exposure Routes Total**	**Ingestion**	**Inhalation**	**Dermal**	**Exposure Routes Total**
Sediment	Sediment	Sediment	Aluminum	--	--	--	--	2.0E-01	--	3.0E-02	2.3E-01
			Antimony	--	--	--	--	7.6E-03	--	7.5E-03	1.5E-02
			Arsenic	2.5E-06	--	1.8E-06	4.4E-06	6.2E-02	--	4.5E-02	1.1E-01
			Barium	--	--	--	--	7.0E-03	--	1.5E-02	2.2E-02
			Cadmium	1.5E-07	--	8.7E-08	2.4E-07	6.9E-04	--	4.0E-04	1.1E-03
			Chromium	--	--	--	--	5.0E-04	--	5.6E-03	6.1E-03
			Cobalt	--	--	--	--	1.8E-01	--	2.6E-02	2.0E-01
			Copper	--	--	--	--	5.9E-03	--	8.6E-04	6.8E-03
			Iron	--	--	--	--	1.7E-01	--	2.5E-02	2.0E-01
			Lead	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	8.9E-03	--	1.3E-03	1.0E-02
			Mercury	--	--	--	--	1.0E-02	--	1.5E-03	1.2E-02
			Molybdenum	--	--	--	--	7.3E-04	--	1.1E-04	8.4E-04
			Nickel	--	--	--	--	2.5E-02	--	9.3E-02	1.2E-01
			Selenium	--	--	--	--	2.2E-04	--	3.2E-05	2.5E-04
			Silver	--	--	--	--	1.7E-04	--	6.2E-04	7.9E-04
			Vanadium	--	--	--	--	8.0E-02	--	4.5E-01	5.3E-01
			Zinc	--	--	--	--	1.2E-03	--	1.8E-04	1.4E-03
			4,4'-DDE	2.1E-11	--	1.5E-11	3.7E-11	8.7E-06	--	6.4E-06	1.5E-05
			4,4'-DDT	9.8E-12	--	7.1E-12	1.7E-11	4.0E-06	--	2.9E-06	7.0E-06
			alpha-Chlordane	4.6E-12	--	3.3E-12	7.9E-12	1.8E-06	--	1.3E-06	3.2E-06
			gamma-Chlordane	2.0E-12	--	1.4E-12	3.4E-12	7.9E-07	--	5.8E-07	1.4E-06
			2-Methylnaphthalene	--	--	--	--	7.2E-06	--	1.6E-05	2.3E-05
			Acenaphthene	--	--	--	--	4.6E-07	--	1.0E-06	1.5E-06
			Acenaphthylene	--	--	--	--	5.7E-07	--	1.3E-06	1.8E-06
			Anthracene	--	--	--	--	2.0E-06	--	4.3E-06	6.3E-06
			Fluorene	--	--	--	--	2.1E-06	--	4.6E-06	6.7E-06
			Naphthalene	--	--	--	--	2.3E-06	--	5.1E-06	7.4E-06
			Phenanthrene	--	--	--	--	1.3E-06	--	2.8E-06	4.1E-06
			Benzo(a)anthracene	8.6E-09	--	1.9E-08	2.8E-08	--	--	--	--
			Benzo(a)pyrene	7.2E-08	--	1.6E-07	2.3E-07	--	--	--	--
			Benzo(b)fluoranthene	9.6E-09	--	2.1E-08	3.1E-08	--	--	--	--
			Benzo(g,h,i)perylene	--	--	--	--	1.8E-05	--	4.0E-05	5.8E-05
			Benzo(k)fluoranthene	9.3E-09	--	2.0E-08	3.0E-08	--	--	--	--
			Chrysene	1.3E-09	--	2.8E-09	4.1E-09	--	--	--	--
			Dibenz(a,h)anthracene	9.6E-09	--	2.1E-08	3.1E-08	--	--	--	--
			Fluoranthene	--	--	--	--	2.4E-05	--	5.2E-05	7.5E-05
			Indeno(1,2,3-cd)pyrene	9.1E-09	--	2.0E-08	2.9E-08	--	--	--	--
			Pyrene	--	--	--	--	3.6E-05	--	7.8E-05	1.1E-04
			Dibutyltin	--	--	--	--	1.0E-04	--	1.5E-04	2.5E-04
			Tributyltin	--	--	--	--	1.7E-04	--	2.4E-04	4.1E-04
			Total PCB Congeners	7.2E-09	--	1.6E-08	2.3E-08	1.3E-02	--	2.8E-02	4.1E-02
			Total TEQ – PCB DLC	4.3E-08	--	1.9E-08	6.3E-08	3.3E-02	--	1.5E-02	4.8E-02
			Chemical Total	2.8E-06	--	2.2E-06	5.1E-06	8.1E-01	--	7.4E-01	1.6E+00
		Exposure Point Total					5.1E-06				1.6E+00
	Exposure Medium Total						5.1E-06				1.6E+00
Medium Total							5.1E-06				1.6E+00
Receptor Total						Total Risk across All Media	5.1E-06			Total Hazard across All Media	1.6E+00

TABLE A-9B

Summary of Receptor Risks and Hazards - Construction Worker, India Basin I

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient			
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Ingestion	Inhalation	Dermal	Exposure Routes Total

Acronyms/Abbreviations:

-- = not available or not applicable

DDD = dichlorodiphenyldichloroethane

DDE = dichlorodiphenyldichloroethylene

DDT = dichlorodiphenyltrichloroethane

PCB = polychlorinated biphenyl

TCDD = tetrachlorodibenzo-p-dioxin

TABLE A-9C

Summary of Risk Drivers - Construction Worker, India Basin I

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient			
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	Sediment	Arsenic	2.5E-06	--	1.8E-06	4.4E-06	6.2E-02	--	4.5E-02	1.1E-01
			Chemical Total	--	--	--	4.4E-06	--	--	--	1.1E-01
		Exposure Point Total					4.4E-06				1.1E-01
	Exposure Medium Total						4.4E-06				1.1E-01
Medium Total							4.4E-06				1.1E-01
Receptor Total						Total Risk across All Media	4.4E-06			Total Hazard across All Media	1.1E-01

Acronyms/Abbreviations:

-- = not available or not applicable

TABLE A-10A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Adult and Child Recreational User, Oil Reclamation Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Noncancer Hazard Quotient				
							Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	Sediment	Ingestion	Aluminum	7.2E+04	mg/kg	7.7E-03	mg/kg-day	--	--	--	6.8E-02	mg/kg-day	1.0E+00	mg/kg-day	6.8E-02
				Antimony	2.8E+00	mg/kg	3.0E-07	mg/kg-day	--	--	--	2.6E-06	mg/kg-day	4.0E-04	mg/kg-day	6.6E-03
				Arsenic	1.3E+01	mg/kg	8.1E-07	mg/kg-day	9.5E+00	(mg/kg-day)-1	7.7E-06	7.2E-06	mg/kg-day	3.0E-04	mg/kg-day	2.4E-02
				Barium	4.4E+02	mg/kg	4.7E-05	mg/kg-day	--	--	--	4.2E-04	mg/kg-day	2.0E-01	mg/kg-day	2.1E-03
				Cadmium	3.9E-01	mg/kg	4.1E-08	mg/kg-day	1.5E+01	(mg/kg-day)-1	6.2E-07	3.7E-07	mg/kg-day	1.0E-03	mg/kg-day	3.7E-04
				Chromium	4.3E+02	mg/kg	4.6E-05	mg/kg-day	--	--	--	4.1E-04	mg/kg-day	1.5E+00	mg/kg-day	2.7E-04
				Cobalt	2.1E+01	mg/kg	2.2E-06	mg/kg-day	--	--	--	2.0E-05	mg/kg-day	3.0E-04	mg/kg-day	6.6E-02
				Copper	8.4E+01	mg/kg	9.0E-06	mg/kg-day	--	--	--	8.0E-05	mg/kg-day	4.0E-02	mg/kg-day	2.0E-03
				Iron	4.7E+04	mg/kg	5.1E-03	mg/kg-day	--	--	--	4.5E-02	mg/kg-day	7.0E-01	mg/kg-day	6.4E-02
				Lead	5.4E+01	mg/kg	5.8E-06	mg/kg-day	--	--	--	5.2E-05	mg/kg-day	--	--	--
				Manganese	5.7E+02	mg/kg	6.1E-05	mg/kg-day	--	--	--	5.4E-04	mg/kg-day	1.4E-01	mg/kg-day	3.9E-03
				Mercury	5.2E-01	mg/kg	5.5E-08	mg/kg-day	--	--	--	4.9E-07	mg/kg-day	1.0E-04	mg/kg-day	4.9E-03
				Molybdenum	1.6E+00	mg/kg	1.7E-07	mg/kg-day	--	--	--	1.6E-06	mg/kg-day	5.0E-03	mg/kg-day	3.1E-04
				Nickel	1.4E+02	mg/kg	1.4E-05	mg/kg-day	--	--	--	1.3E-04	mg/kg-day	2.0E-02	mg/kg-day	6.4E-03
				Selenium	3.8E-01	mg/kg	4.0E-08	mg/kg-day	--	--	--	3.6E-07	mg/kg-day	5.0E-03	mg/kg-day	7.2E-05
				Silver	4.3E-01	mg/kg	4.6E-08	mg/kg-day	--	--	--	4.1E-07	mg/kg-day	5.0E-03	mg/kg-day	8.1E-05
				Vanadium	1.6E+02	mg/kg	1.7E-05	mg/kg-day	--	--	--	1.6E-04	mg/kg-day	5.0E-03	mg/kg-day	3.1E-02
				Zinc	1.6E+02	mg/kg	1.7E-05	mg/kg-day	--	--	--	1.5E-04	mg/kg-day	3.0E-01	mg/kg-day	5.1E-04
				4,4'-DDD	2.7E-03	mg/kg	2.8E-10	mg/kg-day	2.4E-01	(mg/kg-day)-1	6.8E-11	2.5E-09	mg/kg-day	5.0E-04	mg/kg-day	5.1E-06
				4,4'-DDE	1.3E-03	mg/kg	1.4E-10	mg/kg-day	3.4E-01	(mg/kg-day)-1	4.8E-11	1.2E-09	mg/kg-day	5.0E-04	mg/kg-day	2.5E-06
				4,4'-DDT	6.6E-04	mg/kg	7.0E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	2.4E-11	6.3E-10	mg/kg-day	5.0E-04	mg/kg-day	1.3E-06
				alpha-Chlordane	3.6E-04	mg/kg	3.9E-11	mg/kg-day	3.5E-01	(mg/kg-day)-1	1.4E-11	3.4E-10	mg/kg-day	5.0E-04	mg/kg-day	6.9E-07
				Dieldrin	4.4E-04	mg/kg	4.7E-11	mg/kg-day	1.6E+01	(mg/kg-day)-1	7.5E-10	4.2E-10	mg/kg-day	5.0E-05	mg/kg-day	8.4E-06
				gamma-Chlordane	3.8E-04	mg/kg	4.1E-11	mg/kg-day	3.5E-01	(mg/kg-day)-1	1.4E-11	3.6E-10	mg/kg-day	5.0E-04	mg/kg-day	7.2E-07
				2-Methylnaphthalene	8.7E-03	mg/kg	9.2E-10	mg/kg-day	--	--	--	8.2E-09	mg/kg-day	4.0E-03	mg/kg-day	2.1E-06
				Acenaphthene	5.8E-03	mg/kg	6.2E-10	mg/kg-day	--	--	--	5.5E-09	mg/kg-day	6.0E-02	mg/kg-day	9.1E-08
				Acenaphthylene	9.1E-03	mg/kg	9.7E-10	mg/kg-day	--	--	--	8.6E-09	mg/kg-day	6.0E-02	mg/kg-day	1.4E-07
				Anthracene	4.2E-02	mg/kg	4.5E-09	mg/kg-day	--	--	--	4.0E-08	mg/kg-day	3.0E-01	mg/kg-day	1.3E-07
				Fluorene	8.9E-03	mg/kg	9.5E-10	mg/kg-day	--	--	--	8.5E-09	mg/kg-day	4.0E-02	mg/kg-day	2.1E-07
				Naphthalene	1.5E-02	mg/kg	1.6E-09	mg/kg-day	--	--	--	1.4E-08	mg/kg-day	2.0E-02	mg/kg-day	7.2E-07
				Phenanthrene	1.0E-01	mg/kg	1.1E-08	mg/kg-day	--	--	--	9.8E-08	mg/kg-day	3.0E-01	mg/kg-day	3.3E-07
				Benzo(a)anthracene M	1.2E-01	mg/kg	5.8E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	7.0E-08	1.1E-07	mg/kg-day	--	--	--
				Benzo(a)pyrene M	2.0E-01	mg/kg	9.5E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	6.9E-07	1.9E-07	mg/kg-day	--	--	--
				Benzo(b)fluoranthene M	1.3E-01	mg/kg	6.5E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	7.8E-08	1.3E-07	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene	1.8E-01	mg/kg	1.9E-08	mg/kg-day	--	--	--	1.7E-07	mg/kg-day	3.0E-02	mg/kg-day	5.7E-06
				Benzo(k)fluoranthene M	1.4E-01	mg/kg	6.8E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	8.2E-08	1.3E-07	mg/kg-day	--	--	--
				Chrysene M	2.0E-01	mg/kg	9.5E-08	mg/kg-day	1.2E-01	(mg/kg-day)-1	1.1E-08	1.9E-07	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene M	2.1E-02	mg/kg	1.0E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	7.4E-08	2.0E-08	mg/kg-day	--	--	--
				Fluoranthene	2.4E-01	mg/kg	2.6E-08	mg/kg-day	--	--	--	2.3E-07	mg/kg-day	4.0E-02	mg/kg-day	5.7E-06
				Indeno(1,2,3-cd)pyrene M	1.6E-01	mg/kg	7.9E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	9.5E-08	1.5E-07	mg/kg-day	--	--	--
				Pyrene	3.0E-01	mg/kg	3.2E-08	mg/kg-day	--	--	--	2.8E-07	mg/kg-day	3.0E-02	mg/kg-day	9.5E-06
				Monobutyltin	2.7E-03	mg/kg	2.9E-10	mg/kg-day	--	--	--	2.6E-09	mg/kg-day	3.0E-04	mg/kg-day	8.5E-06
				Dibutyltin	1.6E-02	mg/kg	1.7E-09	mg/kg-day	--	--	--	1.5E-08	mg/kg-day	3.0E-04	mg/kg-day	5.1E-05
				Tributyltin	4.1E-02	mg/kg	4.3E-09	mg/kg-day	--	--	--	3.9E-08	mg/kg-day	3.0E-04	mg/kg-day	1.3E-04
				Total PCB Congeners	3.4E-01	mg/kg	3.6E-08	mg/kg-day	2.0E+00	(mg/kg-day)-1	7.2E-08	3.2E-07	mg/kg-day	2.0E-05	mg/kg-day	1.6E-02
				Total TEQ – PCB DLC	8.5E-06	mg/kg	9.1E-13	mg/kg-day	1.3E+05	(mg/kg-day)-1	1.2E-07	8.1E-12	mg/kg-day	7.0E-10	mg/kg-day	1.2E-02
			Exp. Route Total								9.6E-06					3.1E-01

TABLE A-10A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Adult and Child Recreational User, Oil Reclamation Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Cancer Risk Calculations: Intake/Exposure Concentration Value	Intake/Exposure Concentration Units	CSF / Unit Risk Value	CSF / Unit Risk Units	Cancer Risk	Noncancer Hazard Quotient: Intake/Exposure Concentration Value	Intake/Exposure Concentration Units	RfD / RfC Value	RfD / RfC Units	Hazard Quotient
Sediment	Sediment	Sediment	Dermal	Aluminum	7.2E+04	mg/kg	2.5E-04	mg/kg-day	--	--	--	2.0E-03	mg/kg-day	1.0E+00	mg/kg-day	2.0E-03
				Antimony	2.8E+00	mg/kg	9.5E-09	mg/kg-day	--	--	--	7.6E-08	mg/kg-day	6.0E-05	mg/kg-day	1.3E-03
				Arsenic	1.3E+01	mg/kg	1.3E-07	mg/kg-day	9.5E+00	(mg/kg-day)-1	1.2E-06	1.0E-06	mg/kg-day	3.0E-04	mg/kg-day	3.5E-03
				Barium	4.4E+02	mg/kg	1.5E-06	mg/kg-day	--	--	--	1.2E-05	mg/kg-day	1.4E-02	mg/kg-day	8.7E-04
				Cadmium	3.9E-01	mg/kg	1.3E-10	mg/kg-day	6.0E+02	(mg/kg-day)-1	8.0E-08	1.1E-09	mg/kg-day	2.5E-05	mg/kg-day	4.3E-05
				Chromium	4.3E+02	mg/kg	1.5E-06	mg/kg-day	--	--	--	1.2E-05	mg/kg-day	2.0E-02	mg/kg-day	6.1E-04
				Cobalt	2.1E+01	mg/kg	7.1E-08	mg/kg-day	--	--	--	5.7E-07	mg/kg-day	3.0E-04	mg/kg-day	1.9E-03
				Copper	8.4E+01	mg/kg	2.9E-07	mg/kg-day	--	--	--	2.3E-06	mg/kg-day	4.0E-02	mg/kg-day	5.8E-05
				Iron	4.7E+04	mg/kg	1.6E-04	mg/kg-day	--	--	--	1.3E-03	mg/kg-day	7.0E-01	mg/kg-day	1.9E-03
				Lead	5.4E+01	mg/kg	1.9E-07	mg/kg-day	--	--	--	1.5E-06	mg/kg-day	--	--	--
				Manganese	5.7E+02	mg/kg	2.0E-06	mg/kg-day	--	--	--	1.6E-05	mg/kg-day	1.4E-01	mg/kg-day	1.1E-04
				Mercury	5.2E-01	mg/kg	1.8E-09	mg/kg-day	--	--	--	1.4E-08	mg/kg-day	1.0E-04	mg/kg-day	1.4E-04
				Molybdenum	1.6E+00	mg/kg	5.6E-09	mg/kg-day	--	--	--	4.5E-08	mg/kg-day	5.0E-03	mg/kg-day	9.0E-06
				Nickel	1.4E+02	mg/kg	4.6E-07	mg/kg-day	--	--	--	3.7E-06	mg/kg-day	8.0E-04	mg/kg-day	4.7E-03
				Selenium	3.8E-01	mg/kg	1.3E-09	mg/kg-day	--	--	--	1.0E-08	mg/kg-day	5.0E-03	mg/kg-day	2.1E-06
				Silver	4.3E-01	mg/kg	1.5E-09	mg/kg-day	--	--	--	1.2E-08	mg/kg-day	2.0E-04	mg/kg-day	5.9E-05
				Vanadium	1.6E+02	mg/kg	5.6E-07	mg/kg-day	--	--	--	4.5E-06	mg/kg-day	1.3E-04	mg/kg-day	3.5E-02
				Zinc	1.6E+02	mg/kg	5.6E-07	mg/kg-day	--	--	--	4.5E-06	mg/kg-day	3.0E-01	mg/kg-day	1.5E-05
				4,4'-DDD	2.7E-03	mg/kg	4.6E-11	mg/kg-day	2.4E-01	(mg/kg-day)-1	1.1E-11	3.7E-10	mg/kg-day	5.0E-04	mg/kg-day	7.3E-07
				4,4'-DDE	1.3E-03	mg/kg	2.2E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	7.6E-12	1.8E-10	mg/kg-day	5.0E-04	mg/kg-day	3.6E-07
				4,4'-DDT	6.6E-04	mg/kg	1.1E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	3.8E-12	9.1E-11	mg/kg-day	5.0E-04	mg/kg-day	1.8E-07
				alpha-Chlordane	3.6E-04	mg/kg	6.2E-12	mg/kg-day	3.5E-01	(mg/kg-day)-1	2.2E-12	5.0E-11	mg/kg-day	5.0E-04	mg/kg-day	1.0E-07
				Dieldrin	4.4E-04	mg/kg	1.5E-11	mg/kg-day	1.6E+01	(mg/kg-day)-1	2.4E-10	1.2E-10	mg/kg-day	5.0E-05	mg/kg-day	2.4E-06
				gamma-Chlordane	3.8E-04	mg/kg	6.5E-12	mg/kg-day	3.5E-01	(mg/kg-day)-1	2.3E-12	5.2E-11	mg/kg-day	5.0E-04	mg/kg-day	1.0E-07
				2-Methylnaphthalene	8.7E-03	mg/kg	4.5E-10	mg/kg-day	--	--	--	3.6E-09	mg/kg-day	4.0E-03	mg/kg-day	8.9E-07
				Acenaphthene	5.8E-03	mg/kg	3.0E-10	mg/kg-day	--	--	--	2.4E-09	mg/kg-day	6.0E-02	mg/kg-day	4.0E-08
				Acenaphthylene	9.1E-03	mg/kg	4.7E-10	mg/kg-day	--	--	--	3.7E-09	mg/kg-day	6.0E-02	mg/kg-day	6.2E-08
				Anthracene	4.2E-02	mg/kg	2.2E-09	mg/kg-day	--	--	--	1.8E-08	mg/kg-day	3.0E-01	mg/kg-day	5.8E-08
				Fluorene	8.9E-03	mg/kg	4.6E-10	mg/kg-day	--	--	--	3.7E-09	mg/kg-day	4.0E-02	mg/kg-day	9.2E-08
				Naphthalene	1.5E-02	mg/kg	7.8E-10	mg/kg-day	--	--	--	6.3E-09	mg/kg-day	2.0E-02	mg/kg-day	3.1E-07
				Phenanthrene	1.0E-01	mg/kg	5.3E-09	mg/kg-day	--	--	--	4.3E-08	mg/kg-day	3.0E-01	mg/kg-day	1.4E-07
				Benzo(a)anthracene M	1.2E-01	mg/kg	2.7E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	3.2E-08	5.0E-08	mg/kg-day	--	--	--
				Benzo(a)pyrene M	2.0E-01	mg/kg	4.3E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	3.2E-07	8.1E-08	mg/kg-day	--	--	--
				Benzo(b)fluoranthene M	1.3E-01	mg/kg	3.0E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	3.6E-08	5.5E-08	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene	1.8E-01	mg/kg	9.3E-09	mg/kg-day	--	--	--	7.4E-08	mg/kg-day	3.0E-02	mg/kg-day	2.5E-06
				Benzo(k)fluoranthene M	1.4E-01	mg/kg	3.1E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	3.7E-08	5.8E-08	mg/kg-day	--	--	--
				Chrysene M	2.0E-01	mg/kg	4.3E-08	mg/kg-day	1.2E-01	(mg/kg-day)-1	5.2E-09	8.1E-08	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene M	2.1E-02	mg/kg	4.6E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	3.4E-08	8.7E-09	mg/kg-day	--	--	--
				Fluoranthene	2.4E-01	mg/kg	1.2E-08	mg/kg-day	--	--	--	9.9E-08	mg/kg-day	4.0E-02	mg/kg-day	2.5E-06
				Indeno(1,2,3-cd)pyrene M	1.6E-01	mg/kg	3.6E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	4.3E-08	6.7E-08	mg/kg-day	--	--	--
				Pyrene	3.0E-01	mg/kg	1.5E-08	mg/kg-day	--	--	--	1.2E-07	mg/kg-day	3.0E-02	mg/kg-day	4.1E-06
				Monobutyltin	2.7E-03	mg/kg	9.2E-11	mg/kg-day	--	--	--	7.4E-10	mg/kg-day	3.0E-04	mg/kg-day	2.5E-06
				Dibutyltin	1.6E-02	mg/kg	5.5E-10	mg/kg-day	--	--	--	4.4E-09	mg/kg-day	3.0E-04	mg/kg-day	1.5E-05
				Tributyltin	4.1E-02	mg/kg	1.4E-09	mg/kg-day	--	--	--	1.1E-08	mg/kg-day	3.0E-04	mg/kg-day	3.7E-05
				Total PCB Congeners	3.4E-01	mg/kg	1.7E-08	mg/kg-day	2.0E+00	(mg/kg-day)-1	3.5E-08	1.4E-07	mg/kg-day	2.0E-05	mg/kg-day	7.0E-03
				Total TEQ – PCB DLC	8.5E-06	mg/kg	8.7E-14	mg/kg-day	1.3E+05	(mg/kg-day)-1	1.1E-08	7.0E-13	mg/kg-day	7.0E-10	mg/kg-day	1.0E-03
			Exp. Route Total								1.9E-06					6.0E-02
		Exposure Point Total									1.2E-05					3.7E-01
	Exposure Medium Total										1.2E-05					3.7E-01
Medium Total											1.2E-05					3.7E-01

TABLE A-10A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Adult and Child Recreational User, Oil Reclamation Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations: Intake/Exposure Concentration		Cancer Risk Calculations: CSF / Unit Risk		Cancer Risk	Noncancer Hazard Quotient: Intake/Exposure Concentration		Noncancer Hazard Quotient: RfD / RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Macoma[a]	Macoma	Macoma	Ingestion	Aluminum	4.3E+02	mg/kg	3.3E-03	mg/kg-day	--	--	--	1.2E-02	mg/kg-day	1.0E+00	mg/kg-day	1.2E-02
				Antimony	4.4E-02	mg/kg	3.4E-07	mg/kg-day	--	--	--	1.2E-06	mg/kg-day	4.0E-04	mg/kg-day	2.9E-03
				Arsenic	3.9E+00	mg/kg	3.0E-05	mg/kg-day	9.5E+00	(mg/kg-day)-1	2.8E-04	1.0E-04	mg/kg-day	3.0E-04	mg/kg-day	3.5E-01
				Barium	3.7E+00	mg/kg	2.8E-05	mg/kg-day	--	--	--	9.8E-05	mg/kg-day	2.0E-01	mg/kg-day	4.9E-04
				Cadmium	2.0E-01	mg/kg	1.5E-06	mg/kg-day	1.5E+01	(mg/kg-day)-1	2.3E-05	5.3E-06	mg/kg-day	1.0E-03	mg/kg-day	5.3E-03
				Chromium	4.7E+00	mg/kg	3.6E-05	mg/kg-day	--	--	--	1.2E-04	mg/kg-day	1.5E+00	mg/kg-day	8.3E-05
				Cobalt	4.6E-01	mg/kg	3.5E-06	mg/kg-day	--	--	--	1.2E-05	mg/kg-day	3.0E-04	mg/kg-day	4.0E-02
				Copper	3.6E+00	mg/kg	2.8E-05	mg/kg-day	--	--	--	9.7E-05	mg/kg-day	4.0E-02	mg/kg-day	2.4E-03
				Iron	6.0E+02	mg/kg	4.6E-03	mg/kg-day	--	--	--	1.6E-02	mg/kg-day	7.0E-01	mg/kg-day	2.3E-02
				Lead	1.1E+00	mg/kg	8.1E-06	mg/kg-day	--	--	--	2.8E-05	mg/kg-day	--	--	--
				Manganese	8.0E+00	mg/kg	6.1E-05	mg/kg-day	--	--	--	2.1E-04	mg/kg-day	1.4E-01	mg/kg-day	1.5E-03
				Mercury	2.5E-02	mg/kg	1.9E-07	mg/kg-day	--	--	--	6.5E-07	mg/kg-day	1.0E-04	mg/kg-day	6.5E-03
				Molybdenum	5.1E-01	mg/kg	3.9E-06	mg/kg-day	--	--	--	1.4E-05	mg/kg-day	5.0E-03	mg/kg-day	2.7E-03
				Nickel	1.9E+00	mg/kg	1.5E-05	mg/kg-day	--	--	--	5.1E-05	mg/kg-day	2.0E-02	mg/kg-day	2.6E-03
				Selenium	8.7E-01	mg/kg	6.6E-06	mg/kg-day	--	--	--	2.3E-05	mg/kg-day	5.0E-03	mg/kg-day	4.6E-03
				Silver	3.7E-02	mg/kg	2.8E-07	mg/kg-day	--	--	--	9.9E-07	mg/kg-day	5.0E-03	mg/kg-day	2.0E-04
				Vanadium	2.0E+00	mg/kg	1.5E-05	mg/kg-day	--	--	--	5.3E-05	mg/kg-day	5.0E-03	mg/kg-day	1.1E-02
				Zinc	1.9E+01	mg/kg	1.4E-04	mg/kg-day	--	--	--	5.0E-04	mg/kg-day	3.0E-01	mg/kg-day	1.7E-03
				4,4'-DDD	1.2E-03	mg/kg	8.8E-09	mg/kg-day	2.4E-01	(mg/kg-day)-1	2.1E-09	3.1E-08	mg/kg-day	5.0E-04	mg/kg-day	6.2E-05
				4,4'-DDE	2.2E-03	mg/kg	1.7E-08	mg/kg-day	3.4E-01	(mg/kg-day)-1	5.7E-09	5.9E-08	mg/kg-day	5.0E-04	mg/kg-day	1.2E-04
				4,4'-DDT	7.0E-05	mg/kg	5.3E-10	mg/kg-day	3.4E-01	(mg/kg-day)-1	1.8E-10	1.9E-09	mg/kg-day	5.0E-04	mg/kg-day	3.7E-06
				alpha-Chlordane	2.8E-04	mg/kg	2.1E-09	mg/kg-day	3.5E-01	(mg/kg-day)-1	7.4E-10	7.4E-09	mg/kg-day	5.0E-04	mg/kg-day	1.5E-05
				Dieldrin	2.6E-04	mg/kg	2.0E-09	mg/kg-day	1.6E+01	(mg/kg-day)-1	3.2E-08	7.0E-09	mg/kg-day	5.0E-05	mg/kg-day	1.4E-04
				gamma-Chlordane	3.3E-04	mg/kg	2.5E-09	mg/kg-day	3.5E-01	(mg/kg-day)-1	8.9E-10	8.9E-09	mg/kg-day	5.0E-04	mg/kg-day	1.8E-05
				Acenaphthene	1.7E-04	mg/kg	1.3E-09	mg/kg-day	--	--	--	4.6E-09	mg/kg-day	6.0E-02	mg/kg-day	7.7E-08
				Acenaphthylene	4.3E-04	mg/kg	3.3E-09	mg/kg-day	--	--	--	1.1E-08	mg/kg-day	6.0E-02	mg/kg-day	1.9E-07
				Anthracene	1.4E-03	mg/kg	1.0E-08	mg/kg-day	--	--	--	3.6E-08	mg/kg-day	3.0E-01	mg/kg-day	1.2E-07
				Fluorene	2.6E-04	mg/kg	2.0E-09	mg/kg-day	--	--	--	6.9E-09	mg/kg-day	4.0E-02	mg/kg-day	1.7E-07
				Phenanthrene	2.6E-03	mg/kg	2.0E-08	mg/kg-day	--	--	--	6.9E-08	mg/kg-day	3.0E-01	mg/kg-day	2.3E-07
				Benzo(a)anthracene	4.8E-03	mg/kg	3.6E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	4.4E-08	1.3E-07	mg/kg-day	--	--	--
				Benzo(a)pyrene	6.6E-03	mg/kg	5.0E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	3.6E-07	1.7E-07	mg/kg-day	--	--	--
				Benzo(b)fluoranthene	6.8E-03	mg/kg	5.1E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	6.2E-08	1.8E-07	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene	4.5E-03	mg/kg	3.4E-08	mg/kg-day	--	--	--	1.2E-07	mg/kg-day	3.0E-02	mg/kg-day	4.0E-06
				Benzo(k)fluoranthene	8.3E-03	mg/kg	6.3E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	7.5E-08	2.2E-07	mg/kg-day	--	--	--
				Chrysene	9.1E-03	mg/kg	6.9E-08	mg/kg-day	1.2E-01	(mg/kg-day)-1	8.3E-09	2.4E-07	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene	2.8E-04	mg/kg	2.1E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	1.5E-08	7.4E-09	mg/kg-day	--	--	--
				Fluoranthene	1.7E-02	mg/kg	1.3E-07	mg/kg-day	--	--	--	4.6E-07	mg/kg-day	4.0E-02	mg/kg-day	1.2E-05
				Indeno(1,2,3-cd)pyrene	2.7E-03	mg/kg	2.0E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	2.4E-08	7.1E-08	mg/kg-day	--	--	--
				Pyrene	2.0E-02	mg/kg	1.5E-07	mg/kg-day	--	--	--	5.2E-07	mg/kg-day	3.0E-02	mg/kg-day	1.7E-05
				Dibutyltin	3.7E-03	mg/kg	2.8E-08	mg/kg-day	--	--	--	9.9E-08	mg/kg-day	3.0E-04	mg/kg-day	3.3E-04
				Tributyltin	3.2E-02	mg/kg	2.4E-07	mg/kg-day	--	--	--	8.5E-07	mg/kg-day	3.0E-04	mg/kg-day	2.8E-03
				Total PCB Congeners	1.7E-01	mg/kg	1.3E-06	mg/kg-day	2.0E+00	(mg/kg-day)-1	2.6E-06	4.6E-06	mg/kg-day	2.0E-05	mg/kg-day	2.3E-01
				Total TEQ – PCB DLC	5.6E-06	mg/kg	4.3E-11	mg/kg-day	1.3E+05	(mg/kg-day)-1	5.5E-06	1.5E-10	mg/kg-day	7.0E-10	mg/kg-day	2.1E-01
				Total TEQ – TCDD DLC	7.8E-07	mg/kg	5.9E-12	mg/kg-day	1.3E+05	(mg/kg-day)-1	7.7E-07	2.1E-11	mg/kg-day	7.0E-10	mg/kg-day	3.0E-02
			Exp. Route Total								3.1E-04					9.4E-01
		Exposure Point Total									3.1E-04					9.4E-01
	Exposure Medium Total										3.1E-04					9.4E-01
Medium Total											3.1E-04					9.4E-01
										Total of Receptor Risks across All Media	3.3E-04				Total of Receptor Hazards across All Media	1.3E+00

TABLE A-10A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Adult and Child Recreational User, Oil Reclamation Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

							Cancer Risk Calculations					Noncancer Hazard Quotient				
					EPC		Intake/Exposure Concentration		CSF / Unit Risk			Intake/Exposure Concentration		RfD / RfC		
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	Value	Units	Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient

Notes:

[a] Macoma ingestion risks are evaluated for the adult receptor only.

Acronyms/Abbreviations:

-- =	not available or not applicable	(mg/kg-day)-1 =	1/(milligram[s] per kilogram per day)
CSF =	cancer slope factor	mg/kg =	milligram(s) per kilogram
DDD =	dichlorodiphenyldichloroethane	mg/kg-day =	milligram(s) per kilogram per day
DDE =	dichlorodiphenyldichloroethylene	PCB =	polychlorinated biphenyl
DDT =	dichlorodiphenyltrichloroethane	RfC =	reference concentration
EPC =	exposure point concentration	RfD =	reference dose
Exp. =	exposure	RME =	reasonable maximum exposure
M =	lifetime exposure from birth, mutagenic endpoint	TCDD =	tetrachlorodibenzo-p-dioxin

TABLE A-10B

Summary of Receptor Risks and Hazards - Adult and Child Recreational User, Oil Reclamation Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient			
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	Sediment	Aluminum	--	--	--	--	6.8E-02	--	2.0E-03	7.0E-02
			Antimony	--	--	--	--	6.6E-03	--	1.3E-03	7.8E-03
			Arsenic	7.7E-06	--	1.2E-06	9.0E-06	2.4E-02	--	3.5E-03	2.8E-02
			Barium	--	--	--	--	2.1E-03	--	8.7E-04	3.0E-03
			Cadmium	6.2E-07	--	8.0E-08	7.0E-07	3.7E-04	--	4.3E-05	4.1E-04
			Chromium	--	--	--	--	2.7E-04	--	6.1E-04	8.8E-04
			Cobalt	--	--	--	--	6.6E-02	--	1.9E-03	6.8E-02
			Copper	--	--	--	--	2.0E-03	--	5.8E-05	2.1E-03
			Iron	--	--	--	--	6.4E-02	--	1.9E-03	6.6E-02
			Lead	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	3.9E-03	--	1.1E-04	4.0E-03
			Mercury	--	--	--	--	4.9E-03	--	1.4E-04	5.1E-03
			Molybdenum	--	--	--	--	3.1E-04	--	9.0E-06	3.2E-04
			Nickel	--	--	--	--	6.4E-03	--	4.7E-03	1.1E-02
			Selenium	--	--	--	--	7.2E-05	--	2.1E-06	7.4E-05
			Silver	--	--	--	--	8.1E-05	--	5.9E-05	1.4E-04
			Vanadium	--	--	--	--	3.1E-02	--	3.5E-02	6.6E-02
			Zinc	--	--	--	--	5.1E-04	--	1.5E-05	5.3E-04
			4,4'-DDD	6.8E-11	--	1.1E-11	7.9E-11	5.1E-06	--	7.3E-07	5.8E-06
			4,4'-DDE	4.8E-11	--	7.6E-12	5.5E-11	2.5E-06	--	3.6E-07	2.8E-06
			4,4'-DDT	2.4E-11	--	3.8E-12	2.8E-11	1.3E-06	--	1.8E-07	1.4E-06
			alpha-Chlordane	1.4E-11	--	2.2E-12	1.6E-11	6.9E-07	--	1.0E-07	7.9E-07
			Dieldrin	7.5E-10	--	2.4E-10	9.9E-10	8.4E-06	--	2.4E-06	1.1E-05
			gamma-Chlordane	1.4E-11	--	2.3E-12	1.6E-11	7.2E-07	--	1.0E-07	8.3E-07
			2-Methylnaphthalene	--	--	--	--	2.1E-06	--	8.9E-07	2.9E-06
			Acenaphthene	--	--	--	--	9.1E-08	--	4.0E-08	1.3E-07
			Acenaphthylene	--	--	--	--	1.4E-07	--	6.2E-08	2.1E-07
			Anthracene	--	--	--	--	1.3E-07	--	5.8E-08	1.9E-07
			Fluorene	--	--	--	--	2.1E-07	--	9.2E-08	3.0E-07
			Naphthalene	--	--	--	--	7.2E-07	--	3.1E-07	1.0E-06
			Phenanthrene	--	--	--	--	3.3E-07	--	1.4E-07	4.7E-07
			Benzo(a)anthracene	7.0E-08	--	3.2E-08	1.0E-07	--	--	--	--
			Benzo(a)pyrene	6.9E-07	--	3.2E-07	1.0E-06	--	--	--	--
			Benzo(b)fluoranthene	7.8E-08	--	3.6E-08	1.1E-07	--	--	--	--
			Benzo(g,h,i)perylene	--	--	--	--	5.7E-06	--	2.5E-06	8.2E-06
			Benzo(k)fluoranthene	8.2E-08	--	3.7E-08	1.2E-07	--	--	--	--
			Chrysene	1.1E-08	--	5.2E-09	1.7E-08	--	--	--	--
			Dibenz(a,h)anthracene	7.4E-08	--	3.4E-08	1.1E-07	--	--	--	--
			Fluoranthene	--	--	--	--	5.7E-06	--	2.5E-06	8.1E-06
			Indeno(1,2,3-cd)pyrene	9.5E-08	--	4.3E-08	1.4E-07	--	--	--	--
			Pyrene	--	--	--	--	9.5E-06	--	4.1E-06	1.4E-05
			Monobutyltin	--	--	--	--	8.5E-06	--	2.5E-06	1.1E-05
			Dibutyltin	--	--	--	--	5.1E-05	--	1.5E-05	6.6E-05
			Tributyltin	--	--	--	--	1.3E-04	--	3.7E-05	1.7E-04
			Total PCB Congeners	7.2E-08	--	3.5E-08	1.1E-07	1.6E-02	--	7.0E-03	2.3E-02
			Total TEQ – PCB DLC	1.2E-07	--	1.1E-08	1.3E-07	1.2E-02	--	1.0E-03	1.3E-02
			Chemical Total	9.6E-06	--	1.9E-06	1.2E-05	3.1E-01	--	6.0E-02	3.7E-01
		Exposure Point Total					1.2E-05				3.7E-01
	Exposure Medium Total						1.2E-05				3.7E-01
Medium Total							1.2E-05				3.7E-01

TABLE A-10B

Summary of Receptor Risks and Hazards - Adult and Child Recreational User, Oil Reclamation Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk Ingestion	Cancer Risk Inhalation	Cancer Risk Dermal	Cancer Risk Exposure Routes Total	Noncancer Hazard Quotient Ingestion	Noncancer Hazard Quotient Inhalation	Noncancer Hazard Quotient Dermal	Noncancer Hazard Quotient Exposure Routes Total
Macoma	Macoma	Macoma	Aluminum	--	--	--	--	1.2E-02	--	--	1.2E-02
		(ingestion)	Antimony	--	--	--	--	2.9E-03	--	--	2.9E-03
			Arsenic	2.8E-04	--	--	2.8E-04	3.5E-01	--	--	3.5E-01
			Barium	--	--	--	--	4.9E-04	--	--	4.9E-04
			Cadmium	2.3E-05	--	--	2.3E-05	5.3E-03	--	--	5.3E-03
			Chromium	--	--	--	--	8.3E-05	--	--	8.3E-05
			Cobalt	--	--	--	--	4.0E-02	--	--	4.0E-02
			Copper	--	--	--	--	2.4E-03	--	--	2.4E-03
			Iron	--	--	--	--	2.3E-02	--	--	2.3E-02
			Lead	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	1.5E-03	--	--	1.5E-03
			Mercury	--	--	--	--	6.5E-03	--	--	6.5E-03
			Molybdenum	--	--	--	--	2.7E-03	--	--	2.7E-03
			Nickel	--	--	--	--	2.6E-03	--	--	2.6E-03
			Selenium	--	--	--	--	4.6E-03	--	--	4.6E-03
			Silver	--	--	--	--	2.0E-04	--	--	2.0E-04
			Vanadium	--	--	--	--	1.1E-02	--	--	1.1E-02
			Zinc	--	--	--	--	1.7E-03	--	--	1.7E-03
			4,4'-DDD	2.1E-09	--	--	2.1E-09	6.2E-05	--	--	6.2E-05
			4,4'-DDE	5.7E-09	--	--	5.7E-09	1.2E-04	--	--	1.2E-04
			4,4'-DDT	1.8E-10	--	--	1.8E-10	3.7E-06	--	--	3.7E-06
			alpha-Chlordane	7.4E-10	--	--	7.4E-10	1.5E-05	--	--	1.5E-05
			Dieldrin	3.2E-08	--	--	3.2E-08	1.4E-04	--	--	1.4E-04
			gamma-Chlordane	8.9E-10	--	--	8.9E-10	1.8E-05	--	--	1.8E-05
			Acenaphthene	--	--	--	--	7.7E-08	--	--	7.7E-08
			Acenaphthylene	--	--	--	--	1.9E-07	--	--	1.9E-07
			Anthracene	--	--	--	--	1.2E-07	--	--	1.2E-07
			Fluorene	--	--	--	--	1.7E-07	--	--	1.7E-07
			Phenanthrene	--	--	--	--	2.3E-07	--	--	2.3E-07
			Benzo(a)anthracene	4.4E-08	--	--	4.4E-08	--	--	--	--
			Benzo(a)pyrene	3.6E-07	--	--	3.6E-07	--	--	--	--
			Benzo(b)fluoranthene	6.2E-08	--	--	6.2E-08	--	--	--	--
			Benzo(g,h,i)perylene	--	--	--	--	4.0E-06	--	--	4.0E-06
			Benzo(k)fluoranthene	7.5E-08	--	--	7.5E-08	--	--	--	--
			Chrysene	8.3E-09	--	--	8.3E-09	--	--	--	--
			Dibenz(a,h)anthracene	1.5E-08	--	--	1.5E-08	--	--	--	--
			Fluoranthene	--	--	--	--	1.2E-05	--	--	1.2E-05
			Indeno(1,2,3-cd)pyrene	2.4E-08	--	--	2.4E-08	--	--	--	--
			Pyrene	--	--	--	--	1.7E-05	--	--	1.7E-05
			Dibutyltin	--	--	--	--	3.3E-04	--	--	3.3E-04
			Tributyltin	--	--	--	--	2.8E-03	--	--	2.8E-03
			Total PCB Congeners	2.6E-06	--	--	2.6E-06	2.3E-01	--	--	2.3E-01
			Total TEQ – PCB DLC	5.5E-06	--	--	5.5E-06	2.1E-01	--	--	2.1E-01
			Chemical Total	3.1E-04	--	--	3.1E-04	9.1E-01	--	--	9.1E-01
		Exposure Point Total					3.1E-04				9.1E-01
	Exposure Medium Total						3.1E-04				9.1E-01
Medium Total							3.1E-04				9.1E-01
Receptor Total						Total Risk across All Media	3.2E-04			Total Hazard across All Media	1.3E+00

Acronyms/Abbreviations:

-- =	not available or not applicable	DDT =	dichlorodiphenyltrichloroethane
DDD =	dichlorodiphenyldichloroethane	PCB =	polychlorinated biphenyl
DDE =	dichlorodiphenyldichloroethylene	TCDD =	tetrachlorodibenzo-p-dioxin

TABLE A-10C

Summary of Risk Drivers - Adult and Child Recreational User, Oil Reclamation Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Chilc

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk Ingestion	Cancer Risk Inhalation	Cancer Risk Dermal	Cancer Risk Exposure Routes Total	Noncancer Hazard Quotient Ingestion	Noncancer Hazard Quotient Inhalation	Noncancer Hazard Quotient Dermal	Noncancer Hazard Quotient Exposure Routes Total
Sediment	Sediment	Sediment	BAP (EQ)*	9.4E-07	--	4.7E-07	1.4E-06	--	--	--	--
		(Oral/Dermal)	Arsenic	7.7E-06	--	1.2E-06	9.0E-06	2.4E-02	--	3.5E-03	2.8E-02
			Chemical Total	8.7E-06	--	1.7E-06	1.0E-05	2.4E-02	--	3.5E-03	2.8E-02
		Exposure Point Total					1.0E-05				2.8E-02
	Exposure Medium Total						1.0E-05				2.8E-02
Medium Total							1.0E-05				2.8E-02
Macoma	Macoma	Macoma	Arsenic	2.8E-04	--	--	2.8E-04	3.5E-01	--	--	3.5E-01
		(Oral)	Cadmium	2.3E-05	--	--	2.3E-05	5.3E-03	--	--	5.3E-03
			Total PCB Congeners	2.6E-06	--	--	2.6E-06	2.3E-01	--	--	2.3E-01
			Total TEQ – PCB DLC	5.5E-06	--	--	5.5E-06	2.1E-01	--	--	2.1E-01
			Total TEQ – TCDD DLC	7.7E-07	--	--	7.7E-07	3.0E-02	--	--	3.0E-02
			Chemical Total	3.1E-04	--	--	3.1E-04	8.2E-01	--	--	8.2E-01
		Exposure Point Total					3.1E-04				8.2E-01
	Exposure Medium Total						3.1E-04				8.2E-01
Medium Total							3.1E-04				8.2E-01
Receptor Total						Total Risk across All Media	3.2E-04			Total Hazard across All Media	8.5E-01

Notes:

* Risk for benzo(a)pyrene equivalent (BAP [EQ]) is calculated by summing the risks for each of the individual potentially carcinogenic PAHs: benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene.

Acronyms/Abbreviations:

-- = not available or not applicable

BAP (EQ) = benzo(a)pyrene equivalent

PAH = polycyclic aromatic hydrocarbon

PCB = polychlorinated biphenyl

TABLE A-11A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Construction Worker, Oil Reclamation Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Noncancer Hazard Quotient				
							Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	Sediment	Ingestion	Aluminum	7.2E+04	mg/kg	2.9E-03	mg/kg-day	--	--	--	2.0E-01	mg/kg-day	1.0E+00	mg/kg-day	2.0E-01
				Antimony	2.8E+00	mg/kg	1.1E-07	mg/kg-day	--	--	--	7.8E-06	mg/kg-day	4.0E-04	mg/kg-day	2.0E-02
				Arsenic	1.3E+01	mg/kg	3.1E-07	mg/kg-day	9.5E+00	(mg/kg-day)-1	2.9E-06	2.1E-05	mg/kg-day	3.0E-04	mg/kg-day	7.2E-02
				Barium	4.4E+02	mg/kg	1.8E-05	mg/kg-day	--	--	--	1.2E-03	mg/kg-day	2.0E-01	mg/kg-day	6.2E-03
				Cadmium	3.9E-01	mg/kg	1.6E-08	mg/kg-day	1.5E+01	(mg/kg-day)-1	2.3E-07	1.1E-06	mg/kg-day	1.0E-03	mg/kg-day	1.1E-03
				Chromium	4.3E+02	mg/kg	1.7E-05	mg/kg-day	--	--	--	1.2E-03	mg/kg-day	1.5E+00	mg/kg-day	8.1E-04
				Cobalt	2.1E+01	mg/kg	8.4E-07	mg/kg-day	--	--	--	5.9E-05	mg/kg-day	3.0E-04	mg/kg-day	2.0E-01
				Copper	8.4E+01	mg/kg	3.4E-06	mg/kg-day	--	--	--	2.4E-04	mg/kg-day	4.0E-02	mg/kg-day	6.0E-03
				Iron	4.7E+04	mg/kg	1.9E-03	mg/kg-day	--	--	--	1.3E-01	mg/kg-day	7.0E-01	mg/kg-day	1.9E-01
				Lead	5.4E+01	mg/kg	2.2E-06	mg/kg-day	--	--	--	1.5E-04	mg/kg-day	--	--	--
				Manganese	5.7E+02	mg/kg	2.3E-05	mg/kg-day	--	--	--	1.6E-03	mg/kg-day	1.4E-01	mg/kg-day	1.2E-02
				Mercury	5.2E-01	mg/kg	2.1E-08	mg/kg-day	--	--	--	1.5E-06	mg/kg-day	1.0E-04	mg/kg-day	1.5E-02
				Molybdenum	1.6E+00	mg/kg	6.6E-08	mg/kg-day	--	--	--	4.6E-06	mg/kg-day	5.0E-03	mg/kg-day	9.2E-04
				Nickel	1.4E+02	mg/kg	5.5E-06	mg/kg-day	--	--	--	3.8E-04	mg/kg-day	2.0E-02	mg/kg-day	1.9E-02
				Selenium	3.8E-01	mg/kg	1.5E-08	mg/kg-day	--	--	--	1.1E-06	mg/kg-day	5.0E-03	mg/kg-day	2.1E-04
				Silver	4.3E-01	mg/kg	1.7E-08	mg/kg-day	--	--	--	1.2E-06	mg/kg-day	5.0E-03	mg/kg-day	2.4E-04
				Vanadium	1.6E+02	mg/kg	6.6E-06	mg/kg-day	--	--	--	4.6E-04	mg/kg-day	5.0E-03	mg/kg-day	9.2E-02
				Zinc	1.6E+02	mg/kg	6.5E-06	mg/kg-day	--	--	--	4.6E-04	mg/kg-day	3.0E-01	mg/kg-day	1.5E-03
				4,4'-DDD	2.7E-03	mg/kg	1.1E-10	mg/kg-day	2.4E-01	(mg/kg-day)-1	2.6E-11	7.5E-09	mg/kg-day	5.0E-04	mg/kg-day	1.5E-05
				4,4'-DDE	1.3E-03	mg/kg	5.3E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	1.8E-11	3.7E-09	mg/kg-day	5.0E-04	mg/kg-day	7.4E-06
				4,4'-DDT	6.6E-04	mg/kg	2.7E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	9.0E-12	1.9E-09	mg/kg-day	5.0E-04	mg/kg-day	3.7E-06
				alpha-Chlordane	3.6E-04	mg/kg	1.5E-11	mg/kg-day	3.5E-01	(mg/kg-day)-1	5.1E-12	1.0E-09	mg/kg-day	5.0E-04	mg/kg-day	2.0E-06
				Dieldrin	4.4E-04	mg/kg	1.8E-11	mg/kg-day	1.6E+01	(mg/kg-day)-1	2.8E-10	1.2E-09	mg/kg-day	5.0E-05	mg/kg-day	2.5E-05
				gamma-Chlordane	3.8E-04	mg/kg	1.5E-11	mg/kg-day	3.5E-01	(mg/kg-day)-1	5.4E-12	1.1E-09	mg/kg-day	5.0E-04	mg/kg-day	2.1E-06
				2-Methylnaphthalene	8.7E-03	mg/kg	3.5E-10	mg/kg-day	--	--	--	2.4E-08	mg/kg-day	4.0E-03	mg/kg-day	6.1E-06
				Acenaphthene	5.8E-03	mg/kg	2.3E-10	mg/kg-day	--	--	--	1.6E-08	mg/kg-day	6.0E-02	mg/kg-day	2.7E-07
				Acenaphthylene	9.1E-03	mg/kg	3.7E-10	mg/kg-day	--	--	--	2.6E-08	mg/kg-day	6.0E-02	mg/kg-day	4.3E-07
				Anthracene	4.2E-02	mg/kg	1.7E-09	mg/kg-day	--	--	--	1.2E-07	mg/kg-day	3.0E-01	mg/kg-day	4.0E-07
				Fluorene	8.9E-03	mg/kg	3.6E-10	mg/kg-day	--	--	--	2.5E-08	mg/kg-day	4.0E-02	mg/kg-day	6.3E-07
				Naphthalene	1.5E-02	mg/kg	6.1E-10	mg/kg-day	--	--	--	4.3E-08	mg/kg-day	2.0E-02	mg/kg-day	2.1E-06
				Phenanthrene	1.0E-01	mg/kg	4.2E-09	mg/kg-day	--	--	--	2.9E-07	mg/kg-day	3.0E-01	mg/kg-day	9.7E-07
				Benzo(a)anthracene	1.2E-01	mg/kg	4.8E-09	mg/kg-day	1.2E+00	(mg/kg-day)-1	5.8E-09	3.4E-07	mg/kg-day	--	--	--
				Benzo(a)pyrene	2.0E-01	mg/kg	7.9E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	5.8E-08	5.5E-07	mg/kg-day	--	--	--
				Benzo(b)fluoranthene	1.3E-01	mg/kg	5.4E-09	mg/kg-day	1.2E+00	(mg/kg-day)-1	6.5E-09	3.8E-07	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene	1.8E-01	mg/kg	7.3E-09	mg/kg-day	--	--	--	5.1E-07	mg/kg-day	3.0E-02	mg/kg-day	1.7E-05
				Benzo(k)fluoranthene	1.4E-01	mg/kg	5.7E-09	mg/kg-day	1.2E+00	(mg/kg-day)-1	6.8E-09	4.0E-07	mg/kg-day	--	--	--
				Chrysene	2.0E-01	mg/kg	7.9E-09	mg/kg-day	1.2E-01	(mg/kg-day)-1	9.4E-10	5.5E-07	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene	2.1E-02	mg/kg	8.5E-10	mg/kg-day	7.3E+00	(mg/kg-day)-1	6.2E-09	5.9E-08	mg/kg-day	--	--	--
				Fluoranthene	2.4E-01	mg/kg	9.6E-09	mg/kg-day	--	--	--	6.8E-07	mg/kg-day	4.0E-02	mg/kg-day	1.7E-05
				Indeno(1,2,3-cd)pyrene	1.6E-01	mg/kg	6.6E-09	mg/kg-day	1.2E+00	(mg/kg-day)-1	7.9E-09	4.6E-07	mg/kg-day	--	--	--
				Pyrene	3.0E-01	mg/kg	1.2E-08	mg/kg-day	--	--	--	8.4E-07	mg/kg-day	3.0E-02	mg/kg-day	2.8E-05
				Monobutyltin	2.7E-03	mg/kg	1.1E-10	mg/kg-day	--	--	--	7.6E-09	mg/kg-day	3.0E-04	mg/kg-day	2.5E-05
				Dibutyltin	1.6E-02	mg/kg	6.5E-10	mg/kg-day	--	--	--	4.5E-08	mg/kg-day	3.0E-04	mg/kg-day	1.5E-04
				Tributyltin	4.1E-02	mg/kg	1.6E-09	mg/kg-day	--	--	--	1.1E-07	mg/kg-day	3.0E-04	mg/kg-day	3.8E-04
				Total PCB Congeners	3.4E-01	mg/kg	1.4E-08	mg/kg-day	2.0E+00	(mg/kg-day)-1	2.7E-08	9.6E-07	mg/kg-day	2.0E-05	mg/kg-day	4.8E-02
				Total TEQ – PCB DLC	8.5E-06	mg/kg	3.4E-13	mg/kg-day	1.3E+05	(mg/kg-day)-1	4.5E-08	2.4E-11	mg/kg-day	7.0E-10	mg/kg-day	3.4E-02
			Exp. Route Total								3.3E-06					9.2E-01

TABLE A-11A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Construction Worker, Oil Reclamation Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Noncancer Hazard Quotient				
							Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	Sediment	Dermal	Aluminum	7.2E+04	mg/kg	4.2E-04	mg/kg-day	--	--	--	3.0E-02	mg/kg-day	1.0E+00	mg/kg-day	3.0E-02
				Antimony	2.8E+00	mg/kg	1.6E-08	mg/kg-day	--	--	--	1.1E-06	mg/kg-day	6.0E-05	mg/kg-day	1.9E-02
				Arsenic	1.3E+01	mg/kg	2.2E-07	mg/kg-day	9.5E+00	(mg/kg-day)-1	2.1E-06	1.6E-05	mg/kg-day	3.0E-04	mg/kg-day	5.2E-02
				Barium	4.4E+02	mg/kg	2.6E-06	mg/kg-day	--	--	--	1.8E-04	mg/kg-day	1.4E-02	mg/kg-day	1.3E-02
				Cadmium	3.9E-01	mg/kg	2.3E-10	mg/kg-day	6.0E+02	(mg/kg-day)-1	1.4E-07	1.6E-08	mg/kg-day	2.5E-05	mg/kg-day	6.4E-04
				Chromium	4.3E+02	mg/kg	2.5E-06	mg/kg-day	--	--	--	1.8E-04	mg/kg-day	2.0E-02	mg/kg-day	9.1E-03
				Cobalt	2.1E+01	mg/kg	1.2E-07	mg/kg-day	--	--	--	8.6E-06	mg/kg-day	3.0E-04	mg/kg-day	2.9E-02
				Copper	8.4E+01	mg/kg	5.0E-07	mg/kg-day	--	--	--	3.5E-05	mg/kg-day	4.0E-02	mg/kg-day	8.7E-04
				Iron	4.7E+04	mg/kg	2.8E-04	mg/kg-day	--	--	--	2.0E-02	mg/kg-day	7.0E-01	mg/kg-day	2.8E-02
				Lead	5.4E+01	mg/kg	3.2E-07	mg/kg-day	--	--	--	2.3E-05	mg/kg-day	--	--	--
				Manganese	5.7E+02	mg/kg	3.4E-06	mg/kg-day	--	--	--	2.4E-04	mg/kg-day	1.4E-01	mg/kg-day	1.7E-03
				Mercury	5.2E-01	mg/kg	3.1E-09	mg/kg-day	--	--	--	2.1E-07	mg/kg-day	1.0E-04	mg/kg-day	2.1E-03
				Molybdenum	1.6E+00	mg/kg	9.6E-09	mg/kg-day	--	--	--	6.7E-07	mg/kg-day	5.0E-03	mg/kg-day	1.3E-04
				Nickel	1.4E+02	mg/kg	8.0E-07	mg/kg-day	--	--	--	5.6E-05	mg/kg-day	8.0E-04	mg/kg-day	7.0E-02
				Selenium	3.8E-01	mg/kg	2.2E-09	mg/kg-day	--	--	--	1.6E-07	mg/kg-day	5.0E-03	mg/kg-day	3.1E-05
				Silver	4.3E-01	mg/kg	2.5E-09	mg/kg-day	--	--	--	1.8E-07	mg/kg-day	2.0E-04	mg/kg-day	8.8E-04
				Vanadium	1.6E+02	mg/kg	9.6E-07	mg/kg-day	--	--	--	6.7E-05	mg/kg-day	1.3E-04	mg/kg-day	5.2E-01
				Zinc	1.6E+02	mg/kg	9.6E-07	mg/kg-day	--	--	--	6.7E-05	mg/kg-day	3.0E-01	mg/kg-day	2.2E-04
				4,4'-DDD	2.7E-03	mg/kg	7.8E-11	mg/kg-day	2.4E-01	(mg/kg-day)-1	1.9E-11	5.5E-09	mg/kg-day	5.0E-04	mg/kg-day	1.1E-05
				4,4'-DDE	1.3E-03	mg/kg	3.9E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	1.3E-11	2.7E-09	mg/kg-day	5.0E-04	mg/kg-day	5.4E-06
				4,4'-DDT	6.6E-04	mg/kg	1.9E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	6.6E-12	1.4E-09	mg/kg-day	5.0E-04	mg/kg-day	2.7E-06
				alpha-Chlordane	3.6E-04	mg/kg	1.1E-11	mg/kg-day	3.5E-01	(mg/kg-day)-1	3.7E-12	7.5E-10	mg/kg-day	5.0E-04	mg/kg-day	1.5E-06
				Dieldrin	4.4E-04	mg/kg	2.6E-11	mg/kg-day	1.6E+01	(mg/kg-day)-1	4.2E-10	1.8E-09	mg/kg-day	5.0E-05	mg/kg-day	3.6E-05
				gamma-Chlordane	3.8E-04	mg/kg	1.1E-11	mg/kg-day	3.5E-01	(mg/kg-day)-1	3.9E-12	7.8E-10	mg/kg-day	5.0E-04	mg/kg-day	1.6E-06
				2-Methylnaphthalene	8.7E-03	mg/kg	7.7E-10	mg/kg-day	--	--	--	5.4E-08	mg/kg-day	4.0E-03	mg/kg-day	1.3E-05
				Acenaphthene	5.8E-03	mg/kg	5.1E-10	mg/kg-day	--	--	--	3.6E-08	mg/kg-day	6.0E-02	mg/kg-day	5.9E-07
				Acenaphthylene	9.1E-03	mg/kg	8.0E-10	mg/kg-day	--	--	--	5.6E-08	mg/kg-day	6.0E-02	mg/kg-day	9.4E-07
				Anthracene	4.2E-02	mg/kg	3.8E-09	mg/kg-day	--	--	--	2.6E-07	mg/kg-day	3.0E-01	mg/kg-day	8.8E-07
				Fluorene	8.9E-03	mg/kg	7.9E-10	mg/kg-day	--	--	--	5.5E-08	mg/kg-day	4.0E-02	mg/kg-day	1.4E-06
				Naphthalene	1.5E-02	mg/kg	1.3E-09	mg/kg-day	--	--	--	9.4E-08	mg/kg-day	2.0E-02	mg/kg-day	4.7E-06
				Phenanthrene	1.0E-01	mg/kg	9.1E-09	mg/kg-day	--	--	--	6.4E-07	mg/kg-day	3.0E-01	mg/kg-day	2.1E-06
				Benzo(a)anthracene	1.2E-01	mg/kg	1.1E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.3E-08	7.4E-07	mg/kg-day	--	--	--
				Benzo(a)pyrene	2.0E-01	mg/kg	1.7E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	1.3E-07	1.2E-06	mg/kg-day	--	--	--
				Benzo(b)fluoranthene	1.3E-01	mg/kg	1.2E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.4E-08	8.3E-07	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene	1.8E-01	mg/kg	1.6E-08	mg/kg-day	--	--	--	1.1E-06	mg/kg-day	3.0E-02	mg/kg-day	3.7E-05
				Benzo(k)fluoranthene	1.4E-01	mg/kg	1.2E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.5E-08	8.7E-07	mg/kg-day	--	--	--
				Chrysene	2.0E-01	mg/kg	1.7E-08	mg/kg-day	1.2E-01	(mg/kg-day)-1	2.1E-09	1.2E-06	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene	2.1E-02	mg/kg	1.9E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	1.4E-08	1.3E-07	mg/kg-day	--	--	--
				Fluoranthene	2.4E-01	mg/kg	2.1E-08	mg/kg-day	--	--	--	1.5E-06	mg/kg-day	4.0E-02	mg/kg-day	3.7E-05
				Indeno(1,2,3-cd)pyrene	1.6E-01	mg/kg	1.4E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.7E-08	1.0E-06	mg/kg-day	--	--	--
				Pyrene	3.0E-01	mg/kg	2.6E-08	mg/kg-day	--	--	--	1.9E-06	mg/kg-day	3.0E-02	mg/kg-day	6.2E-05
				Monobutyltin	2.7E-03	mg/kg	1.6E-10	mg/kg-day	--	--	--	1.1E-08	mg/kg-day	3.0E-04	mg/kg-day	3.7E-05
				Dibutyltin	1.6E-02	mg/kg	9.5E-10	mg/kg-day	--	--	--	6.7E-08	mg/kg-day	3.0E-04	mg/kg-day	2.2E-04
				Tributyltin	4.1E-02	mg/kg	2.4E-09	mg/kg-day	--	--	--	1.7E-07	mg/kg-day	3.0E-04	mg/kg-day	5.6E-04
				Total PCB Congeners	3.4E-01	mg/kg	3.0E-08	mg/kg-day	2.0E+00	(mg/kg-day)-1	6.0E-08	2.1E-06	mg/kg-day	2.0E-05	mg/kg-day	1.1E-01
				Total TEQ – PCB DLC	8.5E-06	mg/kg	1.5E-13	mg/kg-day	1.3E+05	(mg/kg-day)-1	2.0E-08	1.1E-11	mg/kg-day	7.0E-10	mg/kg-day	1.5E-02
			Exp. Route Total								2.6E-06					9.0E-01
		Exposure Point Total									5.9E-06					1.8E+00
	Exposure Medium Total										5.9E-06					1.8E+00
Medium Total											5.9E-06					1.8E+00
										Total of Receptor Risks across All Media	5.9E-06				Total of Receptor Hazards across All Media	1.8E+00

TABLE A-11A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Construction Worker, Oil Reclamation Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Noncancer Hazard Quotient				
							Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	

Acronyms/Abbreviations:

-- =	not available or not applicable
CSF =	cancer slope factor
DDD =	dichlorodiphenyldichloroethane
DDE =	dichlorodiphenyldichloroethylene
DDT =	dichlorodiphenyltrichloroethane
EPC =	exposure point concentration
Exp. =	exposure
M =	lifetime exposure from birth, mutagenic endpoint
(mg/kg-day)-	1/(milligram[s] per kilogram per day)
mg/kg =	milligram(s) per kilogram
mg/kg-day =	milligram(s) per kilogram per day
PCB =	polychlorinated biphenyl
RfC =	reference concentration
RfD =	reference dose
RME =	reasonable maximum exposure
TCDD =	tetrachlorodibenzo-p-dioxin

TABLE A-11B

Summary of Receptor Risks and Hazards - Construction Worker, Oil Reclamation Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient			
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	Sediment	Aluminum	--	--	--	--	2.0E-01	--	3.0E-02	2.3E-01
			Antimony	--	--	--	--	2.0E-02	--	1.9E-02	3.9E-02
			Arsenic	2.9E-06	--	2.1E-06	5.1E-06	7.2E-02	--	5.2E-02	1.2E-01
			Barium	--	--	--	--	6.2E-03	--	1.3E-02	1.9E-02
			Cadmium	2.3E-07	--	1.4E-07	3.7E-07	1.1E-03	--	6.4E-04	1.7E-03
			Chromium	--	--	--	--	8.1E-04	--	9.1E-03	9.9E-03
			Cobalt	--	--	--	--	2.0E-01	--	2.9E-02	2.2E-01
			Copper	--	--	--	--	6.0E-03	--	8.7E-04	6.8E-03
			Iron	--	--	--	--	1.9E-01	--	2.8E-02	2.2E-01
			Lead	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	1.2E-02	--	1.7E-03	1.3E-02
			Mercury	--	--	--	--	1.5E-02	--	2.1E-03	1.7E-02
			Molybdenum	--	--	--	--	9.2E-04	--	1.3E-04	1.1E-03
			Nickel	--	--	--	--	1.9E-02	--	7.0E-02	8.9E-02
			Selenium	--	--	--	--	2.1E-04	--	3.1E-05	2.4E-04
			Silver	--	--	--	--	2.4E-04	--	8.8E-04	1.1E-03
			Vanadium	--	--	--	--	9.2E-02	--	5.2E-01	6.1E-01
			Zinc	--	--	--	--	1.5E-03	--	2.2E-04	1.7E-03
			4,4'-DDD	2.6E-11	--	1.9E-11	4.5E-11	1.5E-05	--	1.1E-05	2.6E-05
			4,4'-DDE	1.8E-11	--	1.3E-11	3.1E-11	7.4E-06	--	5.4E-06	1.3E-05
			4,4'-DDT	9.0E-12	--	6.6E-12	1.6E-11	3.7E-06	--	2.7E-06	6.4E-06
			alpha-Chlordane	5.1E-12	--	3.7E-12	8.8E-12	2.0E-06	--	1.5E-06	3.5E-06
			Dieldrin	2.8E-10	--	4.2E-10	7.0E-10	2.5E-05	--	3.6E-05	6.1E-05
			gamma-Chlordane	5.4E-12	--	3.9E-12	9.3E-12	2.1E-06	--	1.6E-06	3.7E-06
			2-Methylnaphthalene	--	--	--	--	6.1E-06	--	1.3E-05	2.0E-05
			Acenaphthene	--	--	--	--	2.7E-07	--	5.9E-07	8.7E-07
			Acenaphthylene	--	--	--	--	4.3E-07	--	9.4E-07	1.4E-06
			Anthracene	--	--	--	--	4.0E-07	--	8.8E-07	1.3E-06
			Fluorene	--	--	--	--	6.3E-07	--	1.4E-06	2.0E-06
			Naphthalene	--	--	--	--	2.1E-06	--	4.7E-06	6.9E-06
			Phenanthrene	--	--	--	--	9.7E-07	--	2.1E-06	3.1E-06
			Benzo(a)anthracene	5.8E-09	--	1.3E-08	1.9E-08	--	--	--	--
			Benzo(a)pyrene	5.8E-08	--	1.3E-07	1.8E-07	--	--	--	--
			Benzo(b)fluoranthene	6.5E-09	--	1.4E-08	2.1E-08	--	--	--	--
			Benzo(g,h,i)perylene	--	--	--	--	1.7E-05	--	3.7E-05	5.4E-05
			Benzo(k)fluoranthene	6.8E-09	--	1.5E-08	2.2E-08	--	--	--	--
			Chrysene	9.4E-10	--	2.1E-09	3.0E-09	--	--	--	--
			Dibenz(a,h)anthracene	6.2E-09	--	1.4E-08	2.0E-08	--	--	--	--
			Fluoranthene	--	--	--	--	1.7E-05	--	3.7E-05	5.4E-05
			Indeno(1,2,3-cd)pyrene	7.9E-09	--	1.7E-08	2.5E-08	--	--	--	--
			Pyrene	--	--	--	--	2.8E-05	--	6.2E-05	9.0E-05
			Monobutyltin	--	--	--	--	2.5E-05	--	3.7E-05	6.2E-05
			Dibutyltin	--	--	--	--	1.5E-04	--	2.2E-04	3.7E-04
			Tributyltin	--	--	--	--	3.8E-04	--	5.6E-04	9.4E-04
			Total PCB Congeners	2.7E-08	--	6.0E-08	8.7E-08	4.8E-02	--	1.1E-01	1.5E-01
			Chemical Total	3.3E-06	--	2.5E-06	5.8E-06	8.8E-01	--	8.8E-01	1.8E+00
		Exposure Point Total					5.8E-06				1.8E+00
	Exposure Medium Total						5.8E-06				1.8E+00
Medium Total							5.8E-06				1.8E+00
Receptor Total						Total Risk across All Media	5.8E-06			Total Hazard across All Media	1.8E+00

Acronyms/Abbreviations:

-- =	not available or not applicable	DDT =	dichlorodiphenyltrichloroethane
DDD =	dichlorodiphenyldichloroethane	PCB =	polychlorinated biphenyl
DDE =	dichlorodiphenyldichloroethylene	TCDD =	tetrachlorodibenzo-p-dioxin

TABLE A-11C

Summary of Risk Drivers - Construction Worker, Oil Reclamation Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient			
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	Sediment	Arsenic	2.9E-06	--	2.1E-06	5.1E-06	7.2E-02	--	5.2E-02	1.2E-01
			Chemical Total	--	--	--	5.1E-06	--	--	--	1.2E-01
		Exposure Point Total					5.1E-06				1.2E-01
	Exposure Medium Total						5.1E-06				1.2E-01
Medium Total							5.1E-06				1.2E-01
Receptor Total						Total Risk across All Media	5.1E-06			Total Hazard across All Media	1.2E-01

Acronyms/Abbreviations:

-- = not available or not applicable

TABLE A-12A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Adult and Child Recreational User, Point Avisadero Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

						EPC		Cancer Risk Calculations					Noncancer Hazard Quotient				
								Intake/Exposure Concentration		CSF / Unit Risk			Intake/Exposure Concentration		RfD / RfC		
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern		Value	Units	Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Sediment	Sediment	Sediment	Ingestion	Aluminum		6.8E+04	mg/kg	7.3E-03	mg/kg-day	--	--	--	6.5E-02	mg/kg-day	1.0E+00	mg/kg-day	6.5E-02
				Antimony		5.4E+00	mg/kg	5.8E-07	mg/kg-day	--	--	--	5.2E-06	mg/kg-day	4.0E-04	mg/kg-day	1.3E-02
				Arsenic		1.2E+01	mg/kg	8.0E-07	mg/kg-day	9.5E+00	(mg/kg-day)-1	7.6E-06	7.1E-06	mg/kg-day	3.0E-04	mg/kg-day	2.4E-02
				Barium		4.8E+02	mg/kg	5.1E-05	mg/kg-day	--	--	--	4.5E-04	mg/kg-day	2.0E-01	mg/kg-day	2.3E-03
				Cadmium		3.2E-01	mg/kg	3.5E-08	mg/kg-day	1.5E+01	(mg/kg-day)-1	5.2E-07	3.1E-07	mg/kg-day	1.0E-03	mg/kg-day	3.1E-04
				Chromium		2.6E+02	mg/kg	2.7E-05	mg/kg-day	--	--	--	2.4E-04	mg/kg-day	1.5E+00	mg/kg-day	1.6E-04
				Cobalt		1.8E+01	mg/kg	1.9E-06	mg/kg-day	--	--	--	1.7E-05	mg/kg-day	3.0E-04	mg/kg-day	5.7E-02
				Copper		4.2E+02	mg/kg	4.5E-05	mg/kg-day	--	--	--	4.0E-04	mg/kg-day	4.0E-02	mg/kg-day	1.0E-02
				Iron		4.2E+04	mg/kg	4.5E-03	mg/kg-day	--	--	--	4.0E-02	mg/kg-day	7.0E-01	mg/kg-day	5.7E-02
				Lead		1.0E+02	mg/kg	1.1E-05	mg/kg-day	--	--	--	9.8E-05	mg/kg-day	--	--	--
				Manganese		5.2E+02	mg/kg	5.5E-05	mg/kg-day	--	--	--	4.9E-04	mg/kg-day	1.4E-01	mg/kg-day	3.5E-03
				Mercury		2.5E+00	mg/kg	2.7E-07	mg/kg-day	--	--	--	2.4E-06	mg/kg-day	1.0E-04	mg/kg-day	2.4E-02
				Molybdenum		1.0E+00	mg/kg	1.1E-07	mg/kg-day	--	--	--	9.8E-07	mg/kg-day	5.0E-03	mg/kg-day	2.0E-04
				Nickel		1.3E+02	mg/kg	1.4E-05	mg/kg-day	--	--	--	1.2E-04	mg/kg-day	2.0E-02	mg/kg-day	6.2E-03
				Selenium		4.3E-01	mg/kg	4.6E-08	mg/kg-day	--	--	--	4.1E-07	mg/kg-day	5.0E-03	mg/kg-day	8.1E-05
				Silver		3.0E-01	mg/kg	3.2E-08	mg/kg-day	--	--	--	2.8E-07	mg/kg-day	5.0E-03	mg/kg-day	5.6E-05
				Vanadium		1.4E+02	mg/kg	1.5E-05	mg/kg-day	--	--	--	1.3E-04	mg/kg-day	5.0E-03	mg/kg-day	2.6E-02
				Zinc		1.5E+02	mg/kg	1.6E-05	mg/kg-day	--	--	--	1.4E-04	mg/kg-day	3.0E-01	mg/kg-day	4.7E-04
				2,4'-DDD		8.4E-04	mg/kg	9.0E-11	mg/kg-day	2.4E-01	(mg/kg-day)-1	2.2E-11	8.0E-10	mg/kg-day	5.0E-04	mg/kg-day	1.6E-06
				4,4'-DDD		1.3E-03	mg/kg	1.4E-10	mg/kg-day	2.4E-01	(mg/kg-day)-1	3.3E-11	1.2E-09	mg/kg-day	5.0E-04	mg/kg-day	2.4E-06
				4,4'-DDE		1.2E-03	mg/kg	1.3E-10	mg/kg-day	3.4E-01	(mg/kg-day)-1	4.4E-11	1.1E-09	mg/kg-day	5.0E-04	mg/kg-day	2.3E-06
				4,4'-DDT		3.6E-04	mg/kg	3.8E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	1.3E-11	3.4E-10	mg/kg-day	5.0E-04	mg/kg-day	6.7E-07
				alpha-Chlordane		1.5E-04	mg/kg	1.6E-11	mg/kg-day	3.5E-01	(mg/kg-day)-1	5.6E-12	1.4E-10	mg/kg-day	5.0E-04	mg/kg-day	2.8E-07
				2-Methylnaphthalene		1.2E-02	mg/kg	1.3E-09	mg/kg-day	--	--	--	1.1E-08	mg/kg-day	4.0E-03	mg/kg-day	2.9E-06
				Acenaphthene		4.5E-02	mg/kg	4.8E-09	mg/kg-day	--	--	--	4.3E-08	mg/kg-day	6.0E-02	mg/kg-day	7.2E-07
				Acenaphthylene		3.1E-02	mg/kg	3.3E-09	mg/kg-day	--	--	--	3.0E-08	mg/kg-day	6.0E-02	mg/kg-day	4.9E-07
				Anthracene		1.8E-01	mg/kg	1.9E-08	mg/kg-day	--	--	--	1.7E-07	mg/kg-day	3.0E-01	mg/kg-day	5.7E-07
				Fluorene		4.0E-02	mg/kg	4.3E-09	mg/kg-day	--	--	--	3.8E-08	mg/kg-day	4.0E-02	mg/kg-day	9.5E-07
				Naphthalene		2.5E-02	mg/kg	2.7E-09	mg/kg-day	--	--	--	2.4E-08	mg/kg-day	2.0E-02	mg/kg-day	1.2E-06
				Phenanthrene		4.1E-01	mg/kg	4.4E-08	mg/kg-day	--	--	--	3.9E-07	mg/kg-day	3.0E-01	mg/kg-day	1.3E-06
				Benzo(a)anthracene	M	3.6E-01	mg/kg	1.8E-07	mg/kg-day	1.2E+00	(mg/kg-day)-1	2.1E-07	3.5E-07	mg/kg-day	--	--	--
				Benzo(a)pyrene	M	4.8E-01	mg/kg	2.3E-07	mg/kg-day	7.3E+00	(mg/kg-day)-1	1.7E-06	4.6E-07	mg/kg-day	--	--	--
				Benzo(b)fluoranthene	M	3.3E-01	mg/kg	1.6E-07	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.9E-07	3.1E-07	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene		3.6E-01	mg/kg	3.8E-08	mg/kg-day	--	--	--	3.4E-07	mg/kg-day	3.0E-02	mg/kg-day	1.1E-05
				Benzo(k)fluoranthene	M	3.3E-01	mg/kg	1.6E-07	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.9E-07	3.1E-07	mg/kg-day	--	--	--
				Chrysene	M	4.2E-01	mg/kg	2.1E-07	mg/kg-day	1.2E-01	(mg/kg-day)-1	2.5E-08	4.0E-07	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene	M	5.7E-02	mg/kg	2.8E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	2.0E-07	5.4E-08	mg/kg-day	--	--	--
				Fluoranthene		7.5E-01	mg/kg	8.0E-08	mg/kg-day	--	--	--	7.1E-07	mg/kg-day	4.0E-02	mg/kg-day	1.8E-05
				Indeno(1,2,3-cd)pyrene	M	3.5E-01	mg/kg	1.7E-07	mg/kg-day	1.2E+00	(mg/kg-day)-1	2.0E-07	3.3E-07	mg/kg-day	--	--	--
				Pyrene		8.9E-01	mg/kg	9.5E-08	mg/kg-day	--	--	--	8.5E-07	mg/kg-day	3.0E-02	mg/kg-day	2.8E-05
				Dibutyltin		2.4E-02	mg/kg	2.6E-09	mg/kg-day	--	--	--	2.3E-08	mg/kg-day	3.0E-04	mg/kg-day	7.6E-05
				Tributyltin		8.2E-02	mg/kg	8.8E-09	mg/kg-day	--	--	--	7.8E-08	mg/kg-day	3.0E-04	mg/kg-day	2.6E-04
				Total PCB Congeners		1.7E+00	mg/kg	1.8E-07	mg/kg-day	2.0E+00	(mg/kg-day)-1	3.6E-07	1.6E-06	mg/kg-day	2.0E-05	mg/kg-day	8.1E-02
				Total TEQ – PCB DLC		7.4E-06	mg/kg	7.9E-13	mg/kg-day	1.3E+05	(mg/kg-day)-1	1.0E-07	7.1E-12	mg/kg-day	7.0E-10	mg/kg-day	1.0E-02
			Exp. Route Total									1.1E-05					3.8E-01

TABLE A-12A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Adult and Child Recreational User, Point Avisadero Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Noncancer Hazard Quotient				
							Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	Sediment	Dermal	Aluminum	6.8E+04	mg/kg	2.4E-04	mg/kg-day	--	--	--	1.9E-03	mg/kg-day	1.0E+00	mg/kg-day	1.9E-03
				Antimony	5.4E+00	mg/kg	1.9E-08	mg/kg-day	--	--	--	1.5E-07	mg/kg-day	6.0E-05	mg/kg-day	2.5E-03
				Arsenic	1.2E+01	mg/kg	1.3E-07	mg/kg-day	9.5E+00	(mg/kg-day)-1	1.2E-06	1.0E-06	mg/kg-day	3.0E-04	mg/kg-day	3.4E-03
				Barium	4.8E+02	mg/kg	1.6E-06	mg/kg-day	--	--	--	1.3E-05	mg/kg-day	1.4E-02	mg/kg-day	9.4E-04
				Cadmium	3.2E-01	mg/kg	1.1E-10	mg/kg-day	6.0E+02	(mg/kg-day)-1	6.7E-08	8.9E-10	mg/kg-day	2.5E-05	mg/kg-day	3.6E-05
				Chromium	2.6E+02	mg/kg	8.8E-07	mg/kg-day	--	--	--	7.1E-06	mg/kg-day	2.0E-02	mg/kg-day	3.6E-04
				Cobalt	1.8E+01	mg/kg	6.2E-08	mg/kg-day	--	--	--	5.0E-07	mg/kg-day	3.0E-04	mg/kg-day	1.7E-03
				Copper	4.2E+02	mg/kg	1.5E-06	mg/kg-day	--	--	--	1.2E-05	mg/kg-day	4.0E-02	mg/kg-day	2.9E-04
				Iron	4.2E+04	mg/kg	1.4E-04	mg/kg-day	--	--	--	1.2E-03	mg/kg-day	7.0E-01	mg/kg-day	1.6E-03
				Lead	1.0E+02	mg/kg	3.6E-07	mg/kg-day	--	--	--	2.9E-06	mg/kg-day	--	--	--
				Manganese	5.2E+02	mg/kg	1.8E-06	mg/kg-day	--	--	--	1.4E-05	mg/kg-day	1.4E-01	mg/kg-day	1.0E-04
				Mercury	2.5E+00	mg/kg	8.7E-09	mg/kg-day	--	--	--	7.0E-08	mg/kg-day	1.0E-04	mg/kg-day	7.0E-04
				Molybdenum	1.0E+00	mg/kg	3.5E-09	mg/kg-day	--	--	--	2.8E-08	mg/kg-day	5.0E-03	mg/kg-day	5.7E-06
				Nickel	1.3E+02	mg/kg	4.5E-07	mg/kg-day	--	--	--	3.6E-06	mg/kg-day	8.0E-04	mg/kg-day	4.5E-03
				Selenium	4.3E-01	mg/kg	1.5E-09	mg/kg-day	--	--	--	1.2E-08	mg/kg-day	5.0E-03	mg/kg-day	2.4E-06
				Silver	3.0E-01	mg/kg	1.0E-09	mg/kg-day	--	--	--	8.1E-09	mg/kg-day	2.0E-04	mg/kg-day	4.1E-05
				Vanadium	1.4E+02	mg/kg	4.7E-07	mg/kg-day	--	--	--	3.8E-06	mg/kg-day	1.3E-04	mg/kg-day	2.9E-02
				Zinc	1.5E+02	mg/kg	5.1E-07	mg/kg-day	--	--	--	4.1E-06	mg/kg-day	3.0E-01	mg/kg-day	1.4E-05
				2,4'-DDD	8.4E-04	mg/kg	1.4E-11	mg/kg-day	2.4E-01	(mg/kg-day)-1	3.5E-12	1.2E-10	mg/kg-day	5.0E-04	mg/kg-day	2.3E-07
				4,4'-DDD	1.3E-03	mg/kg	2.2E-11	mg/kg-day	2.4E-01	(mg/kg-day)-1	5.2E-12	1.7E-10	mg/kg-day	5.0E-04	mg/kg-day	3.5E-07
				4,4'-DDE	1.2E-03	mg/kg	2.1E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	7.0E-12	1.7E-10	mg/kg-day	5.0E-04	mg/kg-day	3.3E-07
				4,4'-DDT	3.6E-04	mg/kg	6.1E-12	mg/kg-day	3.4E-01	(mg/kg-day)-1	2.1E-12	4.9E-11	mg/kg-day	5.0E-04	mg/kg-day	9.8E-08
				alpha-Chlordane	1.5E-04	mg/kg	2.6E-12	mg/kg-day	3.5E-01	(mg/kg-day)-1	9.0E-13	2.1E-11	mg/kg-day	5.0E-04	mg/kg-day	4.1E-08
				2-Methylnaphthalene	1.2E-02	mg/kg	6.2E-10	mg/kg-day	--	--	--	5.0E-09	mg/kg-day	4.0E-03	mg/kg-day	1.2E-06
				Acenaphthene	4.5E-02	mg/kg	2.3E-09	mg/kg-day	--	--	--	1.9E-08	mg/kg-day	6.0E-02	mg/kg-day	3.1E-07
				Acenaphthylene	3.1E-02	mg/kg	1.6E-09	mg/kg-day	--	--	--	1.3E-08	mg/kg-day	6.0E-02	mg/kg-day	2.1E-07
				Anthracene	1.8E-01	mg/kg	9.2E-09	mg/kg-day	--	--	--	7.4E-08	mg/kg-day	3.0E-01	mg/kg-day	2.5E-07
				Fluorene	4.0E-02	mg/kg	2.1E-09	mg/kg-day	--	--	--	1.6E-08	mg/kg-day	4.0E-02	mg/kg-day	4.1E-07
				Naphthalene	2.5E-02	mg/kg	1.3E-09	mg/kg-day	--	--	--	1.0E-08	mg/kg-day	2.0E-02	mg/kg-day	5.2E-07
				Phenanthrene	4.1E-01	mg/kg	2.1E-08	mg/kg-day	--	--	--	1.7E-07	mg/kg-day	3.0E-01	mg/kg-day	5.7E-07
				Benzo(a)anthracene M	3.6E-01	mg/kg	8.0E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	9.7E-08	1.5E-07	mg/kg-day	--	--	--
				Benzo(a)pyrene M	4.8E-01	mg/kg	1.1E-07	mg/kg-day	7.3E+00	(mg/kg-day)-1	7.8E-07	2.0E-07	mg/kg-day	--	--	--
				Benzo(b)fluoranthene M	3.3E-01	mg/kg	7.2E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	8.6E-08	1.3E-07	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene	3.6E-01	mg/kg	1.8E-08	mg/kg-day	--	--	--	1.5E-07	mg/kg-day	3.0E-02	mg/kg-day	4.9E-06
				Benzo(k)fluoranthene M	3.3E-01	mg/kg	7.3E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	8.7E-08	1.4E-07	mg/kg-day	--	--	--
				Chrysene M	4.2E-01	mg/kg	9.4E-08	mg/kg-day	1.2E-01	(mg/kg-day)-1	1.1E-08	1.8E-07	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene M	5.7E-02	mg/kg	1.3E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	9.2E-08	2.4E-08	mg/kg-day	--	--	--
				Fluoranthene	7.5E-01	mg/kg	3.9E-08	mg/kg-day	--	--	--	3.1E-07	mg/kg-day	4.0E-02	mg/kg-day	7.7E-06
				Indeno(1,2,3-cd)pyrene M	3.5E-01	mg/kg	7.8E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	9.3E-08	1.5E-07	mg/kg-day	--	--	--
				Pyrene	8.9E-01	mg/kg	4.6E-08	mg/kg-day	--	--	--	3.7E-07	mg/kg-day	3.0E-02	mg/kg-day	1.2E-05
				Dibutyltin	2.4E-02	mg/kg	8.2E-10	mg/kg-day	--	--	--	6.6E-09	mg/kg-day	3.0E-04	mg/kg-day	2.2E-05
				Tributyltin	8.2E-02	mg/kg	2.8E-09	mg/kg-day	--	--	--	2.3E-08	mg/kg-day	3.0E-04	mg/kg-day	7.6E-05
				Total PCB Congeners	1.7E+00	mg/kg	8.7E-08	mg/kg-day	2.0E+00	(mg/kg-day)-1	1.7E-07	7.0E-07	mg/kg-day	2.0E-05	mg/kg-day	3.5E-02
				Total TEQ – PCB DLC	7.4E-06	mg/kg	7.7E-14	mg/kg-day	1.3E+05	(mg/kg-day)-1	1.0E-08	6.1E-13	mg/kg-day	7.0E-10	mg/kg-day	8.8E-04
			Exp. Route Total								2.7E-06					8.3E-02
		Exposure Point Total									1.4E-05					4.6E-01
	Exposure Medium Total										1.4E-05					4.6E-01
Medium Total											1.4E-05					4.6E-01

TABLE A-12A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Adult and Child Recreational User, Point Avisadero Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations: Intake/Exposure Concentration		Cancer Risk Calculations: CSF / Unit Risk		Cancer Risk	Noncancer Hazard Quotient: Intake/Exposure Concentration		Noncancer Hazard Quotient: RfD / RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Macoma[a]	Macoma	Macoma	Ingestion	Aluminum	3.2E+02	mg/kg	2.4E-03	mg/kg-day	--	--	--	8.4E-03	mg/kg-day	1.0E+00	mg/kg-day	8.4E-03
				Antimony	2.6E-02	mg/kg	2.0E-07	mg/kg-day	--	--	--	6.9E-07	mg/kg-day	4.0E-04	mg/kg-day	1.7E-03
				Arsenic	3.5E+00	mg/kg	2.7E-05	mg/kg-day	9.5E+00	(mg/kg-day)-1	2.6E-04	9.4E-05	mg/kg-day	3.0E-04	mg/kg-day	3.1E-01
				Barium	3.3E+00	mg/kg	2.5E-05	mg/kg-day	--	--	--	8.8E-05	mg/kg-day	2.0E-01	mg/kg-day	4.4E-04
				Cadmium	5.0E-02	mg/kg	3.8E-07	mg/kg-day	1.5E+01	(mg/kg-day)-1	5.7E-06	1.3E-06	mg/kg-day	1.0E-03	mg/kg-day	1.3E-03
				Chromium	3.3E+00	mg/kg	2.5E-05	mg/kg-day	--	--	--	8.8E-05	mg/kg-day	1.5E+00	mg/kg-day	5.8E-05
				Cobalt	4.2E-01	mg/kg	3.2E-06	mg/kg-day	--	--	--	1.1E-05	mg/kg-day	3.0E-04	mg/kg-day	3.8E-02
				Copper	1.5E+01	mg/kg	1.1E-04	mg/kg-day	--	--	--	4.0E-04	mg/kg-day	4.0E-02	mg/kg-day	1.0E-02
				Iron	4.8E+02	mg/kg	3.7E-03	mg/kg-day	--	--	--	1.3E-02	mg/kg-day	7.0E-01	mg/kg-day	1.8E-02
				Lead	5.5E-01	mg/kg	4.2E-06	mg/kg-day	--	--	--	1.5E-05	mg/kg-day	--	--	--
				Manganese	7.5E+00	mg/kg	5.7E-05	mg/kg-day	--	--	--	2.0E-04	mg/kg-day	1.4E-01	mg/kg-day	1.4E-03
				Mercury	3.5E-01	mg/kg	2.6E-06	mg/kg-day	--	--	--	9.3E-06	mg/kg-day	1.0E-04	mg/kg-day	9.3E-02
				Molybdenum	4.6E-01	mg/kg	3.5E-06	mg/kg-day	--	--	--	1.2E-05	mg/kg-day	5.0E-03	mg/kg-day	2.4E-03
				Nickel	1.5E+00	mg/kg	1.2E-05	mg/kg-day	--	--	--	4.1E-05	mg/kg-day	2.0E-02	mg/kg-day	2.0E-03
				Selenium	7.1E-01	mg/kg	5.4E-06	mg/kg-day	--	--	--	1.9E-05	mg/kg-day	5.0E-03	mg/kg-day	3.8E-03
				Silver	2.6E-02	mg/kg	2.0E-07	mg/kg-day	--	--	--	6.9E-07	mg/kg-day	5.0E-03	mg/kg-day	1.4E-04
				Vanadium	1.5E+00	mg/kg	1.2E-05	mg/kg-day	--	--	--	4.1E-05	mg/kg-day	5.0E-03	mg/kg-day	8.2E-03
				Zinc	1.8E+01	mg/kg	1.4E-04	mg/kg-day	--	--	--	4.8E-04	mg/kg-day	3.0E-01	mg/kg-day	1.6E-03
				4,4'-DDD	5.4E-04	mg/kg	4.1E-09	mg/kg-day	2.4E-01	(mg/kg-day)-1	9.8E-10	1.4E-08	mg/kg-day	5.0E-04	mg/kg-day	2.9E-05
				4,4'-DDE	1.1E-03	mg/kg	8.1E-09	mg/kg-day	3.4E-01	(mg/kg-day)-1	2.7E-09	2.8E-08	mg/kg-day	5.0E-04	mg/kg-day	5.6E-05
				4,4'-DDT	2.6E-04	mg/kg	2.0E-09	mg/kg-day	3.4E-01	(mg/kg-day)-1	6.7E-10	6.9E-09	mg/kg-day	5.0E-04	mg/kg-day	1.4E-05
				alpha-Chlordane	1.2E-04	mg/kg	9.4E-10	mg/kg-day	3.5E-01	(mg/kg-day)-1	3.3E-10	3.3E-09	mg/kg-day	5.0E-04	mg/kg-day	6.6E-06
				Dieldrin	1.6E-04	mg/kg	1.2E-09	mg/kg-day	1.6E+01	(mg/kg-day)-1	1.9E-08	4.2E-09	mg/kg-day	5.0E-05	mg/kg-day	8.5E-05
				gamma-Chlordane	1.3E-04	mg/kg	1.0E-09	mg/kg-day	3.5E-01	(mg/kg-day)-1	3.5E-10	3.5E-09	mg/kg-day	5.0E-04	mg/kg-day	7.0E-06
				Acenaphthene	3.0E-04	mg/kg	2.3E-09	mg/kg-day	--	--	--	8.0E-09	mg/kg-day	6.0E-02	mg/kg-day	1.3E-07
				Acenaphthylene	5.2E-04	mg/kg	4.0E-09	mg/kg-day	--	--	--	1.4E-08	mg/kg-day	6.0E-02	mg/kg-day	2.3E-07
				Anthracene	3.2E-03	mg/kg	2.4E-08	mg/kg-day	--	--	--	8.5E-08	mg/kg-day	3.0E-01	mg/kg-day	2.8E-07
				Fluorene	4.5E-04	mg/kg	3.4E-09	mg/kg-day	--	--	--	1.2E-08	mg/kg-day	4.0E-02	mg/kg-day	3.0E-07
				Phenanthrene	3.3E-03	mg/kg	2.5E-08	mg/kg-day	--	--	--	8.8E-08	mg/kg-day	3.0E-01	mg/kg-day	2.9E-07
				Benzo(a)anthracene	6.1E-03	mg/kg	4.6E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	5.6E-08	1.6E-07	mg/kg-day	--	--	--
				Benzo(a)pyrene	5.4E-03	mg/kg	4.1E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	3.0E-07	1.4E-07	mg/kg-day	--	--	--
				Benzo(b)fluoranthene	5.3E-03	mg/kg	4.0E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	4.8E-08	1.4E-07	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene	3.1E-03	mg/kg	2.4E-08	mg/kg-day	--	--	--	8.4E-08	mg/kg-day	3.0E-02	mg/kg-day	2.8E-06
				Benzo(k)fluoranthene	6.3E-03	mg/kg	4.8E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	5.7E-08	1.7E-07	mg/kg-day	--	--	--
				Chrysene	7.8E-03	mg/kg	6.0E-08	mg/kg-day	1.2E-01	(mg/kg-day)-1	7.2E-09	2.1E-07	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene	2.1E-04	mg/kg	1.6E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	1.2E-08	5.7E-09	mg/kg-day	--	--	--
				Fluoranthene	2.0E-02	mg/kg	1.5E-07	mg/kg-day	--	--	--	5.4E-07	mg/kg-day	4.0E-02	mg/kg-day	1.3E-05
				Indeno(1,2,3-cd)pyrene	2.1E-03	mg/kg	1.6E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.9E-08	5.5E-08	mg/kg-day	--	--	--
				Pyrene	2.5E-02	mg/kg	1.9E-07	mg/kg-day	--	--	--	6.6E-07	mg/kg-day	3.0E-02	mg/kg-day	2.2E-05
				Monobutyltin	1.6E-03	mg/kg	1.2E-08	mg/kg-day	--	--	--	4.3E-08	mg/kg-day	3.0E-04	mg/kg-day	1.4E-04
				Dibutyltin	8.2E-03	mg/kg	6.2E-08	mg/kg-day	--	--	--	2.2E-07	mg/kg-day	3.0E-04	mg/kg-day	7.3E-04
				Tributyltin	8.1E-02	mg/kg	6.1E-07	mg/kg-day	--	--	--	2.1E-06	mg/kg-day	3.0E-04	mg/kg-day	7.2E-03
				Total PCB Congeners	2.8E-02	mg/kg	2.1E-07	mg/kg-day	2.0E+00	(mg/kg-day)-1	4.3E-07	7.5E-07	mg/kg-day	2.0E-05	mg/kg-day	3.7E-02
				Total TEQ – PCB DLC	8.2E-06	mg/kg	6.2E-11	mg/kg-day	1.3E+05	(mg/kg-day)-1	8.1E-06	2.2E-10	mg/kg-day	7.0E-10	mg/kg-day	3.1E-01
			Exp. Route Total								2.7E-04					8.6E-01
		Exposure Point Total									2.7E-04					8.6E-01
	Exposure Medium Total										2.7E-04					8.6E-01
Medium Total											2.7E-04					8.6E-01
								Total of Receptor Risks across All Media			2.8E-04	Total of Receptor Hazards across All Media				1.3E+00

TABLE A-12A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Adult and Child Recreational User, Point Avisadero Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

							Cancer Risk Calculations					Noncancer Hazard Quotient				
					EPC		Intake/Exposure Concentration		CSF / Unit Risk			Intake/Exposure Concentration		RfD / RfC		
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	Value	Units	Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient

Notes:

[a] Macoma ingestion risks are evaluated for the adult receptor only.

Acronyms/Abbreviations:

-- =	not available or not applicable	(mg/kg-day)-1 =	1/(milligram[s] per kilogram per day)
CSF =	cancer slope factor	mg/kg =	milligram(s) per kilogram
DDD =	dichlorodiphenyldichloroethane	mg/kg-day =	milligram(s) per kilogram per day
DDE =	dichlorodiphenyldichloroethylene	PCB =	polychlorinated biphenyl
DDT =	dichlorodiphenyltrichloroethane	RfC =	reference concentration
EPC =	exposure point concentration	RfD =	reference dose
Exp. =	exposure	RME =	reasonable maximum exposure
M =	lifetime exposure from birth, mutagenic endpoint	TCDD =	tetrachlorodibenzo-p-dioxin

TABLE A-12B

Summary of Receptor Risks and Hazards - Adult and Child Recreational User, Point Avisadero Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient			
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	Sediment	Aluminum	--	--	--	--	6.5E-02	--	1.9E-03	6.7E-02
			Antimony	--	--	--	--	1.3E-02	--	2.5E-03	1.5E-02
			Arsenic	7.6E-06	--	1.2E-06	8.8E-06	2.4E-02	--	3.4E-03	2.7E-02
			Barium	--	--	--	--	2.3E-03	--	9.4E-04	3.2E-03
			Cadmium	5.2E-07	--	6.7E-08	5.8E-07	3.1E-04	--	3.6E-05	3.4E-04
			Chromium	--	--	--	--	1.6E-04	--	3.6E-04	5.2E-04
			Cobalt	--	--	--	--	5.7E-02	--	1.7E-03	5.9E-02
			Copper	--	--	--	--	1.0E-02	--	2.9E-04	1.0E-02
			Iron	--	--	--	--	5.7E-02	--	1.6E-03	5.9E-02
			Lead	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	3.5E-03	--	1.0E-04	3.6E-03
			Mercury	--	--	--	--	2.4E-02	--	7.0E-04	2.5E-02
			Molybdenum	--	--	--	--	2.0E-04	--	5.7E-06	2.0E-04
			Nickel	--	--	--	--	6.2E-03	--	4.5E-03	1.1E-02
			Selenium	--	--	--	--	8.1E-05	--	2.4E-06	8.4E-05
			Silver	--	--	--	--	5.6E-05	--	4.1E-05	9.7E-05
			Vanadium	--	--	--	--	2.6E-02	--	2.9E-02	5.5E-02
			Zinc	--	--	--	--	4.7E-04	--	1.4E-05	4.8E-04
			2,4'-DDD	2.2E-11	--	3.5E-12	2.5E-11	1.6E-06	--	2.3E-07	1.8E-06
			4,4'-DDD	3.3E-11	--	5.2E-12	3.8E-11	2.4E-06	--	3.5E-07	2.8E-06
			4,4'-DDE	4.4E-11	--	7.0E-12	5.1E-11	2.3E-06	--	3.3E-07	2.6E-06
			4,4'-DDT	1.3E-11	--	2.1E-12	1.5E-11	6.7E-07	--	9.8E-08	7.7E-07
			alpha-Chlordane	5.6E-12	--	9.0E-13	6.5E-12	2.8E-07	--	4.1E-08	3.3E-07
			2-Methylnaphthalene	--	--	--	--	2.9E-06	--	1.2E-06	4.1E-06
			Acenaphthene	--	--	--	--	7.2E-07	--	3.1E-07	1.0E-06
			Acenaphthylene	--	--	--	--	4.9E-07	--	2.1E-07	7.1E-07
			Anthracene	--	--	--	--	5.7E-07	--	2.5E-07	8.1E-07
			Fluorene	--	--	--	--	9.5E-07	--	4.1E-07	1.4E-06
			Naphthalene	--	--	--	--	1.2E-06	--	5.2E-07	1.7E-06
			Phenanthrene	--	--	--	--	1.3E-06	--	5.7E-07	1.9E-06
			Benzo(a)anthracene	2.1E-07	--	9.7E-08	3.1E-07	--	--	--	--
			Benzo(a)pyrene	1.7E-06	--	7.8E-07	2.5E-06	--	--	--	--
			Benzo(b)fluoranthene	1.9E-07	--	8.6E-08	2.8E-07	--	--	--	--
			Benzo(g,h,i)perylene	--	--	--	--	1.1E-05	--	4.9E-06	1.6E-05
			Benzo(k)fluoranthene	1.9E-07	--	8.7E-08	2.8E-07	--	--	--	--
			Chrysene	2.5E-08	--	1.1E-08	3.6E-08	--	--	--	--
			Dibenz(a,h)anthracene	2.0E-07	--	9.2E-08	2.9E-07	--	--	--	--
			Fluoranthene	--	--	--	--	1.8E-05	--	7.7E-06	2.6E-05
			Indeno(1,2,3-cd)pyrene	2.0E-07	--	9.3E-08	3.0E-07	--	--	--	--
			Pyrene	--	--	--	--	2.8E-05	--	1.2E-05	4.0E-05
			Dibutyltin	--	--	--	--	7.6E-05	--	2.2E-05	9.8E-05
			Tributyltin	--	--	--	--	2.6E-04	--	7.6E-05	3.4E-04
			Total PCB Congeners	3.6E-07	--	1.7E-07	5.4E-07	8.1E-02	--	3.5E-02	1.2E-01
			Total TEQ – PCB DLC	1.0E-07	--	1.0E-08	1.1E-07	1.0E-02	--	8.8E-04	1.1E-02
			Chemical Total	1.1E-05	--	2.7E-06	1.4E-05	3.8E-01	--	8.3E-02	4.6E-01
		Exposure Point Total					1.4E-05				4.6E-01
	Exposure Medium Total						1.4E-05				4.6E-01
Medium Total							1.4E-05				4.6E-01

TABLE A-12B

Summary of Receptor Risks and Hazards - Adult and Child Recreational User, Point Avisadero Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk: Ingestion	Cancer Risk: Inhalation	Cancer Risk: Dermal	Cancer Risk: Exposure Routes Total	Noncancer Hazard Quotient: Ingestion	Noncancer Hazard Quotient: Inhalation	Noncancer Hazard Quotient: Dermal	Noncancer Hazard Quotient: Exposure Routes Total
Macoma	Macoma	Macoma	Aluminum	--	--	--	--	8.4E-03	--	--	8.4E-03
		(ingestion)	Antimony	--	--	--	--	1.7E-03	--	--	1.7E-03
			Arsenic	2.6E-04	--	--	2.6E-04	3.1E-01	--	--	3.1E-01
			Barium	--	--	--	--	4.4E-04	--	--	4.4E-04
			Cadmium	5.7E-06	--	--	5.7E-06	1.3E-03	--	--	1.3E-03
			Chromium	--	--	--	--	5.8E-05	--	--	5.8E-05
			Cobalt	--	--	--	--	3.8E-02	--	--	3.8E-02
			Copper	--	--	--	--	1.0E-02	--	--	1.0E-02
			Iron	--	--	--	--	1.8E-02	--	--	1.8E-02
			Lead	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	1.4E-03	--	--	1.4E-03
			Mercury	--	--	--	--	9.3E-02	--	--	9.3E-02
			Molybdenum	--	--	--	--	2.4E-03	--	--	2.4E-03
			Nickel	--	--	--	--	2.0E-03	--	--	2.0E-03
			Selenium	--	--	--	--	3.8E-03	--	--	3.8E-03
			Silver	--	--	--	--	1.4E-04	--	--	1.4E-04
			Vanadium	--	--	--	--	8.2E-03	--	--	8.2E-03
			Zinc	--	--	--	--	1.6E-03	--	--	1.6E-03
			4,4'-DDD	9.8E-10	--	--	9.8E-10	2.9E-05	--	--	2.9E-05
			4,4'-DDE	2.7E-09	--	--	2.7E-09	5.6E-05	--	--	5.6E-05
			4,4'-DDT	6.7E-10	--	--	6.7E-10	1.4E-05	--	--	1.4E-05
			alpha-Chlordane	3.3E-10	--	--	3.3E-10	6.6E-06	--	--	6.6E-06
			Dieldrin	1.9E-08	--	--	1.9E-08	8.5E-05	--	--	8.5E-05
			gamma-Chlordane	3.5E-10	--	--	3.5E-10	7.0E-06	--	--	7.0E-06
			Acenaphthene	--	--	--	--	1.3E-07	--	--	1.3E-07
			Acenaphthylene	--	--	--	--	2.3E-07	--	--	2.3E-07
			Anthracene	--	--	--	--	2.8E-07	--	--	2.8E-07
			Fluorene	--	--	--	--	3.0E-07	--	--	3.0E-07
			Phenanthrene	--	--	--	--	2.9E-07	--	--	2.9E-07
			Benzo(a)anthracene	5.6E-08	--	--	5.6E-08	--	--	--	--
			Benzo(a)pyrene	3.0E-07	--	--	3.0E-07	--	--	--	--
			Benzo(b)fluoranthene	4.8E-08	--	--	4.8E-08	--	--	--	--
			Benzo(g,h,i)perylene	--	--	--	--	2.8E-06	--	--	2.8E-06
			Benzo(k)fluoranthene	5.7E-08	--	--	5.7E-08	--	--	--	--
			Chrysene	7.2E-09	--	--	7.2E-09	--	--	--	--
			Dibenz(a,h)anthracene	1.2E-08	--	--	1.2E-08	--	--	--	--
			Fluoranthene	--	--	--	--	1.3E-05	--	--	1.3E-05
			Indeno(1,2,3-cd)pyrene	1.9E-08	--	--	1.9E-08	--	--	--	--
			Pyrene	--	--	--	--	2.2E-05	--	--	2.2E-05
			Monobutyltin	--	--	--	--	1.4E-04	--	--	1.4E-04
			Dibutyltin	--	--	--	--	7.3E-04	--	--	7.3E-04
			Tributyltin	--	--	--	--	7.2E-03	--	--	7.2E-03
			Total PCB Congeners	4.3E-07	--	--	4.3E-07	3.7E-02	--	--	3.7E-02
			Total TEQ – PCB DLC	8.1E-06	--	--	8.1E-06	3.1E-01	--	--	3.1E-01
			Chemical Total	2.7E-04	--	--	2.7E-04	8.6E-01	--	--	8.6E-01
		Exposure Point Total					2.7E-04				8.6E-01
	Exposure Medium Total						2.7E-04				8.6E-01
Medium Total							2.7E-04				8.6E-01
Receptor Total						Total Risk across All Media	2.8E-04			Total Hazard across All Media	1.3E+00

TABLE A-12B

Summary of Receptor Risks and Hazards - Adult and Child Recreational User, Point Avisadero Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient			
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Ingestion	Inhalation	Dermal	Exposure Routes Total

Acronyms/Abbreviations:

-- = not available or not applicable

DDD = dichlorodiphenyldichloroethane

DDE = dichlorodiphenyldichloroethylene

DDT = dichlorodiphenyltrichloroethane

PCB = polychlorinated biphenyl

TCDD = tetrachlorodibenzo-p-dioxin

TABLE A-12C

Summary of Risk Drivers - Adult and Child Recreational User, Point Avisadero Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Chilc

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk Ingestion	Cancer Risk Inhalation	Cancer Risk Dermal	Cancer Risk Exposure Routes Total	Noncancer Hazard Quotient Ingestion	Noncancer Hazard Quotient Inhalation	Noncancer Hazard Quotient Dermal	Noncancer Hazard Quotient Exposure Routes Total
Sediment	Sediment	Sediment (Oral/Dermal)	BAP (EQ)*	2.5E-06	--	1.2E-06	3.7E-06	--	--	--	--
			Arsenic	7.6E-06	--	1.2E-06	8.8E-06	2.4E-02	--	3.4E-03	2.7E-02
			Total PCB Congeners	3.6E-07	--	1.7E-07	5.4E-07	8.1E-02	--	3.5E-02	1.2E-01
			Chemical Total	1.0E-05	--	2.4E-06	1.2E-05	2.4E-02	--	3.4E-03	2.7E-02
		Exposure Point Total					1.2E-05				2.7E-02
	Exposure Medium Total						1.2E-05				2.7E-02
Medium Total							1.2E-05				2.7E-02
Macoma	Macoma	Macoma (Oral)	Arsenic	2.6E-04	--	--	2.6E-04	3.1E-01	--	--	3.1E-01
			Cadmium	5.7E-06	--	--	5.7E-06	1.3E-03	--	--	1.3E-03
			Total TEQ – PCB DLC	8.1E-06	--	--	8.1E-06	3.1E-01	--	--	3.1E-01
			Chemical Total	2.7E-04	--	--	2.7E-04	6.3E-01	--	--	6.3E-01
		Exposure Point Total					2.7E-04				6.3E-01
	Exposure Medium Total						2.7E-04				6.3E-01
Medium Total							2.7E-04				6.3E-01
Receptor Total						Total Risk across All Media	2.8E-04			Total Hazard across All Media	6.5E-01

Notes:

* Risk for benzo(a)pyrene equivalent (BAP [EQ]) is calculated by summing the risks for each of the individual potentially carcinogenic PAHs: benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene.

Acronyms/Abbreviations:

-- =	not available or not applicable	PAH =	polycyclic aromatic hydrocarbon
BAP (EQ) =	benzo(a)pyrene equivalent	PCB =	polychlorinated biphenyl

TABLE A-13A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Construction Worker, Point Avisadero Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

							Cancer Risk Calculations					Noncancer Hazard Quotient				
					EPC		Intake/Exposure Concentration		CSF / Unit Risk			Intake/Exposure Concentration		RfD / RfC		
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	Value	Units	Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Sediment	Sediment	Sediment	Ingestion	Aluminum	6.8E+04	mg/kg	2.8E-03	mg/kg-day	--	--	--	1.9E-01	mg/kg-day	1.0E+00	mg/kg-day	1.9E-01
				Antimony	5.4E+00	mg/kg	2.2E-07	mg/kg-day	--	--	--	1.5E-05	mg/kg-day	4.0E-04	mg/kg-day	3.8E-02
				Arsenic	1.2E+01	mg/kg	3.0E-07	mg/kg-day	9.5E+00	(mg/kg-day)-1	2.9E-06	2.1E-05	mg/kg-day	3.0E-04	mg/kg-day	7.0E-02
				Barium	4.8E+02	mg/kg	1.9E-05	mg/kg-day	--	--	--	1.3E-03	mg/kg-day	2.0E-01	mg/kg-day	6.7E-03
				Cadmium	3.2E-01	mg/kg	1.3E-08	mg/kg-day	1.5E+01	(mg/kg-day)-1	2.0E-07	9.1E-07	mg/kg-day	1.0E-03	mg/kg-day	9.1E-04
				Chromium	2.6E+02	mg/kg	1.0E-05	mg/kg-day	--	--	--	7.2E-04	mg/kg-day	1.5E+00	mg/kg-day	4.8E-04
				Cobalt	1.8E+01	mg/kg	7.3E-07	mg/kg-day	--	--	--	5.1E-05	mg/kg-day	3.0E-04	mg/kg-day	1.7E-01
				Copper	4.2E+02	mg/kg	1.7E-05	mg/kg-day	--	--	--	1.2E-03	mg/kg-day	4.0E-02	mg/kg-day	3.0E-02
				Iron	4.2E+04	mg/kg	1.7E-03	mg/kg-day	--	--	--	1.2E-01	mg/kg-day	7.0E-01	mg/kg-day	1.7E-01
				Lead	1.0E+02	mg/kg	4.2E-06	mg/kg-day	--	--	--	2.9E-04	mg/kg-day	--	--	--
				Manganese	5.2E+02	mg/kg	2.1E-05	mg/kg-day	--	--	--	1.5E-03	mg/kg-day	1.4E-01	mg/kg-day	1.0E-02
				Mercury	2.5E+00	mg/kg	1.0E-07	mg/kg-day	--	--	--	7.2E-06	mg/kg-day	1.0E-04	mg/kg-day	7.2E-02
				Molybdenum	1.0E+00	mg/kg	4.2E-08	mg/kg-day	--	--	--	2.9E-06	mg/kg-day	5.0E-03	mg/kg-day	5.8E-04
				Nickel	1.3E+02	mg/kg	5.2E-06	mg/kg-day	--	--	--	3.7E-04	mg/kg-day	2.0E-02	mg/kg-day	1.8E-02
				Selenium	4.3E-01	mg/kg	1.7E-08	mg/kg-day	--	--	--	1.2E-06	mg/kg-day	5.0E-03	mg/kg-day	2.4E-04
				Silver	3.0E-01	mg/kg	1.2E-08	mg/kg-day	--	--	--	8.3E-07	mg/kg-day	5.0E-03	mg/kg-day	1.7E-04
				Vanadium	1.4E+02	mg/kg	5.6E-06	mg/kg-day	--	--	--	3.9E-04	mg/kg-day	5.0E-03	mg/kg-day	7.8E-02
				Zinc	1.5E+02	mg/kg	6.0E-06	mg/kg-day	--	--	--	4.2E-04	mg/kg-day	3.0E-01	mg/kg-day	1.4E-03
				2,4'-DDD	8.4E-04	mg/kg	3.4E-11	mg/kg-day	2.4E-01	(mg/kg-day)-1	8.1E-12	2.4E-09	mg/kg-day	5.0E-04	mg/kg-day	4.7E-06
				4,4'-DDD	1.3E-03	mg/kg	5.1E-11	mg/kg-day	2.4E-01	(mg/kg-day)-1	1.2E-11	3.6E-09	mg/kg-day	5.0E-04	mg/kg-day	7.2E-06
				4,4'-DDE	1.2E-03	mg/kg	4.8E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	1.6E-11	3.4E-09	mg/kg-day	5.0E-04	mg/kg-day	6.8E-06
				4,4'-DDT	3.6E-04	mg/kg	1.4E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	4.9E-12	1.0E-09	mg/kg-day	5.0E-04	mg/kg-day	2.0E-06
				alpha-Chlordane	1.5E-04	mg/kg	6.0E-12	mg/kg-day	3.5E-01	(mg/kg-day)-1	2.1E-12	4.2E-10	mg/kg-day	5.0E-04	mg/kg-day	8.4E-07
				2-Methylnaphthalene	1.2E-02	mg/kg	4.9E-10	mg/kg-day	--	--	--	3.4E-08	mg/kg-day	4.0E-03	mg/kg-day	8.5E-06
				Acenaphthene	4.5E-02	mg/kg	1.8E-09	mg/kg-day	--	--	--	1.3E-07	mg/kg-day	6.0E-02	mg/kg-day	2.1E-06
				Acenaphthylene	3.1E-02	mg/kg	1.3E-09	mg/kg-day	--	--	--	8.8E-08	mg/kg-day	6.0E-02	mg/kg-day	1.5E-06
				Anthracene	1.8E-01	mg/kg	7.2E-09	mg/kg-day	--	--	--	5.1E-07	mg/kg-day	3.0E-01	mg/kg-day	1.7E-06
				Fluorene	4.0E-02	mg/kg	1.6E-09	mg/kg-day	--	--	--	1.1E-07	mg/kg-day	4.0E-02	mg/kg-day	2.8E-06
				Naphthalene	2.5E-02	mg/kg	1.0E-09	mg/kg-day	--	--	--	7.1E-08	mg/kg-day	2.0E-02	mg/kg-day	3.5E-06
				Phenanthrene	4.1E-01	mg/kg	1.7E-08	mg/kg-day	--	--	--	1.2E-06	mg/kg-day	3.0E-01	mg/kg-day	3.9E-06
				Benzo(a)anthracene	3.6E-01	mg/kg	1.5E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.8E-08	1.0E-06	mg/kg-day	--	--	--
				Benzo(a)pyrene	4.8E-01	mg/kg	1.9E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	1.4E-07	1.4E-06	mg/kg-day	--	--	--
				Benzo(b)fluoranthene	3.3E-01	mg/kg	1.3E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.6E-08	9.2E-07	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene	3.6E-01	mg/kg	1.4E-08	mg/kg-day	--	--	--	1.0E-06	mg/kg-day	3.0E-02	mg/kg-day	3.4E-05
				Benzo(k)fluoranthene	3.3E-01	mg/kg	1.3E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.6E-08	9.3E-07	mg/kg-day	--	--	--
				Chrysene	4.2E-01	mg/kg	1.7E-08	mg/kg-day	1.2E-01	(mg/kg-day)-1	2.1E-09	1.2E-06	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene	5.7E-02	mg/kg	2.3E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	1.7E-08	1.6E-07	mg/kg-day	--	--	--
				Fluoranthene	7.5E-01	mg/kg	3.0E-08	mg/kg-day	--	--	--	2.1E-06	mg/kg-day	4.0E-02	mg/kg-day	5.3E-05
				Indeno(1,2,3-cd)pyrene	3.5E-01	mg/kg	1.4E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.7E-08	9.9E-07	mg/kg-day	--	--	--
				Pyrene	8.9E-01	mg/kg	3.6E-08	mg/kg-day	--	--	--	2.5E-06	mg/kg-day	3.0E-02	mg/kg-day	8.4E-05
				Dibutyltin	2.4E-02	mg/kg	9.7E-10	mg/kg-day	--	--	--	6.8E-08	mg/kg-day	3.0E-04	mg/kg-day	2.3E-04
				Tributyltin	8.2E-02	mg/kg	3.3E-09	mg/kg-day	--	--	--	2.3E-07	mg/kg-day	3.0E-04	mg/kg-day	7.8E-04
				Total PCB Congeners	1.7E+00	mg/kg	6.8E-08	mg/kg-day	2.0E+00	(mg/kg-day)-1	1.4E-07	4.8E-06	mg/kg-day	2.0E-05	mg/kg-day	2.4E-01
				Total TEQ – PCB DLC	7.4E-06	mg/kg	3.0E-13	mg/kg-day	1.3E+05	(mg/kg-day)-1	3.9E-08	2.1E-11	mg/kg-day	7.0E-10	mg/kg-day	3.0E-02
			Exp. Route Total								3.5E-06					1.1E+00

TABLE A-13A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Construction Worker, Point Avisadero Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations: Intake/Exposure Concentration		Cancer Risk Calculations: CSF / Unit Risk		Cancer Risk	Noncancer Hazard Quotient: Intake/Exposure Concentration		Noncancer Hazard Quotient: RfD / RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	Sediment	Dermal	Aluminum	6.8E+04	mg/kg	4.0E-04	mg/kg-day	--	--	--	2.8E-02	mg/kg-day	1.0E+00	mg/kg-day	2.8E-02
				Antimony	5.4E+00	mg/kg	3.2E-08	mg/kg-day	--	--	--	2.2E-06	mg/kg-day	6.0E-05	mg/kg-day	3.7E-02
				Arsenic	1.2E+01	mg/kg	2.2E-07	mg/kg-day	9.5E+00	(mg/kg-day)-1	2.1E-06	1.5E-05	mg/kg-day	3.0E-04	mg/kg-day	5.2E-02
				Barium	4.8E+02	mg/kg	2.8E-06	mg/kg-day	--	--	--	2.0E-04	mg/kg-day	1.4E-02	mg/kg-day	1.4E-02
				Cadmium	3.2E-01	mg/kg	1.9E-10	mg/kg-day	6.0E+02	(mg/kg-day)-1	1.1E-07	1.3E-08	mg/kg-day	2.5E-05	mg/kg-day	5.3E-04
				Chromium	2.6E+02	mg/kg	1.5E-06	mg/kg-day	--	--	--	1.1E-04	mg/kg-day	2.0E-02	mg/kg-day	5.4E-03
				Cobalt	1.8E+01	mg/kg	1.1E-07	mg/kg-day	--	--	--	7.5E-06	mg/kg-day	3.0E-04	mg/kg-day	2.5E-02
				Copper	4.2E+02	mg/kg	2.5E-06	mg/kg-day	--	--	--	1.8E-04	mg/kg-day	4.0E-02	mg/kg-day	4.4E-03
				Iron	4.2E+04	mg/kg	2.5E-04	mg/kg-day	--	--	--	1.7E-02	mg/kg-day	7.0E-01	mg/kg-day	2.5E-02
				Lead	1.0E+02	mg/kg	6.1E-07	mg/kg-day	--	--	--	4.3E-05	mg/kg-day	--	--	--
				Manganese	5.2E+02	mg/kg	3.1E-06	mg/kg-day	--	--	--	2.1E-04	mg/kg-day	1.4E-01	mg/kg-day	1.5E-03
				Mercury	2.5E+00	mg/kg	1.5E-08	mg/kg-day	--	--	--	1.0E-06	mg/kg-day	1.0E-04	mg/kg-day	1.0E-02
				Molybdenum	1.0E+00	mg/kg	6.1E-09	mg/kg-day	--	--	--	4.3E-07	mg/kg-day	5.0E-03	mg/kg-day	8.5E-05
				Nickel	1.3E+02	mg/kg	7.7E-07	mg/kg-day	--	--	--	5.4E-05	mg/kg-day	8.0E-04	mg/kg-day	6.7E-02
				Selenium	4.3E-01	mg/kg	2.5E-09	mg/kg-day	--	--	--	1.8E-07	mg/kg-day	5.0E-03	mg/kg-day	3.5E-05
				Silver	3.0E-01	mg/kg	1.7E-09	mg/kg-day	--	--	--	1.2E-07	mg/kg-day	2.0E-04	mg/kg-day	6.1E-04
				Vanadium	1.4E+02	mg/kg	8.1E-07	mg/kg-day	--	--	--	5.7E-05	mg/kg-day	1.3E-04	mg/kg-day	4.4E-01
				Zinc	1.5E+02	mg/kg	8.8E-07	mg/kg-day	--	--	--	6.1E-05	mg/kg-day	3.0E-01	mg/kg-day	2.0E-04
				2,4'-DDD	8.4E-04	mg/kg	2.5E-11	mg/kg-day	2.4E-01	(mg/kg-day)-1	5.9E-12	1.7E-09	mg/kg-day	5.0E-04	mg/kg-day	3.5E-06
				4,4'-DDD	1.3E-03	mg/kg	3.7E-11	mg/kg-day	2.4E-01	(mg/kg-day)-1	9.0E-12	2.6E-09	mg/kg-day	5.0E-04	mg/kg-day	5.2E-06
				4,4'-DDE	1.2E-03	mg/kg	3.5E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	1.2E-11	2.5E-09	mg/kg-day	5.0E-04	mg/kg-day	5.0E-06
				4,4'-DDT	3.6E-04	mg/kg	1.0E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	3.6E-12	7.3E-10	mg/kg-day	5.0E-04	mg/kg-day	1.5E-06
				alpha-Chlordane	1.5E-04	mg/kg	4.4E-12	mg/kg-day	3.5E-01	(mg/kg-day)-1	1.5E-12	3.1E-10	mg/kg-day	5.0E-04	mg/kg-day	6.2E-07
				2-Methylnaphthalene	1.2E-02	mg/kg	1.1E-09	mg/kg-day	--	--	--	7.5E-08	mg/kg-day	4.0E-03	mg/kg-day	1.9E-05
				Acenaphthene	4.5E-02	mg/kg	4.0E-09	mg/kg-day	--	--	--	2.8E-07	mg/kg-day	6.0E-02	mg/kg-day	4.7E-06
				Acenaphthylene	3.1E-02	mg/kg	2.8E-09	mg/kg-day	--	--	--	1.9E-07	mg/kg-day	6.0E-02	mg/kg-day	3.2E-06
				Anthracene	1.8E-01	mg/kg	1.6E-08	mg/kg-day	--	--	--	1.1E-06	mg/kg-day	3.0E-01	mg/kg-day	3.7E-06
				Fluorene	4.0E-02	mg/kg	3.5E-09	mg/kg-day	--	--	--	2.5E-07	mg/kg-day	4.0E-02	mg/kg-day	6.2E-06
				Naphthalene	2.5E-02	mg/kg	2.2E-09	mg/kg-day	--	--	--	1.6E-07	mg/kg-day	2.0E-02	mg/kg-day	7.8E-06
				Phenanthrene	4.1E-01	mg/kg	3.6E-08	mg/kg-day	--	--	--	2.5E-06	mg/kg-day	3.0E-01	mg/kg-day	8.5E-06
				Benzo(a)anthracene	3.6E-01	mg/kg	3.2E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	3.9E-08	2.3E-06	mg/kg-day	--	--	--
				Benzo(a)pyrene	4.8E-01	mg/kg	4.3E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	3.1E-07	3.0E-06	mg/kg-day	--	--	--
				Benzo(b)fluoranthene	3.3E-01	mg/kg	2.9E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	3.5E-08	2.0E-06	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene	3.6E-01	mg/kg	3.2E-08	mg/kg-day	--	--	--	2.2E-06	mg/kg-day	3.0E-02	mg/kg-day	7.4E-05
				Benzo(k)fluoranthene	3.3E-01	mg/kg	2.9E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	3.5E-08	2.0E-06	mg/kg-day	--	--	--
				Chrysene	4.2E-01	mg/kg	3.8E-08	mg/kg-day	1.2E-01	(mg/kg-day)-1	4.5E-09	2.6E-06	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene	5.7E-02	mg/kg	5.1E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	3.7E-08	3.5E-07	mg/kg-day	--	--	--
				Fluoranthene	7.5E-01	mg/kg	6.6E-08	mg/kg-day	--	--	--	4.6E-06	mg/kg-day	4.0E-02	mg/kg-day	1.2E-04
				Indeno(1,2,3-cd)pyrene	3.5E-01	mg/kg	3.1E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	3.7E-08	2.2E-06	mg/kg-day	--	--	--
				Pyrene	8.9E-01	mg/kg	7.9E-08	mg/kg-day	--	--	--	5.5E-06	mg/kg-day	3.0E-02	mg/kg-day	1.8E-04
				Dibutyltin	2.4E-02	mg/kg	1.4E-09	mg/kg-day	--	--	--	9.9E-08	mg/kg-day	3.0E-04	mg/kg-day	3.3E-04
				Tributyltin	8.2E-02	mg/kg	4.9E-09	mg/kg-day	--	--	--	3.4E-07	mg/kg-day	3.0E-04	mg/kg-day	1.1E-03
				Total PCB Congeners	1.7E+00	mg/kg	1.5E-07	mg/kg-day	2.0E+00	(mg/kg-day)-1	3.0E-07	1.1E-05	mg/kg-day	2.0E-05	mg/kg-day	5.3E-01
				Total TEQ – PCB DLC	7.4E-06	mg/kg	1.3E-13	mg/kg-day	1.3E+05	(mg/kg-day)-1	1.7E-08	9.2E-12	mg/kg-day	7.0E-10	mg/kg-day	1.3E-02
			Exp. Route Total								3.0E-06					1.2E+00
		Exposure Point Total									6.5E-06					2.4E+00
	Exposure Medium Total										6.5E-06					2.4E+00
Medium Total											6.5E-06					2.4E+00
										Total of Receptor Risks across All Media	6.5E-06				Total of Receptor Hazards across All Media	2.4E+00

TABLE A-13A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Construction Worker, Point Avisadero Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Noncancer Hazard Quotient				
							Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	

Acronyms/Abbreviations:

-- =	not available or not applicable	(mg/kg-day)-	1/(milligram[s] per kilogram per day)
CSF =	cancer slope factor	mg/kg =	milligram(s) per kilogram
DDD =	dichlorodiphenyldichloroethane	mg/kg-day =	milligram(s) per kilogram per day
DDE =	dichlorodiphenyldichloroethylene	PCB =	polychlorinated biphenyl
DDT =	dichlorodiphenyltrichloroethane	RfC =	reference concentration
EPC =	exposure point concentration	RfD =	reference dose
Exp. =	exposure	RME =	reasonable maximum exposure
M =	lifetime exposure from birth, mutagenic endpoint	TCDD =	tetrachlorodibenzo-p-dioxin

TABLE A-13B

Summary of Receptor Risks and Hazards - Construction Worker, Point Avisadero Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient			
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	Sediment	Aluminum	--	--	--	--	1.9E-01	--	2.8E-02	2.2E-01
			Antimony	--	--	--	--	3.8E-02	--	3.7E-02	7.6E-02
			Arsenic	2.9E-06	--	2.1E-06	5.0E-06	7.0E-02	--	5.2E-02	1.2E-01
			Barium	--	--	--	--	6.7E-03	--	1.4E-02	2.1E-02
			Cadmium	2.0E-07	--	1.1E-07	3.1E-07	9.1E-04	--	5.3E-04	1.4E-03
			Chromium	--	--	--	--	4.8E-04	--	5.4E-03	5.9E-03
			Cobalt	--	--	--	--	1.7E-01	--	2.5E-02	1.9E-01
			Copper	--	--	--	--	3.0E-02	--	4.4E-03	3.4E-02
			Iron	--	--	--	--	1.7E-01	--	2.5E-02	1.9E-01
			Lead	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	1.0E-02	--	1.5E-03	1.2E-02
			Mercury	--	--	--	--	7.2E-02	--	1.0E-02	8.2E-02
			Molybdenum	--	--	--	--	5.8E-04	--	8.5E-05	6.7E-04
			Nickel	--	--	--	--	1.8E-02	--	6.7E-02	8.5E-02
			Selenium	--	--	--	--	2.4E-04	--	3.5E-05	2.8E-04
			Silver	--	--	--	--	1.7E-04	--	6.1E-04	7.8E-04
			Vanadium	--	--	--	--	7.8E-02	--	4.4E-01	5.2E-01
			Zinc	--	--	--	--	1.4E-03	--	2.0E-04	1.6E-03
			2,4'-DDD	8.1E-12	--	5.9E-12	1.4E-11	4.7E-06	--	3.5E-06	8.2E-06
			4,4'-DDD	1.2E-11	--	9.0E-12	2.1E-11	7.2E-06	--	5.2E-06	1.2E-05
			4,4'-DDE	1.6E-11	--	1.2E-11	2.9E-11	6.8E-06	--	5.0E-06	1.2E-05
			4,4'-DDT	4.9E-12	--	3.6E-12	8.4E-12	2.0E-06	--	1.5E-06	3.5E-06
			alpha-Chlordane	2.1E-12	--	1.5E-12	3.7E-12	8.4E-07	--	6.2E-07	1.5E-06
			2-Methylnaphthalene	--	--	--	--	8.5E-06	--	1.9E-05	2.7E-05
			Acenaphthene	--	--	--	--	2.1E-06	--	4.7E-06	6.8E-06
			Acenaphthylene	--	--	--	--	1.5E-06	--	3.2E-06	4.7E-06
			Anthracene	--	--	--	--	1.7E-06	--	3.7E-06	5.4E-06
			Fluorene	--	--	--	--	2.8E-06	--	6.2E-06	9.0E-06
			Naphthalene	--	--	--	--	3.5E-06	--	7.8E-06	1.1E-05
			Phenanthrene	--	--	--	--	3.9E-06	--	8.5E-06	1.2E-05
			Benzo(a)anthracene	1.8E-08	--	3.9E-08	5.6E-08	--	--	--	--
			Benzo(a)pyrene	1.4E-07	--	3.1E-07	4.5E-07	--	--	--	--
			Benzo(b)fluoranthene	1.6E-08	--	3.5E-08	5.0E-08	--	--	--	--
			Benzo(g,h,i)perylene	--	--	--	--	3.4E-05	--	7.4E-05	1.1E-04
			Benzo(k)fluoranthene	1.6E-08	--	3.5E-08	5.1E-08	--	--	--	--
			Chrysene	2.1E-09	--	4.5E-09	6.6E-09	--	--	--	--
			Dibenz(a,h)anthracene	1.7E-08	--	3.7E-08	5.4E-08	--	--	--	--
			Fluoranthene	--	--	--	--	5.3E-05	--	1.2E-04	1.7E-04
			Indeno(1,2,3-cd)pyrene	1.7E-08	--	3.7E-08	5.4E-08	--	--	--	--
			Pyrene	--	--	--	--	8.4E-05	--	1.8E-04	2.7E-04
			Dibutyltin	--	--	--	--	2.3E-04	--	3.3E-04	5.6E-04
			Tributyltin	--	--	--	--	7.8E-04	--	1.1E-03	1.9E-03
			Total PCB Congeners	1.4E-07	--	3.0E-07	4.4E-07	2.4E-01	--	5.3E-01	7.7E-01
			Total TEQ – PCB DLC	3.9E-08	--	1.7E-08	5.6E-08	3.0E-02	--	1.3E-02	4.3E-02
			Chemical Total	3.5E-06	--	3.0E-06	6.5E-06	1.1E+00	--	1.2E+00	2.4E+00
		Exposure Point Total					6.5E-06				2.4E+00
	Exposure Medium Total						6.5E-06				2.4E+00
Medium Total							6.5E-06				2.4E+00
Receptor Total						Total Risk across All Media	6.5E-06			Total Hazard across All Media	2.4E+00

TABLE A-13B

Summary of Receptor Risks and Hazards - Construction Worker, Point Avisadero Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient			
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Ingestion	Inhalation	Dermal	Exposure Routes Total

Acronyms/Abbreviations:

-- = not available or not applicable

DDD = dichlorodiphenyldichloroethane

DDE = dichlorodiphenyldichloroethylene

DDT = dichlorodiphenyltrichloroethane

PCB = polychlorinated biphenyl

TCDD = tetrachlorodibenzo-p-dioxin

TABLE A-13C

Summary of Risk Drivers - Construction Worker, Point Avisadero Area

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient			
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	Sediment	Arsenic	2.9E-06	--	2.1E-06	5.0E-06	7.0E-02	--	5.2E-02	1.2E-01
			Chemical Total	--	--	--	5.0E-06	--	--	--	1.2E-01
		Exposure Point Total					5.0E-06				1.2E-01
	Exposure Medium Total						5.0E-06				1.2E-01
Medium Total							5.0E-06				1.2E-01
Receptor Total						Total Risk across All Media	5.0E-06			Total Hazard across All Media	1.2E-01

Acronyms/Abbreviations:

-- = not available or not applicable

TABLE A-14A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Adult and Child Recreational User, South Basin Area X

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC Value	EPC Units	Cancer Risk Calculations: Intake/Exposure Concentration Value	Intake/Exposure Concentration Units	CSF / Unit Risk Value	CSF / Unit Risk Units	Cancer Risk	Noncancer Hazard Quotient: Intake/Exposure Concentration Value	Intake/Exposure Concentration Units	RfD / RfC Value	RfD / RfC Units	Hazard Quotient
Sediment	Sediment	Sediment	Ingestion	Aluminum	6.8E+04	mg/kg	7.3E-03	mg/kg-day	--	--	--	6.5E-02	mg/kg-day	1.0E+00	mg/kg-day	6.5E-02
				Antimony	4.3E+00	mg/kg	4.6E-07	mg/kg-day	--	--	--	4.1E-06	mg/kg-day	4.0E-04	mg/kg-day	1.0E-02
				Arsenic	1.1E+01	mg/kg	7.3E-07	mg/kg-day	9.5E+00	(mg/kg-day)-1	6.9E-06	6.5E-06	mg/kg-day	3.0E-04	mg/kg-day	2.2E-02
				Barium	5.6E+02	mg/kg	6.0E-05	mg/kg-day	--	--	--	5.3E-04	mg/kg-day	2.0E-01	mg/kg-day	2.6E-03
				Cadmium	5.2E-01	mg/kg	5.5E-08	mg/kg-day	1.5E+01	(mg/kg-day)-1	8.3E-07	4.9E-07	mg/kg-day	1.0E-03	mg/kg-day	4.9E-04
				Chromium	2.5E+02	mg/kg	2.7E-05	mg/kg-day	--	--	--	2.4E-04	mg/kg-day	1.5E+00	mg/kg-day	1.6E-04
				Cobalt	1.8E+01	mg/kg	1.9E-06	mg/kg-day	--	--	--	1.7E-05	mg/kg-day	3.0E-04	mg/kg-day	5.7E-02
				Copper	1.5E+02	mg/kg	1.6E-05	mg/kg-day	--	--	--	1.4E-04	mg/kg-day	4.0E-02	mg/kg-day	3.5E-03
				Iron	4.3E+04	mg/kg	4.6E-03	mg/kg-day	--	--	--	4.1E-02	mg/kg-day	7.0E-01	mg/kg-day	5.9E-02
				Lead	9.8E+01	mg/kg	1.0E-05	mg/kg-day	--	--	--	9.3E-05	mg/kg-day	--	--	--
				Manganese	4.5E+02	mg/kg	4.8E-05	mg/kg-day	--	--	--	4.3E-04	mg/kg-day	1.4E-01	mg/kg-day	3.1E-03
				Mercury	8.2E-01	mg/kg	8.8E-08	mg/kg-day	--	--	--	7.8E-07	mg/kg-day	1.0E-04	mg/kg-day	7.8E-03
				Molybdenum	1.2E+00	mg/kg	1.3E-07	mg/kg-day	--	--	--	1.2E-06	mg/kg-day	5.0E-03	mg/kg-day	2.3E-04
				Nickel	1.2E+02	mg/kg	1.3E-05	mg/kg-day	--	--	--	1.2E-04	mg/kg-day	2.0E-02	mg/kg-day	5.9E-03
				Selenium	3.6E-01	mg/kg	3.8E-08	mg/kg-day	--	--	--	3.4E-07	mg/kg-day	5.0E-03	mg/kg-day	6.8E-05
				Silver	1.0E+00	mg/kg	1.1E-07	mg/kg-day	--	--	--	9.9E-07	mg/kg-day	5.0E-03	mg/kg-day	2.0E-04
				Vanadium	1.4E+02	mg/kg	1.5E-05	mg/kg-day	--	--	--	1.4E-04	mg/kg-day	5.0E-03	mg/kg-day	2.7E-02
				Zinc	2.1E+02	mg/kg	2.3E-05	mg/kg-day	--	--	--	2.0E-04	mg/kg-day	3.0E-01	mg/kg-day	6.7E-04
				2,4'-DDD	1.2E-04	mg/kg	1.3E-11	mg/kg-day	2.4E-01	(mg/kg-day)-1	3.1E-12	1.1E-10	mg/kg-day	5.0E-04	mg/kg-day	2.3E-07
				4,4'-DDD	1.8E-02	mg/kg	1.9E-09	mg/kg-day	2.4E-01	(mg/kg-day)-1	4.6E-10	1.7E-08	mg/kg-day	5.0E-04	mg/kg-day	3.4E-05
				4,4'-DDE	7.4E-03	mg/kg	7.9E-10	mg/kg-day	3.4E-01	(mg/kg-day)-1	2.7E-10	7.0E-09	mg/kg-day	5.0E-04	mg/kg-day	1.4E-05
				4,4'-DDT	3.6E-03	mg/kg	3.8E-10	mg/kg-day	3.4E-01	(mg/kg-day)-1	1.3E-10	3.4E-09	mg/kg-day	5.0E-04	mg/kg-day	6.8E-06
				alpha-Chlordane	2.1E-03	mg/kg	2.3E-10	mg/kg-day	3.5E-01	(mg/kg-day)-1	7.9E-11	2.0E-09	mg/kg-day	5.0E-04	mg/kg-day	4.0E-06
				Dieldrin	7.2E-03	mg/kg	7.7E-10	mg/kg-day	1.6E+01	(mg/kg-day)-1	1.2E-08	6.8E-09	mg/kg-day	5.0E-05	mg/kg-day	1.4E-04
				gamma-Chlordane	3.3E-03	mg/kg	3.6E-10	mg/kg-day	3.5E-01	(mg/kg-day)-1	1.2E-10	3.2E-09	mg/kg-day	5.0E-04	mg/kg-day	6.3E-06
				Heptachlor	2.1E-03	mg/kg	2.3E-10	mg/kg-day	4.5E+00	(mg/kg-day)-1	1.0E-09	2.0E-09	mg/kg-day	5.0E-04	mg/kg-day	4.0E-06
				2-Methylnaphthalene	2.2E-02	mg/kg	2.3E-09	mg/kg-day	--	--	--	2.0E-08	mg/kg-day	4.0E-03	mg/kg-day	5.1E-06
				Acenaphthene	9.1E-03	mg/kg	9.7E-10	mg/kg-day	--	--	--	8.6E-09	mg/kg-day	6.0E-02	mg/kg-day	1.4E-07
				Acenaphthylene	2.0E-02	mg/kg	2.1E-09	mg/kg-day	--	--	--	1.9E-08	mg/kg-day	6.0E-02	mg/kg-day	3.2E-07
				Anthracene	1.0E-01	mg/kg	1.1E-08	mg/kg-day	--	--	--	9.6E-08	mg/kg-day	3.0E-01	mg/kg-day	3.2E-07
				Fluorene	3.0E-02	mg/kg	3.2E-09	mg/kg-day	--	--	--	2.9E-08	mg/kg-day	4.0E-02	mg/kg-day	7.2E-07
				Naphthalene	3.5E-02	mg/kg	3.7E-09	mg/kg-day	--	--	--	3.3E-08	mg/kg-day	2.0E-02	mg/kg-day	1.6E-06
				Phenanthrene	2.8E-01	mg/kg	3.0E-08	mg/kg-day	--	--	--	2.6E-07	mg/kg-day	3.0E-01	mg/kg-day	8.8E-07
				Benzo(a)anthracene M	2.4E-01	mg/kg	1.1E-07	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.4E-07	2.2E-07	mg/kg-day	--	--	--
				Benzo(a)pyrene M	3.1E-01	mg/kg	1.5E-07	mg/kg-day	7.3E+00	(mg/kg-day)-1	1.1E-06	3.0E-07	mg/kg-day	--	--	--
				Benzo(b)fluoranthene M	2.4E-01	mg/kg	1.1E-07	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.4E-07	2.2E-07	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene	2.7E-01	mg/kg	2.9E-08	mg/kg-day	--	--	--	2.6E-07	mg/kg-day	3.0E-02	mg/kg-day	8.5E-06
				Benzo(k)fluoranthene M	2.4E-01	mg/kg	1.2E-07	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.4E-07	2.3E-07	mg/kg-day	--	--	--
				Chrysene M	3.2E-01	mg/kg	1.5E-07	mg/kg-day	1.2E-01	(mg/kg-day)-1	1.8E-08	3.0E-07	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene M	4.4E-02	mg/kg	2.1E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	1.6E-07	4.2E-08	mg/kg-day	--	--	--
				Fluoranthene	3.9E-01	mg/kg	4.2E-08	mg/kg-day	--	--	--	3.7E-07	mg/kg-day	4.0E-02	mg/kg-day	9.4E-06
				Indeno(1,2,3-cd)pyrene	2.5E-01	mg/kg	1.2E-07	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.4E-07	2.3E-07	mg/kg-day	--	--	--
				Pyrene	4.6E-01	mg/kg	4.9E-08	mg/kg-day	--	--	--	4.4E-07	mg/kg-day	3.0E-02	mg/kg-day	1.5E-05
				Monobutyltin	1.2E-03	mg/kg	1.2E-10	mg/kg-day	--	--	--	1.1E-09	mg/kg-day	3.0E-04	mg/kg-day	3.7E-06
				Dibutyltin	2.2E-02	mg/kg	2.3E-09	mg/kg-day	--	--	--	2.0E-08	mg/kg-day	3.0E-04	mg/kg-day	6.8E-05
				Tributyltin	4.9E-02	mg/kg	5.2E-09	mg/kg-day	--	--	--	4.6E-08	mg/kg-day	3.0E-04	mg/kg-day	1.5E-04
				Total PCB Congeners	1.7E+00	mg/kg	1.8E-07	mg/kg-day	2.0E+00	(mg/kg-day)-1	3.6E-07	1.6E-06	mg/kg-day	2.0E-05	mg/kg-day	8.1E-02
				Total TEQ – PCB DLC	3.0E-05	mg/kg	3.2E-12	mg/kg-day	1.3E+05	(mg/kg-day)-1	4.1E-07	2.8E-11	mg/kg-day	7.0E-10	mg/kg-day	4.0E-02
			Exp. Route Total								1.0E-05					3.9E-01

TABLE A-14A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Adult and Child Recreational User, South Basin Area X

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

							Cancer Risk Calculations					Noncancer Hazard Quotient				
					EPC		Intake/Exposure Concentration		CSF / Unit Risk			Intake/Exposure Concentration		RfD / RfC		
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	Value	Units	Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Sediment	Sediment	Sediment	Dermal	Aluminum	6.8E+04	mg/kg	2.3E-04	mg/kg-day	--	--	--	1.9E-03	mg/kg-day	1.0E+00	mg/kg-day	1.9E-03
				Antimony	4.3E+00	mg/kg	1.5E-08	mg/kg-day	--	--	--	1.2E-07	mg/kg-day	6.0E-05	mg/kg-day	2.0E-03
				Arsenic	1.1E+01	mg/kg	1.2E-07	mg/kg-day	9.5E+00	(mg/kg-day)-1	1.1E-06	9.4E-07	mg/kg-day	3.0E-04	mg/kg-day	3.1E-03
				Barium	5.6E+02	mg/kg	1.9E-06	mg/kg-day	--	--	--	1.5E-05	mg/kg-day	1.4E-02	mg/kg-day	1.1E-03
				Cadmium	5.2E-01	mg/kg	1.8E-10	mg/kg-day	6.0E+02	(mg/kg-day)-1	1.1E-07	1.4E-09	mg/kg-day	2.5E-05	mg/kg-day	5.7E-05
				Chromium	2.5E+02	mg/kg	8.7E-07	mg/kg-day	--	--	--	6.9E-06	mg/kg-day	2.0E-02	mg/kg-day	3.6E-04
				Cobalt	1.8E+01	mg/kg	6.2E-08	mg/kg-day	--	--	--	5.0E-07	mg/kg-day	3.0E-04	mg/kg-day	1.7E-03
				Copper	1.5E+02	mg/kg	5.1E-07	mg/kg-day	--	--	--	4.1E-06	mg/kg-day	4.0E-02	mg/kg-day	1.0E-04
				Iron	4.3E+04	mg/kg	1.5E-04	mg/kg-day	--	--	--	1.2E-03	mg/kg-day	7.0E-01	mg/kg-day	1.7E-03
				Lead	9.8E+01	mg/kg	3.4E-07	mg/kg-day	--	--	--	2.7E-06	mg/kg-day	--	--	--
				Manganese	4.5E+02	mg/kg	1.6E-06	mg/kg-day	--	--	--	1.2E-05	mg/kg-day	1.4E-01	mg/kg-day	8.9E-05
				Mercury	8.2E-01	mg/kg	2.8E-09	mg/kg-day	--	--	--	2.3E-08	mg/kg-day	1.0E-04	mg/kg-day	2.3E-04
				Molybdenum	1.2E+00	mg/kg	4.2E-09	mg/kg-day	--	--	--	3.4E-08	mg/kg-day	5.0E-03	mg/kg-day	6.8E-06
				Nickel	1.2E+02	mg/kg	4.3E-07	mg/kg-day	--	--	--	3.4E-06	mg/kg-day	8.0E-04	mg/kg-day	4.3E-03
				Selenium	3.6E-01	mg/kg	1.2E-09	mg/kg-day	--	--	--	9.9E-09	mg/kg-day	5.0E-03	mg/kg-day	2.0E-06
				Silver	1.0E+00	mg/kg	3.6E-09	mg/kg-day	--	--	--	2.9E-08	mg/kg-day	2.0E-04	mg/kg-day	1.4E-04
				Vanadium	1.4E+02	mg/kg	4.9E-07	mg/kg-day	--	--	--	3.9E-06	mg/kg-day	1.3E-04	mg/kg-day	3.0E-02
				Zinc	2.1E+02	mg/kg	7.3E-07	mg/kg-day	--	--	--	5.9E-06	mg/kg-day	3.0E-01	mg/kg-day	2.0E-05
				2,4'-DDD	1.2E-04	mg/kg	2.1E-12	mg/kg-day	2.4E-01	(mg/kg-day)-1	4.9E-13	1.7E-11	mg/kg-day	5.0E-04	mg/kg-day	3.3E-08
				4,4'-DDD	1.8E-02	mg/kg	3.1E-10	mg/kg-day	2.4E-01	(mg/kg-day)-1	7.5E-11	2.5E-09	mg/kg-day	5.0E-04	mg/kg-day	5.0E-06
				4,4'-DDE	7.4E-03	mg/kg	1.3E-10	mg/kg-day	3.4E-01	(mg/kg-day)-1	4.3E-11	1.0E-09	mg/kg-day	5.0E-04	mg/kg-day	2.0E-06
				4,4'-DDT	3.6E-03	mg/kg	6.2E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	2.1E-11	4.9E-10	mg/kg-day	5.0E-04	mg/kg-day	9.9E-07
				alpha-Chlordane	2.1E-03	mg/kg	3.6E-11	mg/kg-day	3.5E-01	(mg/kg-day)-1	1.3E-11	2.9E-10	mg/kg-day	5.0E-04	mg/kg-day	5.8E-07
				Dieldrin	7.2E-03	mg/kg	2.5E-10	mg/kg-day	1.6E+01	(mg/kg-day)-1	3.9E-09	2.0E-09	mg/kg-day	5.0E-05	mg/kg-day	4.0E-05
				gamma-Chlordane	3.3E-03	mg/kg	5.7E-11	mg/kg-day	3.5E-01	(mg/kg-day)-1	2.0E-11	4.6E-10	mg/kg-day	5.0E-04	mg/kg-day	9.2E-07
				Heptachlor	2.1E-03	mg/kg	7.3E-11	mg/kg-day	4.5E+00	(mg/kg-day)-1	3.3E-10	5.9E-10	mg/kg-day	5.0E-04	mg/kg-day	1.2E-06
				2-Methylnaphthalene	2.2E-02	mg/kg	1.1E-09	mg/kg-day	--	--	--	8.9E-09	mg/kg-day	4.0E-03	mg/kg-day	2.2E-06
				Acenaphthene	9.1E-03	mg/kg	4.7E-10	mg/kg-day	--	--	--	3.8E-09	mg/kg-day	6.0E-02	mg/kg-day	6.3E-08
				Acenaphthylene	2.0E-02	mg/kg	1.0E-09	mg/kg-day	--	--	--	8.2E-09	mg/kg-day	6.0E-02	mg/kg-day	1.4E-07
				Anthracene	1.0E-01	mg/kg	5.2E-09	mg/kg-day	--	--	--	4.2E-08	mg/kg-day	3.0E-01	mg/kg-day	1.4E-07
				Fluorene	3.0E-02	mg/kg	1.6E-09	mg/kg-day	--	--	--	1.3E-08	mg/kg-day	4.0E-02	mg/kg-day	3.1E-07
				Naphthalene	3.5E-02	mg/kg	1.8E-09	mg/kg-day	--	--	--	1.4E-08	mg/kg-day	2.0E-02	mg/kg-day	7.1E-07
				Phenanthrene	2.8E-01	mg/kg	1.4E-08	mg/kg-day	--	--	--	1.1E-07	mg/kg-day	3.0E-01	mg/kg-day	3.8E-07
				Benzo(a)anthracene M	2.4E-01	mg/kg	5.2E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	6.3E-08	9.8E-08	mg/kg-day	--	--	--
				Benzo(a)pyrene M	3.1E-01	mg/kg	6.9E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	5.1E-07	1.3E-07	mg/kg-day	--	--	--
				Benzo(b)fluoranthene M	2.4E-01	mg/kg	5.2E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	6.3E-08	9.8E-08	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene	2.7E-01	mg/kg	1.4E-08	mg/kg-day	--	--	--	1.1E-07	mg/kg-day	3.0E-02	mg/kg-day	3.7E-06
				Benzo(k)fluoranthene M	2.4E-01	mg/kg	5.4E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	6.5E-08	1.0E-07	mg/kg-day	--	--	--
				Chrysene M	3.2E-01	mg/kg	7.0E-08	mg/kg-day	1.2E-01	(mg/kg-day)-1	8.4E-09	1.3E-07	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene M	4.4E-02	mg/kg	9.8E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	7.1E-08	1.8E-08	mg/kg-day	--	--	--
				Fluoranthene	3.9E-01	mg/kg	2.0E-08	mg/kg-day	--	--	--	1.6E-07	mg/kg-day	4.0E-02	mg/kg-day	4.1E-06
				Indeno(1,2,3-cd)pyrene M	2.5E-01	mg/kg	5.5E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	6.6E-08	1.0E-07	mg/kg-day	--	--	--
				Pyrene	4.6E-01	mg/kg	2.4E-08	mg/kg-day	--	--	--	1.9E-07	mg/kg-day	3.0E-02	mg/kg-day	6.4E-06
				Monobutyltin	1.2E-03	mg/kg	4.0E-11	mg/kg-day	--	--	--	3.2E-10	mg/kg-day	3.0E-04	mg/kg-day	1.1E-06
				Dibutyltin	2.2E-02	mg/kg	7.4E-10	mg/kg-day	--	--	--	5.9E-09	mg/kg-day	3.0E-04	mg/kg-day	2.0E-05
				Tributyltin	4.9E-02	mg/kg	1.7E-09	mg/kg-day	--	--	--	1.3E-08	mg/kg-day	3.0E-04	mg/kg-day	4.5E-05
				Total PCB Congeners	1.7E+00	mg/kg	8.7E-08	mg/kg-day	2.0E+00	(mg/kg-day)-1	1.7E-07	7.0E-07	mg/kg-day	2.0E-05	mg/kg-day	3.5E-02
				Total TEQ – PCB DLC	3.0E-05	mg/kg	3.1E-13	mg/kg-day	1.3E+05	(mg/kg-day)-1	4.0E-08	2.5E-12	mg/kg-day	7.0E-10	mg/kg-day	3.5E-03
			Exp. Route Total								2.3E-06					8.6E-02
		Exposure Point Total									1.3E-05					4.7E-01
	Exposure Medium Total										1.3E-05					4.7E-01
Medium Total											1.3E-05					4.7E-01

TABLE A-14A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Adult and Child Recreational User, South Basin Area X

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Noncancer Hazard Quotient				
							Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Macoma[a]	Macoma	Macoma	Ingestion	Aluminum	2.9E+02	mg/kg	2.2E-03	mg/kg-day	--	--	--	7.7E-03	mg/kg-day	1.0E+00	mg/kg-day	7.7E-03
				Antimony	8.4E-02	mg/kg	6.4E-07	mg/kg-day	--	--	--	2.2E-06	mg/kg-day	4.0E-04	mg/kg-day	5.6E-03
				Arsenic	3.4E+00	mg/kg	2.6E-05	mg/kg-day	9.5E+00	(mg/kg-day)-1	2.5E-04	9.1E-05	mg/kg-day	3.0E-04	mg/kg-day	3.0E-01
				Barium	3.0E+00	mg/kg	2.3E-05	mg/kg-day	--	--	--	8.1E-05	mg/kg-day	2.0E-01	mg/kg-day	4.0E-04
				Cadmium	5.0E-02	mg/kg	3.8E-07	mg/kg-day	1.5E+01	(mg/kg-day)-1	5.7E-06	1.3E-06	mg/kg-day	1.0E-03	mg/kg-day	1.3E-03
				Chromium	2.0E+00	mg/kg	1.5E-05	mg/kg-day	--	--	--	5.3E-05	mg/kg-day	1.5E+00	mg/kg-day	3.5E-05
				Cobalt	3.5E-01	mg/kg	2.7E-06	mg/kg-day	--	--	--	9.4E-06	mg/kg-day	3.0E-04	mg/kg-day	3.1E-02
				Copper	3.4E+00	mg/kg	2.6E-05	mg/kg-day	--	--	--	9.2E-05	mg/kg-day	4.0E-02	mg/kg-day	2.3E-03
				Iron	3.8E+02	mg/kg	2.9E-03	mg/kg-day	--	--	--	1.0E-02	mg/kg-day	7.0E-01	mg/kg-day	1.5E-02
				Lead	1.3E+00	mg/kg	1.0E-05	mg/kg-day	--	--	--	3.5E-05	mg/kg-day	--	--	--
				Manganese	4.4E+00	mg/kg	3.3E-05	mg/kg-day	--	--	--	1.2E-04	mg/kg-day	1.4E-01	mg/kg-day	8.3E-04
				Mercury	2.5E-02	mg/kg	1.9E-07	mg/kg-day	--	--	--	6.5E-07	mg/kg-day	1.0E-04	mg/kg-day	6.5E-03
				Molybdenum	4.6E-01	mg/kg	3.5E-06	mg/kg-day	--	--	--	1.2E-05	mg/kg-day	5.0E-03	mg/kg-day	2.4E-03
				Nickel	1.3E+00	mg/kg	1.0E-05	mg/kg-day	--	--	--	3.6E-05	mg/kg-day	2.0E-02	mg/kg-day	1.8E-03
				Selenium	7.5E-01	mg/kg	5.7E-06	mg/kg-day	--	--	--	2.0E-05	mg/kg-day	5.0E-03	mg/kg-day	4.0E-03
				Silver	2.5E-02	mg/kg	1.9E-07	mg/kg-day	--	--	--	6.6E-07	mg/kg-day	5.0E-03	mg/kg-day	1.3E-04
				Vanadium	1.2E+00	mg/kg	9.2E-06	mg/kg-day	--	--	--	3.2E-05	mg/kg-day	5.0E-03	mg/kg-day	6.4E-03
				Zinc	1.8E+01	mg/kg	1.4E-04	mg/kg-day	--	--	--	4.9E-04	mg/kg-day	3.0E-01	mg/kg-day	1.6E-03
				4,4'-DDD	1.9E-03	mg/kg	1.4E-08	mg/kg-day	2.4E-01	(mg/kg-day)-1	3.4E-09	5.0E-08	mg/kg-day	5.0E-04	mg/kg-day	9.9E-05
				4,4'-DDE	6.1E-03	mg/kg	4.6E-08	mg/kg-day	3.4E-01	(mg/kg-day)-1	1.6E-08	1.6E-07	mg/kg-day	5.0E-04	mg/kg-day	3.2E-04
				4,4'-DDT	1.3E-04	mg/kg	1.0E-09	mg/kg-day	3.4E-01	(mg/kg-day)-1	3.4E-10	3.5E-09	mg/kg-day	5.0E-04	mg/kg-day	7.0E-06
				alpha-Chlordane	1.1E-03	mg/kg	8.2E-09	mg/kg-day	3.5E-01	(mg/kg-day)-1	2.9E-09	2.9E-08	mg/kg-day	5.0E-04	mg/kg-day	5.8E-05
				Dieldrin	1.8E-03	mg/kg	1.4E-08	mg/kg-day	1.6E+01	(mg/kg-day)-1	2.2E-07	4.8E-08	mg/kg-day	5.0E-05	mg/kg-day	9.7E-04
				gamma-Chlordane	1.5E-03	mg/kg	1.2E-08	mg/kg-day	3.5E-01	(mg/kg-day)-1	4.0E-09	4.0E-08	mg/kg-day	5.0E-04	mg/kg-day	8.1E-05
				2-Methylnaphthalene	3.3E-04	mg/kg	2.5E-09	mg/kg-day	--	--	--	8.8E-09	mg/kg-day	4.0E-03	mg/kg-day	2.2E-06
				Acenaphthene	3.3E-04	mg/kg	2.5E-09	mg/kg-day	--	--	--	8.7E-09	mg/kg-day	6.0E-02	mg/kg-day	1.5E-07
				Acenaphthylene	4.9E-04	mg/kg	3.7E-09	mg/kg-day	--	--	--	1.3E-08	mg/kg-day	6.0E-02	mg/kg-day	2.2E-07
				Anthracene	1.9E-03	mg/kg	1.5E-08	mg/kg-day	--	--	--	5.1E-08	mg/kg-day	3.0E-01	mg/kg-day	1.7E-07
				Fluorene	3.7E-04	mg/kg	2.8E-09	mg/kg-day	--	--	--	9.8E-09	mg/kg-day	4.0E-02	mg/kg-day	2.5E-07
				Naphthalene	2.0E-03	mg/kg	1.5E-08	mg/kg-day	--	--	--	5.3E-08	mg/kg-day	2.0E-02	mg/kg-day	2.6E-06
				Phenanthrene	3.9E-03	mg/kg	3.0E-08	mg/kg-day	--	--	--	1.0E-07	mg/kg-day	3.0E-01	mg/kg-day	3.5E-07
				Benzo(a)anthracene	5.3E-03	mg/kg	4.0E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	4.8E-08	1.4E-07	mg/kg-day	--	--	--
				Benzo(a)pyrene	7.8E-03	mg/kg	6.0E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	4.3E-07	2.1E-07	mg/kg-day	--	--	--
				Benzo(b)fluoranthene	8.9E-03	mg/kg	6.8E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	8.1E-08	2.4E-07	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene	5.4E-03	mg/kg	4.1E-08	mg/kg-day	--	--	--	1.4E-07	mg/kg-day	3.0E-02	mg/kg-day	4.8E-06
				Benzo(k)fluoranthene	1.2E-02	mg/kg	8.8E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.1E-07	3.1E-07	mg/kg-day	--	--	--
				Chrysene	8.8E-03	mg/kg	6.7E-08	mg/kg-day	1.2E-01	(mg/kg-day)-1	8.0E-09	2.3E-07	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene	5.4E-04	mg/kg	4.1E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	3.0E-08	1.4E-08	mg/kg-day	--	--	--
				Fluoranthene	2.4E-02	mg/kg	1.8E-07	mg/kg-day	--	--	--	6.3E-07	mg/kg-day	4.0E-02	mg/kg-day	1.6E-05
				Indeno(1,2,3-cd)pyrene	3.7E-03	mg/kg	2.8E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	3.3E-08	9.7E-08	mg/kg-day	--	--	--
				Pyrene	3.0E-02	mg/kg	2.3E-07	mg/kg-day	--	--	--	8.0E-07	mg/kg-day	3.0E-02	mg/kg-day	2.7E-05
				Dibutyltin	2.5E-03	mg/kg	1.9E-08	mg/kg-day	--	--	--	6.5E-08	mg/kg-day	3.0E-04	mg/kg-day	2.2E-04
				Tributyltin	1.2E-02	mg/kg	9.3E-08	mg/kg-day	--	--	--	3.2E-07	mg/kg-day	3.0E-04	mg/kg-day	1.1E-03
				Total PCB Congeners	3.3E-01	mg/kg	2.5E-06	mg/kg-day	2.0E+00	(mg/kg-day)-1	5.0E-06	8.8E-06	mg/kg-day	2.0E-05	mg/kg-day	4.4E-01
				Total TEQ – PCB DLC	7.7E-06	mg/kg	5.8E-11	mg/kg-day	1.3E+05	(mg/kg-day)-1	7.6E-06	2.0E-10	mg/kg-day	7.0E-10	mg/kg-day	2.9E-01
				Total TEQ – TCDD DLC	8.8E-07	mg/kg	6.7E-12	mg/kg-day	1.3E+05	(mg/kg-day)-1	8.7E-07	2.3E-11	mg/kg-day	7.0E-10	mg/kg-day	3.3E-02
			Exp. Route Total								2.7E-04					1.2E+00
		Exposure Point Total									2.7E-04					1.2E+00
	Exposure Medium Total										2.7E-04					1.2E+00
Medium Total											2.7E-04					1.2E+00
										Total of Receptor Risks across All Media	2.8E-04				Total of Receptor Hazards across All Media	1.6E+00

TABLE A-14A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Adult and Child Recreational User, South Basin Area X

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Noncancer Hazard Quotient				
							Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	

Notes:

[a] Macoma ingestion risks are evaluated for the adult receptor only.

Acronyms/Abbreviations:

-- = not available or not applicable

CSF = cancer slope factor

DDD = dichlorodiphenyldichloroethane

DDE = dichlorodiphenyldichloroethylene

DDT = dichlorodiphenyltrichloroethane

EPC = exposure point concentration

Exp. = exposure

M = lifetime exposure from birth, mutagenic endpoint

(mg/kg-day)-1 = 1/(milligram[s] per kilogram per day)

mg/kg = milligram(s) per kilogram

mg/kg-day = milligram(s) per kilogram per day

PCB = polychlorinated biphenyl

RfC = reference concentration

RfD = reference dose

RME = reasonable maximum exposure

TCDD = tetrachlorodibenzo-p-dioxin

TABLE A-14B

Summary of Receptor Risks and Hazards - Adult and Child Recreational User, South Basin Area X

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk Ingestion	Cancer Risk Inhalation	Cancer Risk Dermal	Cancer Risk Exposure Routes Total	Noncancer Hazard Quotient Ingestion	Noncancer Hazard Quotient Inhalation	Noncancer Hazard Quotient Dermal	Noncancer Hazard Quotient Exposure Routes Total
Sediment	Sediment	Sediment	Aluminum	--	--	--	--	6.5E-02	--	1.9E-03	6.7E-02
			Antimony	--	--	--	--	1.0E-02	--	2.0E-03	1.2E-02
			Arsenic	6.9E-06	--	1.1E-06	8.1E-06	2.2E-02	--	3.1E-03	2.5E-02
			Barium	--	--	--	--	2.6E-03	--	1.1E-03	3.7E-03
			Cadmium	8.3E-07	--	1.1E-07	9.3E-07	4.9E-04	--	5.7E-05	5.5E-04
			Chromium	--	--	--	--	1.6E-04	--	3.6E-04	5.2E-04
			Cobalt	--	--	--	--	5.7E-02	--	1.7E-03	5.9E-02
			Copper	--	--	--	--	3.5E-03	--	1.0E-04	3.6E-03
			Iron	--	--	--	--	5.9E-02	--	1.7E-03	6.1E-02
			Lead	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	3.1E-03	--	8.9E-05	3.2E-03
			Mercury	--	--	--	--	7.8E-03	--	2.3E-04	8.0E-03
			Molybdenum	--	--	--	--	2.3E-04	--	6.8E-06	2.4E-04
			Nickel	--	--	--	--	5.9E-03	--	4.3E-03	1.0E-02
			Selenium	--	--	--	--	6.8E-05	--	2.0E-06	7.0E-05
			Silver	--	--	--	--	2.0E-04	--	1.4E-04	3.4E-04
			Vanadium	--	--	--	--	2.7E-02	--	3.0E-02	5.7E-02
			Zinc	--	--	--	--	6.7E-04	--	2.0E-05	6.9E-04
			2,4'-DDD	3.1E-12	--	4.9E-13	3.6E-12	2.3E-07	--	3.3E-08	2.6E-07
			4,4'-DDD	4.6E-10	--	7.5E-11	5.4E-10	3.4E-05	--	5.0E-06	3.9E-05
			4,4'-DDE	2.7E-10	--	4.3E-11	3.1E-10	1.4E-05	--	2.0E-06	1.6E-05
			4,4'-DDT	1.3E-10	--	2.1E-11	1.5E-10	6.8E-06	--	9.9E-07	7.8E-06
			alpha-Chlordane	7.9E-11	--	1.3E-11	9.2E-11	4.0E-06	--	5.8E-07	4.6E-06
			Dieldrin	1.2E-08	--	3.9E-09	1.6E-08	1.4E-04	--	4.0E-05	1.8E-04
			gamma-Chlordane	1.2E-10	--	2.0E-11	1.4E-10	6.3E-06	--	9.2E-07	7.2E-06
			Heptachlor	1.0E-09	--	3.3E-10	1.4E-09	4.0E-06	--	1.2E-06	5.2E-06
			2-Methylnaphthalene	--	--	--	--	5.1E-06	--	2.2E-06	7.3E-06
			Acenaphthene	--	--	--	--	1.4E-07	--	6.3E-08	2.1E-07
			Acenaphthylene	--	--	--	--	3.2E-07	--	1.4E-07	4.5E-07
			Anthracene	--	--	--	--	3.2E-07	--	1.4E-07	4.6E-07
			Fluorene	--	--	--	--	7.2E-07	--	3.1E-07	1.0E-06
			Naphthalene	--	--	--	--	1.6E-06	--	7.1E-07	2.4E-06
			Phenanthrene	--	--	--	--	8.8E-07	--	3.8E-07	1.3E-06
			Benzo(a)anthracene	1.4E-07	--	6.3E-08	2.0E-07	--	--	--	--
			Benzo(a)pyrene	1.1E-06	--	5.1E-07	1.6E-06	--	--	--	--
			Benzo(b)fluoranthene	1.4E-07	--	6.3E-08	2.0E-07	--	--	--	--
			Benzo(g,h,i)perylene	--	--	--	--	8.5E-06	--	3.7E-06	1.2E-05
			Benzo(k)fluoranthene	1.4E-07	--	6.5E-08	2.1E-07	--	--	--	--
			Chrysene	1.8E-08	--	8.4E-09	2.7E-08	--	--	--	--
			Dibenz(a,h)anthracene	1.6E-07	--	7.1E-08	2.3E-07	--	--	--	--
			Fluoranthene	--	--	--	--	9.4E-06	--	4.1E-06	1.3E-05
			Indeno(1,2,3-cd)pyrene	1.4E-07	--	6.6E-08	2.1E-07	--	--	--	--
			Pyrene	--	--	--	--	1.5E-05	--	6.4E-06	2.1E-05
			Monobutyltin	--	--	--	--	3.7E-06	--	1.1E-06	4.7E-06
			Dibutyltin	--	--	--	--	6.8E-05	--	2.0E-05	8.8E-05
			Tributyltin	--	--	--	--	1.5E-04	--	4.5E-05	2.0E-04
			Total PCB Congeners	3.6E-07	--	1.7E-07	5.4E-07	8.1E-02	--	3.5E-02	1.2E-01
			Total TEQ – PCB DLC	4.1E-07	--	4.0E-08	4.5E-07	4.0E-02	--	3.5E-03	4.4E-02
			Chemical Total	1.0E-05	--	2.3E-06	1.3E-05	3.9E-01	--	8.6E-02	4.7E-01
		Exposure Point Total					1.3E-05				4.7E-01
	Exposure Medium Total						1.3E-05				4.7E-01
Medium Total							1.3E-05				4.7E-01

TABLE A-14B

Summary of Receptor Risks and Hazards - Adult and Child Recreational User, South Basin Area X

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

				Cancer Risk				Noncancer Hazard Quotient			
Medium	**Exposure Medium**	**Exposure Point**	**Chemical of Potential Concern**	**Ingestion**	**Inhalation**	**Dermal**	**Exposure Routes Total**	**Ingestion**	**Inhalation**	**Dermal**	**Exposure Routes Total**
Macoma	Macoma	Macoma (ingestion)	Aluminum	--	--	--	--	7.7E-03	--	--	7.7E-03
			Antimony	--	--	--	--	5.6E-03	--	--	5.6E-03
			Arsenic	2.5E-04	--	--	2.5E-04	3.0E-01	--	--	3.0E-01
			Barium	--	--	--	--	4.0E-04	--	--	4.0E-04
			Cadmium	5.7E-06	--	--	5.7E-06	1.3E-03	--	--	1.3E-03
			Chromium	--	--	--	--	3.5E-05	--	--	3.5E-05
			Cobalt	--	--	--	--	3.1E-02	--	--	3.1E-02
			Copper	--	--	--	--	2.3E-03	--	--	2.3E-03
			Iron	--	--	--	--	1.5E-02	--	--	1.5E-02
			Lead	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	8.3E-04	--	--	8.3E-04
			Mercury	--	--	--	--	6.5E-03	--	--	6.5E-03
			Molybdenum	--	--	--	--	2.4E-03	--	--	2.4E-03
			Nickel	--	--	--	--	1.8E-03	--	--	1.8E-03
			Selenium	--	--	--	--	4.0E-03	--	--	4.0E-03
			Silver	--	--	--	--	1.3E-04	--	--	1.3E-04
			Vanadium	--	--	--	--	6.4E-03	--	--	6.4E-03
			Zinc	--	--	--	--	1.6E-03	--	--	1.6E-03
			4,4'-DDD	3.4E-09	--	--	3.4E-09	9.9E-05	--	--	9.9E-05
			4,4'-DDE	1.6E-08	--	--	1.6E-08	3.2E-04	--	--	3.2E-04
			4,4'-DDT	3.4E-10	--	--	3.4E-10	7.0E-06	--	--	7.0E-06
			alpha-Chlordane	2.9E-09	--	--	2.9E-09	5.8E-05	--	--	5.8E-05
			Dieldrin	2.2E-07	--	--	2.2E-07	9.7E-04	--	--	9.7E-04
			gamma-Chlordane	4.0E-09	--	--	4.0E-09	8.1E-05	--	--	8.1E-05
			2-Methylnaphthalene	--	--	--	--	2.2E-06	--	--	2.2E-06
			Acenaphthene	--	--	--	--	1.5E-07	--	--	1.5E-07
			Acenaphthylene	--	--	--	--	2.2E-07	--	--	2.2E-07
			Anthracene	--	--	--	--	1.7E-07	--	--	1.7E-07
			Fluorene	--	--	--	--	2.5E-07	--	--	2.5E-07
			Naphthalene	--	--	--	--	2.6E-06	--	--	2.6E-06
			Phenanthrene	--	--	--	--	3.5E-07	--	--	3.5E-07
			Benzo(a)anthracene	4.8E-08	--	--	4.8E-08	--	--	--	--
			Benzo(a)pyrene	4.3E-07	--	--	4.3E-07	--	--	--	--
			Benzo(b)fluoranthene	8.1E-08	--	--	8.1E-08	--	--	--	--
			Benzo(g,h,i)perylene	--	--	--	--	4.8E-06	--	--	4.8E-06
			Benzo(k)fluoranthene	1.1E-07	--	--	1.1E-07	--	--	--	--
			Chrysene	8.0E-09	--	--	8.0E-09	--	--	--	--
			Dibenz(a,h)anthracene	3.0E-08	--	--	3.0E-08	--	--	--	--
			Fluoranthene	--	--	--	--	1.6E-05	--	--	1.6E-05
			Indeno(1,2,3-cd)pyrene	3.3E-08	--	--	3.3E-08	--	--	--	--
			Pyrene	--	--	--	--	2.7E-05	--	--	2.7E-05
			Dibutyltin	--	--	--	--	2.2E-04	--	--	2.2E-04
			Tributyltin	--	--	--	--	1.1E-03	--	--	1.1E-03
			Total PCB Congeners	5.0E-06	--	--	5.0E-06	4.4E-01	--	--	4.4E-01
			Total TEQ – PCB DLC	7.6E-06	--	--	7.6E-06	2.9E-01	--	--	2.9E-01
			Total TEQ – TCDD DLC	8.7E-07	--	--	8.7E-07	3.3E-02	--	--	3.3E-02
			Chemical Total	2.7E-04	--	--	2.7E-04	1.2E+00	--	--	1.2E+00
		Exposure Point Total					2.7E-04				1.2E+00
	Exposure Medium Total						2.7E-04				1.2E+00
Medium Total							2.7E-04				1.2E+00
Receptor Total						Total Risk across All Media	2.8E-04			Total Hazard across All Media	1.6E+00

Acronyms/Abbreviations:

-- = not available or not applicable

DDD = dichlorodiphenyldichloroethane

DDE = dichlorodiphenyldichloroethylene

DDT = dichlorodiphenyltrichloroethane

PCB = polychlorinated biphenyl

TCDD = tetrachlorodibenzo-p-dioxin

TABLE A-14C

Summary of Risk Drivers - Adult and Child Recreational User, South Basin Area X

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Chilc

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk: Ingestion	Cancer Risk: Inhalation	Cancer Risk: Dermal	Cancer Risk: Exposure Routes Total	Noncancer Hazard Quotient: Ingestion	Noncancer Hazard Quotient: Inhalation	Noncancer Hazard Quotient: Dermal	Noncancer Hazard Quotient: Exposure Routes Total
Sediment	Sediment	Sediment (Oral/Dermal)	BAP (EQ)*	1.5E-06	--	7.7E-07	2.3E-06	--	--	--	--
			Arsenic	6.9E-06	--	1.1E-06	8.1E-06	2.2E-02	--	3.1E-03	2.5E-02
			Total PCB Congeners	3.6E-07	--	1.7E-07	5.4E-07	8.1E-02	--	3.5E-02	1.2E-01
			Chemical Total	8.5E-06	--	1.9E-06	1.0E-05	2.2E-02	--	3.1E-03	2.5E-02
		Exposure Point Total					1.0E-05				2.5E-02
	Exposure Medium Total						1.0E-05				2.5E-02
Medium Total							1.0E-05				2.5E-02
Macoma	Macoma	Macoma (Oral)	Arsenic	2.5E-04	--	--	2.5E-04	3.0E-01	--	--	3.0E-01
			Cadmium	5.7E-06	--	--	5.7E-06	1.3E-03	--	--	1.3E-03
			Total PCB Congeners	5.0E-06	--	--	5.0E-06	4.4E-01	--	--	4.4E-01
			Total TEQ – PCB DLC	7.6E-06	--	--	7.6E-06	2.9E-01	--	--	2.9E-01
			Total TEQ – TCDD DLC	8.7E-07	--	--	8.7E-07	3.3E-02	--	--	3.3E-02
			Chemical Total	2.7E-04	--	--	2.7E-04	1.1E+00	--	--	1.1E+00
		Exposure Point Total					2.7E-04				1.1E+00
	Exposure Medium Total						2.7E-04				1.1E+00
Medium Total							2.7E-04				1.1E+00
Receptor Total						Total Risk across All Media	2.8E-04			Total Hazard across All Media	1.1E+00

Notes:

* Risk for benzo(a)pyrene equivalent (BAP [EQ]) is calculated by summing the risks for each of the individual potentially carcinogenic PAHs: benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene.

Acronyms/Abbreviations:

-- = not available or not applicable

BAP (EQ) = benzo(a)pyrene equivalent

PAH = polycyclic aromatic hydrocarbon

PCB = polychlorinated biphenyl

TABLE A-15A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Construction Worker, South Basin Area X

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

							Cancer Risk Calculations					Noncancer Hazard Quotient				
					EPC		Intake/Exposure Concentration		CSF / Unit Risk			Intake/Exposure Concentration		RfD / RfC		
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	Value	Units	Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Sediment	Sediment	Sediment	Ingestion	Aluminum	6.8E+04	mg/kg	2.8E-03	mg/kg-day	--	--	--	1.9E-01	mg/kg-day	1.0E+00	mg/kg-day	1.9E-01
				Antimony	4.3E+00	mg/kg	1.7E-07	mg/kg-day	--	--	--	1.2E-05	mg/kg-day	4.0E-04	mg/kg-day	3.0E-02
				Arsenic	1.1E+01	mg/kg	2.8E-07	mg/kg-day	9.5E+00	(mg/kg-day)-1	2.6E-06	1.9E-05	mg/kg-day	3.0E-04	mg/kg-day	6.4E-02
				Barium	5.6E+02	mg/kg	2.2E-05	mg/kg-day	--	--	--	1.6E-03	mg/kg-day	2.0E-01	mg/kg-day	7.9E-03
				Cadmium	5.2E-01	mg/kg	2.1E-08	mg/kg-day	1.5E+01	(mg/kg-day)-1	3.1E-07	1.5E-06	mg/kg-day	1.0E-03	mg/kg-day	1.5E-03
				Chromium	2.5E+02	mg/kg	1.0E-05	mg/kg-day	--	--	--	7.1E-04	mg/kg-day	1.5E+00	mg/kg-day	4.7E-04
				Cobalt	1.8E+01	mg/kg	7.3E-07	mg/kg-day	--	--	--	5.1E-05	mg/kg-day	3.0E-04	mg/kg-day	1.7E-01
				Copper	1.5E+02	mg/kg	6.0E-06	mg/kg-day	--	--	--	4.2E-04	mg/kg-day	4.0E-02	mg/kg-day	1.1E-02
				Iron	4.3E+04	mg/kg	1.8E-03	mg/kg-day	--	--	--	1.2E-01	mg/kg-day	7.0E-01	mg/kg-day	1.8E-01
				Lead	9.8E+01	mg/kg	4.0E-06	mg/kg-day	--	--	--	2.8E-04	mg/kg-day	--	--	--
				Manganese	4.5E+02	mg/kg	1.8E-05	mg/kg-day	--	--	--	1.3E-03	mg/kg-day	1.4E-01	mg/kg-day	9.1E-03
				Mercury	8.2E-01	mg/kg	3.3E-08	mg/kg-day	--	--	--	2.3E-06	mg/kg-day	1.0E-04	mg/kg-day	2.3E-02
				Molybdenum	1.2E+00	mg/kg	5.0E-08	mg/kg-day	--	--	--	3.5E-06	mg/kg-day	5.0E-03	mg/kg-day	6.9E-04
				Nickel	1.2E+02	mg/kg	5.0E-06	mg/kg-day	--	--	--	3.5E-04	mg/kg-day	2.0E-02	mg/kg-day	1.8E-02
				Selenium	3.6E-01	mg/kg	1.4E-08	mg/kg-day	--	--	--	1.0E-06	mg/kg-day	5.0E-03	mg/kg-day	2.0E-04
				Silver	1.0E+00	mg/kg	4.2E-08	mg/kg-day	--	--	--	2.9E-06	mg/kg-day	5.0E-03	mg/kg-day	5.9E-04
				Vanadium	1.4E+02	mg/kg	5.7E-06	mg/kg-day	--	--	--	4.0E-04	mg/kg-day	5.0E-03	mg/kg-day	8.0E-02
				Zinc	2.1E+02	mg/kg	8.6E-06	mg/kg-day	--	--	--	6.0E-04	mg/kg-day	3.0E-01	mg/kg-day	2.0E-03
				2,4'-DDD	1.2E-04	mg/kg	4.8E-12	mg/kg-day	2.4E-01	(mg/kg-day)-1	1.2E-12	3.4E-10	mg/kg-day	5.0E-04	mg/kg-day	6.8E-07
				4,4'-DDD	1.8E-02	mg/kg	7.3E-10	mg/kg-day	2.4E-01	(mg/kg-day)-1	1.8E-10	5.1E-08	mg/kg-day	5.0E-04	mg/kg-day	1.0E-04
				4,4'-DDE	7.4E-03	mg/kg	3.0E-10	mg/kg-day	3.4E-01	(mg/kg-day)-1	1.0E-10	2.1E-08	mg/kg-day	5.0E-04	mg/kg-day	4.2E-05
				4,4'-DDT	3.6E-03	mg/kg	1.4E-10	mg/kg-day	3.4E-01	(mg/kg-day)-1	4.9E-11	1.0E-08	mg/kg-day	5.0E-04	mg/kg-day	2.0E-05
				alpha-Chlordane	2.1E-03	mg/kg	8.6E-11	mg/kg-day	3.5E-01	(mg/kg-day)-1	3.0E-11	6.0E-09	mg/kg-day	5.0E-04	mg/kg-day	1.2E-05
				Dieldrin	7.2E-03	mg/kg	2.9E-10	mg/kg-day	1.6E+01	(mg/kg-day)-1	4.6E-09	2.0E-08	mg/kg-day	5.0E-05	mg/kg-day	4.1E-04
				gamma-Chlordane	3.3E-03	mg/kg	1.3E-10	mg/kg-day	3.5E-01	(mg/kg-day)-1	4.7E-11	9.4E-09	mg/kg-day	5.0E-04	mg/kg-day	1.9E-05
				Heptachlor	2.1E-03	mg/kg	8.6E-11	mg/kg-day	4.5E+00	(mg/kg-day)-1	3.9E-10	6.0E-09	mg/kg-day	5.0E-04	mg/kg-day	1.2E-05
				2-Methylnaphthalene	2.2E-02	mg/kg	8.7E-10	mg/kg-day	--	--	--	6.1E-08	mg/kg-day	4.0E-03	mg/kg-day	1.5E-05
				Acenaphthene	9.1E-03	mg/kg	3.7E-10	mg/kg-day	--	--	--	2.6E-08	mg/kg-day	6.0E-02	mg/kg-day	4.3E-07
				Acenaphthylene	2.0E-02	mg/kg	8.0E-10	mg/kg-day	--	--	--	5.6E-08	mg/kg-day	6.0E-02	mg/kg-day	9.4E-07
				Anthracene	1.0E-01	mg/kg	4.1E-09	mg/kg-day	--	--	--	2.9E-07	mg/kg-day	3.0E-01	mg/kg-day	9.5E-07
				Fluorene	3.0E-02	mg/kg	1.2E-09	mg/kg-day	--	--	--	8.6E-08	mg/kg-day	4.0E-02	mg/kg-day	2.1E-06
				Naphthalene	3.5E-02	mg/kg	1.4E-09	mg/kg-day	--	--	--	9.7E-08	mg/kg-day	2.0E-02	mg/kg-day	4.9E-06
				Phenanthrene	2.8E-01	mg/kg	1.1E-08	mg/kg-day	--	--	--	7.9E-07	mg/kg-day	3.0E-01	mg/kg-day	2.6E-06
				Benzo(a)anthracene	2.4E-01	mg/kg	9.5E-09	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.1E-08	6.7E-07	mg/kg-day	--	--	--
				Benzo(a)pyrene	3.1E-01	mg/kg	1.3E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	9.3E-08	8.9E-07	mg/kg-day	--	--	--
				Benzo(b)fluoranthene	2.4E-01	mg/kg	9.5E-09	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.1E-08	6.7E-07	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene	2.7E-01	mg/kg	1.1E-08	mg/kg-day	--	--	--	7.6E-07	mg/kg-day	3.0E-02	mg/kg-day	2.5E-05
				Benzo(k)fluoranthene	2.4E-01	mg/kg	9.8E-09	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.2E-08	6.9E-07	mg/kg-day	--	--	--
				Chrysene	3.2E-01	mg/kg	1.3E-08	mg/kg-day	1.2E-01	(mg/kg-day)-1	1.5E-09	8.9E-07	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene	4.4E-02	mg/kg	1.8E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	1.3E-08	1.2E-07	mg/kg-day	--	--	--
				Fluoranthene	3.9E-01	mg/kg	1.6E-08	mg/kg-day	--	--	--	1.1E-06	mg/kg-day	4.0E-02	mg/kg-day	2.8E-05
				Indeno(1,2,3-cd)pyrene	2.5E-01	mg/kg	1.0E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.2E-08	7.0E-07	mg/kg-day	--	--	--
				Pyrene	4.6E-01	mg/kg	1.9E-08	mg/kg-day	--	--	--	1.3E-06	mg/kg-day	3.0E-02	mg/kg-day	4.4E-05
				Monobutyltin	1.2E-03	mg/kg	4.7E-11	mg/kg-day	--	--	--	3.3E-09	mg/kg-day	3.0E-04	mg/kg-day	1.1E-05
				Dibutyltin	2.2E-02	mg/kg	8.7E-10	mg/kg-day	--	--	--	6.1E-08	mg/kg-day	3.0E-04	mg/kg-day	2.0E-04
				Tributyltin	4.9E-02	mg/kg	2.0E-09	mg/kg-day	--	--	--	1.4E-07	mg/kg-day	3.0E-04	mg/kg-day	4.6E-04
				Total PCB Congeners	1.7E+00	mg/kg	6.8E-08	mg/kg-day	2.0E+00	(mg/kg-day)-1	1.4E-07	4.8E-06	mg/kg-day	2.0E-05	mg/kg-day	2.4E-01
				Total TEQ – PCB DLC	3.0E-05	mg/kg	1.2E-12	mg/kg-day	1.3E+05	(mg/kg-day)-1	1.6E-07	8.4E-11	mg/kg-day	7.0E-10	mg/kg-day	1.2E-01
			Exp. Route Total								3.4E-06					1.1E+00

TABLE A-15A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Construction Worker, South Basin Area X

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations: Intake/Exposure Concentration		Cancer Risk Calculations: CSF / Unit Risk		Cancer Risk	Noncancer Hazard Quotient: Intake/Exposure Concentration		Noncancer Hazard Quotient: RfD / RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	Sediment	Dermal	Aluminum	6.8E+04	mg/kg	4.0E-04	mg/kg-day	--	--	--	2.8E-02	mg/kg-day	1.0E+00	mg/kg-day	2.8E-02
				Antimony	4.3E+00	mg/kg	2.5E-08	mg/kg-day	--	--	--	1.8E-06	mg/kg-day	6.0E-05	mg/kg-day	2.9E-02
				Arsenic	1.1E+01	mg/kg	2.0E-07	mg/kg-day	9.5E+00	(mg/kg-day)-1	1.9E-06	1.4E-05	mg/kg-day	3.0E-04	mg/kg-day	4.7E-02
				Barium	5.6E+02	mg/kg	3.3E-06	mg/kg-day	--	--	--	2.3E-04	mg/kg-day	1.4E-02	mg/kg-day	1.6E-02
				Cadmium	5.2E-01	mg/kg	3.0E-10	mg/kg-day	6.0E+02	(mg/kg-day)-1	1.8E-07	2.1E-08	mg/kg-day	2.5E-05	mg/kg-day	8.5E-04
				Chromium	2.5E+02	mg/kg	1.5E-06	mg/kg-day	--	--	--	1.0E-04	mg/kg-day	2.0E-02	mg/kg-day	5.3E-03
				Cobalt	1.8E+01	mg/kg	1.1E-07	mg/kg-day	--	--	--	7.4E-06	mg/kg-day	3.0E-04	mg/kg-day	2.5E-02
				Copper	1.5E+02	mg/kg	8.8E-07	mg/kg-day	--	--	--	6.1E-05	mg/kg-day	4.0E-02	mg/kg-day	1.5E-03
				Iron	4.3E+04	mg/kg	2.6E-04	mg/kg-day	--	--	--	1.8E-02	mg/kg-day	7.0E-01	mg/kg-day	2.6E-02
				Lead	9.8E+01	mg/kg	5.8E-07	mg/kg-day	--	--	--	4.0E-05	mg/kg-day	--	--	--
				Manganese	4.5E+02	mg/kg	2.7E-06	mg/kg-day	--	--	--	1.9E-04	mg/kg-day	1.4E-01	mg/kg-day	1.3E-03
				Mercury	8.2E-01	mg/kg	4.8E-09	mg/kg-day	--	--	--	3.4E-07	mg/kg-day	1.0E-04	mg/kg-day	3.4E-03
				Molybdenum	1.2E+00	mg/kg	7.2E-09	mg/kg-day	--	--	--	5.1E-07	mg/kg-day	5.0E-03	mg/kg-day	1.0E-04
				Nickel	1.2E+02	mg/kg	7.3E-07	mg/kg-day	--	--	--	5.1E-05	mg/kg-day	8.0E-04	mg/kg-day	6.4E-02
				Selenium	3.6E-01	mg/kg	2.1E-09	mg/kg-day	--	--	--	1.5E-07	mg/kg-day	5.0E-03	mg/kg-day	3.0E-05
				Silver	1.0E+00	mg/kg	6.2E-09	mg/kg-day	--	--	--	4.3E-07	mg/kg-day	2.0E-04	mg/kg-day	2.2E-03
				Vanadium	1.4E+02	mg/kg	8.4E-07	mg/kg-day	--	--	--	5.9E-05	mg/kg-day	1.3E-04	mg/kg-day	4.5E-01
				Zinc	2.1E+02	mg/kg	1.3E-06	mg/kg-day	--	--	--	8.8E-05	mg/kg-day	3.0E-01	mg/kg-day	2.9E-04
				2,4'-DDD	1.2E-04	mg/kg	3.5E-12	mg/kg-day	2.4E-01	(mg/kg-day)-1	8.5E-13	2.5E-10	mg/kg-day	5.0E-04	mg/kg-day	5.0E-07
				4,4'-DDD	1.8E-02	mg/kg	5.3E-10	mg/kg-day	2.4E-01	(mg/kg-day)-1	1.3E-10	3.7E-08	mg/kg-day	5.0E-04	mg/kg-day	7.5E-05
				4,4'-DDE	7.4E-03	mg/kg	2.2E-10	mg/kg-day	3.4E-01	(mg/kg-day)-1	7.4E-11	1.5E-08	mg/kg-day	5.0E-04	mg/kg-day	3.1E-05
				4,4'-DDT	3.6E-03	mg/kg	1.1E-10	mg/kg-day	3.4E-01	(mg/kg-day)-1	3.6E-11	7.4E-09	mg/kg-day	5.0E-04	mg/kg-day	1.5E-05
				alpha-Chlordane	2.1E-03	mg/kg	6.3E-11	mg/kg-day	3.5E-01	(mg/kg-day)-1	2.2E-11	4.4E-09	mg/kg-day	5.0E-04	mg/kg-day	8.8E-06
				Dieldrin	7.2E-03	mg/kg	4.2E-10	mg/kg-day	1.6E+01	(mg/kg-day)-1	6.8E-09	3.0E-08	mg/kg-day	5.0E-05	mg/kg-day	5.9E-04
				gamma-Chlordane	3.3E-03	mg/kg	9.8E-11	mg/kg-day	3.5E-01	(mg/kg-day)-1	3.4E-11	6.9E-09	mg/kg-day	5.0E-04	mg/kg-day	1.4E-05
				Heptachlor	2.1E-03	mg/kg	1.3E-10	mg/kg-day	4.5E+00	(mg/kg-day)-1	5.7E-10	8.8E-09	mg/kg-day	5.0E-04	mg/kg-day	1.8E-05
				2-Methylnaphthalene	2.2E-02	mg/kg	1.9E-09	mg/kg-day	--	--	--	1.3E-07	mg/kg-day	4.0E-03	mg/kg-day	3.3E-05
				Acenaphthene	9.1E-03	mg/kg	8.1E-10	mg/kg-day	--	--	--	5.6E-08	mg/kg-day	6.0E-02	mg/kg-day	9.4E-07
				Acenaphthylene	2.0E-02	mg/kg	1.8E-09	mg/kg-day	--	--	--	1.2E-07	mg/kg-day	6.0E-02	mg/kg-day	2.1E-06
				Anthracene	1.0E-01	mg/kg	8.9E-09	mg/kg-day	--	--	--	6.3E-07	mg/kg-day	3.0E-01	mg/kg-day	2.1E-06
				Fluorene	3.0E-02	mg/kg	2.7E-09	mg/kg-day	--	--	--	1.9E-07	mg/kg-day	4.0E-02	mg/kg-day	4.7E-06
				Naphthalene	3.5E-02	mg/kg	3.1E-09	mg/kg-day	--	--	--	2.1E-07	mg/kg-day	2.0E-02	mg/kg-day	1.1E-05
				Phenanthrene	2.8E-01	mg/kg	2.5E-08	mg/kg-day	--	--	--	1.7E-06	mg/kg-day	3.0E-01	mg/kg-day	5.7E-06
				Benzo(a)anthracene	2.4E-01	mg/kg	2.1E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	2.5E-08	1.5E-06	mg/kg-day	--	--	--
				Benzo(a)pyrene	3.1E-01	mg/kg	2.8E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	2.0E-07	1.9E-06	mg/kg-day	--	--	--
				Benzo(b)fluoranthene	2.4E-01	mg/kg	2.1E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	2.5E-08	1.5E-06	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene	2.7E-01	mg/kg	2.4E-08	mg/kg-day	--	--	--	1.7E-06	mg/kg-day	3.0E-02	mg/kg-day	5.6E-05
				Benzo(k)fluoranthene	2.4E-01	mg/kg	2.2E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	2.6E-08	1.5E-06	mg/kg-day	--	--	--
				Chrysene	3.2E-01	mg/kg	2.8E-08	mg/kg-day	1.2E-01	(mg/kg-day)-1	3.3E-09	2.0E-06	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene	4.4E-02	mg/kg	3.9E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	2.9E-08	2.7E-07	mg/kg-day	--	--	--
				Fluoranthene	3.9E-01	mg/kg	3.5E-08	mg/kg-day	--	--	--	2.4E-06	mg/kg-day	4.0E-02	mg/kg-day	6.1E-05
				Indeno(1,2,3-cd)pyrene	2.5E-01	mg/kg	2.2E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	2.6E-08	1.5E-06	mg/kg-day	--	--	--
				Pyrene	4.6E-01	mg/kg	4.1E-08	mg/kg-day	--	--	--	2.9E-06	mg/kg-day	3.0E-02	mg/kg-day	9.6E-05
				Monobutyltin	1.2E-03	mg/kg	6.8E-11	mg/kg-day	--	--	--	4.8E-09	mg/kg-day	3.0E-04	mg/kg-day	1.6E-05
				Dibutyltin	2.2E-02	mg/kg	1.3E-09	mg/kg-day	--	--	--	8.9E-08	mg/kg-day	3.0E-04	mg/kg-day	3.0E-04
				Tributyltin	4.9E-02	mg/kg	2.9E-09	mg/kg-day	--	--	--	2.0E-07	mg/kg-day	3.0E-04	mg/kg-day	6.7E-04
				Total PCB Congeners	1.7E+00	mg/kg	1.5E-07	mg/kg-day	2.0E+00	(mg/kg-day)-1	3.0E-07	1.1E-05	mg/kg-day	2.0E-05	mg/kg-day	5.3E-01
				Total TEQ – PCB DLC	3.0E-05	mg/kg	5.3E-13	mg/kg-day	1.3E+05	(mg/kg-day)-1	6.9E-08	3.7E-11	mg/kg-day	7.0E-10	mg/kg-day	5.3E-02
			Exp. Route Total								2.8E-06					1.3E+00
		Exposure Point Total									6.2E-06					2.4E+00
	Exposure Medium Total										6.2E-06					2.4E+00
Medium Total											6.2E-06					2.4E+00
										Total of Receptor Risks across All Media	6.2E-06				Total of Receptor Hazards across All Media	2.4E+00

TABLE A-15A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Construction Worker, South Basin Area X

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Noncancer Hazard Quotient				
							Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	

Acronyms/Abbreviations:

-- =	not available or not applicable
CSF =	cancer slope factor
DDD =	dichlorodiphenyldichloroethane
DDE =	dichlorodiphenyldichloroethylene
DDT =	dichlorodiphenyltrichloroethane
EPC =	exposure point concentration
Exp. =	exposure
M =	lifetime exposure from birth, mutagenic endpoint
(mg/kg-day)-	1/(milligram[s] per kilogram per day)
mg/kg =	milligram(s) per kilogram
mg/kg-day =	milligram(s) per kilogram per day
PCB =	polychlorinated biphenyl
RfC =	reference concentration
RfD =	reference dose
RME =	reasonable maximum exposure
TCDD =	tetrachlorodibenzo-p-dioxin

TABLE A-15B

Summary of Receptor Risks and Hazards - Construction Worker, South Basin Area X

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk: Ingestion	Cancer Risk: Inhalation	Cancer Risk: Dermal	Cancer Risk: Exposure Routes Total	Noncancer Hazard Quotient: Ingestion	Noncancer Hazard Quotient: Inhalation	Noncancer Hazard Quotient: Dermal	Noncancer Hazard Quotient: Exposure Routes Total
Sediment	Sediment	Sediment	Aluminum	--	--	--	--	1.9E-01	--	2.8E-02	2.2E-01
			Antimony	--	--	--	--	3.0E-02	--	2.9E-02	6.0E-02
			Arsenic	2.6E-06	--	1.9E-06	4.5E-06	6.4E-02	--	4.7E-02	1.1E-01
			Barium	--	--	--	--	7.9E-03	--	1.6E-02	2.4E-02
			Cadmium	3.1E-07	--	1.8E-07	4.9E-07	1.5E-03	--	8.5E-04	2.3E-03
			Chromium	--	--	--	--	4.7E-04	--	5.3E-03	5.8E-03
			Cobalt	--	--	--	--	1.7E-01	--	2.5E-02	1.9E-01
			Copper	--	--	--	--	1.1E-02	--	1.5E-03	1.2E-02
			Iron	--	--	--	--	1.8E-01	--	2.6E-02	2.0E-01
			Lead	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	9.1E-03	--	1.3E-03	1.0E-02
			Mercury	--	--	--	--	2.3E-02	--	3.4E-03	2.7E-02
			Molybdenum	--	--	--	--	6.9E-04	--	1.0E-04	8.0E-04
			Nickel	--	--	--	--	1.8E-02	--	6.4E-02	8.1E-02
			Selenium	--	--	--	--	2.0E-04	--	3.0E-05	2.3E-04
			Silver	--	--	--	--	5.9E-04	--	2.2E-03	2.7E-03
			Vanadium	--	--	--	--	8.0E-02	--	4.5E-01	5.3E-01
			Zinc	--	--	--	--	2.0E-03	--	2.9E-04	2.3E-03
			2,4'-DDD	1.2E-12	--	8.5E-13	2.0E-12	6.8E-07	--	5.0E-07	1.2E-06
			4,4'-DDD	1.8E-10	--	1.3E-10	3.0E-10	1.0E-04	--	7.5E-05	1.8E-04
			4,4'-DDE	1.0E-10	--	7.4E-11	1.8E-10	4.2E-05	--	3.1E-05	7.2E-05
			4,4'-DDT	4.9E-11	--	3.6E-11	8.5E-11	2.0E-05	--	1.5E-05	3.5E-05
			alpha-Chlordane	3.0E-11	--	2.2E-11	5.2E-11	1.2E-05	--	8.8E-06	2.1E-05
			Dieldrin	4.6E-09	--	6.8E-09	1.1E-08	4.1E-04	--	5.9E-04	1.0E-03
			gamma-Chlordane	4.7E-11	--	3.4E-11	8.1E-11	1.9E-05	--	1.4E-05	3.3E-05
			Heptachlor	3.9E-10	--	5.7E-10	9.5E-10	1.2E-05	--	1.8E-05	3.0E-05
			2-Methylnaphthalene	--	--	--	--	1.5E-05	--	3.3E-05	4.8E-05
			Acenaphthene	--	--	--	--	4.3E-07	--	9.4E-07	1.4E-06
			Acenaphthylene	--	--	--	--	9.4E-07	--	2.1E-06	3.0E-06
			Anthracene	--	--	--	--	9.5E-07	--	2.1E-06	3.0E-06
			Fluorene	--	--	--	--	2.1E-06	--	4.7E-06	6.8E-06
			Naphthalene	--	--	--	--	4.9E-06	--	1.1E-05	1.6E-05
			Phenanthrene	--	--	--	--	2.6E-06	--	5.7E-06	8.4E-06
			Benzo(a)anthracene	1.1E-08	--	2.5E-08	3.7E-08	--	--	--	--
			Benzo(a)pyrene	9.3E-08	--	2.0E-07	3.0E-07	--	--	--	--
			Benzo(b)fluoranthene	1.1E-08	--	2.5E-08	3.7E-08	--	--	--	--
			Benzo(g,h,i)perylene	--	--	--	--	2.5E-05	--	5.6E-05	8.1E-05
			Benzo(k)fluoranthene	1.2E-08	--	2.6E-08	3.8E-08	--	--	--	--
			Chrysene	1.5E-09	--	3.3E-09	4.9E-09	--	--	--	--
			Dibenz(a,h)anthracene	1.3E-08	--	2.9E-08	4.1E-08	--	--	--	--
			Fluoranthene	--	--	--	--	2.8E-05	--	6.1E-05	8.9E-05
			Indeno(1,2,3-cd)pyrene	1.2E-08	--	2.6E-08	3.8E-08	--	--	--	--
			Pyrene	--	--	--	--	4.4E-05	--	9.6E-05	1.4E-04
			Monobutyltin	--	--	--	--	1.1E-05	--	1.6E-05	2.7E-05
			Dibutyltin	--	--	--	--	2.0E-04	--	3.0E-04	5.0E-04
			Tributyltin	--	--	--	--	4.6E-04	--	6.7E-04	1.1E-03
			Total PCB Congeners	1.4E-07	--	3.0E-07	4.4E-07	2.4E-01	--	5.3E-01	7.7E-01
			Total TEQ – PCB DLC	1.6E-07	--	6.9E-08	2.2E-07	1.2E-01	--	5.3E-02	1.7E-01
			Chemical Total	3.4E-06	--	2.8E-06	6.2E-06	1.1E+00	--	1.3E+00	2.4E+00
		Exposure Point Total					6.2E-06				2.4E+00
	Exposure Medium Total						6.2E-06				2.4E+00
Medium Total							6.2E-06				2.4E+00
Receptor Total						Total Risk across All Media	6.2E-06			Total Hazard across All Media	2.4E+00

TABLE A-15B

Summary of Receptor Risks and Hazards - Construction Worker, South Basin Area X

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient			
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Ingestion	Inhalation	Dermal	Exposure Routes Total

Acronyms/Abbreviations:

-- = not available or not applicable

DDD = dichlorodiphenyldichloroethane

DDE = dichlorodiphenyldichloroethylene

DDT = dichlorodiphenyltrichloroethane

PCB = polychlorinated biphenyl

TCDD = tetrachlorodibenzo-p-dioxin

TABLE A-15C

Summary of Risk Drivers - Construction Worker, South Basin Area X

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient			
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	Sediment	Arsenic	2.6E-06	--	1.9E-06	4.5E-06	6.4E-02	--	4.7E-02	1.1E-01
			Chemical Total	--	--	--	4.5E-06	--	--	--	1.1E-01
		Exposure Point Total					4.5E-06				1.1E-01
	Exposure Medium Total						4.5E-06				1.1E-01
Medium Total							4.5E-06				1.1E-01
Receptor Total						Total Risk across All Media	4.5E-06			Total Hazard across All Media	1.1E-01

Acronyms/Abbreviations:

-- = not available or not applicable

TABLE A-16A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Adult and Child Recreational User, Reference Stations

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern		EPC Value	EPC Units	Cancer Risk Calculations: Intake/Exposure Concentration Value	Intake/Exposure Concentration Units	CSF / Unit Risk Value	CSF / Unit Risk Units	Cancer Risk	Noncancer Hazard Quotient: Intake/Exposure Concentration Value	Intake/Exposure Concentration Units	RfD / RfC Value	RfD / RfC Units	Hazard Quotient
Sediment	Sediment	Sediment	Ingestion	Aluminum		7.6E+04	mg/kg	8.1E-03	mg/kg-day	--	--	--	7.2E-02	mg/kg-day	1.0E+00	mg/kg-day	7.2E-02
				Antimony		9.2E-01	mg/kg	9.8E-08	mg/kg-day	--	--	--	8.7E-07	mg/kg-day	4.0E-04	mg/kg-day	2.2E-03
				Arsenic		1.2E+01	mg/kg	7.8E-07	mg/kg-day	9.5E+00	(mg/kg-day)-1	7.4E-06	6.9E-06	mg/kg-day	3.0E-04	mg/kg-day	2.3E-02
				Barium		4.8E+02	mg/kg	5.2E-05	mg/kg-day	--	--	--	4.6E-04	mg/kg-day	2.0E-01	mg/kg-day	2.3E-03
				Cadmium		6.4E-01	mg/kg	6.9E-08	mg/kg-day	1.5E+01	(mg/kg-day)-1	1.0E-06	6.1E-07	mg/kg-day	1.0E-03	mg/kg-day	6.1E-04
				Chromium		1.8E+02	mg/kg	1.9E-05	mg/kg-day	--	--	--	1.7E-04	mg/kg-day	1.5E+00	mg/kg-day	1.1E-04
				Cobalt		2.1E+01	mg/kg	2.3E-06	mg/kg-day	--	--	--	2.0E-05	mg/kg-day	3.0E-04	mg/kg-day	6.8E-02
				Copper		4.7E+01	mg/kg	5.0E-06	mg/kg-day	--	--	--	4.5E-05	mg/kg-day	4.0E-02	mg/kg-day	1.1E-03
				Iron		4.9E+04	mg/kg	5.3E-03	mg/kg-day	--	--	--	4.7E-02	mg/kg-day	7.0E-01	mg/kg-day	6.7E-02
				Lead		2.9E+01	mg/kg	3.1E-06	mg/kg-day	--	--	--	2.7E-05	mg/kg-day	--	--	--
				Manganese		6.2E+02	mg/kg	6.6E-05	mg/kg-day	--	--	--	5.8E-04	mg/kg-day	1.4E-01	mg/kg-day	4.2E-03
				Mercury		3.6E-01	mg/kg	3.9E-08	mg/kg-day	--	--	--	3.5E-07	mg/kg-day	1.0E-04	mg/kg-day	3.5E-03
				Molybdenum		8.5E-01	mg/kg	9.1E-08	mg/kg-day	--	--	--	8.1E-07	mg/kg-day	5.0E-03	mg/kg-day	1.6E-04
				Nickel		1.0E+02	mg/kg	1.1E-05	mg/kg-day	--	--	--	9.5E-05	mg/kg-day	2.0E-02	mg/kg-day	4.8E-03
				Selenium		4.6E-01	mg/kg	4.9E-08	mg/kg-day	--	--	--	4.3E-07	mg/kg-day	5.0E-03	mg/kg-day	8.7E-05
				Silver		4.5E-01	mg/kg	4.8E-08	mg/kg-day	--	--	--	4.2E-07	mg/kg-day	5.0E-03	mg/kg-day	8.5E-05
				Vanadium		1.6E+02	mg/kg	1.7E-05	mg/kg-day	--	--	--	1.5E-04	mg/kg-day	5.0E-03	mg/kg-day	3.0E-02
				Zinc		1.3E+02	mg/kg	1.4E-05	mg/kg-day	--	--	--	1.2E-04	mg/kg-day	3.0E-01	mg/kg-day	4.0E-04
				4,4'-DDD		2.4E-03	mg/kg	2.6E-10	mg/kg-day	2.4E-01	(mg/kg-day)-1	6.2E-11	2.3E-09	mg/kg-day	5.0E-04	mg/kg-day	4.6E-06
				4,4'-DDE		9.1E-04	mg/kg	9.8E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	3.3E-11	8.7E-10	mg/kg-day	5.0E-04	mg/kg-day	1.7E-06
				4,4'-DDT		1.7E-03	mg/kg	1.8E-10	mg/kg-day	3.4E-01	(mg/kg-day)-1	6.0E-11	1.6E-09	mg/kg-day	5.0E-04	mg/kg-day	3.1E-06
				alpha-Chlordane		1.2E-04	mg/kg	1.3E-11	mg/kg-day	3.5E-01	(mg/kg-day)-1	4.5E-12	1.1E-10	mg/kg-day	5.0E-04	mg/kg-day	2.3E-07
				2-Methylnaphthalene		6.4E-03	mg/kg	6.9E-10	mg/kg-day	--	--	--	6.1E-09	mg/kg-day	4.0E-03	mg/kg-day	1.5E-06
				Acenaphthene		1.2E-02	mg/kg	1.3E-09	mg/kg-day	--	--	--	1.2E-08	mg/kg-day	6.0E-02	mg/kg-day	2.0E-07
				Acenaphthylene		9.3E-03	mg/kg	9.9E-10	mg/kg-day	--	--	--	8.8E-09	mg/kg-day	6.0E-02	mg/kg-day	1.5E-07
				Anthracene		3.1E-02	mg/kg	3.3E-09	mg/kg-day	--	--	--	3.0E-08	mg/kg-day	3.0E-01	mg/kg-day	9.9E-08
				Fluorene		8.4E-03	mg/kg	8.9E-10	mg/kg-day	--	--	--	7.9E-09	mg/kg-day	4.0E-02	mg/kg-day	2.0E-07
				Naphthalene		1.4E-02	mg/kg	1.5E-09	mg/kg-day	--	--	--	1.4E-08	mg/kg-day	2.0E-02	mg/kg-day	6.8E-07
				Phenanthrene		1.1E-01	mg/kg	1.1E-08	mg/kg-day	--	--	--	1.0E-07	mg/kg-day	3.0E-01	mg/kg-day	3.3E-07
				Benzo(a)anthracene	M	9.5E-02	mg/kg	4.6E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	5.5E-08	9.0E-08	mg/kg-day	--	--	--
				Benzo(a)pyrene	M	1.9E-01	mg/kg	9.0E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	6.6E-07	1.8E-07	mg/kg-day	--	--	--
				Benzo(b)fluoranthene	M	1.2E-01	mg/kg	5.7E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	6.8E-08	1.1E-07	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene		1.8E-01	mg/kg	1.9E-08	mg/kg-day	--	--	--	1.7E-07	mg/kg-day	3.0E-02	mg/kg-day	5.6E-06
				Benzo(k)fluoranthene	M	1.1E-01	mg/kg	5.5E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	6.6E-08	1.1E-07	mg/kg-day	--	--	--
				Chrysene	M	1.1E-01	mg/kg	5.4E-08	mg/kg-day	1.2E-01	(mg/kg-day)-1	6.5E-09	1.1E-07	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene	M	1.9E-02	mg/kg	9.1E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	6.6E-08	1.8E-08	mg/kg-day	--	--	--
				Fluoranthene		2.3E-01	mg/kg	2.5E-08	mg/kg-day	--	--	--	2.2E-07	mg/kg-day	4.0E-02	mg/kg-day	5.5E-06
				Indeno(1,2,3-cd)pyrene	M	1.6E-01	mg/kg	7.7E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	9.3E-08	1.5E-07	mg/kg-day	--	--	--
				Pyrene		2.9E-01	mg/kg	3.1E-08	mg/kg-day	--	--	--	2.8E-07	mg/kg-day	3.0E-02	mg/kg-day	9.3E-06
				Dibutyltin		1.3E-03	mg/kg	1.4E-10	mg/kg-day	--	--	--	1.3E-09	mg/kg-day	3.0E-04	mg/kg-day	4.2E-06
				Tributyltin		4.0E-03	mg/kg	4.3E-10	mg/kg-day	--	--	--	3.8E-09	mg/kg-day	3.0E-04	mg/kg-day	1.3E-05
				Total PCB Congeners		3.0E-02	mg/kg	3.2E-09	mg/kg-day	2.0E+00	(mg/kg-day)-1	6.5E-09	2.9E-08	mg/kg-day	2.0E-05	mg/kg-day	1.4E-03
				Total TEQ – PCB DLC		8.7E-06	mg/kg	9.3E-13	mg/kg-day	1.3E+05	(mg/kg-day)-1	1.2E-07	8.2E-12	mg/kg-day	7.0E-10	mg/kg-day	1.2E-02
			Exp. Route Total									9.5E-06					2.9E-01

TABLE A-16A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Adult and Child Recreational User, Reference Stations

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

								Cancer Risk Calculations					Noncancer Hazard Quotient				
						EPC		Intake/Exposure Concentration		CSF / Unit Risk			Intake/Exposure Concentration		RfD / RfC		
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern		Value	Units	Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Sediment	Sediment	Sediment	Dermal	Aluminum		7.6E+04	mg/kg	2.6E-04	mg/kg-day	--	--	--	2.1E-03	mg/kg-day	1.0E+00	mg/kg-day	2.1E-03
				Antimony		9.2E-01	mg/kg	3.1E-09	mg/kg-day	--	--	--	2.5E-08	mg/kg-day	6.0E-05	mg/kg-day	4.2E-04
				Arsenic		1.2E+01	mg/kg	1.2E-07	mg/kg-day	9.5E+00	(mg/kg-day)-1	1.2E-06	1.0E-06	mg/kg-day	3.0E-04	mg/kg-day	3.3E-03
				Barium		4.8E+02	mg/kg	1.7E-06	mg/kg-day	--	--	--	1.3E-05	mg/kg-day	1.4E-02	mg/kg-day	9.5E-04
				Cadmium		6.4E-01	mg/kg	2.2E-10	mg/kg-day	6.0E+02	(mg/kg-day)-1	1.3E-07	1.8E-09	mg/kg-day	2.5E-05	mg/kg-day	7.1E-05
				Chromium		1.8E+02	mg/kg	6.0E-07	mg/kg-day	--	--	--	4.8E-06	mg/kg-day	2.0E-02	mg/kg-day	2.5E-04
				Cobalt		2.1E+01	mg/kg	7.4E-08	mg/kg-day	--	--	--	5.9E-07	mg/kg-day	3.0E-04	mg/kg-day	2.0E-03
				Copper		4.7E+01	mg/kg	1.6E-07	mg/kg-day	--	--	--	1.3E-06	mg/kg-day	4.0E-02	mg/kg-day	3.2E-05
				Iron		4.9E+04	mg/kg	1.7E-04	mg/kg-day	--	--	--	1.4E-03	mg/kg-day	7.0E-01	mg/kg-day	1.9E-03
				Lead		2.9E+01	mg/kg	9.8E-08	mg/kg-day	--	--	--	7.9E-07	mg/kg-day	--	--	--
				Manganese		6.2E+02	mg/kg	2.1E-06	mg/kg-day	--	--	--	1.7E-05	mg/kg-day	1.4E-01	mg/kg-day	1.2E-04
				Mercury		3.6E-01	mg/kg	1.3E-09	mg/kg-day	--	--	--	1.0E-08	mg/kg-day	1.0E-04	mg/kg-day	1.0E-04
				Molybdenum		8.5E-01	mg/kg	2.9E-09	mg/kg-day	--	--	--	2.3E-08	mg/kg-day	5.0E-03	mg/kg-day	4.7E-06
				Nickel		1.0E+02	mg/kg	3.4E-07	mg/kg-day	--	--	--	2.8E-06	mg/kg-day	8.0E-04	mg/kg-day	3.5E-03
				Selenium		4.6E-01	mg/kg	1.6E-09	mg/kg-day	--	--	--	1.3E-08	mg/kg-day	5.0E-03	mg/kg-day	2.5E-06
				Silver		4.5E-01	mg/kg	1.5E-09	mg/kg-day	--	--	--	1.2E-08	mg/kg-day	2.0E-04	mg/kg-day	6.2E-05
				Vanadium		1.6E+02	mg/kg	5.5E-07	mg/kg-day	--	--	--	4.4E-06	mg/kg-day	1.3E-04	mg/kg-day	3.4E-02
				Zinc		1.3E+02	mg/kg	4.4E-07	mg/kg-day	--	--	--	3.5E-06	mg/kg-day	3.0E-01	mg/kg-day	1.2E-05
				4,4'-DDD		2.4E-03	mg/kg	4.1E-11	mg/kg-day	2.4E-01	(mg/kg-day)-1	9.9E-12	3.3E-10	mg/kg-day	5.0E-04	mg/kg-day	6.6E-07
				4,4'-DDE		9.1E-04	mg/kg	1.6E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	5.3E-12	1.3E-10	mg/kg-day	5.0E-04	mg/kg-day	2.5E-07
				4,4'-DDT		1.7E-03	mg/kg	2.8E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	9.6E-12	2.3E-10	mg/kg-day	5.0E-04	mg/kg-day	4.5E-07
				alpha-Chlordane		1.2E-04	mg/kg	2.1E-12	mg/kg-day	3.5E-01	(mg/kg-day)-1	7.2E-13	1.7E-11	mg/kg-day	5.0E-04	mg/kg-day	3.3E-08
				2-Methylnaphthalene		6.4E-03	mg/kg	3.3E-10	mg/kg-day	--	--	--	2.7E-09	mg/kg-day	4.0E-03	mg/kg-day	6.6E-07
				Acenaphthene		1.2E-02	mg/kg	6.4E-10	mg/kg-day	--	--	--	5.1E-09	mg/kg-day	6.0E-02	mg/kg-day	8.5E-08
				Acenaphthylene		9.3E-03	mg/kg	4.8E-10	mg/kg-day	--	--	--	3.8E-09	mg/kg-day	6.0E-02	mg/kg-day	6.4E-08
				Anthracene		3.1E-02	mg/kg	1.6E-09	mg/kg-day	--	--	--	1.3E-08	mg/kg-day	3.0E-01	mg/kg-day	4.3E-08
				Fluorene		8.4E-03	mg/kg	4.3E-10	mg/kg-day	--	--	--	3.5E-09	mg/kg-day	4.0E-02	mg/kg-day	8.6E-08
				Naphthalene		1.4E-02	mg/kg	7.4E-10	mg/kg-day	--	--	--	5.9E-09	mg/kg-day	2.0E-02	mg/kg-day	3.0E-07
				Phenanthrene		1.1E-01	mg/kg	5.4E-09	mg/kg-day	--	--	--	4.3E-08	mg/kg-day	3.0E-01	mg/kg-day	1.4E-07
				Benzo(a)anthracene	M	9.5E-02	mg/kg	2.1E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	2.5E-08	3.9E-08	mg/kg-day	--	--	--
				Benzo(a)pyrene	M	1.9E-01	mg/kg	4.1E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	3.0E-07	7.7E-08	mg/kg-day	--	--	--
				Benzo(b)fluoranthene	M	1.2E-01	mg/kg	2.6E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	3.1E-08	4.8E-08	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene		1.8E-01	mg/kg	9.2E-09	mg/kg-day	--	--	--	7.4E-08	mg/kg-day	3.0E-02	mg/kg-day	2.5E-06
				Benzo(k)fluoranthene	M	1.1E-01	mg/kg	2.5E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	3.0E-08	4.7E-08	mg/kg-day	--	--	--
				Chrysene	M	1.1E-01	mg/kg	2.5E-08	mg/kg-day	1.2E-01	(mg/kg-day)-1	3.0E-09	4.6E-08	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene	M	1.9E-02	mg/kg	4.1E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	3.0E-08	7.7E-09	mg/kg-day	--	--	--
				Fluoranthene		2.3E-01	mg/kg	1.2E-08	mg/kg-day	--	--	--	9.6E-08	mg/kg-day	4.0E-02	mg/kg-day	2.4E-06
				Indeno(1,2,3-cd)pyrene	M	1.6E-01	mg/kg	3.5E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	4.2E-08	6.6E-08	mg/kg-day	--	--	--
				Pyrene		2.9E-01	mg/kg	1.5E-08	mg/kg-day	--	--	--	1.2E-07	mg/kg-day	3.0E-02	mg/kg-day	4.0E-06
				Dibutyltin		1.3E-03	mg/kg	4.5E-11	mg/kg-day	--	--	--	3.6E-10	mg/kg-day	3.0E-04	mg/kg-day	1.2E-06
				Tributyltin		4.0E-03	mg/kg	1.4E-10	mg/kg-day	--	--	--	1.1E-09	mg/kg-day	3.0E-04	mg/kg-day	3.7E-06
				Total PCB Congeners		3.0E-02	mg/kg	1.6E-09	mg/kg-day	2.0E+00	(mg/kg-day)-1	3.1E-09	1.3E-08	mg/kg-day	2.0E-05	mg/kg-day	6.3E-04
				Total TEQ – PCB DLC		8.7E-06	mg/kg	8.9E-14	mg/kg-day	1.3E+05	(mg/kg-day)-1	1.2E-08	7.2E-13	mg/kg-day	7.0E-10	mg/kg-day	1.0E-03
			Exp. Route Total									1.8E-06					5.0E-02
		Exposure Point Total										1.1E-05					3.4E-01
	Exposure Medium Total											1.1E-05					3.4E-01
Medium Total												1.1E-05					3.4E-01

TABLE A-16A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Adult and Child Recreational User, Reference Stations

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations: Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Noncancer Hazard Quotient: Intake/Exposure Concentration		RfD / RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Macoma[a]	Macoma	Macoma	Ingestion	Aluminum	2.8E+02	mg/kg	2.1E-03	mg/kg-day	--	--	--	7.4E-03	mg/kg-day	1.0E+00	mg/kg-day	7.4E-03
				Antimony	2.7E-02	mg/kg	2.0E-07	mg/kg-day	--	--	--	7.1E-07	mg/kg-day	4.0E-04	mg/kg-day	1.8E-03
				Arsenic	3.8E+00	mg/kg	2.9E-05	mg/kg-day	9.5E+00	(mg/kg-day)-1	2.7E-04	1.0E-04	mg/kg-day	3.0E-04	mg/kg-day	3.4E-01
				Barium	2.9E+00	mg/kg	2.2E-05	mg/kg-day	--	--	--	7.8E-05	mg/kg-day	2.0E-01	mg/kg-day	3.9E-04
				Cadmium	1.5E-01	mg/kg	1.1E-06	mg/kg-day	1.5E+01	(mg/kg-day)-1	1.7E-05	3.9E-06	mg/kg-day	1.0E-03	mg/kg-day	3.9E-03
				Chromium	2.8E+00	mg/kg	2.1E-05	mg/kg-day	--	--	--	7.5E-05	mg/kg-day	1.5E+00	mg/kg-day	5.0E-05
				Cobalt	5.1E-01	mg/kg	3.9E-06	mg/kg-day	--	--	--	1.4E-05	mg/kg-day	3.0E-04	mg/kg-day	4.5E-02
				Copper	2.5E+00	mg/kg	1.9E-05	mg/kg-day	--	--	--	6.6E-05	mg/kg-day	4.0E-02	mg/kg-day	1.7E-03
				Iron	3.9E+02	mg/kg	3.0E-03	mg/kg-day	--	--	--	1.0E-02	mg/kg-day	7.0E-01	mg/kg-day	1.5E-02
				Lead	4.9E-01	mg/kg	3.7E-06	mg/kg-day	--	--	--	1.3E-05	mg/kg-day	--	--	--
				Manganese	7.9E+00	mg/kg	6.0E-05	mg/kg-day	--	--	--	2.1E-04	mg/kg-day	1.4E-01	mg/kg-day	1.5E-03
				Mercury	2.5E-02	mg/kg	1.9E-07	mg/kg-day	--	--	--	6.8E-07	mg/kg-day	1.0E-04	mg/kg-day	6.8E-03
				Molybdenum	4.9E-01	mg/kg	3.7E-06	mg/kg-day	--	--	--	1.3E-05	mg/kg-day	5.0E-03	mg/kg-day	2.6E-03
				Nickel	1.4E+00	mg/kg	1.0E-05	mg/kg-day	--	--	--	3.6E-05	mg/kg-day	2.0E-02	mg/kg-day	1.8E-03
				Selenium	7.9E-01	mg/kg	6.0E-06	mg/kg-day	--	--	--	2.1E-05	mg/kg-day	5.0E-03	mg/kg-day	4.2E-03
				Silver	2.8E-02	mg/kg	2.1E-07	mg/kg-day	--	--	--	7.3E-07	mg/kg-day	5.0E-03	mg/kg-day	1.5E-04
				Vanadium	1.5E+00	mg/kg	1.2E-05	mg/kg-day	--	--	--	4.0E-05	mg/kg-day	5.0E-03	mg/kg-day	8.1E-03
				Zinc	1.8E+01	mg/kg	1.4E-04	mg/kg-day	--	--	--	4.9E-04	mg/kg-day	3.0E-01	mg/kg-day	1.6E-03
				4,4'-DDD	5.1E-04	mg/kg	3.8E-09	mg/kg-day	2.4E-01	(mg/kg-day)-1	9.2E-10	1.3E-08	mg/kg-day	5.0E-04	mg/kg-day	2.7E-05
				4,4'-DDE	8.7E-04	mg/kg	6.6E-09	mg/kg-day	3.4E-01	(mg/kg-day)-1	2.3E-09	2.3E-08	mg/kg-day	5.0E-04	mg/kg-day	4.6E-05
				4,4'-DDT	3.7E-04	mg/kg	2.8E-09	mg/kg-day	3.4E-01	(mg/kg-day)-1	9.6E-10	9.9E-09	mg/kg-day	5.0E-04	mg/kg-day	2.0E-05
				alpha-Chlordane	1.2E-04	mg/kg	8.9E-10	mg/kg-day	3.5E-01	(mg/kg-day)-1	3.1E-10	3.1E-09	mg/kg-day	5.0E-04	mg/kg-day	6.3E-06
				Dieldrin	1.6E-04	mg/kg	1.2E-09	mg/kg-day	1.6E+01	(mg/kg-day)-1	2.0E-08	4.3E-09	mg/kg-day	5.0E-05	mg/kg-day	8.5E-05
				gamma-Chlordane	9.7E-05	mg/kg	7.4E-10	mg/kg-day	3.5E-01	(mg/kg-day)-1	2.6E-10	2.6E-09	mg/kg-day	5.0E-04	mg/kg-day	5.2E-06
				Acenaphthene	1.8E-04	mg/kg	1.4E-09	mg/kg-day	--	--	--	4.9E-09	mg/kg-day	6.0E-02	mg/kg-day	8.2E-08
				Acenaphthylene	3.1E-04	mg/kg	2.4E-09	mg/kg-day	--	--	--	8.3E-09	mg/kg-day	6.0E-02	mg/kg-day	1.4E-07
				Anthracene	1.2E-03	mg/kg	9.3E-09	mg/kg-day	--	--	--	3.2E-08	mg/kg-day	3.0E-01	mg/kg-day	1.1E-07
				Fluorene	2.7E-04	mg/kg	2.0E-09	mg/kg-day	--	--	--	7.1E-09	mg/kg-day	4.0E-02	mg/kg-day	1.8E-07
				Phenanthrene	2.5E-03	mg/kg	1.9E-08	mg/kg-day	--	--	--	6.7E-08	mg/kg-day	3.0E-01	mg/kg-day	2.2E-07
				Benzo(a)anthracene	2.5E-03	mg/kg	1.9E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	2.3E-08	6.6E-08	mg/kg-day	--	--	--
				Benzo(a)pyrene	3.8E-03	mg/kg	2.9E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	2.1E-07	1.0E-07	mg/kg-day	--	--	--
				Benzo(b)fluoranthene	3.5E-03	mg/kg	2.7E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	3.2E-08	9.3E-08	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene	3.0E-03	mg/kg	2.3E-08	mg/kg-day	--	--	--	8.1E-08	mg/kg-day	3.0E-02	mg/kg-day	2.7E-06
				Benzo(k)fluoranthene	4.0E-03	mg/kg	3.0E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	3.6E-08	1.1E-07	mg/kg-day	--	--	--
				Chrysene	4.4E-03	mg/kg	3.3E-08	mg/kg-day	1.2E-01	(mg/kg-day)-1	4.0E-09	1.2E-07	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene	1.4E-04	mg/kg	1.1E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	7.8E-09	3.8E-09	mg/kg-day	--	--	--
				Fluoranthene	1.0E-02	mg/kg	7.7E-08	mg/kg-day	--	--	--	2.7E-07	mg/kg-day	4.0E-02	mg/kg-day	6.7E-06
				Indeno(1,2,3-cd)pyrene	1.8E-03	mg/kg	1.4E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.7E-08	4.9E-08	mg/kg-day	--	--	--
				Pyrene	1.2E-02	mg/kg	9.2E-08	mg/kg-day	--	--	--	3.2E-07	mg/kg-day	3.0E-02	mg/kg-day	1.1E-05
				Dibutyltin	1.6E-03	mg/kg	1.2E-08	mg/kg-day	--	--	--	4.3E-08	mg/kg-day	3.0E-04	mg/kg-day	1.4E-04
				Tributyltin	4.8E-03	mg/kg	3.6E-08	mg/kg-day	--	--	--	1.3E-07	mg/kg-day	3.0E-04	mg/kg-day	4.2E-04
				Total PCB Congeners	1.2E-02	mg/kg	9.1E-08	mg/kg-day	2.0E+00	(mg/kg-day)-1	1.8E-07	3.2E-07	mg/kg-day	2.0E-05	mg/kg-day	1.6E-02
				Total TEQ – PCB DLC	7.2E-06	mg/kg	5.5E-11	mg/kg-day	1.3E+05	(mg/kg-day)-1	7.1E-06	1.9E-10	mg/kg-day	7.0E-10	mg/kg-day	2.7E-01
				Total TEQ – TCDD DLC	3.9E-07	mg/kg	2.9E-12	mg/kg-day	1.3E+05	(mg/kg-day)-1	3.8E-07	1.0E-11	mg/kg-day	7.0E-10	mg/kg-day	1.5E-02
			Exp. Route Total								3.0E-04					7.4E-01
		Exposure Point Total									3.0E-04					7.4E-01
	Exposure Medium Total										3.0E-04					7.4E-01
Medium Total											3.0E-04					7.4E-01
								Total of Receptor Risks across All Media			3.1E-04	Total of Receptor Hazards across All Media				1.1E+00

TABLE A-16A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Adult and Child Recreational User, Reference Stations

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Noncancer Hazard Quotient				
							Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	

Notes:

[a] Macoma ingestion risks are evaluated for the adult receptor only.

Acronyms/Abbreviations:

-- =	not available or not applicable
CSF =	cancer slope factor
DDD =	dichlorodiphenyldichloroethane
DDE =	dichlorodiphenyldichloroethylene
DDT =	dichlorodiphenyltrichloroethane
EPC =	exposure point concentration
Exp. =	exposure
M =	lifetime exposure from birth, mutagenic endpoint
(mg/kg-day)-1 =	1/(milligram[s] per kilogram per day)
mg/kg =	milligram(s) per kilogram
mg/kg-day =	milligram(s) per kilogram per day
PCB =	polychlorinated biphenyl
RfC =	reference concentration
RfD =	reference dose
RME =	reasonable maximum exposure
TCDD =	tetrachlorodibenzo-p-dioxin

TABLE A-16B

Summary of Receptor Risks and Hazards - Adult and Child Recreational User, Reference Stations

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient			
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	Sediment	Aluminum	--	--	--	--	7.2E-02	--	2.1E-03	7.4E-02
			Antimony	--	--	--	--	2.2E-03	--	4.2E-04	2.6E-03
			Arsenic	7.4E-06	--	1.2E-06	8.6E-06	2.3E-02	--	3.3E-03	2.6E-02
			Barium	--	--	--	--	2.3E-03	--	9.5E-04	3.2E-03
			Cadmium	1.0E-06	--	1.3E-07	1.2E-06	6.1E-04	--	7.1E-05	6.8E-04
			Chromium	--	--	--	--	1.1E-04	--	2.5E-04	3.6E-04
			Cobalt	--	--	--	--	6.8E-02	--	2.0E-03	7.0E-02
			Copper	--	--	--	--	1.1E-03	--	3.2E-05	1.1E-03
			Iron	--	--	--	--	6.7E-02	--	1.9E-03	6.9E-02
			Lead	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	4.2E-03	--	1.2E-04	4.3E-03
			Mercury	--	--	--	--	3.5E-03	--	1.0E-04	3.6E-03
			Molybdenum	--	--	--	--	1.6E-04	--	4.7E-06	1.7E-04
			Nickel	--	--	--	--	4.8E-03	--	3.5E-03	8.2E-03
			Selenium	--	--	--	--	8.7E-05	--	2.5E-06	8.9E-05
			Silver	--	--	--	--	8.5E-05	--	6.2E-05	1.5E-04
			Vanadium	--	--	--	--	3.0E-02	--	3.4E-02	6.4E-02
			Zinc	--	--	--	--	4.0E-04	--	1.2E-05	4.1E-04
			4,4'-DDD	6.2E-11	--	9.9E-12	7.2E-11	4.6E-06	--	6.6E-07	5.2E-06
			4,4'-DDE	3.3E-11	--	5.3E-12	3.9E-11	1.7E-06	--	2.5E-07	2.0E-06
			4,4'-DDT	6.0E-11	--	9.6E-12	7.0E-11	3.1E-06	--	4.5E-07	3.6E-06
			alpha-Chlordane	4.5E-12	--	7.2E-13	5.2E-12	2.3E-07	--	3.3E-08	2.6E-07
			2-Methylnaphthalene	--	--	--	--	1.5E-06	--	6.6E-07	2.2E-06
			Acenaphthene	--	--	--	--	2.0E-07	--	8.5E-08	2.8E-07
			Acenaphthylene	--	--	--	--	1.5E-07	--	6.4E-08	2.1E-07
			Anthracene	--	--	--	--	9.9E-08	--	4.3E-08	1.4E-07
			Fluorene	--	--	--	--	2.0E-07	--	8.6E-08	2.8E-07
			Naphthalene	--	--	--	--	6.8E-07	--	3.0E-07	9.7E-07
			Phenanthrene	--	--	--	--	3.3E-07	--	1.4E-07	4.8E-07
			Benzo(a)anthracene	5.5E-08	--	2.5E-08	8.0E-08	--	--	--	--
			Benzo(a)pyrene	6.6E-07	--	3.0E-07	9.6E-07	--	--	--	--
			Benzo(b)fluoranthene	6.8E-08	--	3.1E-08	9.9E-08	--	--	--	--
			Benzo(g,h,i)perylene	--	--	--	--	5.6E-06	--	2.5E-06	8.1E-06
			Benzo(k)fluoranthene	6.6E-08	--	3.0E-08	9.6E-08	--	--	--	--
			Chrysene	6.5E-09	--	3.0E-09	9.5E-09	--	--	--	--
			Dibenz(a,h)anthracene	6.6E-08	--	3.0E-08	9.6E-08	--	--	--	--
			Fluoranthene	--	--	--	--	5.5E-06	--	2.4E-06	7.9E-06
			Indeno(1,2,3-cd)pyrene	9.3E-08	--	4.2E-08	1.3E-07	--	--	--	--
			Pyrene	--	--	--	--	9.3E-06	--	4.0E-06	1.3E-05
			Dibutyltin	--	--	--	--	4.2E-06	--	1.2E-06	5.4E-06
			Tributyltin	--	--	--	--	1.3E-05	--	3.7E-06	1.6E-05
			Total PCB Congeners	6.5E-09	--	3.1E-09	9.6E-09	1.4E-03	--	6.3E-04	2.1E-03
			Total TEQ – PCB DLC	1.2E-07	--	1.2E-08	1.3E-07	1.2E-02	--	1.0E-03	1.3E-02
			Chemical Total	9.5E-06	--	1.8E-06	1.1E-05	2.9E-01	--	5.0E-02	3.4E-01
		Exposure Point Total					1.1E-05				3.4E-01
	Exposure Medium Total						1.1E-05				3.4E-01
Medium Total							1.1E-05				3.4E-01

TABLE A-16B

Summary of Receptor Risks and Hazards - Adult and Child Recreational User, Reference Stations

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk: Ingestion	Cancer Risk: Inhalation	Cancer Risk: Dermal	Cancer Risk: Exposure Routes Total	Noncancer Hazard Quotient: Ingestion	Noncancer Hazard Quotient: Inhalation	Noncancer Hazard Quotient: Dermal	Noncancer Hazard Quotient: Exposure Routes Total
Macoma	Macoma	Macoma	Aluminum	--	--	--	--	7.4E-03	--	--	7.4E-03
		(ingestion)	Antimony	--	--	--	--	1.8E-03	--	--	1.8E-03
			Arsenic	2.7E-04	--	--	2.7E-04	3.4E-01	--	--	3.4E-01
			Barium	--	--	--	--	3.9E-04	--	--	3.9E-04
			Cadmium	1.7E-05	--	--	1.7E-05	3.9E-03	--	--	3.9E-03
			Chromium	--	--	--	--	5.0E-05	--	--	5.0E-05
			Cobalt	--	--	--	--	4.5E-02	--	--	4.5E-02
			Copper	--	--	--	--	1.7E-03	--	--	1.7E-03
			Iron	--	--	--	--	1.5E-02	--	--	1.5E-02
			Lead	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	1.5E-03	--	--	1.5E-03
			Mercury	--	--	--	--	6.8E-03	--	--	6.8E-03
			Molybdenum	--	--	--	--	2.6E-03	--	--	2.6E-03
			Nickel	--	--	--	--	1.8E-03	--	--	1.8E-03
			Selenium	--	--	--	--	4.2E-03	--	--	4.2E-03
			Silver	--	--	--	--	1.5E-04	--	--	1.5E-04
			Vanadium	--	--	--	--	8.1E-03	--	--	8.1E-03
			Zinc	--	--	--	--	1.6E-03	--	--	1.6E-03
			4,4'-DDD	9.2E-10	--	--	9.2E-10	2.7E-05	--	--	2.7E-05
			4,4'-DDE	2.3E-09	--	--	2.3E-09	4.6E-05	--	--	4.6E-05
			4,4'-DDT	9.6E-10	--	--	9.6E-10	2.0E-05	--	--	2.0E-05
			alpha-Chlordane	3.1E-10	--	--	3.1E-10	6.3E-06	--	--	6.3E-06
			Dieldrin	2.0E-08	--	--	2.0E-08	8.5E-05	--	--	8.5E-05
			gamma-Chlordane	2.6E-10	--	--	2.6E-10	5.2E-06	--	--	5.2E-06
			Acenaphthene	--	--	--	--	8.2E-08	--	--	8.2E-08
			Acenaphthylene	--	--	--	--	1.4E-07	--	--	1.4E-07
			Anthracene	--	--	--	--	1.1E-07	--	--	1.1E-07
			Fluorene	--	--	--	--	1.8E-07	--	--	1.8E-07
			Phenanthrene	--	--	--	--	2.2E-07	--	--	2.2E-07
			Benzo(a)anthracene	2.3E-08	--	--	2.3E-08	--	--	--	--
			Benzo(a)pyrene	2.1E-07	--	--	2.1E-07	--	--	--	--
			Benzo(b)fluoranthene	3.2E-08	--	--	3.2E-08	--	--	--	--
			Benzo(g,h,i)perylene	--	--	--	--	2.7E-06	--	--	2.7E-06
			Benzo(k)fluoranthene	3.6E-08	--	--	3.6E-08	--	--	--	--
			Chrysene	4.0E-09	--	--	4.0E-09	--	--	--	--
			Dibenz(a,h)anthracene	7.8E-09	--	--	7.8E-09	--	--	--	--
			Fluoranthene	--	--	--	--	6.7E-06	--	--	6.7E-06
			Indeno(1,2,3-cd)pyrene	1.7E-08	--	--	1.7E-08	--	--	--	--
			Pyrene	--	--	--	--	1.1E-05	--	--	1.1E-05
			Dibutyltin	--	--	--	--	1.4E-04	--	--	1.4E-04
			Tributyltin	--	--	--	--	4.2E-04	--	--	4.2E-04
			Total PCB Congeners	1.8E-07	--	--	1.8E-07	1.6E-02	--	--	1.6E-02
			Total TEQ – PCB DLC	7.1E-06	--	--	7.1E-06	2.7E-01	--	--	2.7E-01
			Total TEQ – TCDD DLC	3.8E-07	--	--	3.8E-07	1.5E-02	--	--	1.5E-02
			Chemical Total	3.0E-04	--	--	3.0E-04	7.4E-01	--	--	7.4E-01
		Exposure Point Total					3.0E-04				7.4E-01
	Exposure Medium Total						3.0E-04				7.4E-01
Medium Total							3.0E-04				7.4E-01
Receptor Total						Total Risk across All Media	3.1E-04			Total Hazard across All Media	1.1E+00

TABLE A-16B

Summary of Receptor Risks and Hazards - Adult and Child Recreational User, Reference Stations

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Child

				Cancer Risk				Noncancer Hazard Quotient			
Medium	**Exposure Medium**	**Exposure Point**	**Chemical of Potential Concern**	**Ingestion**	**Inhalation**	**Dermal**	**Exposure Routes Total**	**Ingestion**	**Inhalation**	**Dermal**	**Exposure Routes Total**

Acronyms/Abbreviations:

-- = not available or not applicable

DDD = dichlorodiphenyldichloroethane

DDE = dichlorodiphenyldichloroethylene

DDT = dichlorodiphenyltrichloroethane

PCB = polychlorinated biphenyl

TCDD = tetrachlorodibenzo-p-dioxin

TABLE A-16C

Summary of Risk Drivers - Adult and Child Recreational User, Reference Stations

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Recreational User
Receptor Age:	Adult and Chilc

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk Ingestion	Cancer Risk Inhalation	Cancer Risk Dermal	Cancer Risk Exposure Routes Total	Noncancer Hazard Quotient Ingestion	Noncancer Hazard Quotient Inhalation	Noncancer Hazard Quotient Dermal	Noncancer Hazard Quotient Exposure Routes Total
Sediment	Sediment	Sediment (Oral/Dermal)	BAP (EQ)*	9.5E-07	--	4.3E-07	1.4E-06	--	--	--	--
			Arsenic	7.4E-06	--	1.2E-06	8.6E-06	2.3E-02	--	3.3E-03	2.6E-02
			Cadmium	1.0E-06	--	1.3E-07	1.2E-06	6.1E-04	--	7.1E-05	6.8E-04
			Chemical Total	8.3E-06	--	1.6E-06	9.9E-06	2.3E-02	--	3.3E-03	2.6E-02
		Exposure Point Total					9.9E-06				2.6E-02
	Exposure Medium Total						9.9E-06				2.6E-02
Medium Total							9.9E-06				2.6E-02
Macoma	Macoma	Macoma (Oral)	Arsenic	2.7E-04	--	--	2.7E-04	3.4E-01	--	--	3.4E-01
			Cadmium	1.7E-05	--	--	1.7E-05	3.9E-03	--	--	3.9E-03
			Total TEQ – PCB DLC	7.1E-06	--	--	7.1E-06	2.7E-01	--	--	2.7E-01
			Chemical Total	3.0E-04	--	--	3.0E-04	6.1E-01	--	--	6.1E-01
		Exposure Point Total					3.0E-04				6.1E-01
	Exposure Medium Total						3.0E-04				6.1E-01
Medium Total							3.0E-04				6.1E-01
Receptor Total				Total Risk across All Media			3.1E-04	Total Hazard across All Media			6.4E-01

Notes:

* Risk for benzo(a)pyrene equivalent (BAP [EQ]) is calculated by summing the risks for each of the individual potentially carcinogenic PAHs: benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene.

Acronyms/Abbreviations:

-- = not available or not applicable

BAP (EQ) = benzo(a)pyrene equivalent

PAH = polycyclic aromatic hydrocarbon

PCB = polychlorinated biphenyl

TABLE A-17A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Construction Worker, Reference Stations

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Noncancer Hazard Quotient				
							Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	Sediment	Ingestion	Aluminum	7.6E+04	mg/kg	3.1E-03	mg/kg-day	--	--	--	2.1E-01	mg/kg-day	1.0E+00	mg/kg-day	2.1E-01
				Antimony	9.2E-01	mg/kg	3.7E-08	mg/kg-day	--	--	--	2.6E-06	mg/kg-day	4.0E-04	mg/kg-day	6.5E-03
				Arsenic	1.2E+01	mg/kg	2.9E-07	mg/kg-day	9.5E+00	(mg/kg-day)-1	2.8E-06	2.1E-05	mg/kg-day	3.0E-04	mg/kg-day	6.8E-02
				Barium	4.8E+02	mg/kg	1.9E-05	mg/kg-day	--	--	--	1.4E-03	mg/kg-day	2.0E-01	mg/kg-day	6.8E-03
				Cadmium	6.4E-01	mg/kg	2.6E-08	mg/kg-day	1.5E+01	(mg/kg-day)-1	3.9E-07	1.8E-06	mg/kg-day	1.0E-03	mg/kg-day	1.8E-03
				Chromium	1.8E+02	mg/kg	7.1E-06	mg/kg-day	--	--	--	5.0E-04	mg/kg-day	1.5E+00	mg/kg-day	3.3E-04
				Cobalt	2.1E+01	mg/kg	8.7E-07	mg/kg-day	--	--	--	6.1E-05	mg/kg-day	3.0E-04	mg/kg-day	2.0E-01
				Copper	4.7E+01	mg/kg	1.9E-06	mg/kg-day	--	--	--	1.3E-04	mg/kg-day	4.0E-02	mg/kg-day	3.3E-03
				Iron	4.9E+04	mg/kg	2.0E-03	mg/kg-day	--	--	--	1.4E-01	mg/kg-day	7.0E-01	mg/kg-day	2.0E-01
				Lead	2.9E+01	mg/kg	1.2E-06	mg/kg-day	--	--	--	8.1E-05	mg/kg-day	--	--	--
				Manganese	6.2E+02	mg/kg	2.5E-05	mg/kg-day	--	--	--	1.7E-03	mg/kg-day	1.4E-01	mg/kg-day	1.2E-02
				Mercury	3.6E-01	mg/kg	1.5E-08	mg/kg-day	--	--	--	1.0E-06	mg/kg-day	1.0E-04	mg/kg-day	1.0E-02
				Molybdenum	8.5E-01	mg/kg	3.4E-08	mg/kg-day	--	--	--	2.4E-06	mg/kg-day	5.0E-03	mg/kg-day	4.8E-04
				Nickel	1.0E+02	mg/kg	4.0E-06	mg/kg-day	--	--	--	2.8E-04	mg/kg-day	2.0E-02	mg/kg-day	1.4E-02
				Selenium	4.6E-01	mg/kg	1.8E-08	mg/kg-day	--	--	--	1.3E-06	mg/kg-day	5.0E-03	mg/kg-day	2.6E-04
				Silver	4.5E-01	mg/kg	1.8E-08	mg/kg-day	--	--	--	1.3E-06	mg/kg-day	5.0E-03	mg/kg-day	2.5E-04
				Vanadium	1.6E+02	mg/kg	6.4E-06	mg/kg-day	--	--	--	4.5E-04	mg/kg-day	5.0E-03	mg/kg-day	9.0E-02
				Zinc	1.3E+02	mg/kg	5.1E-06	mg/kg-day	--	--	--	3.6E-04	mg/kg-day	3.0E-01	mg/kg-day	1.2E-03
				4,4'-DDD	2.4E-03	mg/kg	9.7E-11	mg/kg-day	2.4E-01	(mg/kg-day)-1	2.3E-11	6.8E-09	mg/kg-day	5.0E-04	mg/kg-day	1.4E-05
				4,4'-DDE	9.1E-04	mg/kg	3.7E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	1.3E-11	2.6E-09	mg/kg-day	5.0E-04	mg/kg-day	5.2E-06
				4,4'-DDT	1.7E-03	mg/kg	6.7E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	2.3E-11	4.7E-09	mg/kg-day	5.0E-04	mg/kg-day	9.3E-06
				alpha-Chlordane	1.2E-04	mg/kg	4.8E-12	mg/kg-day	3.5E-01	(mg/kg-day)-1	1.7E-12	3.4E-10	mg/kg-day	5.0E-04	mg/kg-day	6.8E-07
				2-Methylnaphthalene	6.4E-03	mg/kg	2.6E-10	mg/kg-day	--	--	--	1.8E-08	mg/kg-day	4.0E-03	mg/kg-day	4.5E-06
				Acenaphthene	1.2E-02	mg/kg	5.0E-10	mg/kg-day	--	--	--	3.5E-08	mg/kg-day	6.0E-02	mg/kg-day	5.8E-07
				Acenaphthylene	9.3E-03	mg/kg	3.8E-10	mg/kg-day	--	--	--	2.6E-08	mg/kg-day	6.0E-02	mg/kg-day	4.4E-07
				Anthracene	3.1E-02	mg/kg	1.3E-09	mg/kg-day	--	--	--	8.8E-08	mg/kg-day	3.0E-01	mg/kg-day	2.9E-07
				Fluorene	8.4E-03	mg/kg	3.4E-10	mg/kg-day	--	--	--	2.4E-08	mg/kg-day	4.0E-02	mg/kg-day	5.9E-07
				Naphthalene	1.4E-02	mg/kg	5.8E-10	mg/kg-day	--	--	--	4.0E-08	mg/kg-day	2.0E-02	mg/kg-day	2.0E-06
				Phenanthrene	1.1E-01	mg/kg	4.2E-09	mg/kg-day	--	--	--	3.0E-07	mg/kg-day	3.0E-01	mg/kg-day	9.9E-07
				Benzo(a)anthracene	9.5E-02	mg/kg	3.8E-09	mg/kg-day	1.2E+00	(mg/kg-day)-1	4.6E-09	2.7E-07	mg/kg-day	--	--	--
				Benzo(a)pyrene	1.9E-01	mg/kg	7.5E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	5.5E-08	5.3E-07	mg/kg-day	--	--	--
				Benzo(b)fluoranthene	1.2E-01	mg/kg	4.7E-09	mg/kg-day	1.2E+00	(mg/kg-day)-1	5.7E-09	3.3E-07	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene	1.8E-01	mg/kg	7.2E-09	mg/kg-day	--	--	--	5.0E-07	mg/kg-day	3.0E-02	mg/kg-day	1.7E-05
				Benzo(k)fluoranthene	1.1E-01	mg/kg	4.6E-09	mg/kg-day	1.2E+00	(mg/kg-day)-1	5.5E-09	3.2E-07	mg/kg-day	--	--	--
				Chrysene	1.1E-01	mg/kg	4.5E-09	mg/kg-day	1.2E-01	(mg/kg-day)-1	5.4E-10	3.2E-07	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene	1.9E-02	mg/kg	7.5E-10	mg/kg-day	7.3E+00	(mg/kg-day)-1	5.5E-09	5.3E-08	mg/kg-day	--	--	--
				Fluoranthene	2.3E-01	mg/kg	9.4E-09	mg/kg-day	--	--	--	6.6E-07	mg/kg-day	4.0E-02	mg/kg-day	1.6E-05
				Indeno(1,2,3-cd)pyrene	1.6E-01	mg/kg	6.4E-09	mg/kg-day	1.2E+00	(mg/kg-day)-1	7.7E-09	4.5E-07	mg/kg-day	--	--	--
				Pyrene	2.9E-01	mg/kg	1.2E-08	mg/kg-day	--	--	--	8.3E-07	mg/kg-day	3.0E-02	mg/kg-day	2.8E-05
				Dibutyltin	1.3E-03	mg/kg	5.3E-11	mg/kg-day	--	--	--	3.7E-09	mg/kg-day	3.0E-04	mg/kg-day	1.2E-05
				Tributyltin	4.0E-03	mg/kg	1.6E-10	mg/kg-day	--	--	--	1.1E-08	mg/kg-day	3.0E-04	mg/kg-day	3.8E-05
				Total PCB Congeners	3.0E-02	mg/kg	1.2E-09	mg/kg-day	2.0E+00	(mg/kg-day)-1	2.5E-09	8.6E-08	mg/kg-day	2.0E-05	mg/kg-day	4.3E-03
				Total TEQ – PCB DLC	8.7E-06	mg/kg	3.5E-13	mg/kg-day	1.3E+05	(mg/kg-day)-1	4.5E-08	2.4E-11	mg/kg-day	7.0E-10	mg/kg-day	3.5E-02
			Exp. Route Total								3.3E-06					8.7E-01

TABLE A-17A

Calculation of RME Chemical Cancer Risks and Noncancer Hazards - Construction Worker, Reference Stations

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

							Cancer Risk Calculations					Noncancer Hazard Quotient				
					EPC		Intake/Exposure Concentration		CSF / Unit Risk			Intake/Exposure Concentration		RfD / RfC		
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	Value	Units	Value	Units	Value	Units	Cancer Risk	Value	Units	Value	Units	Hazard Quotient
Sediment	Sediment	Sediment	Dermal	Aluminum	7.6E+04	mg/kg	4.5E-04	mg/kg-day	--	--	--	3.1E-02	mg/kg-day	1.0E+00	mg/kg-day	3.1E-02
				Antimony	9.2E-01	mg/kg	5.4E-09	mg/kg-day	--	--	--	3.8E-07	mg/kg-day	6.0E-05	mg/kg-day	6.3E-03
				Arsenic	1.2E+01	mg/kg	2.1E-07	mg/kg-day	9.5E+00	(mg/kg-day)-1	2.0E-06	1.5E-05	mg/kg-day	3.0E-04	mg/kg-day	5.0E-02
				Barium	4.8E+02	mg/kg	2.9E-06	mg/kg-day	--	--	--	2.0E-04	mg/kg-day	1.4E-02	mg/kg-day	1.4E-02
				Cadmium	6.4E-01	mg/kg	3.8E-10	mg/kg-day	6.0E+02	(mg/kg-day)-1	2.3E-07	2.7E-08	mg/kg-day	2.5E-05	mg/kg-day	1.1E-03
				Chromium	1.8E+02	mg/kg	1.0E-06	mg/kg-day	--	--	--	7.3E-05	mg/kg-day	2.0E-02	mg/kg-day	3.7E-03
				Cobalt	2.1E+01	mg/kg	1.3E-07	mg/kg-day	--	--	--	8.9E-06	mg/kg-day	3.0E-04	mg/kg-day	3.0E-02
				Copper	4.7E+01	mg/kg	2.8E-07	mg/kg-day	--	--	--	1.9E-05	mg/kg-day	4.0E-02	mg/kg-day	4.9E-04
				Iron	4.9E+04	mg/kg	2.9E-04	mg/kg-day	--	--	--	2.0E-02	mg/kg-day	7.0E-01	mg/kg-day	2.9E-02
				Lead	2.9E+01	mg/kg	1.7E-07	mg/kg-day	--	--	--	1.2E-05	mg/kg-day	--	--	--
				Manganese	6.2E+02	mg/kg	3.6E-06	mg/kg-day	--	--	--	2.5E-04	mg/kg-day	1.4E-01	mg/kg-day	1.8E-03
				Mercury	3.6E-01	mg/kg	2.1E-09	mg/kg-day	--	--	--	1.5E-07	mg/kg-day	1.0E-04	mg/kg-day	1.5E-03
				Molybdenum	8.5E-01	mg/kg	5.0E-09	mg/kg-day	--	--	--	3.5E-07	mg/kg-day	5.0E-03	mg/kg-day	7.0E-05
				Nickel	1.0E+02	mg/kg	5.9E-07	mg/kg-day	--	--	--	4.1E-05	mg/kg-day	8.0E-04	mg/kg-day	5.2E-02
				Selenium	4.6E-01	mg/kg	2.7E-09	mg/kg-day	--	--	--	1.9E-07	mg/kg-day	5.0E-03	mg/kg-day	3.8E-05
				Silver	4.5E-01	mg/kg	2.6E-09	mg/kg-day	--	--	--	1.8E-07	mg/kg-day	2.0E-04	mg/kg-day	9.2E-04
				Vanadium	1.6E+02	mg/kg	9.4E-07	mg/kg-day	--	--	--	6.6E-05	mg/kg-day	1.3E-04	mg/kg-day	5.1E-01
				Zinc	1.3E+02	mg/kg	7.5E-07	mg/kg-day	--	--	--	5.3E-05	mg/kg-day	3.0E-01	mg/kg-day	1.8E-04
				4,4'-DDD	2.4E-03	mg/kg	7.1E-11	mg/kg-day	2.4E-01	(mg/kg-day)-1	1.7E-11	5.0E-09	mg/kg-day	5.0E-04	mg/kg-day	1.0E-05
				4,4'-DDE	9.1E-04	mg/kg	2.7E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	9.2E-12	1.9E-09	mg/kg-day	5.0E-04	mg/kg-day	3.8E-06
				4,4'-DDT	1.7E-03	mg/kg	4.9E-11	mg/kg-day	3.4E-01	(mg/kg-day)-1	1.7E-11	3.4E-09	mg/kg-day	5.0E-04	mg/kg-day	6.8E-06
				alpha-Chlordane	1.2E-04	mg/kg	3.5E-12	mg/kg-day	3.5E-01	(mg/kg-day)-1	1.2E-12	2.5E-10	mg/kg-day	5.0E-04	mg/kg-day	5.0E-07
				2-Methylnaphthalene	6.4E-03	mg/kg	5.7E-10	mg/kg-day	--	--	--	4.0E-08	mg/kg-day	4.0E-03	mg/kg-day	1.0E-05
				Acenaphthene	1.2E-02	mg/kg	1.1E-09	mg/kg-day	--	--	--	7.7E-08	mg/kg-day	6.0E-02	mg/kg-day	1.3E-06
				Acenaphthylene	9.3E-03	mg/kg	8.2E-10	mg/kg-day	--	--	--	5.8E-08	mg/kg-day	6.0E-02	mg/kg-day	9.6E-07
				Anthracene	3.1E-02	mg/kg	2.8E-09	mg/kg-day	--	--	--	1.9E-07	mg/kg-day	3.0E-01	mg/kg-day	6.5E-07
				Fluorene	8.4E-03	mg/kg	7.4E-10	mg/kg-day	--	--	--	5.2E-08	mg/kg-day	4.0E-02	mg/kg-day	1.3E-06
				Naphthalene	1.4E-02	mg/kg	1.3E-09	mg/kg-day	--	--	--	8.9E-08	mg/kg-day	2.0E-02	mg/kg-day	4.4E-06
				Phenanthrene	1.1E-01	mg/kg	9.3E-09	mg/kg-day	--	--	--	6.5E-07	mg/kg-day	3.0E-01	mg/kg-day	2.2E-06
				Benzo(a)anthracene	9.5E-02	mg/kg	8.4E-09	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.0E-08	5.9E-07	mg/kg-day	--	--	--
				Benzo(a)pyrene	1.9E-01	mg/kg	1.6E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	1.2E-07	1.2E-06	mg/kg-day	--	--	--
				Benzo(b)fluoranthene	1.2E-01	mg/kg	1.0E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.2E-08	7.3E-07	mg/kg-day	--	--	--
				Benzo(g,h,i)perylene	1.8E-01	mg/kg	1.6E-08	mg/kg-day	--	--	--	1.1E-06	mg/kg-day	3.0E-02	mg/kg-day	3.7E-05
				Benzo(k)fluoranthene	1.1E-01	mg/kg	1.0E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.2E-08	7.0E-07	mg/kg-day	--	--	--
				Chrysene	1.1E-01	mg/kg	9.9E-09	mg/kg-day	1.2E-01	(mg/kg-day)-1	1.2E-09	6.9E-07	mg/kg-day	--	--	--
				Dibenz(a,h)anthracene	1.9E-02	mg/kg	1.7E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	1.2E-08	1.2E-07	mg/kg-day	--	--	--
				Fluoranthene	2.3E-01	mg/kg	2.1E-08	mg/kg-day	--	--	--	1.4E-06	mg/kg-day	4.0E-02	mg/kg-day	3.6E-05
				Indeno(1,2,3-cd)pyrene	1.6E-01	mg/kg	1.4E-08	mg/kg-day	1.2E+00	(mg/kg-day)-1	1.7E-08	9.9E-07	mg/kg-day	--	--	--
				Pyrene	2.9E-01	mg/kg	2.6E-08	mg/kg-day	--	--	--	1.8E-06	mg/kg-day	3.0E-02	mg/kg-day	6.1E-05
				Dibutyltin	1.3E-03	mg/kg	7.8E-11	mg/kg-day	--	--	--	5.5E-09	mg/kg-day	3.0E-04	mg/kg-day	1.8E-05
				Tributyltin	4.0E-03	mg/kg	2.4E-10	mg/kg-day	--	--	--	1.7E-08	mg/kg-day	3.0E-04	mg/kg-day	5.6E-05
				Total PCB Congeners	3.0E-02	mg/kg	2.7E-09	mg/kg-day	2.0E+00	(mg/kg-day)-1	5.4E-09	1.9E-07	mg/kg-day	2.0E-05	mg/kg-day	9.4E-03
				Total TEQ – PCB DLC	8.7E-06	mg/kg	1.5E-13	mg/kg-day	1.3E+05	(mg/kg-day)-1	2.0E-08	1.1E-11	mg/kg-day	7.0E-10	mg/kg-day	1.5E-02
			Exp. Route Total								2.5E-06					7.5E-01
		Exposure Point Total									5.8E-06					1.6E+00
	Exposure Medium Total										5.8E-06					1.6E+00
Medium Total											5.8E-06					1.6E+00
										Total of Receptor Risks across All Media	5.8E-06				Total of Receptor Hazards across All Media	1.6E+00

Acronyms/Abbreviations:

-- =	not available or not applicable
CSF =	cancer slope factor
DDD =	dichlorodiphenyldichloroethane
DDE =	dichlorodiphenyldichloroethylene
DDT =	dichlorodiphenyltrichloroethane
EPC =	exposure point concentration
Exp. =	exposure
M =	lifetime exposure from birth, mutagenic endpoint
(mg/kg-day)-	1/(milligram[s] per kilogram per day)
mg/kg =	milligram(s) per kilogram
mg/kg-day =	milligram(s) per kilogram per day
PCB =	polychlorinated biphenyl
RfC =	reference concentration
RfD =	reference dose
RME =	reasonable maximum exposure
TCDD =	tetrachlorodibenzo-p-dioxin

TABLE A-17B

Summary of Receptor Risks and Hazards - Construction Worker, Reference Stations

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

				Cancer Risk				Noncancer Hazard Quotient			
Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Ingestion	Inhalation	Dermal	Exposure Routes Total	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	Sediment	Aluminum	--	--	--	--	2.1E-01	--	3.1E-02	2.5E-01
			Antimony	--	--	--	--	6.5E-03	--	6.3E-03	1.3E-02
			Arsenic	2.8E-06	--	2.0E-06	4.8E-06	6.8E-02	--	5.0E-02	1.2E-01
			Barium	--	--	--	--	6.8E-03	--	1.4E-02	2.1E-02
			Cadmium	3.9E-07	--	2.3E-07	6.2E-07	1.8E-03	--	1.1E-03	2.9E-03
			Chromium	--	--	--	--	3.3E-04	--	3.7E-03	4.1E-03
			Cobalt	--	--	--	--	2.0E-01	--	3.0E-02	2.3E-01
			Copper	--	--	--	--	3.3E-03	--	4.9E-04	3.8E-03
			Iron	--	--	--	--	2.0E-01	--	2.9E-02	2.3E-01
			Lead	--	--	--	--	--	--	--	--
			Manganese	--	--	--	--	1.2E-02	--	1.8E-03	1.4E-02
			Mercury	--	--	--	--	1.0E-02	--	1.5E-03	1.2E-02
			Molybdenum	--	--	--	--	4.8E-04	--	7.0E-05	5.5E-04
			Nickel	--	--	--	--	1.4E-02	--	5.2E-02	6.6E-02
			Selenium	--	--	--	--	2.6E-04	--	3.8E-05	3.0E-04
			Silver	--	--	--	--	2.5E-04	--	9.2E-04	1.2E-03
			Vanadium	--	--	--	--	9.0E-02	--	5.1E-01	6.0E-01
			Zinc	--	--	--	--	1.2E-03	--	1.8E-04	1.4E-03
			4,4'-DDD	2.3E-11	--	1.7E-11	4.0E-11	1.4E-05	--	1.0E-05	2.4E-05
			4,4'-DDE	1.3E-11	--	9.2E-12	2.2E-11	5.2E-06	--	3.8E-06	8.9E-06
			4,4'-DDT	2.3E-11	--	1.7E-11	3.9E-11	9.3E-06	--	6.8E-06	1.6E-05
			alpha-Chlordane	1.7E-12	--	1.2E-12	2.9E-12	6.8E-07	--	5.0E-07	1.2E-06
			2-Methylnaphthalene	--	--	--	--	4.5E-06	--	1.0E-05	1.5E-05
			Acenaphthene	--	--	--	--	5.8E-07	--	1.3E-06	1.9E-06
			Acenaphthylene	--	--	--	--	4.4E-07	--	9.6E-07	1.4E-06
			Anthracene	--	--	--	--	2.9E-07	--	6.5E-07	9.4E-07
			Fluorene	--	--	--	--	5.9E-07	--	1.3E-06	1.9E-06
			Naphthalene	--	--	--	--	2.0E-06	--	4.4E-06	6.5E-06
			Phenanthrene	--	--	--	--	9.9E-07	--	2.2E-06	3.2E-06
			Benzo(a)anthracene	4.6E-09	--	1.0E-08	1.5E-08	--	--	--	--
			Benzo(a)pyrene	5.5E-08	--	1.2E-07	1.8E-07	--	--	--	--
			Benzo(b)fluoranthene	5.7E-09	--	1.2E-08	1.8E-08	--	--	--	--
			Benzo(g,h,i)perylene	--	--	--	--	1.7E-05	--	3.7E-05	5.4E-05
			Benzo(k)fluoranthene	5.5E-09	--	1.2E-08	1.7E-08	--	--	--	--
			Chrysene	5.4E-10	--	1.2E-09	1.7E-09	--	--	--	--
			Dibenz(a,h)anthracene	5.5E-09	--	1.2E-08	1.8E-08	--	--	--	--
			Fluoranthene	--	--	--	--	1.6E-05	--	3.6E-05	5.3E-05
			Indeno(1,2,3-cd)pyrene	7.7E-09	--	1.7E-08	2.5E-08	--	--	--	--
			Pyrene	--	--	--	--	2.8E-05	--	6.1E-05	8.8E-05
			Dibutyltin	--	--	--	--	1.2E-05	--	1.8E-05	3.1E-05
			Tributyltin	--	--	--	--	3.8E-05	--	5.6E-05	9.4E-05
			Total PCB Congeners	2.5E-09	--	5.4E-09	7.8E-09	4.3E-03	--	9.4E-03	1.4E-02
			Total TEQ – PCB DLC	4.5E-08	--	2.0E-08	6.5E-08	3.5E-02	--	1.5E-02	5.0E-02
			Chemical Total	3.3E-06	--	2.5E-06	5.8E-06	8.7E-01	--	7.5E-01	1.6E+00
		Exposure Point Total					5.8E-06				1.6E+00
	Exposure Medium Total						5.8E-06				1.6E+00
Medium Total							5.8E-06				1.6E+00
Receptor Total						Total Risk across All Media	5.8E-06			Total Hazard across All Media	1.6E+00

Acronyms/Abbreviations:

-- =	not available or not applicable	DDT =	dichlorodiphenyltrichloroethane
DDD =	dichlorodiphenyldichloroethane	PCB =	polychlorinated biphenyl
DDE =	dichlorodiphenyldichloroethylene	TCDD =	tetrachlorodibenzo-p-dioxin

TABLE A-17C

Summary of Risk Drivers - Construction Worker, Reference Stations

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Scenario Timeframe:	Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient			
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Ingestion	Inhalation	Dermal	Exposure Routes Total
Sediment	Sediment	Sediment	Arsenic	2.8E-06	--	2.0E-06	4.8E-06	6.8E-02	--	5.0E-02	1.2E-01
			Chemical Total	--	--	--	4.8E-06	--	--	--	1.2E-01
		Exposure Point Total					4.8E-06				1.2E-01
	Exposure Medium Total						4.8E-06				1.2E-01
Medium Total							4.8E-06				1.2E-01
Receptor Total						Total Risk across All Media	4.8E-06			Total Hazard across All Media	1.2E-01

Acronyms/Abbreviations:

-- = not available or not applicable

TABLE A-18

Summary of Cancer Risks and Noncancer Hazards

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Area	Exposure Pathway	CANCER RISK		NONCANCER HAZARD	
		Future Recreational User [a]	Future Construction Worker	Future Recreational User [a]	Future Construction Worker
Eastern Wetland Area	**Sediment Exposure Pathways**				
	Sediment Ingestion	7E-06	2E-06	2E-01	7E-01
	Dermal Contact with Sediment	1E-06	2E-06	4E-02	7E-01
	Sediment TOTAL	**9E-06**	**4E-06**	**3E-01**	**1E+00**
	Macoma Exposure Pathway				
	Macoma Ingestion	3E-04	--	1E+00	--
	Macoma TOTAL	**3E-04**	**--**	**1E+00**	**--**
	Multipathway Total	**4E-04**	**4E-06**	**2E+00**	**1E+00**
India Basin I	**Sediment Exposure Pathways**				
	Sediment Ingestion	9E-06	3E-06	3E-01	8E-01
	Dermal Contact with Sediment	2E-06	2E-06	5E-02	7E-01
	Sediment TOTAL	**1E-05**	**5E-06**	**3E-01**	**2E+00**
	Macoma Exposure Pathway				
	Macoma Ingestion	3E-04	--	9E-01	--
	Macoma TOTAL	**3E-04**	**--**	**9E-01**	**--**
	Multipathway Total	**3E-04**	**5E-06**	**1E+00**	**2E+00**
Oil Reclamation Area	**Sediment Exposure Pathways**				
	Sediment Ingestion	1E-05	3E-06	3E-01	9E-01
	Dermal Contact with Sediment	2E-06	3E-06	6E-02	9E-01
	Sediment TOTAL	**1E-05**	**6E-06**	**4E-01**	**2E+00**
	Macoma Exposure Pathway				
	Macoma Ingestion	3E-04	--	9E-01	--
	Macoma TOTAL	**3E-04**	**--**	**9E-01**	**--**
	Multipathway Total	**3E-04**	**6E-06**	**1E+00**	**2E+00**
Point Avisadero Area	**Sediment Exposure Pathways**				
	Sediment Ingestion	1E-05	3E-06	4E-01	1E+00
	Dermal Contact with Sediment	3E-06	3E-06	8E-02	1E+00
	Sediment TOTAL	**1E-05**	**6E-06**	**5E-01**	**2E+00**
	Macoma Exposure Pathway				
	Macoma Ingestion	3E-04	--	9E-01	--
	Macoma TOTAL	**3E-04**	**--**	**9E-01**	**--**
	Multipathway Total	**3E-04**	**6E-06**	**1E+00**	**2E+00**
South Basin Area X	**Sediment Exposure Pathways**				
	Sediment Ingestion	1E-05	3E-06	4E-01	1E+00
	Dermal Contact with Sediment	2E-06	3E-06	9E-02	1E+00
	Sediment TOTAL	**1E-05**	**6E-06**	**5E-01**	**2E+00**
	Macoma Exposure Pathway				
	Macoma Ingestion	3E-04	--	1E+00	--
	Macoma TOTAL	**3E-04**	**--**	**1E+00**	**--**
	Multipathway Total	**3E-04**	**6E-06**	**2E+00**	**2E+00**

TABLE A-18

Summary of Cancer Risks and Noncancer Hazards

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

Area	Exposure Pathway	CANCER RISK		NONCANCER HAZARD	
		Future Recreational User [a]	Future Construction Worker	Future Recreational User [a]	Future Construction Worker
Reference Stations	**Sediment Exposure Pathways**				
	Sediment Ingestion	1E-05	3E-06	3E-01	9E-01
	Dermal Contact with Sediment	2E-06	2E-06	5E-02	8E-01
	Sediment TOTAL	**1E-05**	**6E-06**	**3E-01**	**2E+00**
	Macoma Exposure Pathway				
	Macoma Ingestion	3E-04	--	7E-01	--
	Macoma TOTAL	**3E-04**	**--**	**7E-01**	**--**
	Multipathway Total	**3E-04**	**6E-06**	**1E+00**	**2E+00**

Notes:

In accordance with USEPA (1989), cumulative risk and hazard estimates are presented to one significant figure.

-- Not applicable; exposure pathway is not complete for this receptor.

a For the recreational user, the cancer risk for sediment exposure is based on adult and child exposures while the noncancer hazard is based on child exposure only. The cancer risk and noncancer hazard for recreational ingestion of macoma is based on adult exposure only.

Reference:

United States Environmental Protection Agency (USEPA). 1989. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. Office of Emergency and Remedial Response. EPA/540/1-89/002. December.

TABLE A-19

Comparison of Updated HHRA Results with 2005 HHRA Results

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

A1. Shellfish Consumption, Recreational User - Summary of Cumulative RME Cancer Risks

Area	*2005 HHRA Results*				*Updated HHRA Results*			
	Cumulative Risk at HPS	Cumulative Risk from Reference	Exceedance Above Safe Risk Level (10^{-6})?	Exceedance Above Reference Levels?	Cumulative Risk at HPS	Cumulative Risk from Reference	Exceedance Above Safe Risk Level (10-6)?	Exceedance Above Reference Levels?
	RME Exposure Factors	RME Exposure Factors	RME Risk	RME Risk	RME Exposure Factors	RME Exposure Factors	RME Risk	RME Risk
Eastern Wetland Area	2.2E-02	3.3E-02	Yes	No	3.5E-04	3.1E-04	Yes	Yes
India Basin Area I	1.7E-03	3.3E-02	Yes	No	2.7E-04	3.1E-04	Yes	No
Oil Reclamation Area	3.9E-02	3.3E-02	Yes	Yes	3.1E-04	3.1E-04	Yes	Yes
Point Avisadero Area	1.8E-03	3.3E-02	Yes	No	2.7E-04	3.1E-04	Yes	No
South Basin Area X	4.3E-02	3.3E-02	Yes	Yes	2.7E-04	3.1E-04	Yes	No

Note:

Results based on adult exposure only.

A2. Shellfish Consumption, Recreational User - RME Cancer Risk Drivers by Area

Area	*2005 HHRA Results*							
	Individual Risk at HPS				Individual Risk at Reference			
	Arsenic	Chromium	Total Congeners	Dioxin	Arsenic	Chromium	Total Congeners	Dioxin
Eastern Wetland Area	1.9E-03	1.5E-04	6.9E-05	1.9E-02	1.7E-03	1.6E-04	1.2E-05	3.1E-02
India Basin Area I	1.5E-03	9.0E-05	2.5E-05	–	1.7E-03	1.6E-04	1.2E-05	3.1E-02
Oil Reclamation Area	1.6E-03	1.3E-04	5.8E-04	3.6E-02	1.7E-03	1.6E-04	1.2E-05	3.1E-02
Point Avisadero Area	1.6E-03	1.8E-04	3.8E-05	–	1.7E-03	1.6E-04	1.2E-05	3.1E-02
South Basin Area X	1.5E-03	1.1E-04	4.7E-04	4.1E-02	1.7E-03	1.6E-04	1.2E-05	3.1E-02

Area	*Updated HHRA Results*									
	Individual Risk at HPS					Individual Risk at Reference				
	Arsenic	Cadmium	Total PCB Congeners	Total TEQ – PCB DLC	Total TEQ – TCDD DLC	Arsenic	Cadmium	Total PCB Congeners	Total TEQ – PCB DLC	Total TEQ – TCDD DLC
Eastern Wetland Area	3.1E-04	2.0E-05	7.3E-07	1.8E-05	--	2.7E-04	1.7E-05	1.8E-07	7.1E-06	3.8E-07
India Basin Area I	2.5E-04	5.4E-06	--	1.3E-05	--	2.7E-04	1.7E-05	1.8E-07	7.1E-06	3.8E-07
Oil Reclamation Area	2.8E-04	2.3E-05	2.6E-06	5.5E-06	--	2.7E-04	1.7E-05	1.8E-07	7.1E-06	3.8E-07
Point Avisadero Area	2.6E-04	5.7E-06	--	8.1E-06	--	2.7E-04	1.7E-05	1.8E-07	7.1E-06	3.8E-07
South Basin Area X	2.5E-04	5.7E-06	5.0E-06	7.6E-06	8.7E-07	2.7E-04	1.7E-05	1.8E-07	7.1E-06	3.8E-07

Note:

-- Chemical was not identified as a risk driver for this area (cancer risk did not exceed 1E-06).

Results based on adult exposure only.

A3. Shellfish Consumption, Adult Recreational User - Percent Contribution by Area and Ratios of Chemical-Specific RME Cancer Risks

Area	*2005 HHRA Results*							
	% Contribution to Cumulative HPS RME Risk				Ratio of Individual Risk from HPS Site to Reference			
	Arsenic	Chromium	Total Congeners	Dioxin	Arsenic	Chromium	Total Congeners	Dioxin
Eastern Wetland Area	9%	0.70%	0.30%	90%	1.1	1	6	0.6
India Basin Area I	90%	5%	1.50%	–	0.9	0.6	2.2	–
Oil Reclamation Area	4%	0.30%	1.50%	94%	1	0.8	50.1	1.2
Point Avisadero Area	86%	10%	2.10%	–	0.9	1.2	3.3	–
South Basin Area X	3%	0.30%	1.10%	95%	0.9	0.7	41.1	1.3

Area	*Updated HHRA Results*									
	% Contribution to Cumulative HPS RME Risk					Ratio of Individual Risk from HPS Site to Reference				
	Arsenic	Cadmium	Total PCB Congeners	Total TEQ – PCB DLC	Total TEQ – TCDD DLC	Arsenic	Cadmium	Total PCB Congeners	Total TEQ – PCB DLC	Total TEQ – TCDD DLC
Eastern Wetland Area	89%	6%	--	5%	--	1.1	1.2	4.0	2.6	--
India Basin Area I	93%	2%	--	5%	--	0.9	0.3	--	1.9	--
Oil Reclamation Area	90%	7%	1%	2%	--	1.0	1.4	14.4	0.8	--
Point Avisadero Area	95%	2%	--	3%	--	0.9	0.3	--	1.1	--
South Basin Area X	92%	2%	2%	3%	0.3%	0.9	0.3	27.7	1.1	2.3

Note:

-- Chemical was not identified as a risk driver for this area (cancer risk did not exceed 1E-06).

Results based on adult exposure only.

B1. Direct Contact with Sediment, Recreational User - Summary of Cumulative RME Cancer Risks

Area	*2005 HHRA Results (a)*				*Updated HHRA Results (a)*			
	Cumulative Risk at HPS	Cumulative Risk from Reference	Exceedance Above Safe Risk Level (10^{-6})?	Exceedance Above Reference Levels?	Cumulative Risk at HPS	Cumulative Risk from Reference	Exceedance Above Safe Risk Level (10^{-6})?	Exceedance Above Reference Levels?
	RME Exposure Factors	RME Exposure Factors	RME Risk	RME Risk	RME Exposure Factors	RME Exposure Factors	RME Risk	RME Risk
Eastern Wetland Area	3.4E-06	2.6E-06	Yes	Yes	8.6E-06	1.1E-05	Yes	No
India Basin Area I	3.4E-06	2.6E-06	Yes	Yes	1.0E-05	1.1E-05	Yes	No
Oil Reclamation Area	4.9E-06	2.6E-06	Yes	Yes	1.2E-05	1.1E-05	Yes	Yes
Point Avisadero Area	3.8E-06	2.6E-06	Yes	Yes	1.4E-05	1.1E-05	Yes	Yes
South Basin Area X	3.7E-06	2.6E-06	Yes	Yes	1.3E-05	1.1E-05	Yes	Yes

Note:

a Previous results based on adult exposure only; updated results based on combined adult and child exposure (cumulative lifetime risk).

TABLE A-19

Comparison of Updated HHRA Results with 2005 HHRA Results

Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

B2. Direct Contact with Sediment, Recreational User - RME Cancer Risk Drivers by Area

Area	*2005 HHRA Results (a)*								*Updated HHRA Results (a)*				
	Individual Risk at HPS				Individual Risk at Reference				Individual Risk at HPS		Individual Risk at Reference		
	Arsenic	Chromium	Benzo(a)pyrene	Total Congeners	Arsenic	Chromium	Benzo(a)pyrene	Total Congeners	BAP (EQ)*	Arsenic	BAP (EQ)*	Arsenic	Cadmium
Eastern Wetland Area	7.1E-07	2.5E-06	1.0E-07	6.1E-09	8.9E-07	1.5E-06	1.5E-07	4.9E-09	1.1E-06	6.8E-06	1.4E-06	8.6E-06	1.2E-06
India Basin Area I	8.0E-07	2.3E-06	1.9E-07	1.6E-08	8.9E-07	1.5E-06	1.5E-07	4.9E-09	1.9E-06	7.8E-06	1.4E-06	8.6E-06	1.2E-06
Oil Reclamation Area	9.3E-07	3.7E-06	1.6E-07	6.0E-08	8.9E-07	1.5E-06	1.5E-07	4.9E-09	1.4E-06	9.0E-06	1.4E-06	8.6E-06	1.2E-06
Point Avisadero Area	9.1E-07	2.2E-06	3.8E-07	9.8E-08	8.9E-07	1.5E-06	1.5E-07	4.9E-09	3.7E-06	8.8E-06	1.4E-06	8.6E-06	1.2E-06
South Basin Area X	8.3E-07	2.2E-06	2.1E-06	2.8E-07	8.9E-07	1.5E-06	1.5E-07	4.9E-09	2.3E-06	8.1E-06	1.4E-06	8.6E-06	1.2E-06

Note:

a Previous results based on adult exposure only; updated results based on combined adult and child exposure (cumulative lifetime risk).

B3. Direct Contact with Sediment, Recreational User - Percent Contribution by Area and Ratios of Chemical-Specific RME Cancer Risks

Area	*Previous 2005 HHRA Results*								*Updated HHRA Results (a)*			
	% Contribution to Cumulative HPS RME Risk				Ratio of Individual Risk from HPS Site to Reference				% Contribution to Cumulative HPS RME Risk		Ratio of Individual Risk from HPS Site to Reference	
	Arsenic	Chromium	Benzo(a)pyrene	Total Congeners	Arsenic	Chromium	Benzo(a)pyrene	Total Congeners	BAP (EQ)*	Arsenic	BAP (EQ)*	Arsenic
Eastern Wetland Area	Not calculated				Not calculated				13%	80%	0.78	0.80
India Basin Area I									18%	74%	1.40	0.91
Oil Reclamation Area									12%	78%	1.02	1.05
Point Avisadero Area									26%	63%	2.67	1.03
South Basin Area X									18%	63%	1.68	0.94

Note:

a Updated results based on combined adult and child exposure (cumulative lifetime risk).

C1. Shellfish Consumption, Recreational User - Summary of Noncancer Hazard Indices

Area	*2005 HHRA Results*				*Updated HHRA Results*			
	Hazard Index at HPS	Hazard Index from Reference	Exceedance Above Benchmark (1.0)?	Exceedance Above Reference Levels?	Hazard Index at HPS	Hazard Index from Reference	Exceedance Above Benchmark (1.0)?	Exceedance Above Reference Levels?
	RME Exposure Factors	RME Exposure Factors	RME Risk	RME Risk	RME Exposure Factors	RME Exposure Factors	RME Risk	RME Risk
Eastern Wetland Area	1.1E+01	9.8E+00	Yes	Yes	1.3E+00	7.4E-01	Yes	Yes
India Basin Area I	8.8E+00	9.8E+00	Yes	No	9.3E-01	7.4E-01	No	Yes
Oil Reclamation Area	9.6E+00	9.8E+00	Yes	No	9.4E-01	7.4E-01	No	Yes
Point Avisadero Area	1.0E+01	9.8E+00	Yes	Yes	8.6E-01	7.4E-01	No	Yes
South Basin Area X	8.9E+00	9.8E+00	Yes	No	1.2E+00	7.4E-01	Yes	Yes

Note:

Results based on adult exposure only.

C2. Shellfish Consumption, Recreational User - RME Noncancer Hazard Index Drivers by Area

Area	*2005 HHRA Results*								*Updated HHRA Results*	
	Individual Hazard at HPS				Individual Hazard at Reference				Individual Hazard at HPS	Individual Hazard at Reference
	Arsenic	Chromium	Mercury	Cadmium	Arsenic	Chromium	Mercury	Cadmium	None	None
Eastern Wetland Area	9.8E+00	6.3E-01	1.6E-01	1.6E-01	8.6E+00	6.4E-01	1.6E-01	1.2E-01	--	--
India Basin Area I	7.9E+00	3.7E-01	1.3E-01	6.5E-02	8.6E+00	6.4E-01	1.6E-01	1.2E-01	--	--
Oil Reclamation Area	8.3E+00	5.3E-01	1.8E-01	7.8E-02	8.6E+00	6.4E-01	1.6E-01	1.2E-01	--	--
Point Avisadero Area	8.1E+00	7.5E-01	1.1E+00	6.8E-02	8.6E+00	6.4E-01	1.6E-01	1.2E-01	--	--
South Basin Area X	7.8E+00	4.6E-01	1.6E-01	6.8E-02	8.6E+00	6.4E-01	1.6E-01	1.2E-01	--	--

Note:

Results based on adult exposure only.

TABLE A-19
Comparison of Updated HHRA Results with 2005 HHRA Results
Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

C3. Shellfish Consumption, Recreational User - Percent Contribution by Area and Ratio of Individual Noncancer Hazard Indices

Area	*2005 HHRA Results*								*Updated HHRA Results*	
	% Contribution to Cumulative HPS RME Hazard				Ratio of Individual Hazard from HPS Site to Reference				% Contribution to Cumulative HPS RME Hazard	Ratio of Individual Hazard from HPS Site to Reference
	Arsenic	Chromium	Mercury	Cadmium	Arsenic	Chromium	Mercury	Cadmium	Not Calculated	Not Calculated
Eastern Wetland Area	88%	6%	1%	2%	1.1E+00	1.0E+00	1.0E+00	1.3E+00	--	--
India Basin Area I	90%	4%	2%	1%	9.0E-01	6.0E-01	8.0E-01	5.0E-01	--	--
Oil Reclamation Area	87%	6%	2%	1%	1.0E+00	8.0E-01	1.1E+00	6.0E-01	--	--
Point Avisadero Area	77%	7%	11%	1%	9.0E-01	1.2E+00	6.9E+00	6.0E-01	--	--
South Basin Area X	88%	5%	2%	1%	9.0E-01	7.0E-01	1.0E+00	6.0E-01	--	--

Note:

Results based on adult exposure only.

D1. Direct Contact with Sediment, Recreational User - Summary of Noncancer Hazard Indices

Area	*2005 HHRA Results*				*Updated HHRA Results*			
	Hazard Index at HPS	Hazard Index from Reference	Exceedance Above Benchmark (1.0)?	Exceedance Above Reference Levels?	Hazard Index at HPS	Hazard Index from Reference	Exceedance Above Benchmark (1.0)?	Exceedance Above Reference Levels?
	RME Exposure Factors	RME Exposure Factors	RME Risk	RME Risk	RME Exposure Factors	RME Exposure Factors	RME Risk	RME Risk
Eastern Wetland Area	8.2E-02	6.0E-02	No	Yes	2.9E-01	3.4E-01	No	No
India Basin Area I	7.3E-02	6.0E-02	No	Yes	3.2E-01	3.4E-01	No	No
Oil Reclamation Area	1.1E-01	6.0E-02	No	Yes	3.7E-01	3.4E-01	No	Yes
Point Avisadero Area	8.4E-02	6.0E-02	No	Yes	4.6E-01	3.4E-01	No	Yes
South Basin Area X	7.8E-02	6.0E-02	No	Yes	4.7E-01	3.4E-01	No	Yes

Notes:

Previous and current results based on child only.

E1. Direct Contact with Sediment, Construction Worker - Summary of Cumulative RME Cancer Risks

Area	*Previous HHRA Results*				*Updated HHRA Results*			
	Cumulative Risk at HPS	Cumulative Risk from Reference	Exceedance Above Safe Risk Level (10^{-6})?	Exceedance Above Reference Levels?	Cumulative Risk at HPS	Cumulative Risk from Reference	Exceedance Above Safe Risk Level (10^{-6})?	Exceedance Above Reference Levels?
	RME Exposure Factors	RME Exposure Factors	RME Risk	RME Risk	RME Exposure Factors	RME Exposure Factors	RME Risk	RME Risk
Eastern Wetland Area	5.2E-07	4.1E-07	No	Yes	4.4E-06	5.8E-06	Yes	No
India Basin Area I	5.3E-07	4.1E-07	No	Yes	5.1E-06	5.8E-06	Yes	Yes
Oil Reclamation Area	7.6E-07	4.1E-07	No	Yes	5.9E-06	5.8E-06	Yes	Yes
Point Avisadero Area	6.0E-07	4.1E-07	No	Yes	6.5E-06	5.8E-06	Yes	Yes
South Basin Area X	5.8E-07	4.1E-07	No	Yes	6.2E-06	5.8E-06	Yes	Yes

Notes:

Previous and current results based on child only.

E2. Direct Contact with Sediment, Construction Worker - RME Cancer Risk Drivers by Area

Area	*Previous HHRA Results*		*Updated HHRA Results*	
	Individual Risk at HPS	Individual Risk at Reference	Individual Risk at HPS	Individual Risk at Reference
	None	None	Arsenic	Arsenic
Eastern Wetland Area	--	--	3.9E-06	4.8E-06
India Basin Area I	--	--	4.4E-06	4.8E-06
Oil Reclamation Area	--	--	5.1E-06	4.8E-06
Point Avisadero Area	--	--	5.0E-06	4.8E-06
South Basin Area X	--	--	4.5E-06	4.8E-06

Note:

-- No chemicals were identified as risk drivers (no chemical-specific cancer risks exceeded 1E-06).

Previous and current results based on child only.

TABLE A-19
Comparison of Updated HHRA Results with 2005 HHRA Results
Appendix A - Updated Human Health Risk Assessment for Chemical Exposures

E3. Direct Contact with Sediment, Construction Worker - Percent Contribution by Area and Ratios of Chemical-Specific RME Cancer Risks

Area	*Updated HHRA Results*	
	% Contribution to Cumulative HPS RME Risk	Ratio of Individual Hazard from HPS Site to Reference
	Arsenic	Arsenic
Eastern Wetland Area	88%	0.8
India Basin Area I	86%	0.9
Oil Reclamation Area	86%	1.0
Point Avisadero Area	76%	1.0
South Basin Area X	73%	0.9

F1. Direct Contact with Sediment, Construction Worker - Summary of RME Noncancer Hazard Indices

Area	*Previous HHRA Results*				*Updated HHRA Results*			
	Hazard Index at HPS	Hazard Index from Reference	Exceedance Above Benchmark (1.0)?	Exceedance Above Reference Levels?	Hazard Index at HPS	Hazard Index from Reference	Exceedance Above Benchmark (1.0)?	Exceedance Above Reference Levels?
	RME Exposure Factors	RME Exposure Factors	RME Risk	RME Risk	RME Exposure Factors	RME Exposure Factors	RME Risk	RME Risk
Eastern Wetland Area	7.0E-02	6.0E-02	Yes	No	1.4E+00	1.6E+00	Yes	No
India Basin Area I	7.0E-02	6.0E-02	Yes	No	1.6E+00	1.6E+00	Yes	No
Oil Reclamation Area	1.0E-01	6.0E-02	Yes	Yes	1.8E+00	1.6E+00	Yes	Yes
Point Avisadero Area	8.0E-02	6.0E-02	Yes	Yes	2.4E+00	1.6E+00	Yes	Yes
South Basin Area X	8.0E-02	6.0E-02	Yes	Yes	2.4E+00	1.6E+00	Yes	Yes

F2. Direct Contact with Sediment, Construction Worker - RME Noncancer Hazard Index Drivers by Area

Area	*Updated HHRA Results*	
	Individual Hazard at HPS	Individual Hazard at Reference
	None	None
Eastern Wetland Area	--	--
India Basin Area I	--	--
Oil Reclamation Area	--	--
Point Avisadero Area	--	--
South Basin Area X	--	--

Note:
-- No chemicals were identified as risk drivers (no chemical-specific noncancer hazard indices exceeded 1).

Abbreviations:

BAP (EQ) =	benzo(a)pyrene equivalents
DLC =	dioxin-like congeners
HHRA =	human health risk assessment
HPS =	Hunters Point Shipyard
PCB =	polychlorinated biphenyls
RME =	reasonable maximum exposure
TCDD =	tetrachlorodibenzo-p-dioxin
TEQ =	toxicity equivalent

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Appendix B
Response to Comments

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RESPONSE TO COMMENTS ON
DRAFT ADDENDUM TO THE FEASIBILITY STUDY REPORT FOR PARCEL F, HUNTERS POINT NAVAL SHIPYARD, SAN FRANCISCO, CALIFORNIA

Comments from:
Amy D. Brownell, P.E., Environmental Engineer, City and County of San Francisco Department of Public Health (SFDPH), March 2, 2016

Comment Number	Section/ Page	Comment	Response
General Comments:			
1.		Please consider appending ProUCL output files for the derivation of EPCs associated with Section 5 and Appendix A.	Tables A-1 and A-2 summarize the specific 95 percent upper confidence limit (95 UCL) concentrations calculated and recommended by the ProUCL software. These tables also summarize the chemical-specific data distributions and statistics on which the recommended 95 UCLs are based.
Specific Comments:			
1.	Section 1.1, Parcel F Study Areas Page 1-2, First Paragraph.	Please define HRA in the first sentence of this paragraph.	The term “Historical Radiological Assessment (HRA)” has been added.
2.	Section 3.1.1, Phase 1 Radiological Screening Survey, Page 3-1, Last Paragraph:	The last sentence of the last paragraph states “the re-analysis is explained further in Section 3.1.1.3”. Please revise the sentence to reference the correct Section “the re-analysis is explained further in Section 3.1.3”.	The section number has been corrected to 3.1.3.
3.	Section 3.1.2, Radiological Data Gap Investigation Phase 2a (2011) Page 3-2, First Paragraph:	The first paragraph of this section states that “the sediment sampling activities conducted as part of Phase 2a were focused on the Submarine Area and the Berths North Area…”Please provide a figure reference to sampling locations for Phase 2a DGI.	A reference to Figures 3-2 and 3-3 has been added.
4.	Section 3.1.2, Radiological Data Gap Investigation Phase 2a (2011) Page 3-2, Fourth Paragraph:	Please provide reference to the sections within this report or other reports that support the statement that “the sediment in this area will not likely be eroded” based on the Sedflume analysis.	The statement is based on the findings of the Sedflume and sediment geochronology age dating analysis presented in Appendix D of *Final Technical Memorandum for Radiological Data Gap Investigation Phase 2a at Parcel F, Hunters Point Naval Shipyard, San Francisco, California* (Battelle and Sea Engineering, Inc., 2013). The citation for this investigation has been added to the last sentence of the fourth paragraph of Section 3.1.2.
5.	Section 3.1.3, Radiological Data Gap Investigation Phase 2b (2013),Page 3-3, Second Paragraph:	This paragraph discusses the retesting of archived Phase 1 samples that were reanalyzed to confirm Ra-226 exceedances that were approximately three times greater than mean values reported by Test America. Please provide the dates for the two different analyses and/or provide confirmation that samples were analyzed within appropriate holding times.	The first set of samples was analyzed in 2009, and the second analysis was performed in 2013. There is no required holding time for radium-226 analysis in EPA 901.1. Radium-226 has a 1,600-year half-life; thus, the concentrations 4 years later are essentially the same.

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DRAFT ADDENDUM TO THE FEASIBILITY STUDY REPORT FOR PARCEL F, HUNTERS POINT NAVAL SHIPYARD, SAN FRANCISCO, CALIFORNIA

Comments from:
Amy D. Brownell, P.E., Environmental Engineer, City and County of San Francisco Department of Public Health (SFDPH), March 2, 2016

Comment Number	Section/ Page	Comment	Response
6.	Section 3.1.3, Radiological Data Gap Investigation Phase 2b (2013) Page 3-3, Second Paragraph:	The text states that "only 11 of the 15 Phase 1 samples had sufficient archived volumes for re-analysis" and "no Ra-226 exceedances of the PAL were detected during the subsequent Phase 2b investigation". Did the remaining four samples that were not analyzed have detections of Ra-226? Please elaborate.	The remaining four samples were analyzed in 2009 and had detections of radium-226. The samples could not be reanalyzed because of insufficient sample volume. See Section 3.2.2 and Table 3-9 of the Phase 2b report for additional details.
7.	Section 4.1, Summary of Parcel F Sediment Radionuclide Data, Page 4-1, First Paragraph:	For the bullet points referring to the samples collected during Phase 1, Phase 2a, and Phase 2b, please reference applicable figures. For addition clarification, in Figures 3-2 through 3-5, please differentiate between the Phase 1 and Phase 2a sampling location symbols.	The bullet list has been revised to add the correct figure number, and the Phase 1 and Phase 2a symbols are now different on figures in Section 3.0.
8.	Section 4.1.2, Statistical Analysis of Radionuclide Distribution, Page 4-2 to 4-3, Last Paragraph:	The text states "Parcel F sediment data from all three phases were statistically compared to sediment data from the six reference areas to determine if the radionuclide activity levels in HPNS Parcel F sediments were statistically greater than the background radionuclide activity levels in San Francisco Bay sediments concentrations greater than PALs (Table 3-1)". Please clarify this statement with the note presented in Table 3-1, which states "The PALs including the background values (PAL + background concentration) were used for comparison purposes, as discussed in Section 4, to determine if any areas of surface sediments pose an unacceptable risk to human health or the environment".	The note has been revised to read as follows: *"The PALs*, *including the background values (PAL + background concentration*), *were used for comparison purposes, as discussed in Section 4*.0.*"*
9.	Section 4.1.4.1, Summary of Tissue Analytical Results, Page 4-5, First Paragraph:	At the end of this section, if it accurate to do so, please provide a statement that the tissue concentrations do not pose risk to human health or environment despite the inability to analyze the undetected or estimated values.	The following text has been added to the end of Section 4.1.4.1: "However, the analytical results indicate that bioaccumulation of ROCs in clam tissue does not pose risk to human health or the environment. The two results qualified as estimated concentrations below the reporting limit are 23 times (Ra-226 at SA-05) to 1,440 times (Cs-137 at SA-05) less than respective PALs that are protective of human health and the environment. Maximum nondetected results for Parcel F samples range from 20 times (Ra-226 at BS09A) to 17,900 times (Co-60 at SB07A) less than respective PALs."

Comments from:
Amy D. Brownell, P.E., Environmental Engineer, City and County of San Francisco Department of Public Health (SFDPH), March 2, 2016

Comment Number	Section/ Page	Comment	Response
10.	Section 4.2.1, Survey Design, Page 4-6, First Paragraph:	Please define Class 3 Survey Units.	The following text has been added: "A Class 3 survey unit is defined as an area having slight or no potential for residual radioactivity." The entire paragraph references the *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM; USEPA, 2000), so no reference is added at the end of this sentence.
11.	Section 5.1.2.1, Phase 1 and 2a Investigations, Page 5-3, Second Paragraph:	Please include reference to calculations and/or a table that illustrates data that was used to calculate the cumulative sum of fraction results. This data will help to justify the statement "the cumulative sum of fraction results for all three CSM exposure scenarios and all six ROCs was 0.16".	A reference to Section 3.2.3 and Table 3-1 of Battelle and Sea Engineering, Inc. (2013) was added to the second paragraph of Section 5.1.2.1, to justify the basis for the sum of fraction results of 0.16.
12.	Section 5.1.3.1, Step 1-Calculate Exposure Point Concentrations for Each ROC and CSM Exposure Scenario, page 5-4, third paragraph:	Regarding the sentence "…. In Pro UCL identify the statistical distribution type (i.e., normal lognormal or nonparametric"). Please add gamma distribution to these examples.	The third paragraph of Section 5.1.3.1 has been revised to include gamma distribution to the list of statistical distribution types identified by ProUCL.
13.	Section 5.2, Combined Radiological and Chemical Risk, Page 5-7, Last Paragraph:	This paragraph states that chemical risks associated with Parcel F for recreational users is 4X10-4, which exceeds the lower end of the USEPA management range for cancer risks. Provide additional explanation for why this is an acceptable risk level, and any steps that will be implemented to protect workers and recreational users.	The objective of the addendum to the Feasibility Study (FS) for Parcel F is to determine whether remedial actions to address radionuclides of concern (ROCs) are needed. Remedial actions to protect receptors from potential exposure to nonradiological chemicals are not addressed in the FS for Parcel F. However, the following sentence has been added to the end of the seventh paragraph of Section 5.2: "The final feasibility study for Parcel F evaluates remedial alternatives to address chemical contamination found in sediments at Parcel F (Barajas, 2008)."
14.	Section 6.0, Sediment Stability, Page 6-2, First Paragraph:	The sediment stability report concluded that storm waves would re-suspend only the top few centimeters of sediment. If there is available sampling data to provide evidence that the top few centimeters did not have ROC detections, include this as justification that erosion of sediments will not redistribute ROCs; please reference the pertinent data table(s) in the earlier reports. If data is unavailable, please provide additional justification that surface sediment erosion will not redistribute ROCs.	As described in Section 4.1.3 of the Draft Addendum to the Feasibility Study Report for Parcel F, sediment samples collected (including those from cores in the 0- to 1 -foot-below-ground-surface interval that include the top few centimeters of sediment) did not contain ROC concentrations exceeding the project action limit (PAL) + background.

Comments from:
Amy D. Brownell, P.E., Environmental Engineer, City and County of San Francisco Department of Public Health (SFDPH), March 2, 2016

Comment Number	Section/ Page	Comment	Response
15.	Table 5.3, Cancer Risk for Radionuclides of Concern in Sediments:	The Parcel F EPCs presented in the third column of Table 5-3 are maximum concentrations. The footnote in Table 5-3 also states that EPCs are based on 95% UCLs. The EPCs should correspond to the 95% UCLs presented in tenth column of Table 5.2. The Incremental Lifetime Cancer Risk estimates presented in Table 5.3 and Table 5.4 appear to be based on 95 % UCLs presented in Table 5.2 and should be verified.	Maximum concentrations were incorrectly listed as exposure point concentrations (EPCs) in the third column of Table 5-3. The concentrations shown in this column have been revised to show the 95 UCL concentrations presented in Table 5-2. The radiological risks based on the Parcel F EPCs presented in Tables 5-2 and 5-3 are correctly based on 95 UCL concentrations as EPCs.
16.	Appendix A Updated Human Health Risk Assessment:	The update should include a section that describes the human health conceptual site model.	Section 1.0 of Appendix A has been revised to refer the reader to the *Hunters Point Shipyard Parcel F, Validation Study Report* (Validation Study; Battelle et al., 2005). The Validation Study report provides further information on the human populations and exposure pathways evaluated for chemical exposure.
17.	Appendix A Updated Human Health Risk Assessment, Section 3.1 Exposure Assumptions and Section 3.2 Dermal Absorption Factors, Page A-3:	These sections reference the 2014 USEPA Regional Screening Levels. The EPA Regional Screening Levels for Chemical Contaminants at Superfund Sites were revised in November 2015. Please revise the updated chemical HHRA to use the 2015 RSLs.	Although the FS addendum included an updated chemical human health risk assessment (HHRA), the 2008 FS for Parcel F identified chemicals of concern (COCs) for sediment and evaluated remedial alternatives for reducing potential human and ecological risk from exposure to the COCs. The United States Department of the Navy (Navy) anticipates that the remedy for COCs at Parcel F will include capping or dredging of sediments. Because COCs have already been identified for Parcel F, and remedial alternatives for the COCs have already been evaluated, no further updates to the HHRA will be made as part of the FS addendum, which addresses ROCs. The FS addendum for Parcel F presented chemical risks in order to estimate the overall (radiological plus chemical) potential human health risk associated with Parcel F, in accordance with United States Environmental Protection Agency (USEPA; 1989). The HHRA was updated as part of the FS addendum to incorporate changes to USEPA and California Department of Toxic Substances Control (DTSC) methods for HHRAs because a number of these methods had changed since the original HHRA was completed in 2005 during the Validation Study (Battelle et al., 2005). In addition, the shellfish consumption rate that was used in the original HHRA was revised following completion of the

Comment Number	Section/ Page	Comment	Response
			Validation Study in 2005. The shellfish consumption rate was revised during the 2008 FS for Parcel F. As noted in the 2008 FS, the shellfish consumption rate used in the 2005 Validation Study reflected consumption rates appropriate for sport fish, not shellfish (Barajas, 2008). The rate was revised in the 2008 FS to reflect the percentage of shellfish that typically composes total seafood consumption among San Francisco Bay anglers (Barajas, 2008). The revised shellfish consumption rate was used in the 2008 FS to calculate preliminary remediation goals (PRGs) for nonradiological COCs in sediment. The revised shellfish consumption rate was also used in the updated chemical HHRA included in the FS addendum. There were no changes between the dermal absorption factors provided in the USEPA regional screening levels (RSLs) from May 2014 RSLs and used in the updated chemical HHRA and the absorption factors from the November 2015 RSLs
18.	Appendix A, Section 4.4, Chromium page A-5, first paragraph, fourth sentence:	We agree that trivalent chromium is the probable dominant species in sediment; however, use of the trivalent chromium toxicity criteria for total chromium should be further supported. Please provide a reference for the sentence, “However, chromium in reducing or even mildly oxidizing conditions do not provide stability for chromium in the hexavalent state”. In addition, please expand the discussion of a reducing environment for chromium in sediment.	Section 4.4 of Appendix A has been revised to include additional information that substantiates the assumption that trivalent chromium is the dominant species of chromium in sediment. Specifically, the first paragraph on page A-5 has been revised and expanded as follows: “Chromium is a COPC in sediment and clam (*Macoma nasuta*) tissue. In the absence of speciation data, the 2005 HHRA assumed all chromium in sediment and clam tissue was present as hexavalent chromium for estimating health risks. Hexavalent chromium is considered a carcinogen (USEPA, 2014a). However, chromium in reducing or even mildly oxidizing conditions in aquatic environments is present primarily as trivalent chromium because these conditions do not provide stability for chromium in the hexavalent state (Rifkin, et. al., 2004). Under the anoxic conditions present in most sediments, hexavalent chromium is readily reduced to the trivalent form by a number of naturally-occurring chemical and microbial species. Natural chemical reductants include reduced iron and sulfur species as well as organic sediment constituents. Once formed,

Comments from:
Amy D. Brownell, P.E., Environmental Engineer, City and County of San Francisco Department of Public Health (SFDPH), March 2, 2016

Comment Number	Section/ Page	Comment	Response
			trivalent chromium has very low solubility at mid-range pH values due to the formation of $Cr(OH)_3$. Oxidation of trivalent to hexavalent chromium does not readily occur, even in the presence of possible oxidants such as oxygen or MnO_2, due to the general reductive capacity of the sediments (Sorensen, et. al., 2010; Truex, et. al., 2015). For these reasons, the updated HHRA based toxicity criteria for chromium on trivalent chromium. Trivalent chromium is only associated with noncancer effects (USEPA, 2014a)."
19.	Appendix A, Section 5.4, Lead, page 113, first paragraph:	We recommend using the HERO 2011 residential risk-based soil screening level for lead (i.e., 80 mg/kg).	Please see the response to SFDPH Specific Comment 17. The COCs identified for sediment at Parcel F include lead. The remedial action objectives and alternatives in the 2008 FS for Parcel F address lead.
20.	Appendix A, Table A-1 Exposure Point Concentration Summary for Sediment and Table A-2 Exposure Point Concentration Summary for Macoma:	Please add to footnote (a) that it is the reporting limit that exceeds the maximum detected concentration for high censored results.	Footnote (a) in Tables A-1 and A-2 has been revised to indicate that the nondetected results are based on the sample-specific detection limits.
21.	Appendix A, Table A-3 Values Used for Daily Intake, Sediment Exposure:	HERO Note 1 was revised in September 2014. Please update the chemical HHRA to use the most recent revision.	Please see the response to SFDPH Specific Comment 17. COCs have already been identified for Parcel F, and remedial alternatives for the COCs have already been evaluated; therefore, no further updates to the HHRA will be made as part of the FS Addendum, which addresses ROCs.
22.	Appendix A, Table A-3, Values Used for Daily Intake, Sediment Exposure:	The RME skin surface area for the construction worker scenario should be revised to 6,032 cm2, consistent with HERO Note 1 (September 2014).	Please see the response to SFDPH Specific Comment 17. COCs have already been identified for Parcel F, and remedial alternatives for the COCs have already been evaluated; therefore, no further updates to the HHRA will be made as part of the FS Addendum, which addresses ROCs.
23.	Appendix A, Table A-5, Cancer and Noncancer Toxicity Values Used for Risk Estimates:	Please format the right hand side of the Table notes, which are currently not visible.	The format for all tables in Appendix A has been checked to ensure that all fields and portions of the tables are visible.

RESPONSE TO COMMENTS ON
DRAFT ADDENDUM TO THE FEASIBILITY STUDY REPORT FOR PARCEL F, HUNTERS POINT NAVAL SHIPYARD, SAN FRANCISCO, CALIFORNIA

Comments from:
Amy D. Brownell, P.E., Environmental Engineer, City and County of San Francisco Department of Public Health (SFDPH), March 2, 2016

Comment Number	Section/ Page	Comment	Response
24.	Appendix A, Tables A-10A, A-11A, A-12A, A-13A, A-14A, A-15A, A-16A, A-17A:	Please include Medium, Exposure Medium, Exposure Point, and Exposure Route fields at the top of each page of the Risk Characterization tables.	The format for all tables in Appendix A has been checked to ensure that all fields and portions of the tables are visible.
25.	Appendix A, Table A-18, Summary of Cancer Risks and Noncancer Hazards:	Note (a) states that the non-cancer hazard is based on child exposure; however, the macoma exposure pathway is included in the multi-pathway Hazard Index and includes adult systemic effects. Please revise the footnote to clarify.	Note (a) on Table A-18 has been revised to indicate that the recreational user noncancer hazard for the shellfish (*Macoma nasuta*) exposure pathway is based on adult exposure only.

RESPONSE TO COMMENTS ON DRAFT ADDENDUM TO THE FEASIBILITY STUDY REPORT FOR PARCEL F, HUNTERS POINT NAVAL SHIPYARD, SAN FRANCISCO, CALIFORNIA

Comments from:
Nina Bacey, Project Manager, Department of Toxic Substances Control (DTSC), March 21, 2016

Comment Number	Section/ Page	Comment	Response
Specific Comments:			
1.	Executive Summary	The FS report concluded that no radioactivity in excess of natural occurring background levels was identified. However, it also indicated that radiological commodities may be present. Therefore, the executive summary should conclude that due to the potential for radiological commodities to be present in sediment, institutional controls may be required for sediment, in regards to dredging and other sediment moving activities, in order to address potential exposure to commodities and waste disposal of such. This information should also be added to Section 8.	No radioluminescent commodities, such as dials, gauges, and deck markers, have been found in Parcel F. The HRA did not identify the potential for commodities at Parcel F (NAVSEA, 2004). The parcel was recommended for further investigation and those investigations have shown that Parcel F is not impacted. Nevertheless, to address the remote potential for radiological commodities at Parcel F, the Navy is recommending institutional controls that will require dredging activities, including dredge spoil reuse and disposal, to be reviewed and approved by DTSC prior to commencing dredging activities.

Comments from:
Kimberly Gettmann, Human Health Toxicologist, Human and Ecological Risk Office (HERO), DTSC, March 21, 2016

Comment Number	Section/ Page	Comment	Response
Specific Comments:			
1.	Exposure Parameters		
	Section 3.1 and Table A-3	a. The updated HHRA uses the more conservative values for exposure assumptions from those listed in the May 2014 USEPA Regional Screening Levels (RSLs) and the parameters listed in DTSC's HHRA Note 1 dated 2011. Please note that DTSC updated their recommended exposure parameters in September 2014, as discussed in HHRA Note 1 (http://www.dtsc.ca.gov/AssessingRisk/upload/HHRA_Note1-2.pdf). The 2014 HRHA Note 1 should be used in this updated HHRA. Please update all references to the 2014 version in the text and tables.	a. Please see the response to SFDPH Specific Comment 17. COCs have already been identified for Parcel F, and remedial alternatives for the COCs have already been evaluated; therefore, no further updates to the HHRA will be made as part of the FS Addendum, which addresses ROCs.
	Table A-3	b. Table A-3. HERO reviewed Table A-3. For the construction worker skin surface area (SA), HERO now recommends a SA of 6032 cm2/day. Please update Table A-3 and corresponding risk calculations.	b. Please see the response to SFDPH Specific Comment 17. COCs have already been identified for Parcel F, and remedial alternatives for the COCs have already been evaluated; therefore, no further updates to the HHRA will be made as part of the FS Addendum, which addresses ROCs.
	Shellfish consumption rate.	c. The shellfish consumption rate was revised in the updated HHRA from 0.048 kg/day to 0.00213 kg/day, to reflect the approach established in the 2008 Feasibility Study (FS) report for Parcel F. Please address whether the shellfish consumption rate established in the 2008 FS report takes into consideration the current population makeup of the Hunters Point area? According to the Final 2014 Community Involvement Plan Update the Asian population at the Hunters Point area is 40.8%.	c. As indicated in the 2008 FS for Parcel F (Barajas, 2008), the revised shellfish consumption rate of 0.00213 kilograms per day (kg/day) is based on the seafood consumption study completed by the San Francisco Estuary Institute (SFEI, 2001) and the study by Wong (1997). The SFEI (2001) study reported a value of 48 grams per day (90^{th} percentile) for a reasonable maximum exposure scenario. The SFEI (2001) study was based on Wong (1997), which reported that shellfish typically make up only 5 percent of total seafood consumption among San Francisco Bay anglers; adjusting the SFEI (2001) study seafood consumption rate by the shellfish-specific percentage reported by Wong (1997) resulted in a revised shellfish ingestion rate of 0.00213 kg/day. The SFEI (2001) study encompassed the San Francisco Bay Area, and not specifically the Hunters Point area. Thirty-three percent of overall study respondents were of Asian ethnicity. However, this percentage includes

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Comments from:
Kimberly Gettmann, Human Health Toxicologist, Human and Ecological Risk Office (HERO), DTSC, March 21, 2016

Comment Number	Section/ Page	Comment	Response
			respondents for all modes of fishing evaluated in the study: fishing, including pier, beach & bank, private boat, and party boat. For shore-based modes of fishing (i.e., pier or beach and bank), over 50 percent of study respondents interviewed at the Candlestick Point study location (just south of the Hunters Point area) were of Asian ethnicity (SFEI, 2001). In addition, 45 percent and 42 percent of overall study respondents who fished by pier or beach and bank modes, respectively, were Asian (SFEI, 2001). The remedial goal established in the 2008 FS for Parcel F for total polychlorinated biphenyls (PCBs) in sediment at Parcel F of 1,240 micrograms per kilogram (µg/kg) is an ecological-based remedial goal that is also protective of human receptors for the shellfish consumption pathway. The total PCB remedial goal of 1,240 µg/kg has also been adopted by USEPA as the cleanup goal for total PCBs at the adjacent Yosemite Slough site.
	Dermal Absorption Factors - Section 3.2	d. Please note in October 2015 DTSC released an updated version of the Preliminary Endangerment Assessment (PEA) Guidance. The updated HHRA references the 2013 document with respect to recommended dermal absorption factors. This comment is intended for informational purposes only as the dermal absorption factors recommended in the 2015 PEA are consistent with USEPA and those used in the updated HHRA.	d. Please see the response to SFDPH Specific Comment 17. COCs have already been identified for Parcel F, and remedial alternatives for the COCs have already been evaluated; therefore, no further updates to the HHRA will be made as part of the FS Addendum, which addresses ROCs.
2.	Lead - Section 5.4.	At several areas in Parcel F, the maximum and 95%UCL concentrations of lead exceed the DTSC recommended residential lead screening level of 80 mg/kg, which is an updated value since the 2005 HHRA. These include: the Point Avisadero Area with a maximum lead concentration of 275 mg/kg and a 95%UCL of 104 mg/kg; and South Basin Area X with a maximum lead concentration of 142 mg/kg and 95% UCL of 98 mg/kg. The text states that since the lead concentrations are below the USEPA RSL of 400 mg/kg no further evaluation was conducted in the updated HRHA. Please revise the updated HHRA to include an evaluation of lead against the DTSC screening level, more specifically the incremental increase in blood lead of 1 ug/dL, CalEPA's blood lead criteria.	Please see the response to SFDPH Specific Comment 19.

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DRAFT ADDENDUM TO THE FEASIBILITY STUDY REPORT FOR PARCEL F, HUNTERS POINT NAVAL SHIPYARD, SAN FRANCISCO, CALIFORNIA

Comments from:
Kimberly Gettmann, Human Health Toxicologist, Human and Ecological Risk Office (HERO), DTSC, March 21, 2016

Comment Number	Section/ Page	Comment	Response
3.	Table A-19	Comparison of Updated HHRA Results with 2005 HHRA Results. Please provide an explanation as to what the "Exceedance Above Reference Levels" means in the following sub-tables: A1, B1, C1, D1, E1, and F1. Please also explain what "Cumulative Risk from Reference" (A1, B1, E1) and "Hazard Index from Reference" (C1, D1, and F1) means. What are the "reference levels"? and how were they established?	Table A-19 uses the same format that was used in the 2005 HHRA to summarize the updated HHRA results. The same format was used for consistency with the original HHRA presented in the Validation Study (Battelle et al., 2005). The “Exceedance Above Reference Levels” column shown in subtables A1, B1, C1, D1, and F1 in Table A-1 compares the cumulative cancer risks for Parcel F (second and sixth columns) to the cumulative cancer risks calculated based on reference levels (third and seventh columns). These subtables also compare the cumulative noncancer hazard indices (HIs) for Parcel F (second and sixth columns) to the cumulative noncancer HIs based on reference levels (third and seventh columns). If the cumulative Parcel F cancer risk (or noncancer HI) exceeded the cumulative cancer risk (or noncancer HI) calculated for the reference area, then a “Yes” is shown in the “Exceedance Above Reference Levels” column. Reference locations for sediment and clam tissue (*Macoma nasuta*) samples and data quality objectives for the reference sampling were established in the *Hunters Point Shipyard Parcel F Validation Study Work Plan* (Battelle et al., 2001). Reference site stations were selected based on the following criteria: (1) similar physical characteristics to Hunters Point Shipyard sediments, (2) representative of regional ambient conditions, (3) history of use in support of past environmental evaluations for Navy programs or other programs in San Francisco Bay, and (4) proximity to Hunters Point Naval Shipyard (Battelle et al., 2005). The Validation Study Report details the analytical results for the reference samples (Battelle et al., 2005).

Comments from:
Kimberly Gettmann, Human Health Toxicologist, Human and Ecological Risk Office (HERO), DTSC, March 21, 2016

Comment Number	Section/ Page	Comment	Response
			The chemicals detected in reference area samples and the corresponding EPCs are summarized at the bottom of Tables A-1 (sediment) and A-2 (clam tissue). These chemicals and EPCs, along with the exposure assumption in Tables A-3 and A-4 and the toxicity criteria in Table A-5, were used to calculate the reference area risks and HIs; That is, the same exposure assumptions and toxicity criteria that were used to calculate risks and HIs for each of the Parcel F exposure areas were used to calculate risks and HIs for the reference area.

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DRAFT ADDENDUM TO THE FEASIBILITY STUDY REPORT FOR PARCEL F, HUNTERS POINT NAVAL SHIPYARD, SAN FRANCISCO, CALIFORNIA

Comments from:
Valerie Chenoweth-Brown, Radiological Toxicologist, DTSC, March 21, 2016

Comment Number	Section/ Page	Comment	Response
General Comments:			
1.		Please include the raw data in the draft final document.	The raw data packages are large and were provided in the Phase 2a and Phase 2b reports. These prior reports will be provided to the agencies separately on CD.

RESPONSE TO COMMENTS ON
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Comments from:
USEPA Comments, March 21, 2016

Comment Number	Section/ Page	Comment	Response
General Comments:			
1.		Section 1.1 states, "Structures such as the piers and berths within Parcel F are not part of this FS [feasibility study] report because they are being addressed as time-critical removal actions as specified in the Final Basewide Radiological Removal Action, Action Memorandum (Navy, 2006);" however, the time-critical removal action (TCRA) to remove the piers was already completed. While radiological sampling was completed, chemical sampling has not. Please revise the Draft Addendum to summarize the radiological sampling conducted as part of the TCRA at the piers. In addition, please revise the Draft Addendum to acknowledge that chemical sampling is required in these areas and that the chemical risk assessment will need to be reassessed when this data becomes available.	The Navy did conduct radiological sampling during the pier TCRA but that sampling was conducted on the wood and concrete pier material for disposal purposes. Prior chemical and radiological sampling of sediments is representative of these areas. Additional chemical sampling in the vicinity of the removed piers will be conducted. However, the risk assessment will not be reassessed and no changes are required to the Draft FS Addendum.
2.		According to Section 3.1.3, Phase 1 samples were re-analyzed to confirm or reject radium-226 (Ra-226) exceedances and assess the need for potential step-out sampling; however, only 11 of the 15 Phase 1 samples had sufficient archived volume for re-analysis. While the re-analysis results indicated that none of the 11 Phase 1 samples were found to exceed the applicable Project Action Limits (PALs) for Ra-226, the locations of the four Phase 1 samples that were not reassessed are not provided and/or referenced. As such, it is unclear if the four Phase 1 samples were concentrated to a specific area and represent a potential data gap. Similarly, the range of original activities conducted is not discussed preventing an assessment of a significant amount of the results. Please revise the Draft Addendum to clarify the locations of the four Phase 1 samples which were not re-analyzed to confirm or reject Ra-226 exceedances and assess the need for potential step-out sampling.	The four samples included one sample from SA05 and three samples from SB09. The Phase 2b report evaluated potential data gaps (Phase 2b Report, Section 3.1.1) after the re-analysis was performed on other samples and the original reported concentrations were rejected, including those from SA05 and SB09. See Figure 3-2 for SA05, and Figure 3-5 for SB09 and the additional samples surrounding the original locations. See Phase 2b Report Section 3.2.2 and Table 3-9 for additional details on re-analysis. Step -out samples for SA05 (SA420, 421, 422, and 426 at four depths, from Phase 2b Report Appendix B1) had a maximum detected radium-226 concentration of 0.701 picoCuries per gram (pCi/g), below the PAL of 1.6 pCi/g. Step-out samples for SB09 (SB246, 232, and 233 at four depths, from Phase 2b Report Appendix B1) had a maximum detected radium-226 concentration of 0.623 pCi/g, below the PAL of 1.6 pCi/g. Stakeholders, including USEPA concurred with the Phase 2b report. The FS addendum has been revised to state that 28 step-out samples associated with SA05 and SB09 samples had low concentrations of radium-226 (less than 0.7 pCi/g).

RESPONSE TO COMMENTS ON
DRAFT ADDENDUM TO THE FEASIBILITY STUDY REPORT FOR PARCEL F, HUNTERS POINT NAVAL SHIPYARD, SAN FRANCISCO, CALIFORNIA

Comments from:
USEPA Comments, March 21, 2016

Comment Number	Section/ Page	Comment	Response
3.		Section 3.3 of the draft addendum uses the term Project Action Limit (PAL) rather than Derived Concentration Guide Limit (DCGL) to establish a value above which some sort of remedial action would be required. The draft addendum does not provide any details as to how the PALs were derived; however, the mathematical model does appear to have included consumption of seafood that was caught by occasional recreational fishermen, ingestion of sediment and direct exposure, and the PALs appear to have been derived for a 1 x 10-4 risk level. The Draft Addendum should include calculated DCGLs for each of the radionuclides, with an appendix that shows the formulas and assumptions that were used in the calculations. Please also provide an explanation of why the Navy chose to depart from the concept of DCGLs in favor of PALs, together with an explanation of the differences between the two concepts.	See the response to USEPA General Comment 8. PALs were derived during Phase 1 and Phase 2a and were approved by the regulatory agencies and the Navy for decision-making purposes. Except for the intertidal PAL for radium-226, the PALs are based on a target cancer risk level of $1x10^{-6}$. Formulas and assumptions used to calculate the PALs are provided in Section 2.2.1 of the Phase 2a Report. The intertidal PAL for radium-226 is 1 pCi/g above background and has been used on this project since Phase 1 in 2009, with the approval of regulatory agencies. The 2008 FS for Parcel F used these values to evaluate risk. Derived concentration guideline levels (DCGL) is defined in the MARSSIM as a release criterion that is met post - remediation to release a site for compliance; however, this Parcel F project is being executed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), not under MARSSIM. Remediation for radionuclides is not warranted, making DCGLs irrelevant to Parcel F.
4.		Section 4.0 of the draft addendum provides no data tables because only existing data was used for the study. However, the figures and tables do provide summary statistics. Figures 4-1 and 4-2 are box-and-whisker plots of measurement data for the ROCs. The investigators also performed the Wilcoxson Rank-Sum Test (described in the draft addendum as the Mann-Whitney Test) to determine if the sample measurement data sets have approximately the same distributions as the reference area (background) measurements. In all cases the WRS Test yielded p-values of <0.0001, indicating that the probability that the concentrations of the ROCs in the samples could exceed the concentrations in the reference data set by more than the PAL is less than 1/100th of 1% (0.01%). Please revise the document to include all of the data that were used to determine the relevant concentrations of the ROCs, showing sums, averages, detection limits, summary statistics and any other pertinent data that leads to the values that were used in comparing the sample area and reference area measurements with the DCGLs. Please provide a workup of the risks for each	See the response to DTSC General Comment 1, which indicates that historical reports containing the raw data will be provided separately to the agencies. The information requested for sums, averages, and detection limits are provided in the original reports (Phase 2a and Phase 2b). Consistent with the approach used for the Phase 2a and Phase 2b data gap investigations (DGIs), potential human health risks from exposure to ROCs are evaluated on a parcel-wide basis. Section 5.0 of the FS addendum provides the risk evaluation for ROCs for the combined Parcel F data (from the Phase 1 data re-analysis, Phase 2a DGI, and Phase 2b DGI), and presents the overall (cumulative) risks for ROCs and chemicals at Parcel F. Appendix C in these reports also provides the results of the Wilcoxon Rank Sum (WRS) Test.

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		radionuclide in each sample area and of the effect that those additional risks have on the overall risks in Parcel F from all contaminants.	
5.		Section 4.1.2 states that background concentrations of the ROCs were "defined as the combination of both natural and anthropogenic inputs in areas not affected or influenced by the HPNS." This approach differs from previous approaches encountered at other sites. It is customary to exclude contaminants of anthropogenic origin from background concentrations. While it is difficult to separate the contributions of contaminants of anthropogenic origin from those of natural origin in either the reference area or the study area, this is a subject that should not be dismissed lightly. Please provide a discussion of the several measurements in the sample data sets that were greater than the highest values in the reference area data sets, together with a demonstration of how data sets can pass the WRST, even when some concentrations in the sample data sets are significantly higher than those in the reference area data sets.	The selection of the background reference area, the data collected, and the evaluations performed was deemed acceptable and concurrence was obtained from regulatory agencies, including USEPA, during Phases 1, 2a, and 2b. The FS Addendum only uses these data and the conclusions from those approved documents. See Appendix C that uses the background plus the PAL for the WRS Test, not only background. A point-by-point comparison to background was not performed. This approach was also concurred with by the agencies. It is not possible to separate the contributions of contaminants of anthropogenic origin from those of natural origin in either the reference area or the study area. The Navy does not dismiss or take lightly any radiological issues.
6.		U.S. EPA's "Radiation Risk Assessment at CERCLA Sites: Q & A" states "The PRG calculators (U.S. EPA 2002a, 2007, 2009a), which are used to develop risk-based PRGs for radionuclides, are recommended by EPA for Superfund remedial radiation risk assessments." (Source: https://epa-prgs.ornl.gov /radionuclides/RadRiskQAwithtransmitmemo_June_13_2014.pdf) As one of multiple lines of evidence, please revise Section 5.0 to show results from the EPA PRG Calculators for Parcel F. This addition would help demonstrate consistency with U.S. EPA's CERCLA approaches. The software is public and free. The human health PRG calculator is at https://epa-prgs.ornl.gov/radionuclides/ and the ecological risk version is at https://epa-eco.ornl.gov/radionuclides/.	See the response to USEPA General Comment 3. Similar to PRGs, the PALs for Parcel F are risk-based. The PALs were derived during the Phase 1 and Phase 2a DGIs and were approved by the regulatory agencies, including USEPA and the Navy for decision-making purposes.

Comments from:
USEPA Comments, March 21, 2016

Comment Number	Section/ Page	Comment	Response
7.		Section 5.0 references shellfish consumption patterns based on a San Francisco Estuary Institute study from 2000 and assumes no subsistence or commercial harvest. This study is not specific to the neighborhood near the Hunters Point Naval Shipyard. The Agency for Toxic Substances and Disease Registry (ATSDR) 2009 Public Health Assessment for the Hunters Point Naval Shipyard stated the following: “Subsistence, commercial and sport fishing take place near and off the HPA shore. People who eat fish and shellfish may be exposed to contaminants in fish. People considered at special risk are Asians (about 14% of the population of the Hunters Point/Bayview area), whose fish and shellfish ingestion rates are greater (60-138 grams/day) and more frequent (more than once a day) than the general population. Available information also shows that the potential exposures may be quite varied, ranging from occasional to long term depending on the population's fishing practices and fish-consumption rates.” (Source: http://www.atsdr.cdc.gov/HAC/pha/PHA.asp?docid=26&pg=4). Since that time, demographics in the Bayview Hunters Point Naval Shipyard have shifted to become 40.8% “Asian” and 10.4% to 26.9% “Hispanic/Latino,” according to the Navy’s 2014 Community Involvement Plan Update. New residents may consume different quantities, species, and parts of the body of fish and shellfish. Members of the community report that some local residents are subsistence fishers and some sell their catch to restaurants. Please revise the Draft Addendum to address these concerns with assumptions in the Human Health Risk Assessment.	Please see the response to DTSC HERO Specific Comment 1c, and the response to SFDPH Specific Comment 17. COCs have already been identified for Parcel F, and remedial alternatives for the COCs have already been evaluated. The remedial alternatives for COCs address the shellfish consumption pathway and will limit receptor exposure to COCs from this pathway. No further updates to the HHRA will be made as part of the FS Addendum, which addresses ROCs.

Comments from:
USEPA Comments, March 21, 2016

Comment Number	Section/ Page	Comment	Response
8.		Several documents are referenced throughout the Draft Addendum and included in Section 9.0; however, given the reliance on the information provided in these documents, it would be helpful if the documents were provided in an Appendix on a CD-ROM within the Draft Addendum. For example, information (e.g., statistical design and methods, sediment stability evaluations) presented in Final Technical Memorandum for Radiological Data Gap Investigation Phase 2a at Parcel F, Hunters Point Naval Shipyard, San Francisco, California, dated April 2013 (Phase 2a Report) and the Final Technical Memorandum for Radiological Data Gap Investigation Phase 2b at Parcel F, Hunters Point Naval Shipyard, San Francisco, California, dated September 2013 (Phase 2b Report) is referenced throughout the Draft Addendum; however, these documents may not be easily accessible. Please revise the Draft Addendum to provide these and other frequently referenced documents in an Appendix on the CD-ROM.	The Phase 2a and Phase 2b reports will be provided on a compact disc separate from the FS Addendum report. these documents are lengthy; for example, the Phase 2b report is 52,492 pages.
Specific Comments:			
1.	Section 2.1, HPNS Background, Page 2-1:	The first paragraph of Section 2.1 implies that the Navy began using Hunters Point Naval Shipyard in 1945; however, the Navy acquired Hunters Point in 1939. From 1939 to 1944, the Hunters Point property was known as U.S. Naval Drydocks, Hunters Point; it was renamed Hunters Point Naval Shipyard in 1945. This is of particular note given that the radiological contamination likely began in 1939 when radioluminescent devices came into wide use, as discussed in Section 2.3.1. Please revise Section 2.1 to clarify that the Navy acquired Hunters Point in 1939 and from 1939 to 1944, the Hunters Point property was known as U.S. Naval Drydocks, Hunters Point.	Section 2.1 has been revised to clarify that the Navy acquired Hunters Point on December 29,1939, and from 1939 to 1944, the Hunters Point property was known as United States Naval Drydocks, Hunters Point. Although radioluminescent devices were used by the Navy when it acquired the property, there is no documentation showing that contamination began in 1939.
2.	Section 5.2, Combined Radiological and Chemical Risk, Page 5-8:	The text indicates that the assessment of radiological risks for construction workers would show that the radionuclide of concern (ROC) risks are below the PAL + background risks. Please revise Section 5.2 to provide and/or reference information to substantiate that assessment of radiological risks for construction workers is unwarranted due to the ROC risks being below the PAL + background risks.	Section 5.2 has been revised to clarify that because all ROC concentrations at Parcel F are below PAL + background concentrations (the maximum allowable concentration for ROCs established for Parcel F), corresponding risks for ROC concentrations at Parcel F are below corresponding risks for PAL + background concentrations (see Table 5-1).

RESPONSE TO COMMENTS ON
DRAFT ADDENDUM TO THE FEASIBILITY STUDY REPORT FOR PARCEL F, HUNTERS POINT NAVAL SHIPYARD, SAN FRANCISCO, CALIFORNIA

Comments from:
USEPA Comments, March 21, 2016

Comment Number	Section/ Page	Comment	Response
3.	Section 6.0, Sediment Stability, Page 6-1:	According to Section 6.0, the SEDZLJ model was used to determine the bottom shear stresses from storm waves in the South Basin for a 25-year storm. Please revise Section 6.0 to clarify how assessment of bottom shear stresses from storm waves in the South Basin only for a 25-year storm event is appropriate rather than for a 100-year storm event.	The fifth paragraph of Section 6.0 has been revised to clarify that extreme event analysis was based on the best available data, including 8 years of continuous wind data. 100-year storm data are not available for the South Basin. The impact from storm events will be evaluated during the remedial design.
4.	Section 8.0, Findings for No Action for Parcel F Sediment, Page 8-1:	Given the potential for radiological devices to be encountered in dredged sediment, it appears that institutional controls (ICs) could be needed at the site to ensure the sediment is kept in place unless dredging is conducted under a sediment management plan. Section 8.0 states, "If sediments are dredged from Parcel F in the future for beneficial reuse, the potential for items should be considered for determining the appropriate disposal or placement of Parcel F sediments." This limitation indicates that ICs are needed since No Action means unrestricted reuse is possible. Please revise and retitle Section 8.0 and update the Draft Addendum to clarify that the findings are that ICs may be needed for Parcel F sediments.	Please see the response to DTSC Specific Comment 1.

RESPONSE TO COMMENTS ON
DRAFT ADDENDUM TO THE FEASIBILITY STUDY REPORT FOR PARCEL F, HUNTERS POINT NAVAL SHIPYARD, SAN FRANCISCO, CALIFORNIA

Comments from:
Tina Low, Water Board, March 21, 2016

Comment Number	Section/ Page	Comment	Response
Specific Comments:			
1.	Executive Summary and Section 8.0 Findings for No Action for Parcel F Sediment:	These sections state that radiological commodities (i.e., radioluminescent items such as dials, gauges and deck markers) may be present in Parcel F sediments due to disposal from moored vessels. These radiological commodities may be encountered if sediments are dredged from Parcel F. If these sediments are dredged in the future, protocols may be needed to ensure the sediments are handled, placed and/or disposed of properly. Therefore, Institutional Controls may be needed to prevent exposure.	Please see the response to DTSC Specific Comment 1.
2.	Section 5.2 Combined Radiological and Chemical Risk:	We concur with EPA's general comment #1 with regards to the need for chemical sampling beneath the former piers. This addendum should note that chemical sampling beneath the former piers will be conducted and the results incorporated into the risk assessment.	Please see the response to USEPA General Comment 1.

RESPONSE TO COMMENTS ON
DRAFT ADDENDUM TO THE FEASIBILITY STUDY REPORT FOR PARCEL F, HUNTERS POINT NAVAL SHIPYARD, SAN FRANCISCO, CALIFORNIA

Comments from:
<u>Sheetal Singh, PhD, Senior Health Physicist, California Department of Public Health, March 21, 2016</u>

Comment Number	Section/ Page	Comment	Response
General Comments:			
1.		Navy has selected "no further action" as the remedy for Parcel F. According to the Comprehensive Environmental Response Compensation Liability Act (CERCLA) regulation, "No Further Action" is described as "no CERCLA remedial action is necessary for the site or operable unit, although it may authorize monitoring to verify that no unacceptable exposures to risks posed by the site or operable until occur in the future". The future use of Parcel F may require institutional controls, a form of remediation; hence "No Further Action" does not apply.	Please see the response to DTSC Specific Comment 1. The report will conclude that No Further Remedial Action applies.
2.		As stated in the executive summary the Navy has concluded "no additional radiological investigation or remediation for radionuclides of Parcel F is warranted". Is the Navy planning to request radiological unrestricted release recommendation (RURR) for Parcel F site? If so, EMB has determined that Parcel F is potentially radiologically impacted (Historical Radiological Assessment, 2004) and cannot recommend "unrestricted release" based on the following reason: a. Executive Summary page ES-4, "Radiological commodities, such as radium dials and gauges on ship vessels may be present in Parcel F even though no items were discovered during the DGIs". The Feasibility Study design does not address radiological commodities; hence Parcel F remains potentially radiologically impacted and may require institutional controls (ICs).	The Navy is not requesting a radiological unrestricted release recommendation for Parcel F because the site is not radiologically contaminated. The potential presence of discrete radiological commodities does not constitute distributed radiological contamination. See the response to SFDPH Specific Comment 4, which identifies the technical memorandum for radiological DGI. As described in the response to DTSC Specific Comment 1, the Navy is recommending ICs for dredging activities including dredge spoil reuse and disposal.
3.		The site remains potentially radiologically impacted and the Navy needs to discuss institutional controls in the current document. Also land/aquatic use restrictions may apply to the property. Before the property is transferred, EMB suggests discussing future use and potential restrictions for the site with Radiological Health Branch within CDPH.	Please see the response to DTSC Specific Comment 1.

RESPONSE TO COMMENTS ON
DRAFT ADDENDUM TO THE FEASIBILITY STUDY REPORT FOR PARCEL F, HUNTERS POINT NAVAL SHIPYARD, SAN FRANCISCO, CALIFORNIA

Comments from:
Sheetal Singh, PhD, Senior Health Physicist, California Department of Public Health, March 21, 2016

Comment Number	Section/ Page	Comment	Response
Specific Comments:			
1.	Section 2.3.1, "Potential Mechanisms for Radiological Release to Parcel F"	Include a description of the potential mechanism for radiological release for Co-60 that was used at the Experimental Shielding area adjacent to the south basin.	The FS Addendum has been edited to add stormwater runoff coming from the Experimental Shielding area.
2.	Section 2.3.2, Parcel F Impacted Site Designation	…states "the HRA identified the same ROC's in the "All Ships Berths" with the exception of U-235". What is the primary use of U-235 and why was not included as a radionuclide of concern (ROC) for Ship berths: Berths North Area and Berths South Area?	Uranium-235 was associated with atomic weapons testing and decontamination of ships that participated in those tests (see HRA Appendix E, Response to Comment 13, Page E-37). The decontamination activity is associated with All Ships Berth only.
3.	Section 2.3.4, Parcel F Impacted Site Designation	…states the HRA designated sediment in the "Underwater Areas" and all "Ship Berths" as having a low potential for contamination and low potential for serving a migration pathway". The Navy should include a description on how the Navy determined the sediments had low potential for contamination since in the section 2.3 "Site Designations at Hunters Point Naval Shipyard", bullet point two summarizes that the sites where there were known spills, discharges or other unusual occurrences of radioactive material that resulted in release or spread of contamination.	Please see the Glossary Section of the HRA (NAVSEA, 2004) for the definition of terms used in the HRA including "Low."
4.	Section 3.1, "Parcel F Radiological Investigations	The HRA assessment states previous radiological investigations in "2002 NWT Phase V" had areas containing 137Cs slightly exceeding limits. Include Navy's conclusions after the Navy further investigated the areas where the 137Cs exceeded the limits was found in 2002.	Cesium-137 is commonly present in San Francisco Bay sediments and has been a ROC for Parcel F. The Navy has concluded that the cesium-137 concentration is less than the PALs, and the presence of cesium-137 is not attributable to Parcel F activities (see Section 3.2.1 and conclusions for all ROCs at Parcel F).
5.	Section 5.1.1, "Conceptual Site models"	….does not include an explanation on the exposure pathways for resuspension by transport of sediment from humans disturbing the soil. Please include an explanation.	The Validation Study (Battelle et al., 2005) discusses uncertainties associated with the sediment data and with the risk assessment, including uncertainties associated with resuspension of sediment. The 2005 Validation Study will be provided to the agencies separately on CD.

RESPONSE TO COMMENTS ON
DRAFT ADDENDUM TO THE FEASIBILITY STUDY REPORT FOR PARCEL F, HUNTERS POINT NAVAL SHIPYARD, SAN FRANCISCO, CALIFORNIA

Comments from:
Sheetal Singh, PhD, Senior Health Physicist, California Department of Public Health, March 21, 2016

Comment Number	Section/ Page	Comment	Response
6.	Section 6.0, "Sediment Stability"	…also stated on page 62, states "The core from BN 312 in the Berths Revetment Area yielded a net sediment accumulation rate of 5.8 cm/year which was considered anomalously high and inconsistent with field observations". Please further explain how this result is inconsistent with field observations.	The Navy believes that this comment refers to the core from BN304 and not from BN312 as indicated in the comment. The text in Section 6.0 has been revised to clarify that the rate of 5.8 centimeters per year (cm/yr) estimated for BN304 was considered anomalous because it was higher than other deposition rates estimated for Parcel F. The deposition rate at SA01 was 2.3 cm/yr, similar to the rate previously estimated for India Basin, and slightly higher than the rate of 1 cm/yr estimated for South Basin (Battelle et al., 2005; Battelle and Sea Engineering, Inc., 2013).
7.	Section 7.0, "Updated Conceptual Site Model"	EMB would like to understand the significance of this section. According the HRA 2004, Parcel F is potentially impacted and the Feasibility Report suggests the same. Please clarify why the Navy has concluded conceptual site model has changed and needs to be updated?	Section 7.0 presents past practices related to radiological items and their transport, and provides a summary of the Phase 1 and Phase 2a findings. Section 7.0 is meant to augment the Conceptual Site Model (CSM) for radiological items and is not a change to the CSM. The following will be added to Section 2.3.2 Parcel F Impacted Site Designation: "The impacted designation was based on limited information and can be updated once additional information is collected." In addition, see the response to DTSC Specific Comment 1. The FS will conclude that the recommendations from the HRA have been implemented and the site is not impacted.
8.	Section 8.0, "Findings for No Action for Parcel F"	EMB cannot accept findings for No Action for Parcel F sediment due to the following statement, "Although no radiological commodities were found during the radiological gaps investigation at Parcel F, potential remains for these items to be present in locations where ships were present during HPNS operation". EMB considers the sediment is potentially impacted until the discrete items have been addressed. Secondly IC's maybe needed in the future.	Please see the response to DTSC Specific Comment 1.

Comments from:
Sheetal Singh, PhD, Senior Health Physicist, California Department of Public Health, March 21, 2016

Comment Number	Section/ Page	Comment	Response
9.	Table Section, Table 4-2	Parcel F Sediment Radionuclide Data WRS Test Statistics Phase 1, 2a, 2b, shows the WRS Test P-value. Include the WRS data associated with this table.	The data packages associated with these three reports are large will be provided to the agencies separately from the FS. One combined dataset for all data at Parcel F used in the WRS test is not available. Section 4.1 has been updated to indicate where data can be found in these historical reports, as follows: Phase 1 – Phase 2a Report, Appendix B1, B3, B4 Phase 2a – Phase 2a Report, Appendix B1, B5 Phase 2b – Phase 2b Report, Appendix B1, B3

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RESPONSE TO COMMENTS ON NAVY'S COMMENTS ON HERO'S 21 MARCH 2016 COMMENTS FOR THE DOCUMENT, "APPENDIX A, UPDATED HUMAN HEALTH RISK ASSESSMENT FOR CHEMICAL EXPOSURES, ADDENDUM TO THE FEASIBILITY STUDY REPORT FOR PARCEL F, HUNTERS POINT NAVAL SHIPYARD, SAN FRANCISCO, CALIFORNIA

Comments from:
Kimberly Gettmann, DTSC Toxicologist, DTSC HERO, September 16, 2016

Comment Number	Section/ Page	Comment	Response
Specific Comments			
1.	Section 3.1 and Table A-3	HERO Comments 1a, b, c, and d - Exposure Parameters a. HERO does not concur with the Navy's response. HERO's original comment requested that the 2014 HHRA Note 1 be used in the updated HHRA. The response to this comment was that the COCs have already been identified for Parcel F and the remedial alternatives have been evaluated, thus, no further updates will be made to the HHRA as part of the FS Addendum. However, according to the Navy's Response to SFDPH Comment 17, "the HHRA was updated as part of the FS addendum to incorporate changes to the USEPA and California Department of Toxic Substances [DTSC] methods for HHRAs because a number of these methods had changed since the original HHRA was completed in 2005 during the Validation Study." HHRA Note 1 is one of the changes to DTSC currently recommended HHRA methods. HERO reiterates our original comment. Please update all references to the 2014 version in the text and tables. b. HERO does not concur with the Navy's response. Please see HERO's response to Comment 1a above. HERO reiterates our original comment. c. Shellfish consumption rate. Concur. d. Dermal Absorption Factors – Section 3.2. No additional response necessary.	a. The Navy will revise Appendix A to incorporate the 2014 version of HERO Note 1. The following text was added to the Executive Summary and to Section 1.3 "The HHRA was updated as part of this addendum to incorporate the 2014 HHRA Note 1." b. Please see the response to 1a above. c. No additional response required. d. No additional response required.
2.	Section 5.4	HERO Comment 2 - Lead – Section 5.4. The Navy's response to our comment regarding DTSC's recommended screening level for lead of 80 mg/kg was that lead has already been identified as a COC for Parcel F and to see SFDPH Comment 17. HERO does not completely concur with the Navy's response. The text in Appendix A, Section 5.4 specifically mentions that lead concentrations are below the USEPA RSL of 400 mg/kg. For completeness, the DTSC's screening level should also be included in the text. DTSC does not concur with the use of the residential lead soil value	Potential receptors for Parcel F are recreational users and construction workers (BBL, 2005). Exposure pathways incorporated in the DTSC (2011) residential screening level for soil lead of 80 milligram per kilogram (mg/kg) are ingestion, re-suspension (inhalation), and dermal contact. In addition, the DTSC residential screening level assumes daily residential child exposure of seven days per week. These assumptions overestimate potential exposure to lead in sediment at Parcel F. The inhalation pathway is expected to be

Comments from:
Kimberly Gettmann, DTSC Toxicologist, DTSC HERO, September 16, 2016

Comment Number	Section/ Page	Comment	Response
		of 400 mg/kg and recommends 80 mg/kg. DTSC's soil lead screening level should be included in the text of Section 5.4 as this is a change to the HHRA methods recommended by DTSC since the original 2005 HHRA. HERO reiterates our original comment.	negligible because the intertidal and subtidal locations of Parcel F sediments will minimize or prevent suspension and resuspension of sediments in air. In addition, recreational exposure to sediment is assumed to occur 26 days per year, or 0.5 days per week (BBL, 2005). This recreational exposure frequency is 14 times less than the daily exposure frequency used by DTSC (2011) to develop the soil lead screening level for residential exposure. Adjustment of the exposure frequency in the DTSC (2011) lead risk assessment spreadsheet (i.e., LeadSpread 8) from 7 days per week to the exposure frequency of 0.5 days per week used to evaluate sediment exposure to recreational child receptors for Parcel F results in a revised soil lead screening level of 1,100 mg/kg for non-pica children and 540 mg/kg for pica children (note that these levels are rounded to two significant digits). No adjustment was made to exclude the inhalation exposure pathway. Exposure point concentrations for sediment lead (based on 95 percent upper confidence limits) range from 24.7 mg/kg (Eastern Wetland Area VIII) to 115 mg/kg (India Basin Area I). No sediment lead EPCs for Parcel F exceed the adjusted soil screening levels of 1,100 mg/kg (non-pica children) and 540 mg/kg (pica children). This comparison indicates that lead concentrations in sediment at Parcel F do not require further evaluation.
3.		HERO Comment 3 - Table A-19 – Comparison of Updated HHRA Results with 2005 HHRA Results. Concur.	No additional response required.

RESPONSE TO COMMENTS ON
NAVY'S COMMENTS ON HERO'S 21 MARCH 2016 COMMENTS FOR THE DOCUMENT, "APPENDIX A, UPDATED HUMAN HEALTH RISK ASSESSMENT FOR CHEMICAL EXPOSURES, ADDENDUM TO THE FEASIBILITY STUDY REPORT FOR PARCEL F, HUNTERS POINT NAVAL SHIPYARD, SAN FRANCISCO, CALIFORNIA

Comments from:
Juanita Bacey, Project Manager, DTSC, September 16, 2016

Comment Number	Section/ Page	Comment	Response
Specific Comments			
1.	Section 3.1	It appears that the intent of the FS addendum was not only to address radiological chemicals at Parcel F but also to update the Human Health Risk Assessment for chemical contamination. However, reference to such appears to be missing from the document. It is not indicated in the title, executive summary or introduction. I found the only place it is referenced is in Section 1.3 Organization of the Addendum. Therefore, please reference the update of the Human Health Risk Assessment (Appendix A) in the title, Executive summary and in the Introduction of the addendum.	Please see the response to Kimberly Gettmann comment #1.

Comments from:
USEPA, September 26, 2016

Comment Number	Section/ Page	Comment	Response
Specific Comments			
1.	**Evaluation of the Response to General Comment 1:**	1a.) The response partially addresses the comment by acknowledging that chemical sampling will be conducted in the vicinity of the removed piers and radiological sampling was conducted during the pier time-critical removal action (TCRA). However, the Redline Draft Final Addendum to the Feasibility Study Report for Parcel F (the Redline FS Addendum) was not revised to include this chemical sampling. Please revise the Redline FS Addendum to discuss acknowledging the need for chemical sampling. 1b.) Also, as indicated in the original comment, the text in Section 1.1 states that the TCRAs are ongoing, but the pier removal TCRA has been complete for some time. Please revise the text to correct inaccurate phrasing regarding that implies that the Pier removal TCRA is ongoing. 1c.) Additionally, the response states that "[p]rior chemical and radiological sampling of sediments is representative of these areas," but sediment tends to accumulate under piers at other Navy bases, (e.g., the Long Beach Naval Shipyard). It has been demonstrated that contaminant concentrations in sediment are typically higher under piers than in other areas (e.g., because mixing and redistribution of sediment under the piers does not occur because of the low energy environment, areas under the piers are not dredged, etc.). As a result, sediment data collected in other areas cannot be considered representative of contaminant concentrations in sediment under the former piers. Also, before demolition of the piers, it was not possible to collect samples of the sediment beneath the piers, in part because it was too dangerous to send divers under collapsing piers, which had been in poor condition for years. Please revise the Redline FS Addendum to acknowledge that the prior chemical and radiological sampling in other areas is not representative of the sediment under the former piers.	1a.) The following text has been added to Section 5.2 "Additional chemical samples will be collected in the vicinity of the former Parcel B Piers. This work will be proposed in a separate work plan, and the results will be provided in an investigation summary report." 1b.) Section 1.1 has been revised to correct phrasing regarding the TCRA. 1c.) The Navy has acknowledged that additional sediment sampling will be performed in the vicinity of the former Parcel B Piers. The Navy has decided not to revise the text regarding the previous samples not being representative of the sediment under the former Parcel B Piers as this statement would be speculative at this point. 1d.) The Navy, with the BCT, will determine the appropriate method for evaluating the sediment sampling chemical results in the Parcel B Piers work plan.

Comments from:
USEPA, September 26, 2016

Comment Number	Section/ Page	Comment	Response
		1d.) Finally, the response states, "However, the risk assessment will not be reassessed and no changes are required to the Draft FS", but no explanation has been provided to support this response. If chemical data collected from sediment that was beneath the former piers is substantially different, the risk assessments will no longer be representative. Please explain in detail why the risk assessment will not be reassessed when new chemical sampling data becomes available.	
2.	**Evaluation of the Response to General Comment 6:**	The response does not address the comment. The on-line Preliminary Remediation Goal (PRG) calculator should be used to ensure consistency with U.S. EPA's CERCLA approach for Superfund remedial radiation risk assessment. It should be noted that slope factors for some radionuclides may have changed since the risk assessments for Parcel F were done. While a specific calculator for exposure to Parcel F sediment and consumption of shellfish is not part of the on-line PRG calculator, the Oak Ridge National Laboratory (ORNL) developed the PRG calculators and can be consulted to help customize the PRG calculator (i.e., there is a link on the PRG calculator web page for help from ORNL). Please revise Section 5.0 to include results from the EPA PRG calculators for Parcel F.	As indicated in the previous response, project action limits (PALs) for Parcel F were derived during the Phase 1 and Phase 2a data gap investigations and were approved by the regulatory agencies, including USEPA and the Navy for decision-making purposes. To demonstrate that changes to the PALs are not needed, the Navy calculated risk-based concentrations (RBCs) for the Parcel F radionuclides of concern (ROCs) using the equations provided in the USEPA (2016) on-line PRG preliminary remediation goal calculator for radionuclides. The equations were modified to include the shellfish consumption pathway. Calculations for the RBCs plus background are provided in Attachment 2 to these response to comments (RTCs). The calculated RBCs incorporate updated slope factors for radionuclides provided in USEPA (2016), the USEPA (2016) equations for recreational adult and child exposure to soil from incidental ingestion and external exposure, the Parcel F approach for adult shellfish consumption (Battelle and Sea Engineering, 2013; ITSI & Gilbane, 2013), and the Parcel F exposure assumptions for recreational exposure (Battelle and Sea Engineering, 2013; ITSI & Gilbane, 2013). Table 1 of Attachment 2 to these RTCs shows that all ROC concentrations at Parcel F are less than RBC + background concentrations. Therefore, radiological risks associated with Parcel F ROCs would be less than radiological risks associated with RBC + background levels. These results are consistent with the findings of the FS addendum: all Parcel F ROC concentrations are less than Parcel F PAL + background levels, and radiological risks associated with Parcel F ROCs are less than radiological risks associated with

Comments from:
USEPA, September 26, 2016

Comment Number	Section/ Page	Comment	Response
			PAL + background levels. This evaluation shows that the RBCs do not change the overall conclusions of the FS addendum or risk assessment. Therefore, no changes are needed to the PALs.
3.	**Evaluation of the Response to General Comment 7:**	The response partially addresses the comment. The information in the original comment from ATSDR and the demographic information should be incorporated into the text of Section 5. It also is not clear that the much lower shellfish consumption rate is appropriate. Please revise the Redline FS Addendum to include information from ATSDR and to justify the lower shellfish consumption rate.	Section 5 will be revised to incorporate demographic information for the Hunters Point/Bayview area (as it pertains to fishing and fish and shellfish consumption) that was provided in the original comment from USEPA (based on the Agency for Toxic Substances and Disease Registry and 2009 Public Health Assessment for the Hunters Point Naval Shipyard). Section 5 will also be revised to incorporate information provided in the Navy's previous response to USEPA's comment regarding the revised shellfish consumption rate.
4.	**Evaluation of the Response to Specific Comment 1:**	It does not appear that the second paragraph of the response can be substantiated. Specifically, the absence of documentation to indicate that radiological devices were not discarded is not an indication that disposal of these devices did not occur. Since Navy vessels and submarines were repaired at Hunters Point in the most expedient manner possible during World War II (WWII) when time was of the essence and the dangers of radiological devices were not properly understood, it is possible these devices were discarded without considering the associated risks. For example, deck markers and other small radiological devices that fell into the dry docks were probably washed out when water was pumped out of the dry docks. This conceptual site model was acknowledged when the drainage channels under Dry Dock 4 were sealed. Further, radiological devices have been found in many locations on Hunters Point when excavation or radiological surveys have been done, which suggests that these devices were not handled with care. Please revise the Redline FS Addendum to acknowledge that radiological devices may have been discarded during WWII.	The second paragraph of the original response to comments is not included in the text of the Addendum to the Feasibility Study Report for Parcel F. The text will not be revised in response to this comment. The Executive Summary and Section 8.0 identify that radiological devices may have been discarded at Parcel F. These statements include any timeframe, not just WWII, and is more appropriate given a lack of any documentation. The Executive Summary in the last paragraph on page ES-4 states: "Radiological commodities, such as, radium dials and gauges on ship vessels may be present in Parcel F even though no items were discovered during the DGIs. " Section 8 in the last paragraph on page 8-1 states: "Although no radiological commodities were found during the radiological data gaps investigations at Parcel F, potential remains for these items to be present in locations in Parcel F where ships were present during HPNS operation." Finally, the Navy is recommending institutional controls be placed on Parcel F sediments for potential future dredging activities to address the potential improper disposal of radiological devices.

USEPA REVIEW OF THE RESPONSES TO COMMENTS ON DRAFT ADDENDUM TO THE FEASIBILITY STUDY REPORT FOR PARCEL F, AND THE REDLINE DRAFT FINAL ADDENDUM TO THE FEASIBILITY STUDY REPORT FOR PARCEL F, HUNTERS POINT NAVAL SHIPYARD, SAN FRANCISCO, CALIFORNIA, AUGUST 2016

Comments from:
Tina Low, Regional Water Quality Control Board, September 28, 2016

Comment Number	Section/ Page	Comment	Response
Specific Comments			
1.	Executive Summary and Section 8.0	My original comment #1 stated that "If [Parcel F] sediments are dredged in the future, protocols may be needed to ensure the sediments are handled, placed and/or disposed of properly. Therefore, Institutional Controls may be needed to prevent exposure." The Navy's response was "Please see the response to DTSC Specific Comment 1." The Navy's response to DTSC Specific Comment 1 states that "the Navy is recommending institutional controls that will require dredging activities, including dredge and spoil reuse and disposal, to be reviewed and approved by DTSC prior to commencing dredging activities." This response, and the corresponding revisions to the Executive Summary and the last paragraph of Section 8.0, indicate that the Navy is recommending Further Action in the form of Institutional Controls. However, the Navy's response to CDPH General Comment #1 states that "The report will conclude that No Further Action applies." In addition, Section 8.0 is still titled "Findings for No Action for Parcel F Sediment". Please revise the responses and/or text to clarify that further action in the form of Institutional Controls is recommended.	The RTCs, the title of Section 8, and appropriate text throughout the document has been edited to read "Institutional Controls for dredge sediments"

References

California Department of Toxic Substances Control (DTSC). 2011. Lead Risk Assessment Spreadsheet (LeadSpread). Version 8. http://www.dtsc.ca.gov/AssessingRisk/LeadSpread8.cfm

Battelle, Blasland, Bouck & Lee, Inc. (BBL), and Neptune & Company. 2005. Final Hunter Point Shipyard Parcel F, Validation Study Report, San Francisco Bay, California. May 2.

Battelle and Sea Engineering, Inc. 2013. Final Technical Memorandum for Radiological Data Gap Investigation Phase 2a at Parcel F, Hunters Point Naval Shipyard, San Francisco, California. April.

ITSI Gilbane & SAIC. 2013. Final Technical Memorandum for Radiological Data Gap Investigation Phase 2b at Parcel F, Hunters Point Naval Shipyard, San Francisco, California. September.

United States Environmental Protection Agency (USEPA). 2016. Preliminary Remediation Goals (PRG) Calculator for Radionuclides. Accessed October 6. https://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search

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RESPONSE TO COMMENTS ON
DRAFT ADDENDUM TO THE FEASIBILITY STUDY REPORT FOR PARCEL F
HUNTERS POINT NAVAL SHIPYARD, SAN FRANCISCO, CALIFORNIA

Comments from:

Lily Lee, United States Environmental Protection Agency, December 21, 2016

Section/Page	Comment	Response
Response to General Comment 1c	Currently the response to 1(c) states: “The Navy has acknowledged that additional sediment sampling will be performed in the vicinity of the former Parcel B Piers. The Navy has decided not to revise the text regarding the previous samples not being representative of the sediment under the former Parcel B Piers as this statement would be speculative at this point.“ Please modify Draft FS Addendum to acknowledge the data gap. For example, here is suggested alternative language: “[p]rior chemical and radiological sampling of sediments is representative of **most** of the area, **expect areas under the pier where no samples were collected due to safely concerns**.”	In response to General Comment 1c, the Navy has added the following text to Section 5.2: “Additional chemical samples will be collected in the vicinity of the former Parcel B piers because these areas were not available for sampling previously. This work will be proposed in a separate work plan, and the results will be provided in an investigation summary report.” Decisions about representativeness of the previous data will be made following the proposed investigation.
Response to General Comment 1d	The response partially addresses the comment. Specifically, the response to Part 1(d) states that the Navy, with the Base Realignment and Closure (BRAC) Cleanup Team (BCT) will determine the appropriate method to evaluate the sediment sampling chemical results. We understand that the Navy has a contract to do future sampling and a workplan will be developed. For the record, our understanding is that as part of the future process the Navy should, with BCT involvement, reevaluate the risk assessment if the data from the chemical sampling beneath the piers are substantially different than previously assumed.	Yes, EPA’s understanding is correct.
Response to General Comment Number 2 (Original General Comment 6)	The response states that Risk Based Concentrations (RBCs) were calculated using EPA’s Preliminary Remediation Goal (PRG) calculator to demonstrate that the Project Action Limits (PAL) established for Parcel F are consistent with the U. S. EPA’s Comprehensive Environmental, Compensation, and Liability Act (CERCLA) approach for Superfund remedial radiation risk assessment. This response included Attachment 1, which provided the RBC calculations using formulas from the EPA PRG calculator. The results of the calculations as presented in Table 1 of Attachment 1 indicate that for the subtidal exposure scenario, the RBC values significantly exceed the maximum detection within Parcel F. After review of the calculations performed to estimate the RBCs, the following concerns were identified: • For the subtidal exposure scenario, the calculations included a gamma shielding factor (GSF) that results in a larger RBC. While Attachment 1 indicates the GSF values were obtained from technical reference documents (Feasibility Study and Data Gap Investigation) specific to Parcel F at Hunter’s Point, use of such factors should be reviewed to determine the extent to which they are representative of the specific exposure scenario considered. The small GSFs for subtidal exposures require further justification to establish that they	(a) The regulatory agencies concurred with the GSFs established for Parcel F during the phase 2a and phase 2b radiological data gap investigations (DGIs) (Battelle and SEA Engineering, Inc., 2013 and ITSI Gilbane & SAIC, 2013). The GSFs were estimated using the Microshield 7 computer model based on a contaminated sediment thickness of one meter and three feet of water overlying the contaminated sediments (i.e., the water provides the shielding). Attachment 1 to these responses to comments provides the modeling for the GSFs (taken from Appendix E of Battelle and SEA Engineering, Inc. [2013]). The conditions assumed to model the GSFs for the subtidal area of Parcel F (i.e., three feet of water overlying a contaminated sediment thickness of one meter) remain appropriate. In fact, the depth of water overlying sediments at Parcel F has been increasing and is likely to continue to increase based on predictions regarding sea level rise (California Climate Change Center, 2009; AECOM, 2016).

Comments from:
Lily Lee, United States Environmental Protection Agency, December 21, 2016

Section/Page	Comment	Response
	are appropriate for this application. • The Distribution Coefficients (Kd values) provided in Attachment 1 are very large, and in some cases do not correspond to other literature values for most of the radionuclides, which results in larger RBC values. For example, the Distribution Coefficient (in Liters per kilogram, L/Kg) for Plutonium-239 is listed as 100,000 L/Kg; however in the EPA document Understanding Variation In Partition Coefficient, Kd, Values, EPA 402-R-99-004B, August 1999 lists a range from 80-2,200 L/Kg, depending on the soil type, oxidation state, pH, and various other factors. These values were obtained from testing fourteen soil types from across seven Department of Energy (DOE) sites in order to provide a representative range of values. While Attachment 1 indicates the Kd values used in the calculations were obtained from site-specific documents, these values require further examination and justification to establish that they are appropriate for this application. • The formula used to calculate the RBC for incidental soil ingestion – intertidal and subtidal scenario, uses the formula provided in EPA's PRG calculator; however, the milligrams (mg) of soil ingestion assumed for the child is 200 in the PRG calculator but is listed as half that amount (100 mg) in Equation 2 (Exhibit 1 RBC Equations) of Attachment I. In order to provide the appropriate comparisons in showing consistency with the PRG calculator, the RBC for incidental soil ingestion should be re-calculated using the exposure assumption that the child consumes 200 mg of soil per day. Please revise Attachment 1 to provide justification for the GSFs used for subtidal exposures, the Kd values, and revise the calculations to assume a child consumes 200 mg of soil per day.	(b) The regulatory agencies concurred with the K_d values established for Parcel F during the phase 2a and phase 2b radiological DGIs (Battelle and SEA Engineering, Inc., 2013 and ITSI Gilbane & SAIC, 2013). The K_d values used for the shellfish consumption RBCs are specific to marine environments (i.e., seawater) and are based on assessments and recommendations by the International Atomic Energy Agency (IAEA, 2004). K_d values recommended by USEPA for calculation of radiological PRGs were not used because they are intended for evaluating partitioning from soil to groundwater (i.e., freshwater) and for evaluating partitioning to freshwater fish. USEPA's document *Understanding Variation in Partition Coefficient, K_d, Values* (USEPA, 1999) includes K_d values from studies specific to marine environments. For example, K_d values cited in USEPA (1999) for plutonium adsorption based on marine studies range from 2,500 to 2,800,000 milliliters per gram (equivalent to liters per kilogram [L/Kg]). The K_d value of 100,000 L/kg used for Plutonium-239 to calculate the shellfish consumption RBC is well within the range of K_d values cited by USEPA (1999) for marine environments. (c) The RBCs for incidental soil ingestion were re-calculated to incorporate the USEPA (2014 and 2016)-recommended incidental soil ingestion rate for children of 200 milligrams per day. Attachment 2 to these responses to comments provides the updated RBC calculations for the Parcel F radionuclides of concern.

References

AECOM. 2016. San Francisco Bay Tidal Datums and Extreme Tides Study. Final Report. February.

Battelle and Sea Engineering, Inc. 2013. Final Technical Memorandum for Radiological Data Gap Investigation Phase 2a at Parcel F, Hunters Point Naval Shipyard, San Francisco, California. April.

California Climate Change Center. 2009. The Impacts of Sea-Level Rise on the California Coast. CEC-200-2009-024-F. May.

International Atomic Energy Agency (IAEA). 2004. Sediment Distribution Coefficients and Concentration Factors for Biota in the Marine Environment. Technical Reports Series No. 422. April.

ITSI Gilbane & SAIC. 2013. Final Technical Memorandum for Radiological Data Gap Investigation Phase 2b at Parcel F, Hunters Point Naval Shipyard, San Francisco, California. September.

United States Environmental Protection Agency (USEPA). 1999. Understanding Variation in Partition Coefficient, K_d, Values. Office of Air and Radiation. EPA 402-R-99-004B. August.

United States Environmental Protection Agency (USEPA). 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. Office of Solid Waste and Emergency Management. OSWER Directive 9200.1-120. February 6.

United States Environmental Protection Agency (USEPA). 2016. Preliminary Remediation Goals (PRG) Calculator for Radionuclides. https://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search

Attachment 1

Gamma Shielding Factors for Parcel F

Source: Appendix E, Battelle and Sea Engineering, Inc. 2013. *Final Technical Memorandum for Radiological Data Gap Investigation Phase 2a at Parcel F, Hunters Point Naval Shipyard, San Francisco, California.* April.

APPENDIX E

SHIELDING FACTORS

The shielding factors for the subtidal conceptual site model were estimated using the MicroShield 7 computer code (Grove Software, 2006) based on a contaminated sediment thickness of 1 meter and 3 feet of water overlying the sediments, which provided shielding from the radiation emitted from the sediments. The 1-meter thick contaminated sediments were assumed to have infinite lateral extent.

The shielding factors were estimated based on the ratio of the shielded and unshielded dose rates:

$$\text{Shielding Factor} = \frac{\text{Shielded Dose Rate (mSv/hr)}}{\text{Unshielded Dose Rate (mSv/hr)}}$$

The unshielded and shielded dose rates used the rotational geometry effective dose equivalent rate with buildup from the MicroShield output. For the purposes of estimating the shielding factors, the sediments were assumed to be contaminated with 1 pCi/g of Cs-137, Sr-90, U-235, Ra-226, Pu-239, or Co-60. The sediments were assumed to have a density of 1.5 g/cm^3. In the case of the unshielded dose rate, the dose rate was determined at 1 meter above the contaminated sediments. Air was assumed to be present between the contaminated sediments and the point at which the dose rate was estimated. In the case of the shielded dose rate, the dose rate was estimated based on 3 feet of water overlying the contaminated sediments and was determined at a distance of 1 meter above the surface of the water. Air was assumed to be present between the surface of the water overlying the contaminated sediments and the point at which the dose rate was estimated.

Table E-1 lists the unshielded and shielded dose rates and the shielding factors for the subtidal conceptual site model.

Table E-1. Unshielded and Shielded Dose Rates and Shielding Factors for the Subtidal Conceptual Site Model

Radionuclide	Unshielded Dose Rate (mSv/hr)	Shielded Dose Rate (mSv/hr)	Shielding Factor
Cs-137	5.074E-6	2.329E-9	4.59E-4
Sr-90	5.947E-14	4.788E-45	8.05E-32
U-235	1.179E-6	3.901E-11	3.31E-5
Ra-226	1.666E-5	5.486E-8	3.29E-3
Pu-239	7.639E-10	4.459E-14	5.84E-5
Co-60	2.374E-5	7.088E-8	2.99E-3

Note: The unshielded and shielded dose rates were based on the rotational geometry effective dose equivalent rate with buildup.

For the revetment, shielding factors were also estimated using the MicroShield 7 computer code. A 1-meter thick layer of contaminated sediment was assumed to be present underneath the revetment. For the purposes of estimating the shielding factors, the sediment was assumed to be contaminated with 1 pCi/g of Cs-137, Sr-90, U-235, Ra-226, Pu-239, or Co-60. The sediment was assumed to have a density of 1.5 g/cm^3 and to have infinite lateral extent. The revetment would be constructed from filter fabric, graded crushed rock, and armor stone. The filter fabric layer would not provide significant radiation shielding and was ignored in estimating the shielding factors. The layer of crushed rock was estimated to be about 6 inches to 1 foot thick, and the layer of armor stones was estimated to be about 6 feet thick. An exposed person would be exposed to the contaminated sediments under the revetment, but would be shielded by the structure of the revetment. For the purposes of estimating the radiation shielding provided by the crushed rock and armor stone, a 2-foot layer of concrete with a density of 2.7 g/cm^3 was used. A density of 2.7 g/cm^3 is representative of the density of typical stones used to construct revetments. Although the armor stone layer of the revetment would be about 6 feet thick, a 2-foot layer was used in estimating the shielding factors to account for gaps between the armor stones.

In the case of the unshielded dose rate, the dose rate was determined at 1 meter above the contaminated sediments. Air was assumed to be present between the contaminated sediments and the point at which the dose rate was estimated. In the case of the shielded dose rate, the dose rate was estimated based on the 2-foot revetment wall overlying the contaminated sediments and was determined at a distance of 1 meter above the ground surface of the revetment. Air was assumed to be present between the ground surface of the revetment overlying the contaminated sediments and the point at which the dose rate was estimated.

Table E-2 lists the unshielded and shielded dose rates and the shielding factors for the revetment.

The MicroShield output used to estimate the shielding factors are included as Attachment E-1.

Table E-2. Unshielded and Shielded Dose Rates and Shielding Factors for the Revetment

Radionuclide	Unshielded Dose Rate (mSv/hr)	Shielded Dose Rate (mSv/hr)	Shielding Factor
Cs-137	5.074E-6	1.148E-11	2.26E-6
Sr-90	5.947E-14	0.0	0.0
U-235	1.179E-6	5.415E-15	4.59E-9
Ra-226	1.666E-5	2.459E-9	1.48E-4
Pu-239	7.639E-10	8.835E-17	1.16E-7
Co-60	2.374E-5	2.118E-9	8.92E-5

Note: The unshielded and shielded dose rates were based on the rotational geometry effective dose equivalent rate with buildup.

References

Grove Software. 2006. *MicroShield User's Manual*, Version 7. Grove Software, Inc., Lynchburg, VA. October.

ATTACHMENT E-1

MicroShield Output

Unshielded Cs-137 MicroShield Output

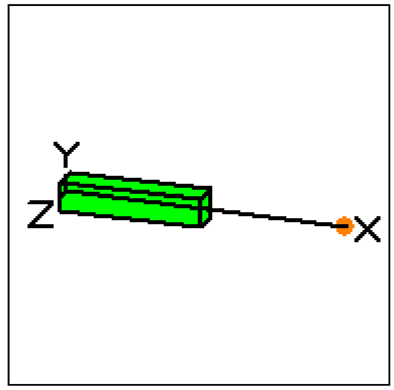
MicroShield 7.02
Battelle (05-MSD-7.00-1022)

Date	By	Checked

Filename	Run Date	Run Time	Duration
Cs-137_00_ft_01_m.ms7	May 20, 2010	10:40:28 PM	-01:59:6

Project Info	
Case Title	Cs-137 1 meter air
Description	Cs-137 1 pCi/g sediment 1 meter air shield
Geometry	16 - Infinite Slab

Source Dimensions	
Thickness	100.0 cm (3 ft 3.4 in)



Dose Points			
A	X	Y	Z
#1	200.0 cm (6 ft 6.7 in)	0.0 cm (0.0 in)	0.0 cm (0.0 in)

Shields			
Shield N	Dimension	Material	Density
Source	Infinite	Concrete	1.5
Air Gap		Air	0.00122

Source Input: Grouping Method - Standard Indices
Number of Groups: 25
Lower Energy Cutoff: 0.015
Photons < 0.015: Included
Library: ICRP-38

Nuclide	μCi/cm³	Bq/cm³
Ba-137m	1.4190e-006	5.2503e-002
Cs-137	1.5000e-006	5.5500e-002

Buildup: The material reference is Source
Integration Parameters

Results

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	4.665e-04	1.709e-07	1.736e-07	1.466e-08	1.489e-08
0.03	3.179e-03	2.379e-05	2.787e-05	2.358e-07	2.762e-07
0.04	7.554e-04	1.572e-05	2.252e-05	6.953e-08	9.959e-08
0.6	4.714e-02	1.110e-01	3.613e-01	2.167e-04	7.053e-04
Totals	**5.154e-02**	**1.111e-01**	**3.614e-01**	**2.170e-04**	**7.056e-04**

MicroShield 7.02 (05-MSD-7.00-1022)
Battelle
Conversion of calculated exposure in air to dose
FILE: C:\ushield\CaseFiles\Cs-137_00_ft_01_m.ms7
Case Title: Cs-137 1 meter air
This case was run on Thursday, May 20, 2010 at 10:40:28 PM
Dose Point # 1 - (200,0,0) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	1.862e-001	6.037e-001
Photon Energy Fluence Rate	MeV/cm²/sec	1.111e-001	3.614e-001
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	2.170e-004	7.056e-004
Absorbed Dose Rate in Air	mGy/hr	1.895e-006	6.160e-006
"	mrad/hr	1.895e-004	6.160e-004
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	2.261e-006	7.353e-006
o Opposed	"	1.787e-006	5.812e-006
o Rotational	"	1.787e-006	5.812e-006
o Isotropic	"	1.580e-006	5.140e-006
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	2.395e-006	7.787e-006
o Opposed	"	2.267e-006	7.374e-006
o Rotational	"	2.267e-006	7.374e-006
o Isotropic	"	1.687e-006	5.487e-006
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.993e-006	6.484e-006
o Posterior/Anterior	"	1.746e-006	5.681e-006
o Lateral	"	1.279e-006	4.163e-006
o Rotational	"	1.560e-006	5.074e-006 ←
o Isotropic	"	1.320e-006	4.293e-006

3-Foot Water Shielding Cs-137 MicroShield Output

MicroShield 7.02 Battelle (05-MSD-7.00-1022)

Date	By	Checked

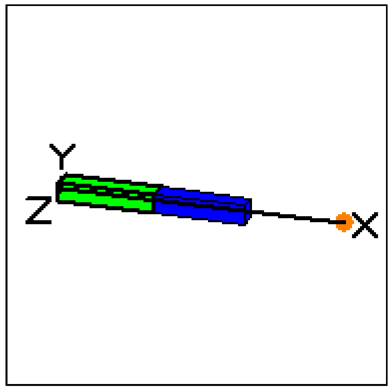
Filename	Run Date	Run Time	Duration
Cs-137_03_ft_01_m.ms7	May 20, 2010	10:46:10 PM	00:00:00

Project Info	
Case Title	Cs-137 3 foot water
Description	Cs-137 1 pCi/g sediment 3 foot water shield
Geometry	16 - Infinite Slab

Source Dimensions	
Thickness	100.0 cm (3 ft 3.4 in)

Dose Points			
A	X	Y	Z
#1	291.44 cm (9 ft 6.7 in)	0.0 cm (0.0 in)	0.0 cm (0.0 in)

Shields			
Shield N	Dimension	Material	Density
Source	Infinite	Concrete	1.5
Shield 1	91.44 cm	Water	1
Air Gap		Air	0.00122



Source Input: Grouping Method - Standard Indices Number of Groups: 25 Lower Energy Cutoff: 0.015 Photons < 0.015: Included Library: ICRP-38		
Nuclide	µCi/cm³	Bq/cm³
Ba-137m	1.4190e-006	5.2503e-002
Cs-137	1.5000e-006	5.5500e-002

Buildup: The material reference is Shield 1 Integration Parameters

Results					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	4.665e-04	0.000e+00	0.000e+00	0.000e+00	0.000e+00
0.03	3.179e-03	1.521e-20	4.497e-19	1.507e-22	4.456e-21
0.04	7.554e-04	8.042e-17	9.523e-15	3.557e-19	4.212e-17
0.6	4.714e-02	3.244e-06	1.659e-04	6.332e-09	3.237e-07
Totals	**5.154e-02**	**3.244e-06**	**1.659e-04**	**6.332e-09**	**3.237e-07**

MicroShield 7.02 (05-MSD-7.00-1022)
Battelle
Conversion of calculated exposure in air to dose
FILE: C:\ushield\CaseFiles\Cs-137_03_ft_01_m.ms7
Case Title: Cs-137 3 foot water
This case was run on Thursday, May 20, 2010 at 10:46:10 PM
Dose Point # 1 - (291.44,0,0) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	5.407e-006	2.764e-004
Photon Energy Fluence Rate	MeV/cm²/sec	3.244e-006	1.659e-004
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	6.332e-009	3.237e-007
Absorbed Dose Rate in Air	mGy/hr	5.528e-011	2.826e-009
"	mrad/hr	5.528e-009	2.826e-007
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	6.598e-011	3.374e-009
o Opposed	"	5.216e-011	2.667e-009
o Rotational	"	5.216e-011	2.667e-009
o Isotropic	"	4.613e-011	2.358e-009
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	6.987e-011	3.573e-009
o Opposed	"	6.618e-011	3.383e-009
o Rotational	"	6.618e-011	3.383e-009
o Isotropic	"	4.924e-011	2.518e-009
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	5.820e-011	2.975e-009
o Posterior/Anterior	"	5.099e-011	2.607e-009
o Lateral	"	3.737e-011	1.911e-009
o Rotational	"	4.554e-011	2.329e-009 ←
o Isotropic	"	3.854e-011	1.970e-009

2-Foot Stone Revetment Shielding Cs-137 MicroShield Output

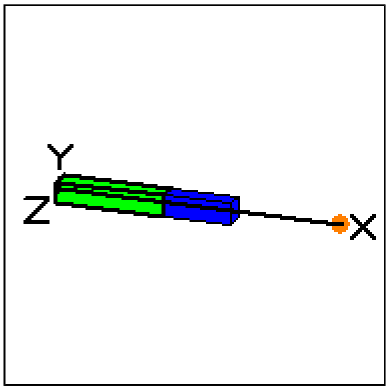
MicroShield 7.02
Battelle (05-MSD-7.00-1022)

Date	By	Checked

Filename	Run Date	Run Time	Duration
Cs-137_02_ft_01_m.ms7	May 20, 2010	10:44:42 PM	-01:59:6

Project Info	
Case Title	Cs-137 2 foot stone
Description	Cs-137 1 pCi/g sediment 2 foot armor stone shield
Geometry	16 - Infinite Slab

Source Dimensions	
Thickness	100.0 cm (3 ft 3.4 in)



Dose Points			
A	X	Y	Z
#1	260.96 cm (8 ft 6.7 in)	0.0 cm (0.0 in)	0.0 cm (0.0 in)

Shields			
Shield N	Dimension	Material	Density
Source	Infinite	Concrete	1.5
Shield 1	60.96 cm	Concrete	2.7
Air Gap		Air	0.00122

Source Input: Grouping Method - Standard Indices
Number of Groups: 25
Lower Energy Cutoff: 0.015
Photons < 0.015: Included
Library: ICRP-38

Nuclide	μCi/cm³	Bq/cm³
Ba-137m	1.4190e-006	5.2503e-002
Cs-137	1.5000e-006	5.5500e-002

Buildup: The material reference is Shield 1
Integration Parameters

Results					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	4.665e-04	0.000e+00	0.000e+00	0.000e+00	0.000e+00
0.03	3.179e-03	0.000e+00	0.000e+00	0.000e+00	0.000e+00
0.04	7.554e-04	4.297e-48	4.297e-48	1.901e-50	1.901e-50
0.6	4.714e-02	1.299e-08	8.174e-07	2.535e-11	1.596e-09
Totals	**5.154e-02**	**1.299e-08**	**8.174e-07**	**2.535e-11**	**1.596e-09**

MicroShield 7.02 (05-MSD-7.00-1022)
Battelle
Conversion of calculated exposure in air to dose
FILE: C:\ushield\CaseFiles\Cs-137_02_ft_01_m.ms7
Case Title: Cs-137 2 foot stone
This case was run on Thursday, May 20, 2010 at 10:44:42 PM
Dose Point # 1 - (260.96,0,0) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	2.165e-008	1.362e-006
Photon Energy Fluence Rate	MeV/cm²/sec	1.299e-008	8.174e-007
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	2.535e-011	1.596e-009
Absorbed Dose Rate in Air	mGy/hr	2.213e-013	1.393e-011
"	mrad/hr	2.213e-011	1.393e-009
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	2.642e-013	1.663e-011
o Opposed	"	2.089e-013	1.314e-011
o Rotational	"	2.089e-013	1.314e-011
o Isotropic	"	1.847e-013	1.162e-011
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	2.798e-013	1.761e-011
o Opposed	"	2.650e-013	1.668e-011
o Rotational	"	2.650e-013	1.668e-011
o Isotropic	"	1.972e-013	1.241e-011
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	2.330e-013	1.466e-011
o Posterior/Anterior	"	2.042e-013	1.285e-011
o Lateral	"	1.496e-013	9.417e-012
o Rotational	"	1.824e-013	1.148e-011 ←
o Isotropic	"	1.543e-013	9.711e-012

Unshielded Sr-90 MicroShield Output

MicroShield 7.02 Battelle (05-MSD-7.00-1022)

Date	By	Checked

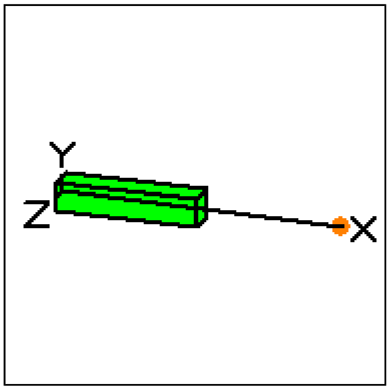
Filename	Run Date	Run Time	Duration
Sr-90_00_ft_01_m.ms7	May 20, 2010	11:06:07 PM	00:00:00

Project Info	
Case Title	Sr-90 1 meter air
Description	Sr-90 1 pCi/g sediment 1 meter air shield
Geometry	16 - Infinite Slab

Source Dimensions	
Thickness	100.0 cm (3 ft 3.4 in)

Dose Points			
A	X	Y	Z
#1	200.0 cm (6 ft 6.7 in)	0.0 cm (0.0 in)	0.0 cm (0.0 in)

Shields			
Shield N	Dimension	Material	Density
Source	Infinite	Concrete	1.5
Air Gap		Air	0.00122



Source Input: Grouping Method - Standard Indices Number of Groups: 25 Lower Energy Cutoff: 0.015 Photons < 0.015: Included Library: ICRP-38		
Nuclide	μCi/cm³	Bq/cm³
Sr-90	1.5000e-006	5.5500e-002
Y-90	1.5000e-006	5.5500e-002

Buildup: The material reference is Source Integration Parameters

Results					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	5.122e-06	1.877e-09	1.907e-09	1.610e-10	1.635e-10
0.02	9.229e-07	1.306e-09	1.363e-09	4.524e-11	4.721e-11
Totals	**6.045e-06**	**3.183e-09**	**3.269e-09**	**2.062e-10**	**2.107e-10**

MicroShield 7.02 (05-MSD-7.00-1022)
Battelle
Conversion of calculated exposure in air to dose
FILE: C:\ushield\CaseFiles\Sr-90_00_ft_01_m.ms7
Case Title: Sr-90 1 meter air
This case was run on Thursday, May 20, 2010 at 11:06:07 PM
Dose Point # 1 - (200,0,0) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	1.904e-007	1.952e-007
Photon Energy Fluence Rate	MeV/cm²/sec	3.183e-009	3.269e-009
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	2.062e-010	2.107e-010
Absorbed Dose Rate in Air	mGy/hr	1.800e-012	1.840e-012
"	mrad/hr	1.800e-010	1.840e-010
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	6.195e-013	6.359e-013
o Opposed	"	3.177e-013	3.263e-013
o Rotational	"	1.886e-013	1.939e-013
o Isotropic	"	1.432e-013	1.474e-013
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.774e-012	1.813e-012
o Opposed	"	9.585e-013	9.805e-013
o Rotational	"	8.974e-013	9.183e-013
o Isotropic	"	8.498e-013	8.689e-013
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.267e-013	1.302e-013
o Posterior/Anterior	"	3.437e-014	3.548e-014
o Lateral	"	2.641e-014	2.714e-014
o Rotational	"	5.784e-014	5.947e-014 ←
o Isotropic	"	4.711e-014	4.845e-014

3-Foot Water Shielding Sr-90 MicroShield Output

MicroShield 7.02
Battelle (05-MSD-7.00-1022)

Date	By	Checked

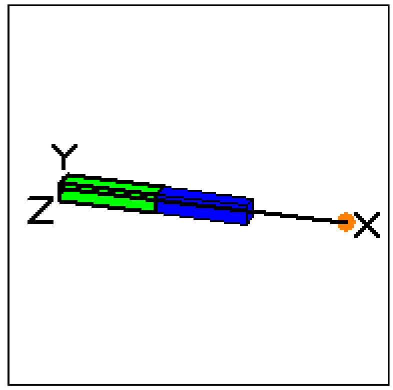
Filename	Run Date	Run Time	Duration
Sr-90_03_ft_01_m.ms7	May 20, 2010	11:08:43 PM	-01:59:6

Project Info	
Case Title	Sr-90 3 foot water
Description	Sr-90 1 pCi/g sediment 3 foot water shield
Geometry	16 - Infinite Slab

Source Dimensions	
Thickness	100.0 cm (3 ft 3.4 in)

Dose Points			
A	X	Y	Z
#1	291.44 cm (9 ft 6.7 in)	0.0 cm (0.0 in)	0.0 cm (0.0 in)

Shields			
Shield N	Dimension	Material	Density
Source	Infinite	Concrete	1.5
Shield 1	91.44 cm	Water	1
Air Gap		Air	0.00122



Source Input: Grouping Method - Standard Indices
Number of Groups: 25
Lower Energy Cutoff: 0.015
Photons < 0.015: Included
Library: ICRP-38

Nuclide	µCi/cm³	Bq/cm³
Sr-90	1.5000e-006	5.5500e-002
Y-90	1.5000e-006	5.5500e-002

Buildup: The material reference is Shield 1
Integration Parameters

Results

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	5.122e-06	0.000e+00	0.000e+00	0.000e+00	0.000e+00
0.02	9.229e-07	3.555e-41	2.418e-40	1.231e-42	8.376e-42
Totals	**6.045e-06**	**3.555e-41**	**2.418e-40**	**1.231e-42**	**8.376e-42**

MicroShield 7.02 (05-MSD-7.00-1022)
Battelle
Conversion of calculated exposure in air to dose
FILE: C:\ushield\CaseFiles\Sr-90_03_ft_01_m.ms7
Case Title: Sr-90 3 foot water
This case was run on Thursday, May 20, 2010 at 11:08:43 PM
Dose Point # 1 - (291.44,0,0) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	1.777e-039	1.209e-038
Photon Energy Fluence Rate	MeV/cm²/sec	3.555e-041	2.418e-040
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.231e-042	8.376e-042
Absorbed Dose Rate in Air	mGy/hr	1.075e-044	7.312e-044
"	mrad/hr	1.075e-042	7.312e-042
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	6.527e-045	4.440e-044
o Opposed	"	3.475e-045	2.363e-044
o Rotational	"	2.278e-045	1.550e-044
o Isotropic	"	1.875e-045	1.275e-044
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.101e-044	7.487e-044
o Opposed	"	6.719e-045	4.570e-044
o Rotational	"	6.527e-045	4.440e-044
o Isotropic	"	5.477e-045	3.726e-044
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.523e-045	1.036e-044
o Posterior/Anterior	"	5.554e-046	3.778e-045
o Lateral	"	3.142e-046	2.137e-045
o Rotational	"	7.039e-046	4.788e-045 ←
o Isotropic	"	5.836e-046	3.970e-045

2-Foot Stone Revetment Shielding Sr-90 MicroShield Output

MicroShield 7.02
Battelle (05-MSD-7.00-1022)

Date	By	Checked

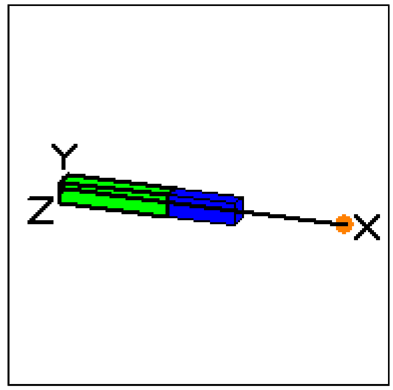
Filename	Run Date	Run Time	Duration
Sr-90_02_ft_01_m.ms7	May 20, 2010	11:07:14 PM	00:00:00

Project Info	
Case Title	Sr-90 2 foot stone
Description	Sr-90 1 pCi/g sediment 2 foot armor stone shield
Geometry	16 - Infinite Slab

Source Dimensions	
Thickness	100.0 cm (3 ft 3.4 in)

Dose Points			
A	X	Y	Z
#1	260.96 cm (8 ft 6.7 in)	0.0 cm (0.0 in)	0.0 cm (0.0 in)

Shields			
Shield N	Dimension	Material	Density
Source	Infinite	Concrete	1.5
Shield 1	60.96 cm	Concrete	2.7
Air Gap		Air	0.00122



Source Input: Grouping Method - Standard Indices
Number of Groups: 25
Lower Energy Cutoff: 0.015
Photons < 0.015: Included
Library: ICRP-38

Nuclide	µCi/cm³	Bq/cm³
Sr-90	1.5000e-006	5.5500e-002
Y-90	1.5000e-006	5.5500e-002

Buildup: The material reference is Shield 1
Integration Parameters

Results

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	5.122e-06	0.000e+00	0.000e+00	0.000e+00	0.000e+00
0.02	9.229e-07	0.000e+00	0.000e+00	0.000e+00	0.000e+00
Totals	**6.045e-06**	**0.000e+00**	**0.000e+00**	**0.000e+00**	**0.000e+00**

MicroShield 7.02 (05-MSD-7.00-1022)
Battelle
Conversion of calculated exposure in air to dose
FILE: C:\ushield\CaseFiles\Sr-90_02_ft_01_m.ms7
Case Title: Sr-90 2 foot stone
This case was run on Thursday, May 20, 2010 at 11:07:14 PM
Dose Point # 1 - (260.96,0,0) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	0.000e+000	0.000e+000
Photon Energy Fluence Rate	MeV/cm²/sec	0.000e+000	0.000e+000
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	0.000e+000	0.000e+000
Absorbed Dose Rate in Air	mGy/hr	0.000e+000	0.000e+000
"	mrad/hr	0.000e+000	0.000e+000
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	0.000e+000	0.000e+000
o Opposed	"	0.000e+000	0.000e+000
o Rotational	"	0.000e+000	0.000e+000
o Isotropic	"	0.000e+000	0.000e+000
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	0.000e+000	0.000e+000
o Opposed	"	0.000e+000	0.000e+000
o Rotational	"	0.000e+000	0.000e+000
o Isotropic	"	0.000e+000	0.000e+000
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	0.000e+000	0.000e+000
o Posterior/Anterior	"	0.000e+000	0.000e+000
o Lateral	"	0.000e+000	0.000e+000
o Rotational	"	0.000e+000	0.000e+000 ←
o Isotropic	"	0.000e+000	0.000e+000

Unshielded U-235 MicroShield Output

MicroShield 7.02 Battelle (05-MSD-7.00-1022)

Date	By	Checked

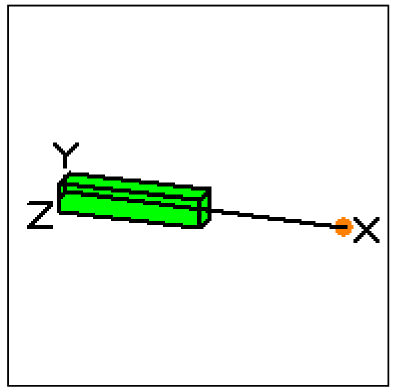
Filename	Run Date	Run Time	Duration
U-235_00_ft_01_m.ms7	May 20, 2010	11:10:42 PM	00:00:00

Project Info	
Case Title	U-235 1 meter air
Description	U-235 1 pCi/g sediment 1 meter air shield
Geometry	16 - Infinite Slab

Source Dimensions	
Thickness	100.0 cm (3 ft 3.4 in)

Dose Points			
A	X	Y	Z
#1	200.0 cm (6 ft 6.7 in)	0.0 cm (0.0 in)	0.0 cm (0.0 in)

Shields			
Shield N	Dimension	Material	Density
Source	Infinite	Concrete	1.5
Air Gap		Air	0.00122



Source Input: Grouping Method - Standard Indices Number of Groups: 25 Lower Energy Cutoff: 0.015 Photons < 0.015: Included Library: ICRP-38		
Nuclide	μCi/cm^3	Bq/cm^3
Th-231	1.5000e-006	5.5500e-002
U-235	1.5000e-006	5.5500e-002

Buildup: The material reference is Source Integration Parameters

Results					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm^2/sec No Buildup	Fluence Rate MeV/cm^2/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	4.927e-02	1.805e-05	1.834e-05	1.548e-06	1.573e-06
0.02	6.255e-03	8.853e-06	9.237e-06	3.067e-07	3.200e-07
0.03	8.223e-03	6.153e-05	7.208e-05	6.098e-07	7.144e-07
0.04	7.132e-05	1.484e-06	2.126e-06	6.565e-09	9.403e-09
0.05	6.839e-05	2.812e-06	4.701e-06	7.490e-09	1.252e-08
0.06	3.055e-04	2.018e-05	4.324e-05	4.009e-08	8.589e-08
0.08	6.958e-03	8.477e-04	2.196e-03	1.341e-06	3.476e-06
0.1	6.648e-03	1.196e-03	3.892e-03	1.830e-06	5.955e-06

0.15	8.785e-03	2.911e-03	1.186e-02	4.793e-06	1.952e-05
0.2	3.393e-02	1.685e-02	7.125e-02	2.975e-05	1.258e-04
0.3	7.344e-05	6.426e-05	2.622e-04	1.219e-07	4.974e-07
0.4	4.832e-05	6.349e-05	2.393e-04	1.237e-07	4.663e-07
0.5	4.662e-06	8.433e-06	2.949e-05	1.655e-08	5.788e-08
0.8	5.550e-07	1.996e-06	5.689e-06	3.796e-09	1.082e-08
Totals	**1.206e-01**	**2.206e-02**	**8.988e-02**	**4.050e-05**	**1.585e-04**

MicroShield 7.02 (05-MSD-7.00-1022)
Battelle
Conversion of calculated exposure in air to dose
FILE: C:\ushield\CaseFiles\U-235_00_ft_01_m.ms7
Case Title: U-235 1 meter air
This case was run on Thursday, May 20, 2010 at 11:10:42 PM
Dose Point # 1 - (200,0,0) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	1.308e-001	5.082e-001
Photon Energy Fluence Rate	MeV/cm²/sec	2.206e-002	8.988e-002
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	4.050e-005	1.585e-004
Absorbed Dose Rate in Air	mGy/hr	3.535e-007	1.383e-006
"	mrad/hr	3.535e-005	1.383e-004
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	4.854e-007	1.945e-006
o Opposed	"	3.041e-007	1.229e-006
o Rotational	"	3.022e-007	1.226e-006
o Isotropic	"	2.789e-007	1.130e-006
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	4.963e-007	1.956e-006
o Opposed	"	4.296e-007	1.721e-006
o Rotational	"	4.291e-007	1.720e-006
o Isotropic	"	3.068e-007	1.223e-006
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	4.136e-007	1.676e-006
o Posterior/Anterior	"	3.348e-007	1.364e-006
o Lateral	"	2.185e-007	8.915e-007
o Rotational	"	2.896e-007	1.179e-006 ←
o Isotropic	"	2.377e-007	9.677e-007

3-Foot Water Shielding U-235 MicroShield Output

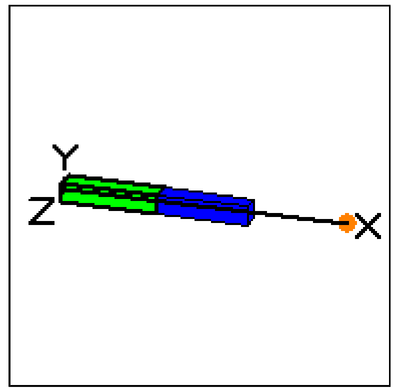
MicroShield 7.02
Battelle (05-MSD-7.00-1022)

Date	By	Checked

Filename	Run Date	Run Time	Duration
U-235_03_ft_01_m.ms7	May 20, 2010	11:13:08 PM	00:00:00

Project Info	
Case Title	U-235 3 foot water
Description	U-235 1 pCi/g sediment 3 foot water shield
Geometry	16 - Infinite Slab

Source Dimensions	
Thickness	100.0 cm (3 ft 3.4 in)



Dose Points			
A	X	Y	Z
#1	291.44 cm (9 ft 6.7 in)	0.0 cm (0.0 in)	0.0 cm (0.0 in)

Shields			
Shield N	Dimension	Material	Density
Source	Infinite	Concrete	1.5
Shield 1	91.44 cm	Water	1
Air Gap		Air	0.00122

Source Input: Grouping Method - Standard Indices
Number of Groups: 25
Lower Energy Cutoff: 0.015
Photons < 0.015: Included
Library: ICRP-38

Nuclide	μCi/cm³	Bq/cm³
Th-231	1.5000e-006	5.5500e-002
U-235	1.5000e-006	5.5500e-002

Buildup: The material reference is Shield 1
Integration Parameters

Results

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	4.927e-02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
0.02	6.255e-03	2.409e-37	1.639e-36	8.346e-39	5.677e-38
0.03	8.223e-03	3.933e-20	1.163e-18	3.898e-22	1.153e-20
0.04	7.132e-05	7.593e-18	8.991e-16	3.358e-20	3.977e-18
0.05	6.839e-05	4.130e-16	1.562e-13	1.100e-18	4.160e-16
0.06	3.055e-04	1.593e-14	1.151e-11	3.165e-17	2.285e-14
0.08	6.958e-03	4.026e-12	5.310e-09	6.371e-15	8.403e-12

0.1	6.648e-03	1.670e-11	2.325e-08	2.555e-14	3.557e-11
0.15	8.785e-03	2.412e-10	2.043e-07	3.971e-13	3.364e-10
0.2	3.393e-02	4.900e-09	2.654e-06	8.648e-12	4.685e-09
0.3	7.344e-05	1.068e-10	2.358e-08	2.026e-13	4.474e-11
0.4	4.832e-05	3.591e-10	4.143e-08	6.996e-13	8.071e-11
0.5	4.662e-06	1.194e-10	8.592e-09	2.344e-13	1.687e-11
0.8	5.550e-07	1.745e-10	5.191e-09	3.320e-13	9.874e-12
Totals	**1.206e-01**	**5.922e-09**	**2.966e-06**	**1.055e-11**	**5.218e-09**

MicroShield 7.02 (05-MSD-7.00-1022)
Battelle
Conversion of calculated exposure in air to dose
FILE: C:\ushield\CaseFiles\U-235_03_ft_01_m.ms7
Case Title: U-235 3 foot water
This case was run on Thursday, May 20, 2010 at 11:13:08 PM
Dose Point # 1 - (291.44,0,0) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	2.804e-008	1.514e-005
Photon Energy Fluence Rate	MeV/cm²/sec	5.922e-009	2.966e-006
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.055e-011	5.218e-009
Absorbed Dose Rate in Air	mGy/hr	9.207e-014	4.555e-011
"	mrad/hr	9.207e-012	4.555e-009
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.265e-013	6.356e-011
o Opposed	"	8.304e-014	4.088e-011
o Rotational	"	8.303e-014	4.088e-011
o Isotropic	"	7.582e-014	3.750e-011
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.271e-013	6.361e-011
o Opposed	"	1.148e-013	5.698e-011
o Rotational	"	1.148e-013	5.698e-011
o Isotropic	"	8.155e-014	4.036e-011
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.096e-013	5.503e-011
o Posterior/Anterior	"	9.030e-014	4.506e-011
o Lateral	"	6.016e-014	2.969e-011
o Rotational	"	7.840e-014	3.901e-011 ←
o Isotropic	"	6.473e-014	3.211e-011

2-Foot Stone Revetment Shielding U-235 MicroShield Output

MicroShield 7.02
Battelle (05-MSD-7.00-1022)

Date	By	Checked

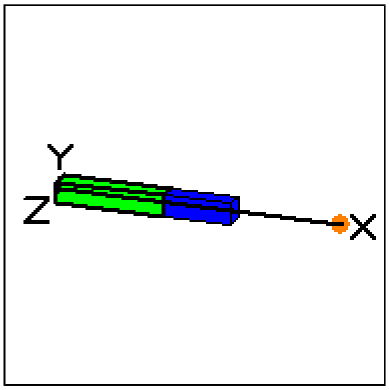
Filename	Run Date	Run Time	Duration
U-235_02_ft_01_m.ms7	May 20, 2010	11:11:46 PM	00:00:00

Project Info	
Case Title	U-235 2 foot stone
Description	U-235 1 pCi/g sediment 2 foot armor stone shield
Geometry	16 - Infinite Slab

Source Dimensions	
Thickness	100.0 cm (3 ft 3.4 in)

Dose Points			
A	X	Y	Z
#1	260.96 cm (8 ft 6.7 in)	0.0 cm (0.0 in)	0.0 cm (0.0 in)

Shields			
Shield N	Dimension	Material	Density
Source	Infinite	Concrete	1.5
Shield 1	60.96 cm	Concrete	2.7
Air Gap		Air	0.00122



Source Input: Grouping Method - Standard Indices
Number of Groups: 25
Lower Energy Cutoff: 0.015
Photons < 0.015: Included
Library: ICRP-38

Nuclide	µCi/cm³	Bq/cm³
Th-231	1.5000e-006	5.5500e-002
U-235	1.5000e-006	5.5500e-002

Buildup: The material reference is Shield 1
Integration Parameters

Results

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	4.927e-02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
0.02	6.255e-03	0.000e+00	0.000e+00	0.000e+00	0.000e+00
0.03	8.223e-03	0.000e+00	0.000e+00	0.000e+00	0.000e+00
0.04	7.132e-05	4.058e-49	4.058e-49	1.795e-51	1.795e-51
0.05	6.839e-05	4.070e-34	6.927e-33	1.084e-36	1.845e-35
0.06	3.055e-04	1.083e-26	4.312e-25	2.152e-29	8.565e-28
0.08	6.958e-03	1.293e-19	8.553e-18	2.046e-22	1.353e-20

0.1	6.648e-03	2.900e-17	3.842e-15	4.437e-20	5.878e-18
0.15	8.785e-03	1.275e-14	3.069e-12	2.100e-17	5.054e-15
0.2	3.393e-02	9.362e-13	2.428e-10	1.652e-15	4.285e-13
0.3	7.344e-05	7.513e-14	1.388e-11	1.425e-16	2.633e-14
0.4	4.832e-05	5.417e-13	6.500e-11	1.056e-15	1.266e-13
0.5	4.662e-06	3.124e-13	2.649e-11	6.132e-16	5.199e-14
0.8	5.550e-07	1.319e-12	5.141e-11	2.508e-15	9.779e-14
Totals	**1.206e-01**	**3.197e-12**	**4.027e-10**	**5.993e-15**	**7.363e-13**

MicroShield 7.02 (05-MSD-7.00-1022)
Battelle
Conversion of calculated exposure in air to dose
FILE: C:\ushield\CaseFiles\U-235_02_ft_01_m.ms7
Case Title: U-235 2 foot stone
This case was run on Thursday, May 20, 2010 at 11:11:46 PM
Dose Point # 1 - (260.96,0,0) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	8.644e-012	1.560e-009
Photon Energy Fluence Rate	MeV/cm²/sec	3.197e-012	4.027e-010
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	5.993e-015	7.363e-013
Absorbed Dose Rate in Air	mGy/hr	5.232e-017	6.428e-015
"	mrad/hr	5.232e-015	6.428e-013
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	6.558e-017	8.506e-015
o Opposed	"	4.878e-017	5.875e-015
o Rotational	"	4.878e-017	5.875e-015
o Isotropic	"	4.358e-017	5.310e-015
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	6.812e-017	8.658e-015
o Opposed	"	6.363e-017	7.939e-015
o Rotational	"	6.363e-017	7.939e-015
o Isotropic	"	4.671e-017	5.702e-015
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	5.749e-017	7.394e-015
o Posterior/Anterior	"	4.947e-017	6.194e-015
o Lateral	"	3.534e-017	4.240e-015
o Rotational	"	4.369e-017	5.415e-015
o Isotropic	"	3.683e-017	4.505e-015

Unshielded Ra-226 MicroShield Output

MicroShield 7.02
Battelle (05-MSD-7.00-1022)

Date	By	Checked

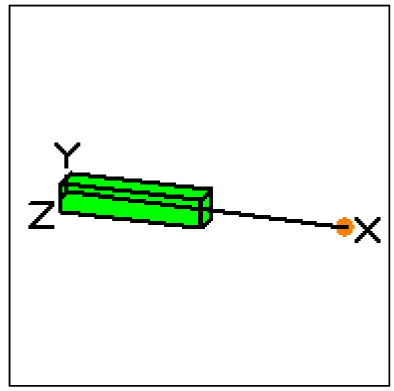
Filename	Run Date	Run Time	Duration
Ra-226_00_ft_01_m.ms7	May 20, 2010	10:57:03 PM	00:00:00

Project Info	
Case Title	Ra-226 1 meter air
Description	Ra-226 1 pCi/g sediment 1 meter air shield
Geometry	16 - Infinite Slab

Source Dimensions	
Thickness	100.0 cm (3 ft 3.4 in)

Dose Points			
A	X	Y	Z
#1	200.0 cm (6 ft 6.7 in)	0.0 cm (0.0 in)	0.0 cm (0.0 in)

Shields			
Shield N	Dimension	Material	Density
Source	Infinite	Concrete	1.5
Air Gap		Air	0.00122



Source Input: Grouping Method - Standard Indices
Number of Groups: 25
Lower Energy Cutoff: 0.015
Photons < 0.015: Included
Library: ICRP-38

Nuclide	μCi/cm³	Bq/cm³
At-218	3.0000e-010	1.1100e-005
Bi-214	1.5000e-006	5.5500e-002
Pb-214	1.5000e-006	5.5500e-002
Po-214	1.5000e-006	5.5500e-002
Po-218	1.5000e-006	5.5500e-002
Ra-226	1.5000e-006	5.5500e-002
Rn-222	1.5000e-006	5.5500e-002

Buildup: The material reference is Source
Integration Parameters

Results

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	8.111e-03	2.972e-06	3.019e-06	2.549e-07	2.589e-07
0.05	6.118e-04	2.515e-05	4.206e-05	6.701e-08	1.120e-07
0.08	1.352e-02	1.647e-03	4.267e-03	2.606e-06	6.752e-06

0.1	1.374e-04	2.471e-05	8.042e-05	3.780e-08	1.230e-07
0.15	5.456e-05	1.807e-05	7.363e-05	2.976e-08	1.212e-07
0.2	6.005e-03	2.983e-03	1.261e-02	5.265e-06	2.226e-05
0.3	1.152e-02	1.008e-02	4.115e-02	1.913e-05	7.806e-05
0.4	2.120e-02	2.785e-02	1.050e-01	5.426e-05	2.046e-04
0.5	1.157e-03	2.092e-03	7.316e-03	4.106e-06	1.436e-05
0.6	2.695e-02	6.348e-02	2.066e-01	1.239e-04	4.033e-04
0.8	5.433e-03	1.953e-02	5.569e-02	3.716e-05	1.059e-04
1.0	1.569e-02	7.875e-02	2.039e-01	1.452e-04	3.759e-04
1.5	1.070e-02	9.958e-02	2.149e-01	1.675e-04	3.615e-04
2.0	1.533e-02	2.215e-01	4.349e-01	3.426e-04	6.725e-04
3.0	9.446e-05	2.523e-03	4.416e-03	3.423e-06	5.991e-06
Totals	**1.365e-01**	**5.301e-01**	**1.291e+00**	**9.055e-04**	**2.252e-03**

MicroShield 7.02 (05-MSD-7.00-1022)
Battelle
Conversion of calculated exposure in air to dose
FILE: C:\ushield\CaseFiles\Ra-226_00_ft_01_m.ms7
Case Title: Ra-226 1 meter air
This case was run on Thursday, May 20, 2010 at 10:57:03 PM
Dose Point # 1 - (200,0,0) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	5.310e-001	1.513e+000
Photon Energy Fluence Rate	MeV/cm²/sec	5.301e-001	1.291e+000
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	9.055e-004	2.252e-003
Absorbed Dose Rate in Air	mGy/hr	7.905e-006	1.966e-005
"	mrad/hr	7.905e-004	1.966e-003
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	9.158e-006	2.298e-005
o Opposed	"	7.751e-006	1.913e-005
o Rotational	"	7.750e-006	1.913e-005
o Isotropic	"	6.938e-006	1.710e-005
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	9.635e-006	2.417e-005
o Opposed	"	9.257e-006	2.315e-005
o Rotational	"	9.257e-006	2.315e-005
o Isotropic	"	7.307e-006	1.806e-005
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	8.190e-006	2.049e-005
o Posterior/Anterior	"	7.479e-006	1.854e-005
o Lateral	"	5.916e-006	1.445e-005
o Rotational	"	6.737e-006	1.666e-005
o Isotropic	"	5.937e-006	1.458e-005

3-Foot Water Shielding Ra-226 MicroShield Output

MicroShield 7.02
Battelle (05-MSD-7.00-1022)

Date	By	Checked

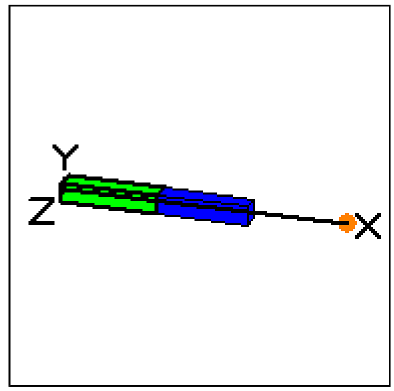
Filename	Run Date	Run Time	Duration
Ra-226_03_ft_01_m.ms7	May 20, 2010	10:59:26 PM	00:00:00

Project Info	
Case Title	Ra-226 3 foot water
Description	Ra-226 1 pCi/g sediment 3 foot water shield
Geometry	16 - Infinite Slab

Source Dimensions	
Thickness	100.0 cm (3 ft 3.4 in)

Dose Points			
A	X	Y	Z
#1	291.44 cm (9 ft 6.7 in)	0.0 cm (0.0 in)	0.0 cm (0.0 in)

Shields			
Shield N	Dimension	Material	Density
Source	Infinite	Concrete	1.5
Shield 1	91.44 cm	Water	1
Air Gap		Air	0.00122



Source Input: Grouping Method - Standard Indices
Number of Groups: 25
Lower Energy Cutoff: 0.015
Photons < 0.015: Included
Library: ICRP-38

Nuclide	$\mu Ci/cm^3$	Bq/cm^3
At-218	3.0000e-010	1.1100e-005
Bi-214	1.5000e-006	5.5500e-002
Pb-214	1.5000e-006	5.5500e-002
Po-214	1.5000e-006	5.5500e-002
Po-218	1.5000e-006	5.5500e-002
Ra-226	1.5000e-006	5.5500e-002
Rn-222	1.5000e-006	5.5500e-002

Buildup: The material reference is Shield 1
Integration Parameters

Results					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm^2/sec No Buildup	Fluence Rate MeV/cm^2/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	8.111e-03	0.000e+00	0.000e+00	0.000e+00	0.000e+00
0.05	6.118e-04	3.694e-15	1.397e-12	9.841e-18	3.721e-15

0.08	1.352e-02	7.822e-12	1.032e-08	1.238e-14	1.633e-11
0.1	1.374e-04	3.451e-13	4.805e-10	5.280e-16	7.351e-13
0.15	5.456e-05	1.498e-12	1.269e-09	2.466e-15	2.089e-12
0.2	6.005e-03	8.673e-10	4.698e-07	1.531e-12	8.292e-10
0.3	1.152e-02	1.676e-08	3.701e-06	3.180e-11	7.020e-09
0.4	2.120e-02	1.575e-07	1.817e-05	3.069e-10	3.540e-08
0.5	1.157e-03	2.962e-08	2.132e-06	5.814e-11	4.184e-09
0.6	2.695e-02	1.855e-06	9.483e-05	3.620e-09	1.851e-07
0.8	5.433e-03	1.709e-06	5.082e-05	3.250e-09	9.665e-08
1.0	1.569e-02	1.547e-05	3.201e-04	2.851e-08	5.900e-07
1.5	1.070e-02	7.610e-05	8.527e-04	1.280e-07	1.435e-06
2.0	1.533e-02	3.991e-04	3.110e-03	6.172e-07	4.810e-06
3.0	9.446e-05	1.289e-05	6.651e-05	1.749e-08	9.023e-08
Totals	**1.365e-01**	**5.074e-04**	**4.520e-03**	**7.985e-07**	**7.254e-06**

MicroShield 7.02 (05-MSD-7.00-1022)
Battelle
Conversion of calculated exposure in air to dose
FILE: C:\ushield\CaseFiles\Ra-226_03_ft_01_m.ms7
Case Title: Ra-226 3 foot water
This case was run on Thursday, May 20, 2010 at 10:59:26 PM
Dose Point # 1 - (291.44,0,0) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	2.758e-004	2.752e-003
Photon Energy Fluence Rate	MeV/cm²/sec	5.074e-004	4.520e-003
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	7.985e-007	7.254e-006
Absorbed Dose Rate in Air	mGy/hr	6.971e-009	6.333e-008
"	mrad/hr	6.971e-007	6.333e-006
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	7.889e-009	7.187e-008
o Opposed	"	7.015e-009	6.338e-008
o Rotational	"	7.015e-009	6.338e-008
o Isotropic	"	6.323e-009	5.702e-008
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	8.258e-009	7.541e-008
o Opposed	"	8.029e-009	7.316e-008
o Rotational	"	8.029e-009	7.316e-008
o Isotropic	"	6.584e-009	5.954e-008
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	7.123e-009	6.480e-008
o Posterior/Anterior	"	6.681e-009	6.049e-008
o Lateral	"	5.537e-009	4.968e-008
o Rotational	"	6.069e-009	5.486e-008 ←
o Isotropic	"	5.469e-009	4.921e-008

2-Foot Stone Revetment Shielding Ra-226 MicroShield Output

MicroShield 7.02
Battelle (05-MSD-7.00-1022)

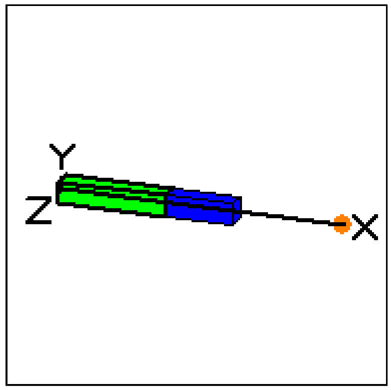
Date	By	Checked

Filename	Run Date	Run Time	Duration
Ra-226_02_ft_01_m.ms7	May 20, 2010	10:58:22 PM	00:00:00

Project Info	
Case Title	Ra-226 2 foot stone
Description	Ra-226 1 pCi/g sediment 2 foot armor stone shield
Geometry	16 - Infinite Slab

Source Dimensions	
Thickness	100.0 cm (3 ft 3.4 in)

Dose Points			
A	X	Y	Z
#1	260.96 cm (8 ft 6.7 in)	0.0 cm (0.0 in)	0.0 cm (0.0 in)



Shields			
Shield N	Dimension	Material	Density
Source	Infinite	Concrete	1.5
Shield 1	60.96 cm	Concrete	2.7
Air Gap		Air	0.00122

Source Input: Grouping Method - Standard Indices
Number of Groups: 25
Lower Energy Cutoff: 0.015
Photons < 0.015: Included
Library: ICRP-38

Nuclide	μCi/cm³	Bq/cm³
At-218	3.0000e-010	1.1100e-005
Bi-214	1.5000e-006	5.5500e-002
Pb-214	1.5000e-006	5.5500e-002
Po-214	1.5000e-006	5.5500e-002
Po-218	1.5000e-006	5.5500e-002
Ra-226	1.5000e-006	5.5500e-002
Rn-222	1.5000e-006	5.5500e-002

Buildup: The material reference is Shield 1
Integration Parameters

Results

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	8.111e-03	0.000e+00	0.000e+00	0.000e+00	0.000e+00
0.05	6.118e-04	3.641e-33	6.196e-32	9.699e-36	1.651e-34

0.08	1.352e-02	2.512e-19	1.662e-17	3.975e-22	2.630e-20
0.1	1.374e-04	5.992e-19	7.939e-17	9.167e-22	1.215e-19
0.15	5.456e-05	7.919e-17	1.906e-14	1.304e-19	3.138e-17
0.2	6.005e-03	1.657e-13	4.297e-11	2.925e-16	7.585e-14
0.3	1.152e-02	1.179e-11	2.178e-09	2.237e-14	4.132e-12
0.4	2.120e-02	2.376e-10	2.851e-08	4.630e-13	5.555e-11
0.5	1.157e-03	7.751e-11	6.571e-09	1.521e-13	1.290e-11
0.6	2.695e-02	7.427e-09	4.674e-07	1.450e-11	9.123e-10
0.8	5.433e-03	1.291e-08	5.033e-07	2.455e-11	9.573e-10
1.0	1.569e-02	1.852e-07	5.037e-06	3.413e-10	9.285e-09
1.5	1.070e-02	1.935e-06	2.879e-05	3.256e-09	4.843e-08
2.0	1.533e-02	1.573e-05	1.655e-04	2.432e-08	2.559e-07
3.0	9.446e-05	8.175e-07	5.672e-06	1.109e-09	7.696e-09
Totals	**1.365e-01**	**1.869e-05**	**2.060e-04**	**2.907e-08**	**3.233e-07**

MicroShield 7.02 (05-MSD-7.00-1022)
Battelle
Conversion of calculated exposure in air to dose
FILE: C:\ushield\CaseFiles\Ra-226_02_ft_01_m.ms7
Case Title: Ra-226 2 foot stone
This case was run on Thursday, May 20, 2010 at 10:58:22 PM
Dose Point # 1 - (260.96,0,0) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	9.642e-006	1.104e-004
Photon Energy Fluence Rate	MeV/cm²/sec	1.869e-005	2.060e-004
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	2.907e-008	3.233e-007
Absorbed Dose Rate in Air	mGy/hr	2.538e-010	2.822e-009
"	mrad/hr	2.538e-008	2.822e-007
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	2.870e-010	3.193e-009
o Opposed	"	2.561e-010	2.842e-009
o Rotational	"	2.561e-010	2.842e-009
o Isotropic	"	2.311e-010	2.562e-009
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	2.999e-010	3.341e-009
o Opposed	"	2.919e-010	3.249e-009
o Rotational	"	2.919e-010	3.249e-009
o Isotropic	"	2.403e-010	2.667e-009
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	2.593e-010	2.883e-009
o Posterior/Anterior	"	2.437e-010	2.706e-009
o Lateral	"	2.029e-010	2.245e-009
o Rotational	"	2.216e-010	2.459e-009 ←
o Isotropic	"	2.001e-010	2.217e-009

Unshielded Pu-239 MicroShield Output

MicroShield 7.02
Battelle (05-MSD-7.00-1022)

Date	By	Checked

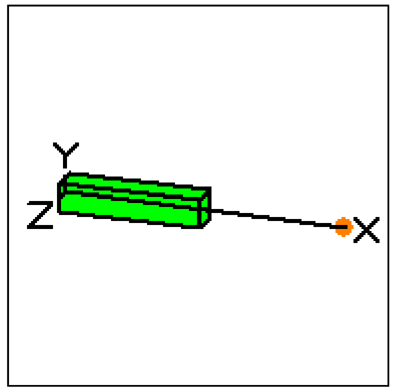
Filename	Run Date	Run Time	Duration
Pu-239_00_ft_01_m.ms7	May 20, 2010	10:48:00 PM	00:00:00

Project Info	
Case Title	Pu-239 1 meter air
Description	Pu-239 1 pCi/g sediment 1 meter air shield
Geometry	16 - Infinite Slab

Source Dimensions	
Thickness	100.0 cm (3 ft 3.4 in)

Dose Points			
A	X	Y	Z
#1	200.0 cm (6 ft 6.7 in)	0.0 cm (0.0 in)	0.0 cm (0.0 in)

Shields			
Shield N	Dimension	Material	Density
Source	Infinite	Concrete	1.5
Air Gap		Air	0.00122



Source Input: Grouping Method - Standard Indices
Number of Groups: 25
Lower Energy Cutoff: 0.015
Photons < 0.015: Included
Library: ICRP-38

Nuclide	μCi/cm^3	Bq/cm^3
Pu-239	1.5000e-006	5.5500e-002

Buildup: The material reference is Source
Integration Parameters

Results					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm^2/sec No Buildup	Fluence Rate MeV/cm^2/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	5.749e-02	2.106e-05	2.140e-05	1.806e-06	1.835e-06
0.02	2.696e-04	3.816e-07	3.982e-07	1.322e-08	1.379e-08
0.03	5.828e-08	4.361e-10	5.108e-10	4.322e-12	5.063e-12
0.04	3.308e-06	6.884e-08	9.860e-08	3.045e-10	4.361e-10
0.05	1.194e-05	4.908e-07	8.206e-07	1.307e-09	2.186e-09
0.06	9.463e-07	6.251e-08	1.339e-07	1.242e-10	2.660e-10
0.08	3.663e-07	4.462e-08	1.156e-07	7.062e-11	1.830e-10
0.1	6.185e-06	1.113e-06	3.621e-06	1.702e-09	5.540e-09
0.15	3.859e-06	1.279e-06	5.208e-06	2.105e-09	8.577e-09

0.2	4.996e-07	2.482e-07	1.049e-06	4.381e-10	1.852e-09
0.3	9.052e-07	7.921e-07	3.232e-06	1.503e-09	6.131e-09
0.4	2.689e-06	3.533e-06	1.332e-05	6.885e-09	2.595e-08
0.5	1.121e-07	2.028e-07	7.091e-07	3.980e-10	1.392e-09
0.6	3.752e-08	8.837e-08	2.876e-07	1.725e-10	5.614e-10
0.8	1.316e-08	4.733e-08	1.349e-07	9.003e-11	2.566e-10
1.0	1.182e-10	5.935e-10	1.537e-09	1.094e-12	2.832e-12
Totals	**5.779e-02**	**2.941e-05**	**5.053e-05**	**1.835e-06**	**1.902e-06**

MicroShield 7.02 (05-MSD-7.00-1022)
Battelle
Conversion of calculated exposure in air to dose
FILE: C:\ushield\CaseFiles\Pu-239_00_ft_01_m.ms7
Case Title: Pu-239 1 meter air
This case was run on Thursday, May 20, 2010 at 10:48:00 PM
Dose Point # 1 - (200,0,0) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	1.469e-003	1.591e-003
Photon Energy Fluence Rate	MeV/cm²/sec	2.941e-005	5.053e-005
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.835e-006	1.902e-006
Absorbed Dose Rate in Air	mGy/hr	1.602e-008	1.661e-008
"	mrad/hr	1.602e-006	1.661e-006
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	4.514e-009	5.040e-009
o Opposed	"	2.291e-009	2.633e-009
o Rotational	"	1.322e-009	1.648e-009
o Isotropic	"	9.631e-010	1.255e-009
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.567e-008	1.638e-008
o Opposed	"	8.220e-009	8.765e-009
o Rotational	"	7.612e-009	8.146e-009
o Isotropic	"	7.454e-009	7.870e-009
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	9.644e-010	1.369e-009
o Posterior/Anterior	"	2.883e-010	6.145e-010
o Lateral	"	2.541e-010	4.754e-010
o Rotational	"	4.758e-010	7.639e-010 ←
o Isotropic	"	3.848e-010	6.231e-010

3-Foot Water Shielding Pu-239 MicroShield Output

MicroShield 7.02
Battelle (05-MSD-7.00-1022)

Date	By	Checked

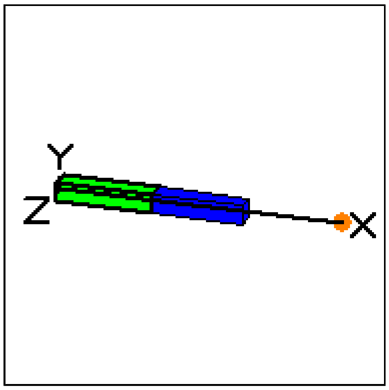
Filename	Run Date	Run Time	Duration
Pu-239_03_ft_01_m.ms7	May 20, 2010	10:51:39 PM	00:00:00

Project Info	
Case Title	Pu-239 3 foot water
Description	Pu-239 1 pCi/g sediment 3 foot water shield
Geometry	16 - Infinite Slab

Source Dimensions	
Thickness	100.0 cm (3 ft 3.4 in)

Dose Points			
A	X	Y	Z
#1	291.44 cm (9 ft 6.7 in)	0.0 cm (0.0 in)	0.0 cm (0.0 in)

Shields			
Shield N	Dimension	Material	Density
Source	Infinite	Concrete	1.5
Shield 1	91.44 cm	Water	1
Air Gap		Air	0.00122



Source Input: Grouping Method - Standard Indices
Number of Groups: 25
Lower Energy Cutoff: 0.015
Photons < 0.015: Included
Library: ICRP-38

Nuclide	µCi/cm³	Bq/cm³
Pu-239	1.5000e-006	5.5500e-002

Buildup: The material reference is Shield 1
Integration Parameters

Results

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	5.749e-02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
0.02	2.696e-04	1.039e-38	7.065e-38	3.598e-40	2.447e-39
0.03	5.828e-08	2.787e-25	8.242e-24	2.762e-27	8.169e-26
0.04	3.308e-06	3.522e-19	4.170e-17	1.557e-21	1.844e-19
0.05	1.194e-05	7.209e-17	2.726e-14	1.920e-19	7.261e-17
0.06	9.463e-07	4.935e-17	3.564e-14	9.802e-20	7.078e-17
0.08	3.663e-07	2.119e-16	2.795e-13	3.354e-19	4.423e-16
0.1	6.185e-06	1.554e-14	2.163e-11	2.377e-17	3.309e-14

0.15	3.859e-06	1.059e-13	8.974e-11	1.745e-16	1.478e-13
0.2	4.996e-07	7.216e-14	3.909e-11	1.274e-16	6.899e-14
0.3	9.052e-07	1.317e-12	2.907e-10	2.498e-15	5.514e-13
0.4	2.689e-06	1.998e-11	2.305e-09	3.893e-14	4.492e-12
0.5	1.121e-07	2.871e-12	2.066e-10	5.636e-15	4.056e-13
0.6	3.752e-08	2.582e-12	1.320e-10	5.040e-15	2.577e-13
0.8	1.316e-08	4.140e-12	1.231e-10	7.874e-15	2.342e-13
1.0	1.182e-10	1.166e-13	2.412e-12	2.148e-16	4.446e-15
Totals	**5.779e-02**	**3.120e-11**	**3.211e-09**	**6.052e-14**	**6.196e-12**

MicroShield 7.02 (05-MSD-7.00-1022)
Battelle
Conversion of calculated exposure in air to dose
FILE: C:\ushield\CaseFiles\Pu-239_03_ft_01_m.ms7
Case Title: Pu-239 3 foot water
This case was run on Thursday, May 20, 2010 at 10:51:39 PM
Dose Point # 1 - (291.44,0,0) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	7.091e-011	8.537e-009
Photon Energy Fluence Rate	MeV/cm²/sec	3.120e-011	3.211e-009
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	6.052e-014	6.196e-012
Absorbed Dose Rate in Air	mGy/hr	5.284e-016	5.409e-014
"	mrad/hr	5.284e-014	5.409e-012
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	6.553e-016	6.836e-014
o Opposed	"	4.943e-016	5.035e-014
o Rotational	"	4.943e-016	5.035e-014
o Isotropic	"	4.381e-016	4.475e-014
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	6.823e-016	7.070e-014
o Opposed	"	6.440e-016	6.635e-014
o Rotational	"	6.440e-016	6.635e-014
o Isotropic	"	4.687e-016	4.789e-014
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	5.708e-016	5.931e-014
o Posterior/Anterior	"	4.917e-016	5.060e-014
o Lateral	"	3.512e-016	3.562e-014
o Rotational	"	4.348e-016	4.459e-014
o Isotropic	"	3.660e-016	3.737e-014

2-Foot Stone Revetment Shielding Pu-239 MicroShield Output

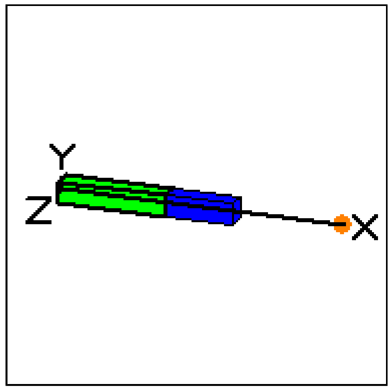
MicroShield 7.02 Battelle (05-MSD-7.00-1022)

Date	By	Checked

Filename	Run Date	Run Time	Duration
Pu-239_02_ft_01_m.ms7	May 20, 2010	10:49:36 PM	00:00:00

Project Info	
Case Title	Pu-239 2 foot stone
Description	Pu-239 1 pCi/g sediment 2 foot armor stone shield
Geometry	16 - Infinite Slab

Source Dimensions	
Thickness	100.0 cm (3 ft 3.4 in)



Dose Points			
A	X	Y	Z
#1	260.96 cm (8 ft 6.7 in)	0.0 cm (0.0 in)	0.0 cm (0.0 in)

Shields			
Shield N	Dimension	Material	Density
Source	Infinite	Concrete	1.5
Shield 1	60.96 cm	Concrete	2.7
Air Gap		Air	0.00122

Source Input: Grouping Method - Standard Indices Number of Groups: 25 Lower Energy Cutoff: 0.015 Photons < 0.015: Included Library: ICRP-38		
Nuclide	µCi/cm³	Bq/cm³
Pu-239	1.5000e-006	5.5500e-002

Buildup: The material reference is Shield 1 Integration Parameters

Results

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	5.749e-02	0.000e+00	0.000e+00	0.000e+00	0.000e+00
0.02	2.696e-04	0.000e+00	0.000e+00	0.000e+00	0.000e+00
0.03	5.828e-08	0.000e+00	0.000e+00	0.000e+00	0.000e+00
0.04	3.308e-06	1.882e-50	1.882e-50	8.323e-53	8.323e-53
0.05	1.194e-05	7.104e-35	1.209e-33	1.892e-37	3.221e-36
0.06	9.463e-07	3.356e-29	1.335e-27	6.665e-32	2.653e-30
0.08	3.663e-07	6.805e-24	4.502e-22	1.077e-26	7.125e-25
0.1	6.185e-06	2.698e-20	3.574e-18	4.127e-23	5.468e-21

0.15	3.859e-06	5.602e-18	1.348e-15	9.225e-21	2.220e-18
0.2	4.996e-07	1.379e-17	3.575e-15	2.433e-20	6.311e-18
0.3	9.052e-07	9.261e-16	1.711e-13	1.757e-18	3.246e-16
0.4	2.689e-06	3.015e-14	3.617e-12	5.874e-17	7.048e-15
0.5	1.121e-07	7.513e-15	6.369e-13	1.475e-17	1.250e-15
0.6	3.752e-08	1.034e-14	6.507e-13	2.018e-17	1.270e-15
0.8	1.316e-08	3.128e-14	1.219e-12	5.949e-17	2.319e-15
1.0	1.182e-10	1.395e-15	3.796e-14	2.572e-18	6.997e-17
Totals	**5.779e-02**	**8.161e-14**	**6.338e-12**	**1.575e-16**	**1.229e-14**

MicroShield 7.02 (05-MSD-7.00-1022)
Battelle
Conversion of calculated exposure in air to dose
FILE: C:\ushield\CaseFiles\Pu-239_02_ft_01_m.ms7
Case Title: Pu-239 2 foot stone
This case was run on Thursday, May 20, 2010 at 10:49:36 PM
Dose Point # 1 - (260.96,0,0) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	1.513e-013	1.356e-011
Photon Energy Fluence Rate	MeV/cm²/sec	8.161e-014	6.338e-012
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.575e-016	1.229e-014
Absorbed Dose Rate in Air	mGy/hr	1.375e-018	1.073e-016
"	mrad/hr	1.375e-016	1.073e-014
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.664e-018	1.321e-016
o Opposed	"	1.297e-018	1.006e-016
o Rotational	"	1.297e-018	1.006e-016
o Isotropic	"	1.148e-018	8.912e-017
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.751e-018	1.379e-016
o Opposed	"	1.659e-018	1.304e-016
o Rotational	"	1.659e-018	1.304e-016
o Isotropic	"	1.228e-018	9.533e-017
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.462e-018	1.153e-016
o Posterior/Anterior	"	1.278e-018	9.975e-017
o Lateral	"	9.333e-019	7.170e-017
o Rotational	"	1.136e-018	8.835e-017 ←
o Isotropic	"	9.630e-019	7.451e-017

Unshielded Co-60 MicroShield Output

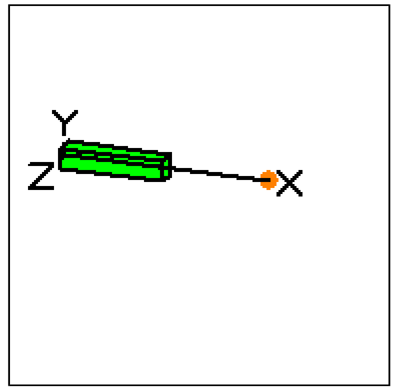
MicroShield 7.02
Battelle (05-MSD-7.00-1022)

Date	By	Checked

Filename	Run Date	Run Time	Duration
Co-60_00_ft_01_m.ms7	January 26, 2012	10:50:56 AM	00:00:00

Project Info	
Case Title	Co-60 1 meter air
Description	Co-60 1 pCi/g sediment 1 meter air shield
Geometry	16 - Infinite Slab

Source Dimensions	
Thickness	100.0 cm (3 ft 3.4 in)



Dose Points			
A	X	Y	Z
#1	200.0 cm (6 ft 6.7 in)	0.0 cm (0.0 in)	0.0 cm (0.0 in)

Shields			
Shield N	Dimension	Material	Density
Source	Infinite	Concrete	1.5
Air Gap		Air	0.00122

Source Input: Grouping Method - Standard Indices
Number of Groups: 25
Lower Energy Cutoff: 0.015
Photons < 0.015: Included
Library: ICRP-38

Nuclide	μCi/cm³	Bq/cm³
Co-60	1.5000e-006	5.5500e-002

Buildup: The material reference is Source
Integration Parameters

Results					
Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	6.129e-06	2.245e-09	2.281e-09	1.926e-10	1.957e-10
0.3	4.218e-06	3.691e-06	1.506e-05	7.002e-09	2.857e-08
0.8	4.218e-06	1.517e-05	4.324e-05	2.885e-08	8.224e-08
1.0	5.544e-02	2.783e-01	7.207e-01	5.131e-04	1.328e-03
1.5	5.549e-02	5.164e-01	1.114e+00	8.687e-04	1.874e-03
2.0	6.105e-07	8.822e-06	1.732e-05	1.364e-08	2.678e-08
3.0	1.998e-09	5.337e-08	9.340e-08	7.240e-11	1.267e-10
Totals	**1.109e-01**	**7.947e-01**	**1.835e+00**	**1.382e-03**	**3.203e-03**

MicroShield 7.02 (05-MSD-7.00-1022)
Battelle
Conversion of calculated exposure in air to dose
FILE: E:\ushield\Co-60_00_ft_01_m.ms7
Case Title: Co-60 1 meter air
This case was run on Thursday, January 26, 2012 at 10:50:56 AM
Dose Point # 1 - (200,0,0) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	6.226e-001	1.464e+000
Photon Energy Fluence Rate	MeV/cm²/sec	7.947e-001	1.835e+000
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.382e-003	3.203e-003
Absorbed Dose Rate in Air	mGy/hr	1.206e-005	2.796e-005
"	mrad/hr	1.206e-003	2.796e-003
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.372e-005	3.181e-005
o Opposed	"	1.183e-005	2.739e-005
o Rotational	"	1.183e-005	2.739e-005
o Isotropic	"	1.057e-005	2.446e-005
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.457e-005	3.382e-005
o Opposed	"	1.405e-005	3.258e-005
o Rotational	"	1.405e-005	3.258e-005
o Isotropic	"	1.117e-005	2.588e-005
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.234e-005	2.862e-005
o Posterior/Anterior	"	1.138e-005	2.635e-005
o Lateral	"	9.071e-006	2.097e-005
o Rotational	"	1.025e-005	2.374e-005 ←
o Isotropic	"	9.077e-006	2.100e-005

3-Foot Water Shielding Co-60 MicroShield Output

MicroShield 7.02
Battelle (05-MSD-7.00-1022)

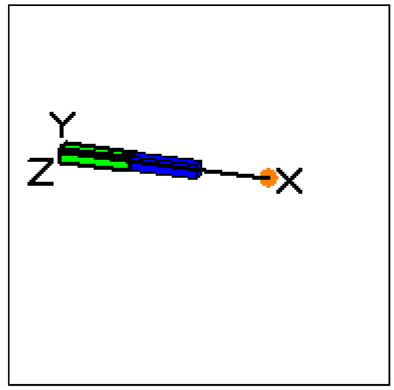
Date	By	Checked

Filename	Run Date	Run Time	Duration
Co-60_03_ft_01_m.ms7	January 26, 2012	10:55:41 AM	00:00:00

Project Info	
Case Title	Co-60 3 foot water
Description	Co-60 1 pCi/g sediment 3 foot water shield
Geometry	16 - Infinite Slab

Source Dimensions	
Thickness	100.0 cm (3 ft 3.4 in)

Dose Points			
A	X	Y	Z
#1	291.44 cm (9 ft 6.7 in)	0.0 cm (0.0 in)	0.0 cm (0.0 in)



Shields			
Shield N	Dimension	Material	Density
Source	Infinite	Concrete	1.5
Shield 1	91.44 cm	Water	1
Air Gap		Air	0.00122

Source Input: Grouping Method - Standard Indices
Number of Groups: 25
Lower Energy Cutoff: 0.015
Photons < 0.015: Included
Library: ICRP-38

Nuclide	µCi/cm³	Bq/cm³
Co-60	1.5000e-006	5.5500e-002

Buildup: The material reference is Shield 1
Integration Parameters

Results

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	6.129e-06	0.000e+00	0.000e+00	0.000e+00	0.000e+00
0.3	4.218e-06	6.135e-12	1.355e-09	1.164e-14	2.570e-12
0.8	4.218e-06	1.327e-09	3.945e-08	2.523e-12	7.504e-11
1.0	5.544e-02	5.466e-05	1.131e-03	1.008e-07	2.085e-06
1.5	5.549e-02	3.946e-04	4.422e-03	6.640e-07	7.440e-06
2.0	6.105e-07	1.589e-08	1.239e-07	2.458e-11	1.915e-10
3.0	1.998e-09	2.727e-10	1.407e-09	3.700e-13	1.908e-12
Totals	**1.109e-01**	**4.493e-04**	**5.553e-03**	**7.648e-07**	**9.525e-06**

MicroShield 7.02 (05-MSD-7.00-1022)
Battelle
Conversion of calculated exposure in air to dose
FILE: E:\ushield\Co-60_03_ft_01_m.ms7
Case Title: Co-60 3 foot water
This case was run on Thursday, January 26, 2012 at 10:55:41 AM
Dose Point # 1 - (291.44,0,0) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	3.178e-004	4.079e-003
Photon Energy Fluence Rate	MeV/cm²/sec	4.493e-004	5.553e-003
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	7.648e-007	9.525e-006
Absorbed Dose Rate in Air	mGy/hr	6.676e-009	8.316e-008
"	mrad/hr	6.676e-007	8.316e-006
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	7.564e-009	9.433e-008
o Opposed	"	6.580e-009	8.180e-008
o Rotational	"	6.580e-009	8.180e-008
o Isotropic	"	5.897e-009	7.323e-008
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	8.014e-009	1.000e-007
o Opposed	"	7.749e-009	9.663e-008
o Rotational	"	7.749e-009	9.663e-008
o Isotropic	"	6.213e-009	7.726e-008
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	6.816e-009	8.496e-008
o Posterior/Anterior	"	6.316e-009	7.858e-008
o Lateral	"	5.089e-009	6.308e-008
o Rotational	"	5.701e-009	7.088e-008 ←
o Isotropic	"	5.076e-009	6.299e-008

2-Foot Stone Revetment Shielding Co-60 MicroShield Output

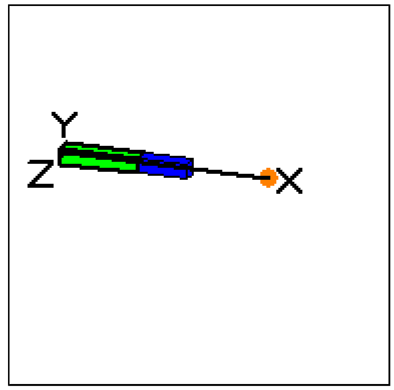
MicroShield 7.02
Battelle (05-MSD-7.00-1022)

Date	By	Checked

Filename	Run Date	Run Time	Duration
Co-60_02_ft_01_m.ms7	January 26, 2012	10:53:49 AM	00:00:00

Project Info	
Case Title	Co-60 2 foot stone
Description	Co-60 1 pCi/g sediment 2 foot armor stone shield
Geometry	16 - Infinite Slab

Source Dimensions	
Thickness	100.0 cm (3 ft 3.4 in)



Dose Points			
A	X	Y	Z
#1	260.96 cm (8 ft 6.7 in)	0.0 cm (0.0 in)	0.0 cm (0.0 in)

Shields			
Shield N	Dimension	Material	Density
Source	Infinite	Concrete	1.5
Shield 1	60.96 cm	Concrete	2.7
Air Gap		Air	0.00122

Source Input: Grouping Method - Standard Indices
Number of Groups: 25
Lower Energy Cutoff: 0.015
Photons < 0.015: Included
Library: ICRP-38

Nuclide	µCi/cm³	Bq/cm³
Co-60	1.5000e-006	5.5500e-002

Buildup: The material reference is Shield 1
Integration Parameters

Results

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	6.129e-06	0.000e+00	0.000e+00	0.000e+00	0.000e+00
0.3	4.218e-06	4.315e-15	7.973e-13	8.186e-18	1.512e-15
0.8	4.218e-06	1.002e-11	3.907e-10	1.906e-14	7.432e-13
1.0	5.544e-02	6.544e-07	1.780e-05	1.206e-09	3.282e-08
1.5	5.549e-02	1.004e-05	1.493e-04	1.689e-08	2.511e-07
2.0	6.105e-07	6.264e-10	6.590e-09	9.686e-13	1.019e-11
3.0	1.998e-09	1.729e-11	1.200e-10	2.346e-14	1.628e-13
Totals	**1.109e-01**	**1.069e-05**	**1.671e-04**	**1.809e-08**	**2.840e-07**

MicroShield 7.02 (05-MSD-7.00-1022)
Battelle
Conversion of calculated exposure in air to dose
FILE: E:\ushield\Co-60_02_ft_01_m.ms7
Case Title: Co-60 2 foot stone
This case was run on Thursday, January 26, 2012 at 10:53:49 AM
Dose Point # 1 - (260.96,0,0) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	7.345e-006	1.173e-004
Photon Energy Fluence Rate	MeV/cm²/sec	1.069e-005	1.671e-004
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.809e-008	2.840e-007
Absorbed Dose Rate in Air	mGy/hr	1.579e-010	2.479e-009
"	mrad/hr	1.579e-008	2.479e-007
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.788e-010	2.808e-009
o Opposed	"	1.559e-010	2.444e-009
o Rotational	"	1.559e-010	2.444e-009
o Isotropic	"	1.398e-010	2.191e-009
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.893e-010	2.974e-009
o Opposed	"	1.831e-010	2.877e-009
o Rotational	"	1.831e-010	2.877e-009
o Isotropic	"	1.472e-010	2.308e-009
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.611e-010	2.530e-009
o Posterior/Anterior	"	1.496e-010	2.346e-009
o Lateral	"	1.208e-010	1.892e-009
o Rotational	"	1.351e-010	2.118e-009 ←
o Isotropic	"	1.204e-010	1.886e-009

Attachment 2

Risk-Based Concentrations for Radionuclides of Concern

Risk-Based Concentrations for Radionuclides of Concern
Addendum to the Feasibility Study Report for Parcel F, Hunters Point Naval Shipyard,
San Francisco, California

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TABLES

EXHIBIT

Table 1

Comparison of RBC + Background Concentrations for ROCs to Maximum Detected ROC Concentrations

Addendum to the Feasibility Study Report for Parcel F, Hunters Point Naval Shipyard, San Francisco, California

Exposure Scenario	ROC	Background Concentration (pCi/g)	RBC[(a)] + Background Concentration (pCi/g)	Maximum Detected Concentration (pCi/g)	Maximum Detection Exceeds RBC + Background?
Intertidal	Cs-137	0.0747	0.92	0.248	N
	Co-60	0.0426	0.50	0.0452	N
	Pu-239	0.0173	36.77	0.0422	N
	Ra-226	0.6039	1.6039	1.06	N
	Sr-90	0.1747	6.27	4.56	N
	U-235	0.2342	2.92	0.672	N
Subtidal	Cs-137	0.0747	256.06	0.245	N
	Co-60	0.0426	121.77	0.0884	N
	Pu-239	0.0173	36.95	0.753	N
	Ra-226	0.6039	9.48	1.38	N
	Sr-90	0.1747	6.63	0.759	N
	U-235	0.2342	57.77	0.697	N

Notes:

a Tables 8 and 9 summarize the RBCs. RBCs were calculated using equations provided in the USEPA (2016) PRG calculator for radionuclides, modified to include the shellfish consumption pathway (see Exhibit 1 for equations). The RBCs incorporate slope factors provided in USEPA (2016), the USEPA (2016) equations for recreational adult and child exposure to soil from incidental ingestion and external exposure, the Parcel F approach for adult shellfish consumption (Battelle and Sea Engineering, 2013; ITSI & Gilbane, 2013), and the Parcel F exposure assumptions for recreational exposure (Battelle and Sea Engineering, 2013; ITSI & Gilbane, 2013).

The intertidal RBC for Ra-226 is less the than the background concentration for Ra-226. The terrestrial soil PAL of 1 pCi/g is used as the Ra-226 RBC for intertidal sediments, consistent with the approach in Battelle and Sea Engineering (2013) and ITSI & Gilbane (2013).

PAL project action limit
pCi/g picocurie per gram
PRG preliminary remediation goal
RBC risk-based concentration
ROC radionuclide of concern

References:

Battelle and Sea Engineering, Inc. 2013. Final Technical Memorandum for Radiological Data Gap Investigation Phase 2a at Parcel F, Hunters Point Naval Shipyard, San Francisco, California. April.

ITSI Gilbane & SAIC. 2013. Final Technical Memorandum for Radiological Data Gap Investigation Phase 2b at Parcel F, Hunters Point Naval Shipyard, San Francisco, California. September.

United States Environmental Protection Agency (USEPA). 2016. Preliminary Remediation Goals (PRG) Calculator for Radionuclides. Accessed October 6. https://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search

TABLE 2
Exposure Assumptions
Addendum to the Feasibility Study Report for Parcel F, Hunters Point Naval Shipyard, San Francisco, California

Exposure Medium	Exposure Route	Receptor Population	Receptor Age	Parameter	Parameter Definition	Value	Units	Reference
Sediment	Ingestion	Recreational User	Adult and Child	IRS_{rec-a}	Adult Ingestion Rate – Sediment	100	mg/day	ITSI Gilbane & SAIC, 2013. Table 2-1.
				IRS_{rec-c}	Child Ingestion Rate – Sediment	200	mg/day	USEPA, 2014 and 2016
				$IFS_{rec-adj}$	Age-Adjusted Ingestion Fraction – Sediment	83,200	mg	Calculated - see Exhibit 1.
				EF_{rec-a}	Adult Exposure Frequency	26	days/year	ITSI Gilbane & SAIC, 2013. Table 2-1.
				EF_{rec-c}	Child Exposure Frequency	26	days/year	ITSI Gilbane & SAIC, 2013. Table 2-1.
				ED_{rec-a}	Adult Exposure Duration	20	years	USEPA, 2014 and 2016 (a).
				ED_{rec-c}	Child Exposure Duration	6	years	USEPA, 2014 and 2016 (a).
				t_{rec}	Time – Recreational User	26	years	ITSI Gilbane & SAIC, 2013. Table 2-1.
	External Exposure	Recreational User	Adult and Child	ET_{rec}	Exposure Time	8	hours/day	ITSI Gilbane & SAIC, 2013. Table 2-1.
				EF_{rec}	Exposure Frequency	26	days/year	ITSI Gilbane & SAIC, 2013. Table 2-1.
				ED_{rec}	Exposure Duration	26	years	USEPA, 2014 and 2016 (a).
				t_{rec}	Time – Recreational User	26	years	ITSI Gilbane & SAIC, 2013. Table 2-1.
				ACF_{ext-sv}	Area Correction Factor	1	unitless	USEPA, 2016. Based on a site area of 1,000,000 square meters.
Shellfish	Ingestion	Recreational User	Adult	$IRSFISH_{rec-a}$	Adult Ingestion Rate – Shellfish	2.13	grams/day	ITSI Gilbane & SAIC, 2013. Table 2-1.
				FI_{sfish}	Fraction Ingested from Contaminated Source	0.1	unitless	ITSI Gilbane & SAIC, 2013. Table 2-1.
				$EF_{rec-a-sfish}$	Exposure Frequency	365	days/year	Barajas & Associates, Inc., 2008. Table 2-1.
				t_{rec-a}	Time – Recreational User	20	years	ITSI Gilbane & SAIC, 2013. Table 2-1.

Notes:

a A residential exposure duration was used to evaluate recreational users (ITSI Gilbane & SAIC, 2013). The exposure duration was revised based on the USEPA (2014, 2016) recommended default exposure duration for residential exposure (20 years for an adult plus 6 years for a child).

b Children under the age of six years were assumed not to consume shellfish (ITSI Gilbane & SAIC, 2013). The exposure duration was revised based on the USEPA (2014, 2016) total default residential exposure duration of 26 years, less the UESPA (2016) default exposure duration for children of 6 years.

mg milligram
mg/day milligram per day

References:

Barajas & Associates, Inc. (Barajas). 2008. Final Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California. April 30.

ITSI Gilbane & SAIC. 2013. Final Technical Memorandum for Radiological Data Gap Investigation Phase 2b at Parcel F, Hunters Point Naval Shipyard, San Francisco, California. September.

United States Environmental Protection Agency (USEPA). 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. Office of Solid

United States Environmental Protection Agency (USEPA). 2016. Preliminary Remediation Goals (PRG) Calculator for Radionuclides. Accessed October 6. https://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search

Table 3

Slope Factors and Isotope-Specific Information

Addendum to the Feasibility Study Report for Parcel F, Hunters Point Naval Shipyard, San Francisco, California

ROC	Half-life[a] (years)	λ[a] (1/years)	Food Ingestion Slope Factor (SF_{food})[a] (risk/pCi)	Soil Ingestion Slope Factor (SF_{s})[a] (risk/pCi)	External Slope Factor (SF_{ext-sv})[a] (risk/pCi)	K_d Distribution Coefficient[b,c] (L/kg)	Mollusk Bioconcentration Factor (MCF)[b,c] (pCi/kg per pCi/L)	Intertidal Gamma Shielding Factor ($GSF_{int-ext-sv}$)[b,c] (unitless)	Subtidal Gamma Shielding Factor ($GSF_{sub-ext-sv}$)[b,c] (unitless)
Cs-137	3.02E+01	2.30E-02	3.74E-11	4.26E-11	2.53E-06	4,000	60	1.00E+00	4.59E-04
Co-60	5.27E+00	1.31E-01	2.23E-11	3.81E-11	1.24E-05	300,000	20,000	1.00E+00	2.99E-03
Pu-239	2.41E+04	2.87E-05	1.74E-10	2.28E-10	2.09E-10	100,000	3,000	1.00E+00	5.84E-05
Ra-226	1.60E+03	4.33E-04	5.14E-10	6.77E-10	8.37E-06	2,000	100	1.00E+00	3.29E-03
Sr-90	2.88E+01	2.41E-02	9.51E-11	1.35E-10	1.95E-08	8	10	1.00E+00	8.05E-32
U-235	7.04E+08	9.84E-10	9.77E-11	1.54E-10	5.76E-07	1,000	30	1.00E+00	3.31E-05

Notes:

a. United States Environmental Protection Agency. Preliminary Remediation Goals for Radionuclides (PRG). October 26, 2016. https://epa-prgs.ornl.gov/radionuclides/download.html

b. Battelle and Sea Engineering, Inc. 2013. Final Technical Memorandum for Radiological Data Gap Investigation Phase 2a at Parcel F, Hunters Point Naval Shipyard, San Francisco, California. April.

c. ITSI Gilbane & SAIC. 2013. Final Technical Memorandum for Radiological Data Gap Investigation Phase 2b at Parcel F, Hunters Point Naval Shipyard, San Francisco, California.

ROC	radionuclide of concern	pCi/L	picocurie per liter
L/kg	liter per kilogram	risk/pCi	risk per picocurie
pCi/kg	picocurie per kilogram	ROC	radionuclide of concern

Table 4

RBCs for Shellfish Consumption – Intertidal and Subtidal Scenarios

Addendum to the Feasibility Study Report for Parcel F, Hunters Point Naval Shipyard, San Francisco, California

ROC	Food Ingestion Slope Factor (SF_{food})[a] (risk/pCi)	K_d Distribution Coefficient[a] (L/kg)	Mollusk Bioconcentration Factor (MCF)[a] (pCi/kg per pCi/L)	Half-life[a] (years)	λ[a] (1/years)	$1 - e^{-\lambda trec-a}$	$RBC_{rec\text{-}sed\text{-}sfish}$[b] (pCi/g)
Cs-137	3.74E-11	4,000	60	3.02E+01	2.30E-02	3.69E-01	1.43E+03
Co-60	2.23E-11	300,000	20,000	5.27E+00	1.31E-01	9.27E-01	1.22E+03
Pu-239	1.74E-10	100,000	3,000	2.41E+04	2.87E-05	5.74E-04	1.23E+02
Ra-226	5.14E-10	2,000	100	1.60E+03	4.33E-04	8.62E-03	2.51E+01
Sr-90	9.51E-11	8	10	2.88E+01	2.41E-02	3.82E-01	6.82E+00
U-235	9.77E-11	1,000	30	7.04E+08	9.84E-10	1.97E-08	2.19E+02

Notes:

a. See Table 3 for sources of slope factors and isotope-specific values.

b. See Exhibit 1 for RBC equations. Exposure assumptions are provided in Table 2.

L/kg	liter per kilogram
pCi/g	picocurie per gram
pCi/kg	picocurie per kilogram
pCi/L	picocurie per liter
RBC	risk-based concentration
risk/pCi	risk per picocurie
ROC	radionuclide of concern

Table 5

RBCs for Incidental Soil Ingestion – Intertidal and Subtidal Scenarios

Addendum to the Feasibility Study Report for Parcel F, Hunters Point Naval Shipyard, San combined

ROC	Soil Ingestion Slope Factor (SF_s)[a] (risk/pCi)	Half-life[a] (years)	λ[a] (1/years)	$1 - e^{-\lambda trec}$	$RBC_{rec\text{-}sed\text{-}ing}$[b] (pCi/g)
Cs-137	4.26E-11	3.02E+01	2.30E-02	4.50E-01	3.75E+02
Co-60	3.81E-11	5.27E+00	1.31E-01	9.67E-01	1.11E+03
Pu-239	2.28E-10	2.41E+04	2.87E-05	7.46E-04	5.27E+01
Ra-226	6.77E-10	1.60E+03	4.33E-04	1.12E-02	1.79E+01
Sr-90	1.35E-10	2.88E+01	2.41E-02	4.66E-01	1.20E+02
U-235	1.54E-10	7.04E+08	9.84E-10	2.56E-08	7.80E+01

Notes:

a. Sources for slope factors and isotope-specific information are provided in Table 3.

b. See Exhibit 1 for RBC equations. Exposure assumptions are provided in Table 2.

pCi/g	picocurie per gram
RBC	risk-based concentration
risk/pCi	risk per picocurie
ROC	radionuclide of concern

Table 6

RBCs for External Exposure – Intertidal Scenario

Addendum to the Feasibility Study Report for Parcel F, Hunters Point Naval Shipyard, San Francisco, California

ROC	External Slope Factor (SF_{ext-sv})[a] (risk/pCi)	Half-life[a] (years)	λ[a] (1/years)	$1 - e^{-\lambda trec}$	Intertidal Gamma Shielding Factor ($GSF_{int-ext-sv}$)[a] (unitless)	$RBC_{rec-sed-ext-int}$[b] (pCi/g)
Cs-137	2.53E-06	3.02E+01	2.30E-02	4.50E-01	1.00E+00	8.51E-01
Co-60	1.24E-05	5.27E+00	1.31E-01	9.67E-01	1.00E+00	4.60E-01
Pu-239	2.09E-10	2.41E+04	2.87E-05	7.46E-04	1.00E+00	7.75E+03
Ra-226	8.37E-06	1.60E+03	4.33E-04	1.12E-02	1.00E+00	1.95E-01
Sr-90	1.95E-08	2.88E+01	2.41E-02	4.66E-01	1.00E+00	1.12E+02
U-235	5.76E-07	7.04E+08	9.84E-10	2.56E-08	1.00E+00	2.81E+00

Notes:

a. Sources for slope factors and isotope-specific information are provided in Table 3.

b. See Exhibit 1 for RBC equations. Exposure assumptions are provided in Table 2.

pCi/g	picocurie per gram
RBC	risk-based concentration
risk/pCi	risk per picocurie
ROC	radionuclide of concern

Table 7

RBCs for External Exposure – Subtidal Scenario

Addendum to the Feasibility Study Report for Parcel F, Hunters Point Naval Shipyard, San Francisco, California

ROC	External Slope Factor (SF_{ext-sv})[a] (risk/pCi)	Half-life[a] (years)	λ[a] (1/years)	$1 - e^{-\lambda trec}$	Subtidal Gamma Shielding Factor ($GSF_{sub-ext-sv}$)[a] (unitless)	$RBC_{rec-sed-ext-sub}$[b] (pCi/g)
Cs-137	2.53E-06	3.02E+01	2.30E-02	4.50E-01	4.59E-04	1.85E+03
Co-60	1.24E-05	5.27E+00	1.31E-01	9.67E-01	2.99E-03	1.54E+02
Pu-239	2.09E-10	2.41E+04	2.87E-05	7.46E-04	5.84E-05	1.33E+08
Ra-226	8.37E-06	1.60E+03	4.33E-04	1.12E-02	3.29E-03	5.92E+01
Sr-90	1.95E-08	2.88E+01	2.41E-02	4.66E-01	8.05E-32	1.39E+33
U-235	5.76E-07	7.04E+08	9.84E-10	2.56E-08	3.31E-05	8.50E+04

Notes:

a. Sources for slope factors and isotope-specific information are provided in Table 3.

b. See Exhibit 1 for RBC equations. Exposure assumptions are provided in Table 2.

pCi/g	picocurie per gram
RBC	risk-based concentration
risk/pCi	risk per picocurie
ROC	radionuclide of concern

Table 8

Updated Multi-pathway RBCs – Intertidal Scenario

Addendum to the Feasibility Study Report for Parcel F, Hunters Point Naval Shipyard, San Francisco, California

ROC	Slope Factors and Isotope-Specific Information					Carcinogenic Target Risk (TR) = $1x10^{-6}$			
	Half-life[a] (years)	λ[a] (1/years)	Food Ingestion Slope Factor (SF_{food})[a] (risk/pCi)	Soil Ingestion Slope Factor (SF_s)[a] (risk/pCi)	External Slope Factor (SF_{ext-sv})[a] (risk/pCi)	$RBC_{rec-sed-sfish}$[b] (pCi/g)	$RBC_{rec-sed-ing}$[b] (pCi/g)	$RBC_{rec-sed-ext-int}$[b] (pCi/g)	$RBC_{rec-sed-int-tot}$[b,c] (pCi/g)
Cs-137	3.02E+01	2.30E-02	3.74E-11	4.26E-11	2.53E-06	1.43E+03	3.75E+02	8.51E-01	8.48E-01
Co-60	5.27E+00	1.31E-01	2.23E-11	3.81E-11	1.24E-05	1.22E+03	1.11E+03	4.60E-01	4.60E-01
Pu-239	2.41E+04	2.87E-05	1.74E-10	2.28E-10	2.09E-10	1.23E+02	5.27E+01	7.75E+03	3.68E+01
Ra-226	1.60E+03	4.33E-04	5.14E-10	6.77E-10	8.37E-06	2.51E+01	1.79E+01	1.95E-01	1.91E-01
Sr-90	2.88E+01	2.41E-02	9.51E-11	1.35E-10	1.95E-08	6.82E+00	1.20E+02	1.12E+02	6.10E+00
U-235	7.04E+08	9.84E-10	9.77E-11	1.54E-10	5.76E-07	2.19E+02	7.80E+01	2.81E+00	2.68E+00

Notes:

a. Sources for slope factors and isotope-specific information are provided in Table 3.

b. See Exhibit 1 for RBC equations. Exposure assumptions are provided in Table 2.

c. The RBCs in this column are the multi-pathway, intertidal scenario RBCs for shellfish consumption, sediment ingestion, and external exposure.

pCi/g	picocurie per gram
RBC	risk-based concentration
risk/pCi	risk per picocurie
ROC	radionuclide of concern

Table 9
Updated Multi-pathway RBCs – Subtidal Scenario
Addendum to the Feasibility Study Report for Parcel F, Hunters Point Naval Shipyard, San Francisco, California

ROC	Slope Factors and Isotope-Specific Information					Carcinogenic Target Risk (TR) = $1x10^{-6}$			
	Half-life[a] (years)	λ[a] (1/years)	Food Ingestion Slope Factor (SF_{food})[a] (risk/pCi)	Soil Ingestion Slope Factor (SF_s)[a] (risk/pCi)	External Slope Factor (SF_{ext-sv})[a] (risk/pCi)	$RBC_{rec-sed-sfish}$[b] (pCi/g)	$RBC_{rec-sed-ing}$[b] (pCi/g)	$RBC_{rec-sed-ext-sub}$[b] (pCi/g)	$RBC_{rec-sed-sub-tot}$[b,c] (pCi/g)
Cs-137	3.02E+01	2.30E-02	3.74E-11	4.26E-11	2.53E-06	1.43E+03	3.75E+02	1.85E+03	2.56E+02
Co-60	5.27E+00	1.31E-01	2.23E-11	3.81E-11	1.24E-05	1.22E+03	1.11E+03	1.54E+02	1.22E+02
Pu-239	2.41E+04	2.87E-05	1.74E-10	2.28E-10	2.09E-10	1.23E+02	5.27E+01	1.33E+08	3.69E+01
Ra-226	1.60E+03	4.33E-04	5.14E-10	6.77E-10	8.37E-06	2.51E+01	1.79E+01	5.92E+01	8.87E+00
Sr-90	2.88E+01	2.41E-02	9.51E-11	1.35E-10	1.95E-08	6.82E+00	1.20E+02	1.39E+33	6.45E+00
U-235	7.04E+08	9.84E-10	9.77E-11	1.54E-10	5.76E-07	2.19E+02	7.80E+01	8.50E+04	5.75E+01

Notes:
a. Sources for slope factors and isotope-specific information are provided in Table 3.
b. See Exhibit 1 for RBC equations. Exposure assumptions are provided in Table 2.
c. The RBCs in this column are the multi-pathway, subtidal scenario RBCs for shellfish consumption, sediment ingestion, and external exposure.

pCi/g	picocurie per gram
RBC	risk-based concentration
risk/pCi	risk per picocurie
ROC	radionuclide of concern

EXHIBIT 1. RBC EQUATIONS

Equation 1. RBC for Shellfish Consumption – Intertidal and Subtidal Scenario[a]

$$RBC_{rec-sed-sfish}\,(pCi/g) = \frac{TR\,(1 \times 10^{-6}) \times K_d\left(\frac{L}{kg}\right) \times \lambda\left(\frac{1}{years}\right)}{SF_{food}\left(\frac{risk}{pCi}\right) \times EF_{rec-a-sfish}\left(\frac{days}{year}\right) \times IRSFISH_{rec-a}\left(\frac{grams}{day}\right) \times FI_{sfish} \times MCF\left(\frac{pCi/kg}{pCi/L}\right) \times (1 - e^{-\lambda t_{rec-a}})}$$

Equation 2. RBC for Incidental Soil Ingestion – Intertidal and Subtidal Scenario[b]

$$RBC_{rec-sed-ing}\,(pCi/g) = \frac{TR\,(1 \times 10^{-6}) \times t_{rec}(years) \times \lambda\left(\frac{1}{years}\right)}{(1 - e^{-\lambda t_{rec}}) \times SF_s\left(\frac{risk}{pCi}\right) \times IFS_{rec-adj}(mg) \times \left(\frac{g}{1000\,mg}\right)}$$

where:

$$IFS_{rec-adj}(mg) = \left(\left(EF_{rec-c}\left(\frac{days}{year}\right) \times ED_{rec-c}(years) \times IRS_{rec-c}\left(\frac{200\,mg}{day}\right)\right) + \left(EF_{rec-a}\left(\frac{days}{year}\right) \times ED_{rec-a}(years) \times IRS_{rec-a}\left(\frac{100\,mg}{day}\right)\right)\right)$$

Equation 3. RBC for External Exposure – Intertidal Scenario[b]

$$RBC_{rec-sed-ext-int}\,(pCi/g) = \frac{TR\,(1 \times 10^{-6}) \times t_{rec}(years) \times \lambda\frac{1}{years}}{(1 - e^{\lambda t_{rec}}) \times SF_{ext-sv}\left(\frac{risk/year}{pCi/g}\right) \times EF_{rec}\left(\frac{days}{year}\right) \times \left(\frac{1\,year}{365\,days}\right) \times ED_{rec}(years) \times ACF_{ext-sv}(1.0\,[unitless]) \times ET_{rec}\frac{hours}{day} \times \frac{1\,day}{24\,hours} \times GSF_{int-ext-sv}(1.0\,[unitless])}$$

Equation 4. PAL for External Exposure – Subtidal Scenario[b]

$$RBC_{rec-sed-ext-sub}(pCi/g) = \frac{TR\,(1 \times 10^{-6}) \times t_{rec}(years) \times \lambda\frac{1}{years}}{(1 - e^{\lambda t_{rec}}) \times SF_{ext-sv}\left(\frac{risk/year}{pCi/g}\right) \times EF_{rec}\left(\frac{days}{year}\right) \times \left(\frac{1\,year}{365\,days}\right) \times ED_{rec}(years) \times ACF_{ext-sv}(1.0\,[unitless]) \times ET_{rec}\frac{hours}{day} \times \frac{1\,day}{24\,hours} \times GSF_{sub-ext-sv}(unitless)}$$

Equation 5. Multi-pathway RBC – Intertidal Scenario[c]

$$RBC_{rec-sed-int-tot}\,(pCi/g) = \frac{1}{\frac{1}{RBC_{rec-sed-sfish}} + \frac{1}{RBC_{rec-sed-ing}} + \frac{1}{RBC_{rec-sed-ext-int}}}$$

Equation 6. Multi-pathway RBC – Subtidal Scenario[c]

$$RBC_{rec-sed-sub-tot}\,(pCi/g) = \frac{1}{\frac{1}{RBC_{rec-sed-sfish}} + \frac{1}{RBC_{rec-sed-ing}} + \frac{1}{RBC_{rec-sed-ext-sub}}}$$

Notes:
[a] Equation 1 taken from Battelle and Sea Engineering (2013) and ITSI & Gilbane (2013).
[b] Equations 2 through 4 taken from USEPA (2016).
[c] Equations 5 and 6 adapted from USEPA (2016).
See Table 2 for exposure assumptions.
See Table 3 for slope factors and isotope-specific information.
g = gram
L/kg = liter per kilogram
mg = milligram
pCi/g = picocurie per gram
RBC = risk-based concentration
risk/pCi = risk per picocurie
TR = target cancer risk

References:
Battelle and Sea Engineering, Inc. 2013. Final Technical Memorandum for Radiological Data Gap Investigation Phase 2a at Parcel F, Hunters Point Naval Shipyard, San Francisco, California. April.

ITSI Gilbane & SAIC. 2013. Final Technical Memorandum for Radiological Data Gap Investigation Phase 2b at Parcel F, Hunters Point Naval Shipyard, San Francisco, California. September.

United States Environmental Protection Agency (USEPA). 2016. Preliminary Remediation Goals (PRG) Calculator for Radionuclides. Accessed October 6. https://epa-prgs.ornl.gov/radionuclides/equations.html

TABLE 4-3 RADIONUCLIDES OF CONCERN AT HPS		
Radionuclide	**Half Life**	**Radiations**
Ac-227 (Actinium)	21.8 Years	Alpha, beta, and gamma
Am-241 (Americium)	432.7 Years	Alpha, beta, and gamma
Am-243	7,370 Years	Alpha and gamma
Ba-133 (Barium)	10.5 Years	Beta and gamma
Bi-207 (Bismuth)	32 Years	Beta and gamma
C-14 (Carbon)	5715 Years	Beta
Cl-36 (Chlorine)	3.01×10^5 Years	Beta
Cm-244 (Curium)	18.1 Years	Alpha and gamma
Co-60 (Cobalt)	5.27 Years	Beta and gamma
Cs-137 (Cesium)	30.1 Years	Beta and gamma
Eu-152 (Europium)	13.5 Years	Beta and gamma
Eu-154	8.6 Years	Beta and gamma
Gd-152 (Gadolinium)	1.1×10^{14} Years	Alpha
H-3 (Tritium)	12.3 Years	Beta
In-115 (Indium)	4.4×10^{14} Years	Beta
K-40 (Potassium)	1.27×10^9 Years	Beta and gamma
Nb-94 (Niobium)	2×10^4 Years	Beta and gamma
Ni-63 (Nickel)	100 Years	Beta
Np-237 (Neptunium)	2.14×10^6 Years	Alpha and gamma
Pb-210 (Lead)	22.6 Years	Beta and gamma
Pu-238 (Plutonium)	87.7 Years	Alpha and gamma
PU-239	2.41×10^4 Years	Alpha, beta, and gamma
Ra-226 (Radium)	1,599 Years	Alpha and gamma
Sr-90 (Strontium)	28.78 Years	Beta
Tc-97 (Technetium)	2.6×10^6 Years	Beta and gamma
Tc-99	2.1×10^5 Years	Beta and gamma
Th-232 (Thorium)	1.4×10^{10} Years	Alpha
Ti-44 (Titanium)	67 Years	Gamma
Tl-204 (Thallium)	3.78 Years	Beta
U-233 (Uranium)	1.59×10^5 Years	Alpha and gamma
U-235	7.04×10^8 Years	Alpha and gamma
U-236	2.34×10^7 Years	Alpha and gamma
U-238	4.478×10^9 Years	Alpha and gamma

Table 3. Chemicals of Concern in Soil Requiring Response Action and Remediation Goals
Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California

Exposure Scenario	Chemical	Unit	Number of Analyses	Number of Detections	Detections[1]	Minimum Detected Concentration[1]	Maximum Detected Concentration[1]	Average Detected Concentration[1]	Detections Greater than Remediation Goal[1]	Remediation Goal[2]	Basis[2]
Residential	1,2-Dichloroethane	mg/kg	1,283	20	1.6%	0.002	12	1.27	15.0%	0.28	RBC
	1,4-Dichlorobenzene	mg/kg	1,124	48	4.3%	0.00309	94	6.37	31.3%	2	RBC
	2-Methylnaphthalene	mg/kg	1,827	337	18.5%	0.008	280	1.96	0.3%	150	RBC
	3,3'-Dichlorobenzidine	mg/kg	655	1	0.2%	0.036	0.036	0.036	0.0%	1.6	PQL
	Antimony	mg/kg	701	354	50.5%	0.23	30.1	4.68	10.5%	10	RBC
	Aroclor-1254	mg/kg	1,408	22	1.6%	0.023	0.87	0.19	50.0%	0.093	RBC
	Aroclor-1260	mg/kg	1,545	291	18.8%	0.006	270	4.18	30.2%	0.21	RBC
	Arsenic	mg/kg	1,821	1,289	70.8%	0.178	245	8.43	16.3%	11.1	HPAL
	Benzene	mg/kg	1,428	222	15.6%	0.00049	9.1	0.96	31.5%	0.18	RBC
	Benzo(a)anthracene	mg/kg	2,153	600	27.9%	0.008	32	0.55	17.7%	0.37	RBC
	Benzo(a)pyrene	mg/kg	2,144	548	25.6%	0.008	27	0.54	21.4%	0.33	PQL
	Benzo(b)fluoranthene	mg/kg	2,153	670	31.1%	0.008	27	0.48	16.4%	0.34	RBC
	Benzo(k)fluoranthene	mg/kg	2,114	385	18.2%	0.008	6.5	0.32	19.5%	0.34	RBC
	bis(2-Ethylhexyl)phthalate	mg/kg	669	20	3.0%	0.08	3.2	0.54	15.0%	1.1	RBC
	Cadmium	mg/kg	1,166	413	35.4%	0.04	31.5	1.63	10.9%	3.5	RBC
	Chrysene	mg/kg	2,154	746	34.6%	0.009	44	0.56	2.8%	3.3	RBC
	Copper	mg/kg	1,749	1,730	98.9%	0.93	7,600	112	12.8%	160	RBC
	Dibenz(a,h)anthracene	mg/kg	2,095	146	7.0%	0.009	3.9	0.21	11.6%	0.33	PQL
	Dieldrin	mg/kg	630	7	1.1%	0.002	0.045	0.009	14.3%	0.003	PQL
	gamma-BHC (Lindane)	mg/kg	629	2	0.3%	0.005	0.0089	0.007	100.0%	0.0026	RBC
	Heptachlor epoxide	mg/kg	618	8	1.3%	0.0007	0.03	0.006	50.0%	0.002	PQL
	Hexachlorobenzene	mg/kg	659	1	0.2%	0.082	0.082	0.082	0.0%	0.33	PQL
	Indeno(1,2,3-cd)pyrene	mg/kg	2,133	370	17.4%	0.008	14	0.35	14.1%	0.35	RBC
	Iron	mg/kg	706	706	100.0%	121	125,000	35,120	4.1%	58,000	HPAL
	Lead	mg/kg	1,468	1,249	85.1%	0.15	2,610	53	7.3%	155	RBC
	Manganese	mg/kg	1,865	1,865	100.0%	2.1	55,300	2,234	33.6%	1,431	HPAL
	Mercury	mg/kg	922	586	63.6%	0.025	124	1.99	9.7%	2.28	HPAL
	Naphthalene	mg/kg	2,279	384	16.9%	0.00278	110	0.98	5.5%	1.7	RBC
	Nickel	mg/kg	745	743	99.7%	3.1	5,080	599	0.5%	2,650	HPAL
	n-Nitroso-di-n-propylamine	mg/kg	671	1	0.2%	0.11	0.11	0.11	0.0%	0.33	PQL
	Organic Lead	mg/kg	312	25	8.0%	0.31	62	4.61	84.0%	0.5	PQL
	Tetrachloroethene	mg/kg	1,300	172	13.2%	0.0008	139	2.07	7.6%	0.48	RBC
	Thallium	mg/kg	1,148	153	13.3%	0.3	60.9	4.63	24.8%	5	RBC
	Trichloroethene	mg/kg	1,284	287	22.4%	0.001	120	2.11	8.7%	2.9	RBC
	Vanadium	mg/kg	739	738	99.9%	0.63	636	62	6.1%	117	HPAL
	Vinyl chloride	mg/kg	1,285	26	2.0%	0.002	1.5	0.11	42.3%	0.024	RBC
	Zinc	mg/kg	1,347	1,323	98.2%	8.8	36,000	161	5.8%	370	RBC

Cancer Risks and Hazard Indices, IR 59, Parcel A - 2002 PRGs

Chemical of Concern	HPAL (mg/kg)	Exposure Point Concentration (mg/kg)	EPA 2002 non-cancer PRG (mg/kg)	EPA 2002 cancer PRG (mg/kg)	Hazard Quotient	Cancer Risk
Aluminum		11118.1	7.6E+04		0.15	
Antimony	9.05	NA	3.1E+01			
Arsenic*	11.1	4.52	2.2E+01	3.9E-01	0.21	1.2E-05
Barium	314.36	100.3	5.4E+03		0.02	
Beryllium*	0.71	NA	1.5E+02	1.1E+03		
Cadmium*	3.14	NA	1.7E+00	1.4E+03		
Chromium*	99.14	94.93	2.1E+02	2.2E+02	0.45	4.3E-07
Cobalt*	19.11	14.64	1.4E+03	9.0E+02	0.01	1.6E-08
Copper*	124.31	17.05	3.1E+03		0.01	
Lead	8.99	70.66	1.5E+02		0.47	
Manganese*	1431	416.59	1.8E+03		0.23	
Mercury*	2.28	0.1	6.1E+00		0.02	
Molybdenum	2.68	NA	3.9E+02			
Nickel*	92.85	70.45	1.6E+03		0.04	
Selenium	1.95	NA	3.9E+02			
Silver	1.43	NA	3.9E+02			
Thallium*	0.81	NA	5.2E+00			
Vanadium	117.17	51.88	5.5E+02		0.09	
Zinc	109.86	65.39	2.3E+04		0.00	
TOTAL					**1.70**	**1.2E-05**

* denotes PRGs that have changed since 1995. The most significant changes are seen in chromium, cadmium, and nickel. The reasons for some of these changes are as follows:

Chromium was previously thought to be a carcinogen by the oral route of exposure, but that cannot be determined with current research, according to the EPA. This has caused the PRG to be less stringent.

A cancer PRG has now been developed for cobalt.

There is no longer a cancer PRG for nickel as soluble salts.

For more toxicology information on a particular metal, visit http://www.epa.gov/iris/ or

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Incident Report # 1342958

INCIDENT DESCRIPTION

*Report taken by NRC on 29-JUL-22 at 13:20 ET.
Incident Type: FIXED
Incident Cause: UNKNOWN
Affected Area:
Incident was discovered on 29-JUL-22 at 10:00 local incident time.
Affected Medium: OTHER / UNKNWON MEDIUMS

SUSPECTED RESPONSIBLE PARTY

Organization: NAVY

UNKNOWN, XX

Type of Organization: MILITARY

INCIDENT LOCATION
SEE LAT AND LONG County: SAN FRANCISCO
State: CA Zip: 94124
Latitude: 37° 43' 36" N
Longitude: 122° 22' 37" W

RELEASED MATERIAL(S)
CHRIS Code: RAM Official Material Name: RADIOACTIVE MATERIAL
Also Known As:
Qty Released: 0 UNKNOWN AMOUNT Qty in Water: 0 UNKNOWN AMOUNT

DESCRIPTION OF INCIDENT
THE CALLER STATED THAT THEY ARE A DOCTOR AT A SUPERFUND SITE (A RADIOACTIVE LANDFILL) THAT IS CURRENTLY SCREENING RESIDENTS AROUND THE AREA. ACCORDING TO THE CALLER THE SCREENING RESULTS HAVE COME BACK STATING THE INDIVIDUALS HAVE RADIOACTIVE AND CANCER CAUSING CHEMICALS IN THEIR SYSTEM AND BODY BURDENS. THE INDIVIDUALS BEING SCREENED ARE WITHIN 50 FEET OF THE FENCE LINE OF THE SUPERFUND SITE. THE CALLER STATED AROUND 120 INDIVIDUALS TOOK PLACE IN THE SCREENING. THE CALLER IS REPORTING A 100 INJURED INDIVIDUALS, AND 10 FATALITIES IN CONNECTION WITH THIS INCIDENT.

Alisa Somera, Clerk GAO Committee
RE: Item 220720 and 220721 Hunter's Point Naval Shipyard Contamination

Dear Supervisors Preston, Chan and Mandelman,

I was very pleased to see that this committee is ready to support the findings and recommendations of the Grand Jury (per item 220721) in relation to the continuing toxic and radioactive wastes at the old Hunter's Point Naval Shipyard, and to urge the Mayor to implement those recommendations.

The history of this toxic pollution is shameful indeed. And this issue has been lingering in the environment of Hunter's Point/Bay View since the end of World War II, almost 80 years ago. Perhaps it is finally time to take care of this health crisis in a thorough manner that will render the area, and indeed the City and the Bay, clean and healthy. With the advent of climate change and sea level rise, this is a disaster that will continue to cause health impacts, destruction and death. The idea that a concrete cap can contain these dangerous substances is ludicrous, as noted by the Grand Jury, as a number of these toxins are water soluble.

This is clearly an environmental justice issue, where a lower-income community is made to pay the price for shoddy work that was poorly executed. I am asking you to use your influence to make sure that the Mayor and the other Supervisors understand that San Franciscans are no longer willing to tolerate endangering the health and well being of the Hunter's Point/Bayview community.

I support the recommendations of the Grand Jury, the retesting of the site by an honest testing company, and the clean-up of the site such that it no longer poses a danger. And I hope that this committee will do so as well and advocate to your colleagues for this outcome.

Thank you,

Elena Engel
350SF, SF-CEC
District 9 resident

San Francisco Board of Supervisors'
Government Audit and Oversight Committee Meeting
September 15, 2022
Joint Regulatory Agency Statement

INTRODUCTION

- The US Environmental Protection Agency Region 9, the San Francisco Bay Regional Water Quality Control Board, and the California Department of Toxic Substances Control, as the primary regulatory agencies ("the Agencies") overseeing the Navy's environmental cleanup of the Hunters Point Naval Shipyard Superfund Site, were asked to provide a joint statement regarding the 2021-2022 City and County of San Francisco Civil Grand Jury Report, *"Buried Problems and a Buried Process: The Hunters Point Naval Shipyard in a Time of Climate Change."* Specifically, the Agencies were asked to discuss our oversight role and the role of the Superfund Five-Year Review process in ensuring that climate change considerations, especially as they relate to sea and groundwater level rise, are factored into the protectiveness of remedies at the Shipyard.
- The Agencies are committed to protecting the Bayview Hunters Point community and ensuring that the Navy addresses contamination at the Shipyard. We take this mission very seriously.
- The Navy is the lead for the cleanup at the Hunters Point Naval Shipyard Superfund Site. Since 1989, the Agencies represented here today have overseen the Navy's cleanup to ensure that it is done in a manner that follows the national Superfund laws, regulations, policy and guidance, and State laws that protect public health and the environment, both now and in the long-term. The Navy and the Agencies have a Superfund Federal Facility

Agreement in place that governs the way we consult with one another, set priorities, and resolve any differences that may arise.

- The Agencies appreciate the Mayor's, the Board of Supervisors', and the Civil Grand Jury's concern for climate considerations in the Shipyard cleanup. We agree that Superfund site cleanups should be implemented in a way that is adaptive to respond to climate change, including sea and groundwater level rise. The existing Superfund remedy selection, implementation, and long-term evaluation/review process provides a basis to consider potential climate issues, as warranted, to increase remedy resilience moving forward.

CLIMATE CONSIDERATIONS IN THE FIVE-YEAR REVIEW PROCESS

- Where the Navy's remedies or Records of Decision (RODs) result in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure (e.g., the Parcel E-2 landfill, the durable covers), the Superfund law requires that no less than every five years, the Navy must conduct a review (the so-called Five-Year Review) of each remedy to ensure protection of human health and the environment. These reviews must continue even after property transfer.
- While the Navy's remedies made certain climate considerations at the time they were selected, Five-Year Reviews are a dynamic process which provide opportunities to consider site changes or vulnerabilities that may not have been apparent during remedy selection, implementation or operation and maintenance to ensure the protectiveness of a remedy is adequately assessed. Site changes and vulnerabilities are informed by evolving science and information, especially from State and regional authorities, on incremental climate-related changes such as sea and groundwater level rise, seasonal changes in

precipitation or temperatures, and changes in the intensity, frequency or duration of extreme weather events.

- These considerations are evaluated along with the regular monitoring information and data that are required to be gathered for these remedies. Information from such inspections, interviews, and/or environmental sampling events may also feed into site-specific modeling efforts to consider future climate-related events.
- If, as a result of a Five-Year Review, the Navy and Agencies determine the original remedial action selected in a ROD requires climate resilience-related changes, they would be formally documented per Superfund guidance, and the change would be implemented. The Navy's next Five-Year Review for the Shipyard must be completed no later than the end of September 2024.

CONCLUSION

- The US Environmental Protection Agency Region 9, the San Francisco Bay Regional Water Quality Control Board, and the California Department of Toxic Substances Control appreciate this opportunity to discuss how climate change will continue to be actively considered to ensure human health and the environment remain protected at the Hunters Point Naval Shipyard Superfund Site.
- If you have any follow-up questions, please feel free to contact any of us.

From:	Somera, Alisa (BOS)
To:	Cabrera, Stephanie (BOS); Major, Erica (BOS)
Subject:	FW: Re: This Thursday & Tuesday, Speak up for Cleanup in Hunters Point
Date:	Tuesday, September 13, 2022 1:02:14 PM

For Civil Grand Jury file.

Alisa Somera
Legislative Deputy Director
San Francisco Board of Supervisors
1 Dr. Carlton B. Goodlett Place, Room 244
San Francisco, CA 94102
415.554.7711 direct | 415.554.5163 fax
alisa.somera@sfgov.org

From: Colette Crutcher <kramm51@earthlink.net>
Sent: Tuesday, September 13, 2022 12:52 PM
To: Somera, Alisa (BOS) <alisa.somera@sfgov.org>
Subject: Fw: Re: This Thursday & Tuesday, Speak up for Cleanup in Hunters Point

Supervisors Preston, Chan, and Mandelman--

As a Shipyard artist since 1986, I've participated in the whole history of the Navy's relationship with the place and the artist community. My perhaps too pessimistic take on the situation currently is that the very real possibility exists that the Shipyard cannot be cleaned up, that it is physically impossible to separate the toxins from the fabric of the landfill that makes up most of the contaminated areas of the facility. The grand jury's warnings about sea level rise make it clear that even if the ground is cleaned up to the depths of a few feet, the rising water table will bring deeper contaminants back up to the surface in the near future.

In light of this, I urge you to raise this possibility as an issue the city, the developer and Navy have to address. In other words, if the shipyard conceivably is unredeemable, they both need to acknowledge their willingness to ~~shelf~~ shelve the development plans, at least for the portions of the shipyard that are on fill. The City and the developer need to be honest about what is truly possible, clean-up wise. I fear that this hiatus in the clean-up and development process has gone on for so long because the city and the Navy genuinely don't know what to do next—their 30 years of clean-up, having failed so dismally, leaves them in a real quandary. We need to know if that quandary is just uncertainty about how to proceed, or is based on real doubt that there is ANYTHING they can do. If the latter, we need to know that, so we can arrive at realistic expectations for the future of the Shipyard.

Unfortunately, I am out of the country right now so i won't be able to attend the meetings.

Thanks,

Mark Roller

-----Original Message-----
From: <info@sfclimateemergency.org>
Sent: Sep 13, 2022 8:17 AM
To: <colette@colettecrutcher.com>
Subject: This Thursday & Tuesday, Speak up for Cleanup in Hunters Point

Hello Colette,

The Board of Supervisors Hearings on the SF Civil Grand Jury Report on the Shipyard Superfund Site is now scheduled. As usual, notice is short. It will be heard in the Government Audit and Oversight (GAO) Committee and then referred to the full Board for a hearing.

Call: The GAO committee is Dean Preston (415-554-7630), Connie Chan (415-554-7410), and Rafael Mandelman (415-554-6968).
If you're in one of their districts (check here), give them a quick call to say the Navy has been supposed to be cleaning up the contamination at Hunters Point for **over thirty years** and San Francisco needs to raise some hell.
Comment at the hearings, in person (Room 250) or by phone. If you can attend, please come! If not, please call in your comment and/or call or email your Supervisor (contact info). You can email your comment to the Clerk of the Board and it will be put in the official record - if you send it by *5PM the day before the meeting*. Follow the instructions in the Agenda.
GAO Committee Agenda
Supervisors Agenda will be posted here

Talking points here

WHEN
GAO Committee: Thursday September 15, 10 AM
Board of Supervisors: Tuesday September 20, 2 PM

WHERE
San Francisco City Hall, Room 250

Background

Clean Up Not Cover Up is a campaign by allies including Greenaction for Health and Environmental Justice, the Marie Harrison Community Foundation, Bayview Hunters Point Mothers and Fathers Committee, the BVHP Community Advocates and others who have been working on the continuing scandal of **the Navy's decades-long failure to clean up radioactive and toxic waste at the Hunters Point Shipyard**.
A recent Civil Grand Jury report reviews the long story of neglect and disease inflicted on people considered disposable, and emphasizes that rising sea levels will make it worse.
Now we need to pack the board chambers and demand the city/county implement the grand jury recommendations AND tell the Navy that any attempt to transfer parcels from the shipyard to the city that are not 100 percent clean would be rejected; no capping of contaminants.
There's a quick history of civil grand juries and the shipyard scandal halfway down the page here.

Talking points here

Sara on behalf of SF Climate Emergency Coalition Steering Committee

---

Alisa Somera, Clerk GAO Committee
RE: Item 220720 and 220721 Hunter's Point Naval Shipyard Contamination

Dear Supervisors Preston, Chan and Mandelman,

I was very pleased to see that this committee is ready to support the findings and recommendations of the Grand Jury (per item 220721) in relation to the continuing toxic and radioactive wastes at the old Hunter's Point Naval Shipyard, and to urge the Mayor to implement those recommendations.

The history of this toxic pollution is shameful indeed. And this issue has been lingering in the environment of Hunter's Point/Bay View since the end of World War II, almost 80 years ago. Perhaps it is finally time to take care of this health crisis in a thorough manner that will render the area, and indeed the City and the Bay, clean and healthy. With the advent of climate change and sea level rise, this is a disaster that will continue to cause health impacts, destruction and death. The idea that a concrete cap can contain these dangerous substances is ludicrous, as noted by the Grand Jury, as a number of these toxins are water soluble.

This is clearly an environmental justice issue, where a lower-income community is made to pay the price for shoddy work that was poorly executed. I am asking you to use your influence to make sure that the Mayor and the other Supervisors understand that San Franciscans are no longer willing to tolerate endangering the health and well being of the Hunter's Point/Bayview community.

I support the recommendations of the Grand Jury, the retesting of the site by an honest testing company, and the clean-up of the site such that it no longer poses a danger. And I hope that this committee will do so as well and advocate to your colleagues for this outcome.

Thank you,

Elena Engel
350SF, SF-CEC
District 9 resident

From:	Board of Supervisors, (BOS)
To:	BOS-Supervisors; BOS-Legislative Aides
Cc:	Calvillo, Angela (BOS); Somera, Alisa (BOS); Ng, Wilson (BOS); De Asis, Edward (BOS); Mchugh, Eileen (BOS); BOS Legislation, (BOS); Cabrera, Stephanie (BOS)
Subject:	FW: Clean Up Hunters Point!
Date:	Wednesday, September 14, 2022 11:51:15 AM

Hello,

Please see below for communication from Glen Thomas regarding File Nos. 220720 and 220721.

> **File No. 220720 -** Hearing - Civil Grand Jury Report - "Buried Problems and a Buried Process - The Hunters Point Naval Shipyard in a Time of Climate Change."
>
> **File No. 220721 -** Board Response - Civil Grand Jury Report - Buried Problems and a Buried Process: The Hunters Point Naval Shipyard in a Time of Climate Change

Sincerely,

Joe Adkins
Office of the Clerk of the Board
San Francisco Board of Supervisors
1 Dr. Carlton B. Goodlett Place, Room 244
San Francisco, CA 94102
Phone: (415) 554-5184 | Fax: (415) 554-5163
board.of.supervisors@sfgov.org | www.sfbos.org

From: Glen Thomas <glenthusiast89@gmail.com>
Sent: Wednesday, September 14, 2022 11:29 AM
To: Preston, Dean (BOS) <dean.preston@sfgov.org>; Board of Supervisors, (BOS) <board.of.supervisors@sfgov.org>
Subject: Clean Up Hunters Point!

Hello,

I'm writing to express my support as an SF District 15 constituent for the Hunters Point clean-up. It's past time that the Navy cleans up its toxic mess to protect SF citizens and local wildlife.

Please keep SF residents' best interests in mind and voice your support for the Hunters Point clean-up at the upcoming GAO Committee & Board of Supervisors meetings.

Thank you!!

--
Glen Thomas (he/him)
ACSM Certified Exercise Physiologist
EXOS Certified Health Fitness Specialist

From:	Somera, Alisa (BOS)
To:	Cabrera, Stephanie (BOS); Major, Erica (BOS)
Subject:	FW: Hearing - Civil Grand Jury Report - The Hunters Point Naval Shipyard
Date:	Tuesday, September 13, 2022 4:31:10 PM

For file

Alisa Somera
Legislative Deputy Director
San Francisco Board of Supervisors
1 Dr. Carlton B. Goodlett Place, Room 244
San Francisco, CA 94102
415.554.7711 direct | 415.554.5163 fax
alisa.somera@sfgov.org

From: Nancy Haber <nancyhaber38@gmail.com>
Sent: Tuesday, September 13, 2022 4:10 PM
To: Somera, Alisa (BOS) <alisa.somera@sfgov.org>; Preston, Dean (BOS) <dean.preston@sfgov.org>; ChanStaff (BOS) <chanstaff@sfgov.org>; MandelmanStaff, [BOS] <mandelmanstaff@sfgov.org>
Subject: Hearing - Civil Grand Jury Report - The Hunters Point Naval Shipyard

Dear GAO Committee Supervisors,

Despite some 30 years of environmental cleanup efforts, the Hunters Point Naval Shipyard continues to be an ongoing danger to the health and wellbeing not only of the residents of the surrounding neighborhoods, but to all San Franciscans.

The Navy plans on leaving significant amounts of radioactive and toxic waste buried at the Shipyard. The Grand Jury report notes that the most pernicious toxins are both water soluble and volatile--and could poison us by leaking into our air or water systems if not properly removed and as our sea levels rise. Regulation of the cleanup has been legally assigned to the US Environmental Protection Agency, the California Environmental Protection Agency, the State Department of Toxic Substances Control, and the SF Bay Regional Water Quality Control Board.

I ask that you strongly urge the full Board of Supervisors to call on all four regulatory agencies to require:
* Implementation of the San Francisco Civil Grand Jury’s recommendations
* New, comprehensive, and independent retesting of the entire Shipyard Superfund Site and adjacent areas, with community oversight
* A total, comprehensive cleanup and removal of all radioactive and contamination at the Shipyard Superfund Site

Please act to protect the health of our communities and environment in this urgent matter!

Thank you,
Nancy Haber
San Francisco

From:	Somera, Alisa (BOS)
To:	Cabrera, Stephanie (BOS); Major, Erica (BOS)
Subject:	FW: Public Comment for GAO Meeting 9/15
Date:	Wednesday, September 14, 2022 11:40:10 AM

For file

Alisa Somera
Legislative Deputy Director
San Francisco Board of Supervisors
1 Dr. Carlton B. Goodlett Place, Room 244
San Francisco, CA 94102
415.554.7711 direct | 415.554.5163 fax
alisa.somera@sfgov.org

From: Fabiha Priyana Hannan <fpjhannan@gmail.com>
Sent: Wednesday, September 14, 2022 2:20 AM
To: Somera, Alisa (BOS) <alisa.somera@sfgov.org>
Subject: Public Comment for GAO Meeting 9/15

Hello,

Here is my public comment for the GAO meeting on 9/15 regarding cleanup in Hunters Point.

I urge the Government Audit and Oversight Committee and the Board of Supervisors to hold agencies accountable and protect the citizens they represent. ***It is imperative that the hazardous waste at the Hunters Point Shipyard is cleaned up and removed. Yet, the Navy has failed to do so for decades now.*** There are lives at risk and children who have grown up in these communities for generations -- they are now adults raising their own kids.

Please implement the San Francisco Civil Grand Jury's recommendations and after cleanup and removal, retest the entire site with community oversight.

The SF Department of Public Health is already engaged.
We need the following agencies to finally execute on their legally assigned responsibilities:

US Environmental Protection Agency

The California Environmental Protection Agency

The State Department of Toxic Substances Control

The SF Bay Regional Water Quality Control Board.

Thank you very much.

--
Best wishes,
Priyana Fabiha Hannan (She/Her)

From:	Somera, Alisa (BOS)
To:	Cabrera, Stephanie (BOS); Major, Erica (BOS)
Subject:	FW: Public Comment: 9/15/22 Government Audit and Oversight Committee meeting
Date:	Tuesday, September 13, 2022 5:27:14 PM

For File

Alisa Somera
Legislative Deputy Director
San Francisco Board of Supervisors
1 Dr. Carlton B. Goodlett Place, Room 244
San Francisco, CA 94102
415.554.7711 direct | 415.554.5163 fax
alisa.somera@sfgov.org

From: Joey Kotfica <jkotfica@gmail.com>
Sent: Tuesday, September 13, 2022 5:00 PM
To: Somera, Alisa (BOS) <alisa.somera@sfgov.org>
Subject: Public Comment: 9/15/22 Government Audit and Oversight Committee meeting

Good afternoon,
I am writing in response to item 220506, the recent Civil Grand Jury's findings around the Hunter's Point Shipyard property. I believe it would be in the best interest of the residents of the City and County of San Francisco to create a permanent, multidisciplinary oversight committee focused on

the environmental future of the Hunter's Point Shipyard property and community.
As we all know, the Hunter's Point community has suffered many environmental justice harms already. It is our duty to ensure that we can do all that we can to prevent future residents from coming to harm that may be avoidable. There are buried toxins of all kinds that may affect the health and welfare of future residents, and the studies that have been done thus far are insufficient. We need to make sure that steps are taken to prevent future harm to San Francisco residents.
Thank you,
Joey Kotfica
94117

From:	Somera, Alisa (BOS)
To:	Major, Erica (BOS); Cabrera, Stephanie (BOS)
Subject:	FW: 9/15 SF Hearing on Grand Jury Report "Buried Problems and a Buried Process"
Date:	Tuesday, September 13, 2022 10:53:48 AM
Attachments:	RE 915 SF Hearing on Grand Jury Report Buried Problems and a Buried Process .msg

For file

Alisa Somera
Legislative Deputy Director
San Francisco Board of Supervisors
1 Dr. Carlton B. Goodlett Place, Room 244
San Francisco, CA 94102
415.554.7711 direct | 415.554.5163 fax
alisa.somera@sfgov.org

-----Original Message-----
From: Gee, Natalie (BOS) <natalie.gee@sfgov.org>
Sent: Tuesday, September 13, 2022 10:49 AM
To: Somera, Alisa (BOS) <alisa.somera@sfgov.org>
Cc: BOS Legislation, (BOS) <bos.legislation@sfgov.org>; Hernandez, Melissa G (BOS) <melissa.g.hernandez@sfgov.org>
Subject: FW: 9/15 SF Hearing on Grand Jury Report "Buried Problems and a Buried Process"

Good morning Madam Clerk,

Please add this response from the US Navy to File No. 220720 [Hearing - Civil Grand Jury Report - “Buried Problems and a Buried Process - The Hunters Point Naval Shipyard in a Time of Climate Change.”]

Thank you,
Natalie

Natalie Gee **朱凱勤**, Chief of Staff

Supervisor Shamann Walton, District 10
President, Board of Supervisors
1 Dr. Carlton B. Goodlett Pl, San Francisco | Room 282
Direct: 415.554.7672 | Office: 415.554.7670

-----Original Message-----
From: Robinson, Derek J CIV USN NAVFAC SW SAN CA (USA) <derek.j.robinson1.civ@us.navy.mil>
Sent: Tuesday, September 13, 2022 8:00 AM
To: Gee, Natalie (BOS) <natalie.gee@sfgov.org>; Ostrowski, Kimberly A CIV USN COMNAVFACENGCOM DC (USA) <kimberly.a.ostrowski.civ@us.navy.mil>; Macchiarella, Thomas L CIV USN COMNAVFACENGCOM DC (USA) <thomas.l.macchiarella.civ@us.navy.mil>; Lisa.McCann@waterboards.ca.gov; Nathan.King@waterboards.ca.gov; Montgomery.Michael@epa.gov; Chesnutt.John@epa.gov; julie.pettijohn@dtsc.ca.gov; Kimberly.Walsh@dtsc.ca.gov; nelline.kowbel@dtsc.ca.gov
Cc: Kaslofsky, Thor (CII) <Thor.Kaslofsky@sfgov.org>
Subject: RE: 9/15 SF Hearing on Grand Jury Report "Buried Problems and a Buried Process"

From:	Somera, Alisa (BOS)
To:	Cabrera, Stephanie (BOS); Major, Erica (BOS)
Subject:	FW: GOA Agenda Item 220721 / Hunter''s Point Naval Shipyard
Date:	Wednesday, September 14, 2022 3:11:59 PM

Alisa Somera
Legislative Deputy Director
San Francisco Board of Supervisors
1 Dr. Carlton B. Goodlett Place, Room 244
San Francisco, CA 94102
415.554.7711 direct | 415.554.5163 fax
alisa.somera@sfgov.org

(VIRTUAL APPOINTMENTS) To schedule a "virtual" meeting with me (on Microsoft Teams), please ask and I can answer your questions in real time.

Due to the current COVID-19 health emergency and the Shelter in Place Order, the Office of the Clerk of the Board is working remotely while providing complete access to the legislative process and our services.

Click **HERE** to complete a Board of Supervisors Customer Service Satisfaction form.

The Legislative Research Center provides 24-hour access to Board of Supervisors legislation, and archived matters since August 1998.

~ ~ ~ ~ ~ ~

From: Dave Rhody <dave@rhodyco.com>
Sent: Wednesday, September 14, 2022 2:38 PM
To: Somera, Alisa (BOS) <alisa.somera@sfgov.org>; Mandelman, Rafael (BOS) <rafael.mandelman@sfgov.org>; ChanStaff (BOS) <chanstaff@sfgov.org>; Preston, Dean (BOS) <dean.preston@sfgov.org>
Cc: Board of Supervisors, (BOS) <board.of.supervisors@sfgov.org>
Subject: GOA Agenda Item 220721 / Hunter's Point Naval Shipyard

Supervisors -
San Francisco shares the shame of the Navy's decades-long failure to clean up radioactive and toxic waste at the Hunters Point Shipyard. We have not pressed the point. We have failed the citizens of Bay View / Hunter's Point. Families from that area have tried to get the attention of the SF BOS and the Mayor for years. Their children are falling ill from respiratory illnesses; they have an unnecessarily high rate of cancer.

It's time we forced the Dept. of Defense to do its job. It's time to show San Franciscans that we believe in climate justice!

Please, do what's right.

-Dave Rhody, Climate Reality Leader
1594 45th Ave.
SF, CA 94122

From:	Board of Supervisors, (BOS)
To:	BOS-Supervisors; BOS-Legislative Aides
Cc:	Calvillo, Angela (BOS); Somera, Alisa (BOS); Ng, Wilson (BOS); De Asis, Edward (BOS); Mchugh, Eileen (BOS); BOS Legislation, (BOS); Cabrera, Stephanie (BOS)
Subject:	FW: GOA Agenda Item 220721 / Hunter''s Point Naval Shipyard
Date:	Wednesday, September 14, 2022 2:58:40 PM

Hello,

Please see below for communication from Dave Rhody regarding File No. 220721, which is Item No. 4 at the Government Audit & Oversight Committee meeting scheduled for September 15, 2022.

> **File No. 220721 –** Board Response – Civil Grand Jury Report – Buried Problems and a Buried Process: The Hunters Point Naval Shipyard in a Time of Climate Change.

Sincerely,

Joe Adkins
Office of the Clerk of the Board
San Francisco Board of Supervisors
1 Dr. Carlton B. Goodlett Place, Room 244
San Francisco, CA 94102
Phone: (415) 554-5184 | Fax: (415) 554-5163
board.of.supervisors@sfgov.org | www.sfbos.org

From: Dave Rhody <dave@rhodyco.com>
Sent: Wednesday, September 14, 2022 2:38 PM
To: Somera, Alisa (BOS) <alisa.somera@sfgov.org>; Mandelman, Rafael (BOS) <rafael.mandelman@sfgov.org>; ChanStaff (BOS) <chanstaff@sfgov.org>; Preston, Dean (BOS) <dean.preston@sfgov.org>
Cc: Board of Supervisors, (BOS) <board.of.supervisors@sfgov.org>
Subject: GOA Agenda Item 220721 / Hunter's Point Naval Shipyard

Supervisors -
San Francisco shares the shame of the Navy's decades-long failure to clean up radioactive and toxic waste at the Hunters Point Shipyard. We have not pressed the point. We have failed the citizens of Bay View / Hunter’s Point. Families from that area have tried to get the attention of the SF BOS and the Mayor for years. Their children are falling ill from respiratory illnesses; they have an unnecessarily high rate of cancer.

It’s time we forced the Dept. of Defense to do its job. It’s time to show San Franciscans that we believe in climate justice!

Please, do what’s right.

-Dave Rhody, Climate Reality Leader
1594 45th Ave.
SF, CA 94122

From:	Somera, Alisa (BOS)
To:	Cabrera, Stephanie (BOS); Major, Erica (BOS)
Subject:	FW: Item 220505
Date:	Wednesday, September 14, 2022 3:58:31 PM

Alisa Somera
Legislative Deputy Director
San Francisco Board of Supervisors
1 Dr. Carlton B. Goodlett Place, Room 244
San Francisco, CA 94102
415.554.7711 direct | 415.554.5163 fax
alisa.somera@sfgov.org

From: Joni <jonieisen@sbcglobal.net>
Sent: Wednesday, September 14, 2022 3:57 PM
To: Somera, Alisa (BOS) <alisa.somera@sfgov.org>; Preston, Dean (BOS) <dean.preston@sfgov.org>; ChanStaff (BOS) <chanstaff@sfgov.org>; Mandelman, Rafael (BOS) <rafael.mandelman@sfgov.org>
Cc: Walton, Shamann (BOS) <shamann.walton@sfgov.org>
Subject: Re: Item 220505

Dear Supervisors Preston, Chan, Mandelman, and Walton,

The Civil Grand Jury has performed an enormous service to the people of San Francisco. They deserve profound thanks for waking us up - especially, we hope, public officials who can actually move on this long-simmering issue.

The Navy cannot be allowed to leave all manner of dangerous toxins buried in the low-lying soil at the Shipyard. New science has shown the likelihood of climate-induced rising sea levels to also raise groundwater, spreading those toxins into the air and water and damaging future structures. New, thorough testing must be required of the whole Shipyard Superfund Site and surrounding areas to see what's there and how to remove it - if that's even possible. Covering it up is not an option - especially now in light of the risks described in the Civil Grand Jury report.

Supervisors, first of all, please do as the Grand Jury recommends: "...create, without delay, a permanent Hunters Point Shipyard Cleanup Oversight Committee, made up of representatives from City departments with pertinent expertise," and ensure the Committee gets the ongoing necessary data and support from the SF Dept of Public Health.

But what if - after new, expert, independent and publicly overseen testing - we find out that widespread radiation, other various toxins making up this poisonous brew, and the probability of rising groundwater make it impossible *ever* to clean up the Shipyard? What then?

The public, especially residents and workers of the Shipyard, deserve pertinent, up-to-date, *true* information.

Thank you for your attention.

Sincerely,

Joni Eisen
District 10 resident

The Mayor's Hunters Point Shipyard Citizens Advisory Committee

Bayview Hunters Point Shipyard, 451 Galvez Ave. Suit 100, San Francisco, CA 94124 Phone: 415.822.4622 Fax: 415.822.4840 Email: info@hpscac.com

September 14, 2022

Government Audit and Oversight Committee
1 Dr. Carlton B. Goodlett Place
San Francisco, CA 94102-4689
Attn: Alisa Somera, Legislative Deputy Director

RE: *Civil Grand Jury Report: Buried Problems and a Buried Process: The Hunters Point Naval Shipyard in a Time of Climate Change*

Dear Members of the Government Audit and Oversight Committee:

The Hunters Point Shipyard CAC (Shipyard CAC) was established in 1993 in an effort to increase community participation in advising the Office of Community Investment and Infrastructure (OCII) and the City on matters related to the Hunters Point Shipyard redevelopment. The members of the CAC are appointed by the Mayor. The Shipyard CAC has regular monthly meetings, as well as several subcommittee meetings, all open to the public. One of our sub-committees is the Environmental and Reuse (E&R) Subcommittee. At the E&R meetings, the Navy and environmental regulators, such as Environmental Protection Agency (EPA) and the Department of Toxics and Substance Control, provide clean up reports, presentations, and solicit feedback from the Shipyard CAC and the public.

The Navy and the regulators have technical and community liaisons available to disseminate information and answer questions on a variety of complex topics. When needed, the CAC also reaches out to City Departments, such as the Department of Public Health or the OCII, on matters related to the cleanup and the redevelopment activities. Given the complexity of the cleanup, the E&R meetings provide a community forum for the public to seek and advocate on matters related to the ongoing clean up and retesting efforts.

The Civil Grand Jury report does not adequately acknowledge the community's role in decades of CAC and community advocacy with the Navy and Federal environmental regulators. We invite the Civil Grand Jury members and all members of the public to attend E&R Subcommittee meetings, where they can get regular explanatory materials and briefings about cleanup governance documents and engage in a discourse with the Navy and environmental regulators. These meetings are scheduled on the fourth Monday of each month and tend to happen on a quarterly basis but can occur monthly depending on the cleanup activities that are underway. Most recently, the CAC has requested that the Navy present a detailed presentation on sea level rise at the next CAC E&R meeting on October 24, 2022.

There is no need for another oversight committee because it is unnecessary and will further complicate the existing structure in place which is working very well.

As residents of Bayview Hunters Point, the CAC members are concerned about the health and safety of the Bayview community, and we have dedicated numerous years in ensuring a transparent process regarding the cleanup activities of the Navy. We welcome you to attend our CAC meetings, so you will have an opportunity to better understand the cleanup process, so you can receive the sea level rise update, and so you can get other pertinent Hunters Point Shipyard and Candlestick Point information.

Sincerely,

Dr. Veronica Hunnicutt

Dr. Veronica Hunnicutt
Chair of the CAC for the Shipyard/Candlestick Point

From:	Somera, Alisa (BOS)
To:	Cabrera, Stephanie (BOS)
Cc:	Major, Erica (BOS)
Subject:	FW: Public Comment from SF Baykeeper - Buried Problems and a Buried Process
Date:	Wednesday, September 14, 2022 4:44:09 PM
Attachments:	SFBaykeeper_Public Comment_HPNS CGJ Report.docx

Alisa Somera
Legislative Deputy Director
San Francisco Board of Supervisors
1 Dr. Carlton B. Goodlett Place, Room 244
San Francisco, CA 94102
415.554.7711 direct | 415.554.5163 fax
alisa.somera@sfgov.org

(VIRTUAL APPOINTMENTS) To schedule a "virtual" meeting with me (on Microsoft Teams), please ask and I can answer your questions in real time.

Due to the current COVID-19 health emergency and the Shelter in Place Order, the Office of the Clerk of the Board is working remotely while providing complete access to the legislative process and our services.

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The Legislative Research Center provides 24-hour access to Board of Supervisors legislation, and archived matters since August 1998.

From: Julia Dowell <julia@baykeeper.org>
Sent: Wednesday, September 14, 2022 4:14 PM
To: Somera, Alisa (BOS) <alisa.somera@sfgov.org>
Subject: Public Comment from SF Baykeeper - Buried Problems and a Buried Process

To the Government Audit and Oversight Committee:

The attached public comment is in regard to the San Francisco Civil Grand Jury Report: “Buried Problems and a Buried Process: The Hunters Point Naval Shipyard in a Time of Climate Change”. Please ensure that this comment becomes part of the official record. Thank you.

Respectfully,
Julia Dowell

--

Keeping an eye on the Bay since 1989

Julia Dowell, *Field Investigator and Community Advocate* (she/her)

San Francisco Baykeeper 1736 Franklin Street, Suite 800 | Oakland, CA 94612
Cell: (562) 858-9957

baykeeper.org

Julia Dowell
San Francisco Baykeeper
julia@baykeeper.org
(510) 735-9700 x114

September 14, 2022

Supervisor Preston
Supervisor Chan
Supervisor Mandelman
San Francisco Board of Supervisors
Government Audit and Oversight Committee

To the Members of the Government Audit and Oversight Committee:

My name is Julia Dowell and I am here today on behalf of San Francisco Baykeeper. The San Francisco Civil Grand Jury report "Buried Problems and a Buried Process: The Hunters Point Naval Shipyard in a Time of Climate Change" brought to light many serious oversights within the cleanup process at the Hunters Point Naval Shipyard. Most notably, the Jury's report found that groundwater rise poses a serious threat to the Shipyard that has not been considered by any of the oversight agencies. While these agencies, including the Navy, EPA, DTSC, and the Water Board are the Federal Facility Agreement signatories that must sign off on a parcel before it is transferred, the City and County of San Francisco holds the power to block the transfer of land if the cleanup is inadequate. We urge the San Francisco Board of Supervisors to block the transfer of land unless and until a parcel is completely cleaned up and doesn't pose a threat to the Bay or surrounding communities. This is especially pertinent for parcels of land where there are plans for residential development. As sea level rise and groundwater rise threaten to inundate and re-activate even previously "remediated" contaminated sites on the Bay shoreline the City and County of San Francisco, along with other cities around the Bay, must take the precautionary approach to adequately protect the health of residents and the Bay's ecosystem.

The recommendations of the Civil Grand Jury to address these oversights are thoughtful, timely, and vital. It is disappointing that Mayor Breed decided not to implement any of the 7 recommendations provided. Baykeeper is especially frustrated that Recommendations 1 and 2 will not be implemented – which would have the City, in collaboration with the Department of Public Health, commission an independent study of the future impacts of shallow groundwater surface, groundwater flows, and potential interactions with hazardous materials under various sea level rise scenarios. Increasing the understanding of how groundwater will interact with contaminants can only benefit the residents of San Francisco, especially Bayview Hunters Point, and the Bay ecosystem at-large. We urge the Board of Supervisors to implement *at least* these recommendations in order to protect the health and resilience of the San Francisco community and the Bay. Thank you for your time. We hope the Board of Supervisors will use this vital opportunity to become leaders in the time of climate change.

Respectfully,
San Francisco Baykeeper

From:	Board of Supervisors, (BOS)
To:	BOS-Supervisors; BOS-Legislative Aides
Cc:	Calvillo, Angela (BOS); Somera, Alisa (BOS); Ng, Wilson (BOS); De Asis, Edward (BOS); Mchugh, Eileen (BOS); Cabrera, Stephanie (BOS); BOS Legislation, (BOS)
Subject:	FW: Demanding a full cleanup of all radioactive and hazardous waste at the Hunters Point Naval Shipyard Superfund Site
Date:	Thursday, September 15, 2022 9:07:29 AM
Attachments:	Bay Area letter to San Francisco Board of Supervisors about Hunters Pt. Shipyard Superfund Site.docx.pdf

Hello,

Please see below and attached for communication regarding File No. 220720, which is Item No. 3 on today's Government Audit and Oversight Committee agenda.

> **File No. 220720 -** Hearing - Civil Grand Jury Report - "Buried Problems and a Buried Process - The Hunters Point Naval Shipyard in a Time of Climate Change."

Sincerely,

Joe Adkins
Office of the Clerk of the Board
San Francisco Board of Supervisors
1 Dr. Carlton B. Goodlett Place, Room 244
San Francisco, CA 94102
Phone: (415) 554-5184 | Fax: (415) 554-5163
board.of.supervisors@sfgov.org | www.sfbos.org

From: terri@greenaction.org <terri@greenaction.org>
Sent: Thursday, September 15, 2022 8:16 AM
To: Board of Supervisors, (BOS) <board.of.supervisors@sfgov.org>; ChanStaff (BOS) <chanstaff@sfgov.org>; MandelmanStaff, [BOS] <mandelmanstaff@sfgov.org>; MelgarStaff (BOS) <melgarstaff@sfgov.org>; Preston, Dean (BOS) <dean.preston@sfgov.org>; Safai, Ahsha (BOS) <ahsha.safai@sfgov.org>; Walton, Shamann (BOS) <shamann.walton@sfgov.org>; DorseyStaff (BOS) <DorseyStaff@sfgov.org>; Mar, Gordon (BOS) <gordon.mar@sfgov.org>; Peskin, Aaron (BOS) <aaron.peskin@sfgov.org>; Ronen, Hillary <hillary.ronen@sfgov.org>; Stefani, Catherine (BOS) <catherine.stefani@sfgov.org>
Cc: Bradley Angel <bradley@greenaction.org>
Subject: Demanding a full cleanup of all radioactive and hazardous waste at the Hunters Point Naval Shipyard Superfund Site

Dear Supervisors,

Please see the Bay Area letter to San Francisco Board of Supervisors, attached.

September 13, 2022

To the San Francisco Board of Supervisors:

We the undersigned organizations from across the San Francisco Bay Area respectfully request

that the San Francisco Board of Supervisors officially require **full** cleanup of **all** radioactive and

hazardous waste contamination at the Hunters Point Naval Shipyard Superfund Site.

We make this request as the Navy plans on leaving significant amounts of radioactive and toxic

waste buried at the Shipyard despite the harmful impact this contamination has had and will

continue to have on the health of residents and the environment, including San Francisco Bay.

As the San Francisco Civil Grand Jury documented in their well-researched report "Buried

Problems and a Buried Process: The Hunters Point Naval Shipyard in a Time of Climate Change,"

the government regulatory agencies have never considered if rising groundwater and sea levels

could flood and spread the radioactive and toxic contaminated areas that the government plans

on capping and not removing.

We call on the Board of Supervisors to act immediately and join us in calling on the Navy, United

States Environmental Protection Agency, California Environmental Protection Agency, State

Department of Toxic Substances Control, and the Regional Water Quality Control Board to

require the following measures to protect public health and the environment:

● Conduct a total, comprehensive cleanup and removal of all, not some, radioactive and

toxic contamination at the Shipyard Superfund Site – no capping of contamination

● Require new, comprehensive, and independent retesting of the entire Shipyard

Superfund Site and adjacent areas, with community oversight

- Implement the San Francisco Civil Grand Jury's recommendations

Respectfully submitted, for environmental health and justice,

Julia Dowell, **San Francisco Baykeeper**

Extinction Rebellion San Francisco Bay Area

Sara Greenwald, **350 San Francisco**

SF Climate Emergency Coalition

Democratic Socialists of America San Francisco

Alma Soongi Beck, Tiffany Ngo, and S. Louie, Climate Justice Co-Chairs, **Climate Reality Project,**

Bay Area Chapter

Harriet Harvey-Horn and Bonnie Hamilton, Chapter Co-Chairs, **Climate Reality Project, Bay Area**

Chapter

Eric Brooks, **Our City**

Shirley Dean, President, and Robert Cheasty, Executive Director, **Citizens for East Shore Parks**

Ms. Margaret Gordon, **West Oakland Environmental Indicators Project**

--
Terri Saul
they/them
Special Projects and Environmental Justice Organizer
Greenaction

e: terri@greenaction.org
c: 510-304-6485

From:	Somera, Alisa (BOS)
To:	Cabrera, Stephanie (BOS)
Subject:	FW: Comments on Agenda Item 3: 220720
Date:	Thursday, September 15, 2022 10:25:35 AM

-----Original Message-----
From: Sally Tobin <otwsally@gmail.com>
Sent: Thursday, September 15, 2022 10:17 AM
To: Somera, Alisa (BOS) <alisa.somera@sfgov.org>
Subject: Comments on Agenda Item 3: 220720

Dear Members of the Government Audit and Oversight Committee:
These comments address today's hearing on the Civil Grand Jury Report “Buried Problems and a Buried Process - The Hunters Point Naval Shipyard in a Time of Climate Change.” As a biological scientist, I have great respect for this report. It incorporates the latest science. It takes human values into consideration. The report also takes a long-term view of the problem posed by contamination of the Shipyard. The time for band-aid approaches is over. Capping of contamination will not work in this era of climate change and sea level rise, as demonstrated by the highly respected work of Dr. Kristina Hill that is cited in the Report.
Yes, removal will cost money, but it is time that we place a high value on human health and human lives and on the damage inflicted on the environmental justice community that lives in the area. If this excellent Report is ignored, contamination will (1) cause a West Coast version of Love Canal, destroying many lives and families in the process; (2) affect the entire Bay and its food chain, just as mercury from the Gold Rush persists today.
We as a society have a responsibility to leave the earth in better shape than we found it. So far, we have done a lousy job, and we see evidence of our ignorance and errors on a daily basis. But this Report takes away the excuse of ignorance. Please commit to a complete cleanup of the Hunters Point Naval Shipyard.
Sincerely,
Sara L. Tobin, Ph.D.
Representative of Citizens for East Shore Parks to the San Francisco Bay Contamination Cleanup Coalition

HEARING STATEMENT TO BOARD OF SUPERVISORS

HUNTERS POINT NAVAL SHIPYARD

15 September 2022

Thank you for the opportunity to provide this statement to the Board of Supervisors' Government Audit and Oversight Committee regarding the June 2022 report from the Civil Grand Jury (CGJ). The Navy takes a comprehensive approach to cleanup at the former Hunters Point Naval Shipyard (HPNS) to ensure the health and safety of the community – now and into the future.

Our responsibility is to complete work in a way that ensures long-term public health and safety before any parcel is transferred to the City of San Francisco. That's why the Navy remains methodical in its cleanup approach, which is based on the best available data, science and engineering. Our sampling and testing requirements are vetted through rigorous work plans that have been prepared by Navy cleanup experts, and reviewed and concurred with by the regulatory agencies and the City of San Francisco. Once work has been performed, reports documenting completion are vetted following the same rigorous review process by the Navy and regulatory agencies that our work plans undergo. Our work plans and reports are available to the public through the Administrative Record website.

The June 2022 CGI Report makes many claims about the Navy's environmental program at HPNS and concludes that the program does not adequately account for future Sea Level Rise. We disagree with the report's conclusion. The Navy has not only accounted for current and future sea level rise at HPNS, but there are measures and monitoring requirements in place at the Shipyard that demonstrate this fact. For example, the Remedial Action underway at Parcel E-2 includes an engineered shoreline designed to address 100-year sea level rise projections. These efforts are consistent with the Navy's goal to protect public health over the long term – even after property is transferred to the City of San Francisco.

With respect to regular, ongoing monitoring, the Navy is required to evaluate the protectiveness of the remedies in place at HPNS every five years, indefinitely. Under the Five Year Review process, the Navy, federal and state regulatory agencies and the City of San Francisco re-evaluate the protectiveness of the remedies currently in place as required by the Comprehensive Environmental Response, Compensation, and Liability Act (or CERCLA) to ensure that public health is protected.

The following provides the Committee some specifics about the Navy's work to account for the effects of climate change:

- Sea level rise is evaluated and accounted for in design documents that are reviewed by federal, state and local regulatory agencies as part of the CERCLA regulatory process. The Navy's response actions are dependent on site-specific conditions.

- The Navy has monitored groundwater elevation changes due to tidal influences and seasonal variations under the Navy's basewide groundwater monitoring program at HPNS for over two decades. Several years ago, the Navy's groundwater monitoring program was enhanced to provide groundwater data to evaluate groundwater level rise over time. This groundwater data will be used to evaluate the site and ensure it remains safe. The Navy will make adjustments to the remedies in place as needed throughout time so they remain protective.

- Measures the Navy uses to counter sea level rise at HPNS include: (a) below and above-ground walls that prevent water and soil movement to limit erosion, (b) increasing the shoreline elevation, (c) excavation and removal of contaminated soils, (d) groundwater treatment, and (e) long-term monitoring/maintenance to ensure that treatment technologies remain effective.

- The Parcel E-2 landfill remedy under construction at the Shipyard is an example of how the Navy has factored sea level rise into the HPNS cleanup. The Navy's remedy includes armoring the shoreline with large boulders and building a 3-foot-high concrete seawall to provide erosion protection to a combined 12' above the mean sea level. Parcel E-2 will be inspected at least yearly, and any required maintenance will be identified and addressed.

- At Parcel E, the Navy is addressing soil contamination through "in-situ stabilization", a method specifically designed to prevent contaminants moving from soil into groundwater, regardless of groundwater elevation.

- The next Five Year Review for HPNS will be completed in 2023, and will include an evaluation of the potential effects of sea level rise and associated groundwater elevation changes on the remedies currently in place. The 2023 Five Year Review will be available on our website in Spring/Summer of 2023. The Navy will also present relevant SLR information to the HPNS community during our monthly community outreach activities as information becomes available.

- In March 2022, Navy experts at the Naval Facilities Engineering and Expeditionary Warfare Center (NAVFAC EXWC), who specialize in groundwater and surface water modeling and who evaluate the effects of sea level rise on CERCLA sites across the Department of Navy, began a review of the remedial actions at HPNS. NAVFAC EXWC will support and inform the upcoming HPNS Five Year Review, which will be coordinated with regulatory agencies, the City of San Francisco, and other stakeholders at HPNS.

- We will continue working together with the U.S. Environmental Protection Agency, the California Department of Toxic Substances Control (DTSC) and the Water Board to assess sea level rise impacts to remedies that are in place to ensure they remain protective of human health and the environment.

The Navy maintains a close working relationship with the City, regulatory agencies, and other stakeholders on the HPNS cleanup program, and bases its decisions on sound science. This represents our collective commitment now and in the future to ensure necessary actions are taken to protect the public and environment from the potential impacts of climate change, namely sea level rise. We encourage the public to view our website at www.bracpmo.navy.mil/hpns where we announce opportunities to meet with the Navy and to learn more about the environmental cleanup program at Hunters Point.

Should the Committee have any questions about HPNS, please contact the Navy's HPNS Environmental Coordinator, Derek Robinson at derek.j.robinson1@navy.mil.

From:	Somera, Alisa (BOS)
To:	Cabrera, Stephanie (BOS)
Subject:	FW: Public comment on the Civil Grand Jury Report
Date:	Thursday, September 15, 2022 11:20:26 AM
Attachments:	Civil Grand Jury Report.pdf

From: Roni Diamant-Wilson <roniandjessie@gmail.com>
Sent: Wednesday, September 14, 2022 9:56 PM
To: Somera, Alisa (BOS) <alisa.somera@sfgov.org>
Subject: Public comment on the Civil Grand Jury Report

Re: Public comment on the Civil Grand Jury Report – "Buried Problems and a Buried Process – The Hunters Point Naval Shipyard in a Time of Climate Change." (Meeting ID: 2490 644 7603; File # 220720).

To the Board of Supervisors Government Audit and Oversight Committee,

As a San Franciscan, I am deeply concerned about the extent climate change is affecting us, particularly in our most vulnerable BIPOC communities, and am in favor of the Board of Supervisors adopting the Civil Grand Jury's recommendations in their report entitled "Buried Problems and a Buried Process – The Hunters Point Naval Shipyard in a Time of Climate Change."

Mayor Breed has agreed with the Civil Grand Jury's report findings that the risks posed by rising groundwater in the Hunter's Point Naval Shipyard are serious and real. The Board of Supervisor should adopt the Civil Grand Jury's recommendation that the City investigate rising groundwater in the Shipyard. By having a special commission of our own, we will have a clearer understanding of whether rising groundwater containing soil contaminants could plume and destroy corrosive pipes and create an environment hazard in the Shipyard and surrounding communities.

I believe establishing a Shipyard Cleanup Oversight Committee and placing relevant experts from throughout the City is both warranted and reasonable. The federal government has yet to study rising ground water at the Shipyard making San Francisco's participation in the Superfund process imperative. Obtaining answers about the effects of rising groundwater will bring about greater institutional knowledge and awareness of potential problems. This should occur before any more land is transferred to the City and construction of new projects begin.

The effects of climate change are not only the Navy’s problem. It’s our problem too.

Sincerely,
Dr. Roni Diamant-Wilson

9/19/2022

Dear President Walton and Supervisors Preston, Chan, and Mandelman,

We are writing in support of Recommendation 1 for an independent, in-depth study of groundwater rise at Hunters Point from the Civil Grand Jury Report, *Buried Problems and a Buried Process*.

Rising groundwater in response to sea level rise causes far greater problems than sea level rise alone. The science on groundwater rise is new, and hasn't been integrated into commonly used tools for sea level rise planning.

Based on best available science, we know that the amount of land area that will be flooded or waterlogged in low-lying places like Hunters Point will be much greater than was thought in the past. Even before groundwater emerges at the surface, it can mobilize contaminants in the soil.

There hasn't been a rigorous study modeling groundwater rise focused on Hunters Point. It's not well understood how groundwater levels will change at the site or how buried contaminants may be mobilized.

It's clear the Navy hasn't fully factored in groundwater rise to their plans for Hunter's Point. In their statement on September 15 to the Board of Supervisors Audit and Oversight Committee, they said their response includes armoring the shoreline. Armoring the shoreline *exacerbates* the problem of groundwater rise.

To fully understand how Hunters Point will be impacted by shallow or emergent groundwater, we recommend that the Board of Supervisors direct a city department knowledgeable about groundwater, such as San Francisco Public Utilities Commission, to develop a scope of work for a study. This study should look at Hunters Point and its surrounding Operational Land Unit (OLU), include comprehensive data on current groundwater elevation at Hunters Point, model how groundwater elevation will change with sea level rise, and include a fate and transport study to understand mobilization of contaminants. It should also examine how groundwater rise will interact with the cleanup process and redevelopment plans at the site, including the proposal to armor the shoreline.

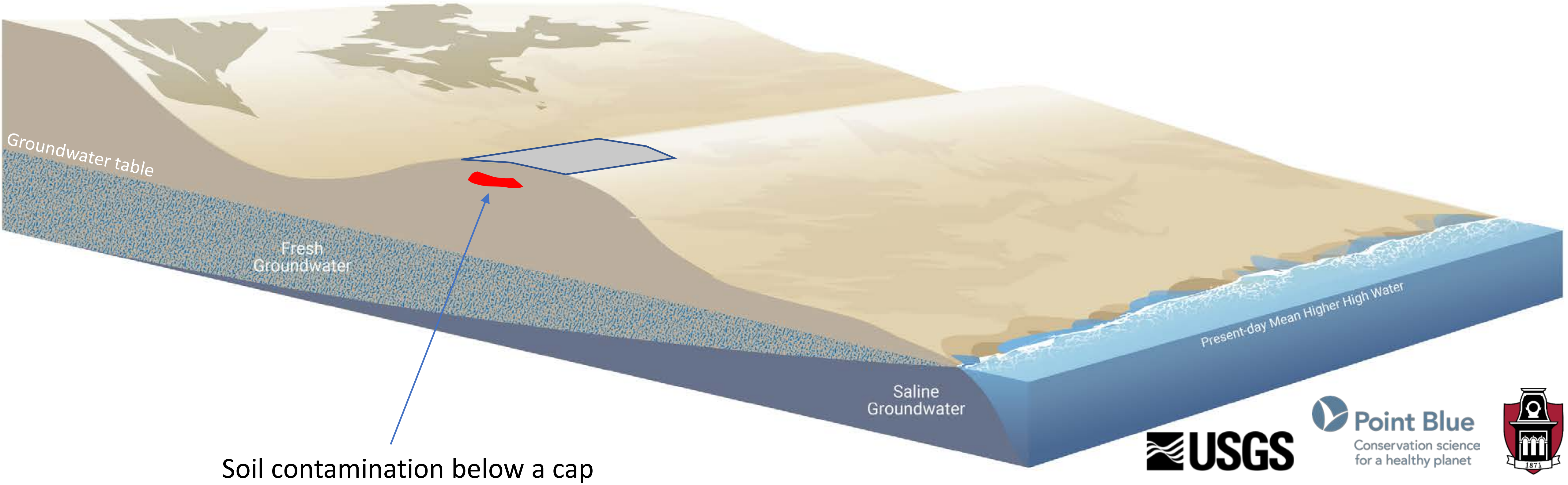
Regardless of who pays for the study - the City or the Navy - the important point is that current scientific understanding of the impacts of groundwater rise at Hunters Point is sorely lacking. We urge the Board of Supervisors to rectify this gap.

If you have questions, please reach out to Laura Feinstein at lfeinstein@spur.org or 510.827.1286.

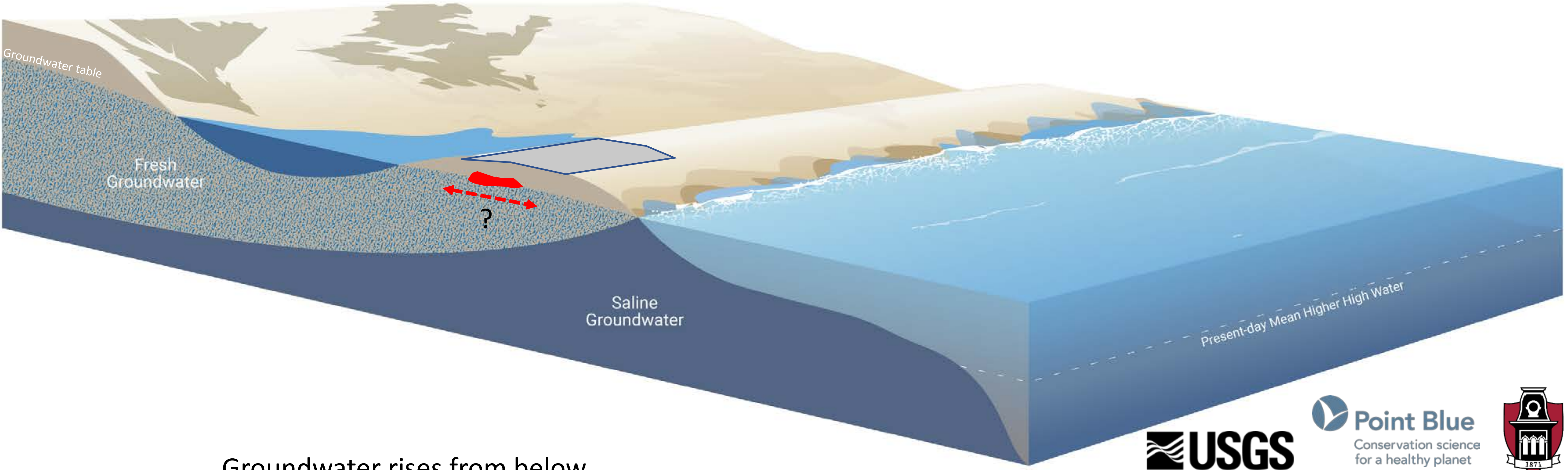
Best regards,

Laura Feinstein, PhD
Sustainability and Resilience Policy Director, SPUR

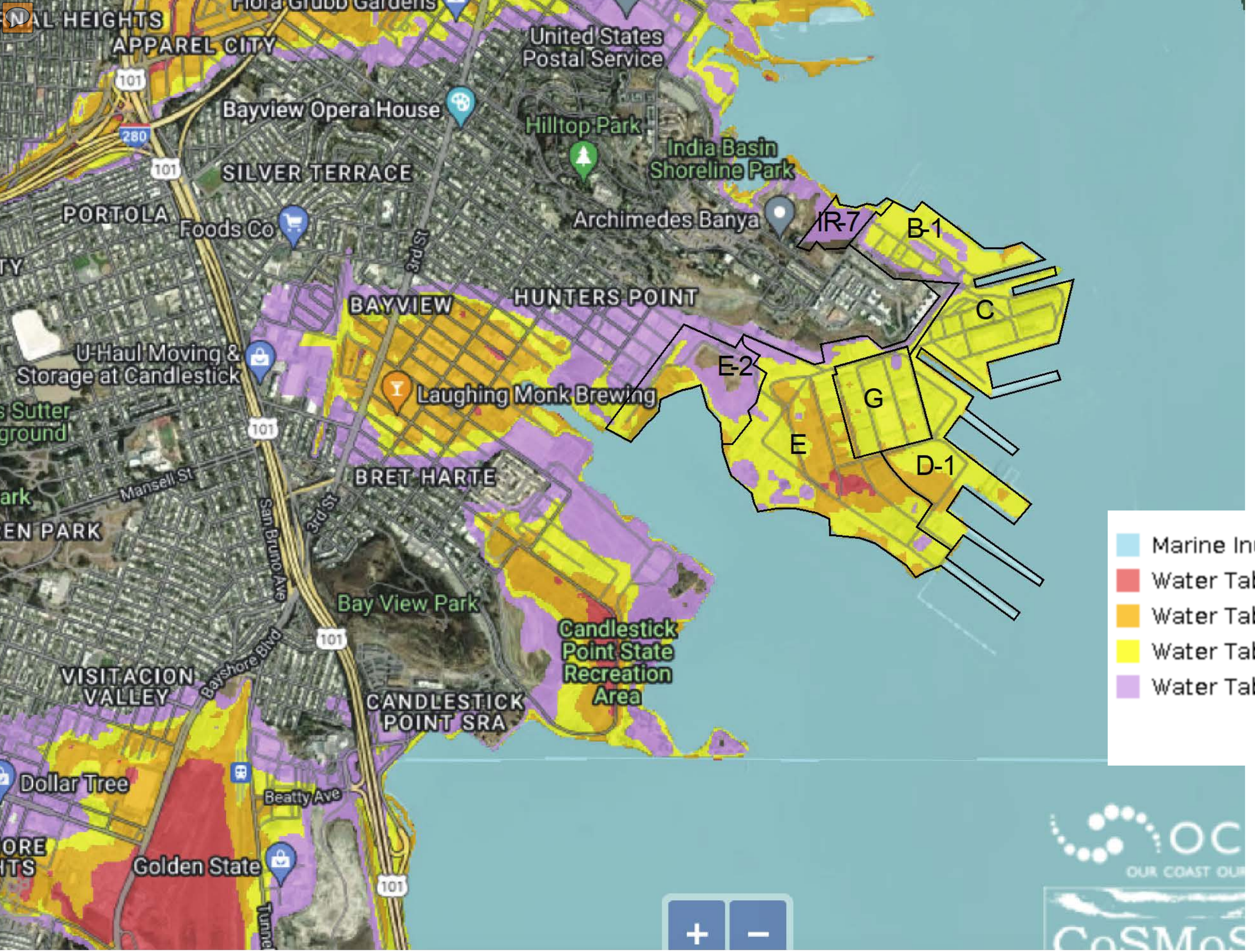
How sea-level rise affects the groundwater table



How sea-level rise affects the groundwater table

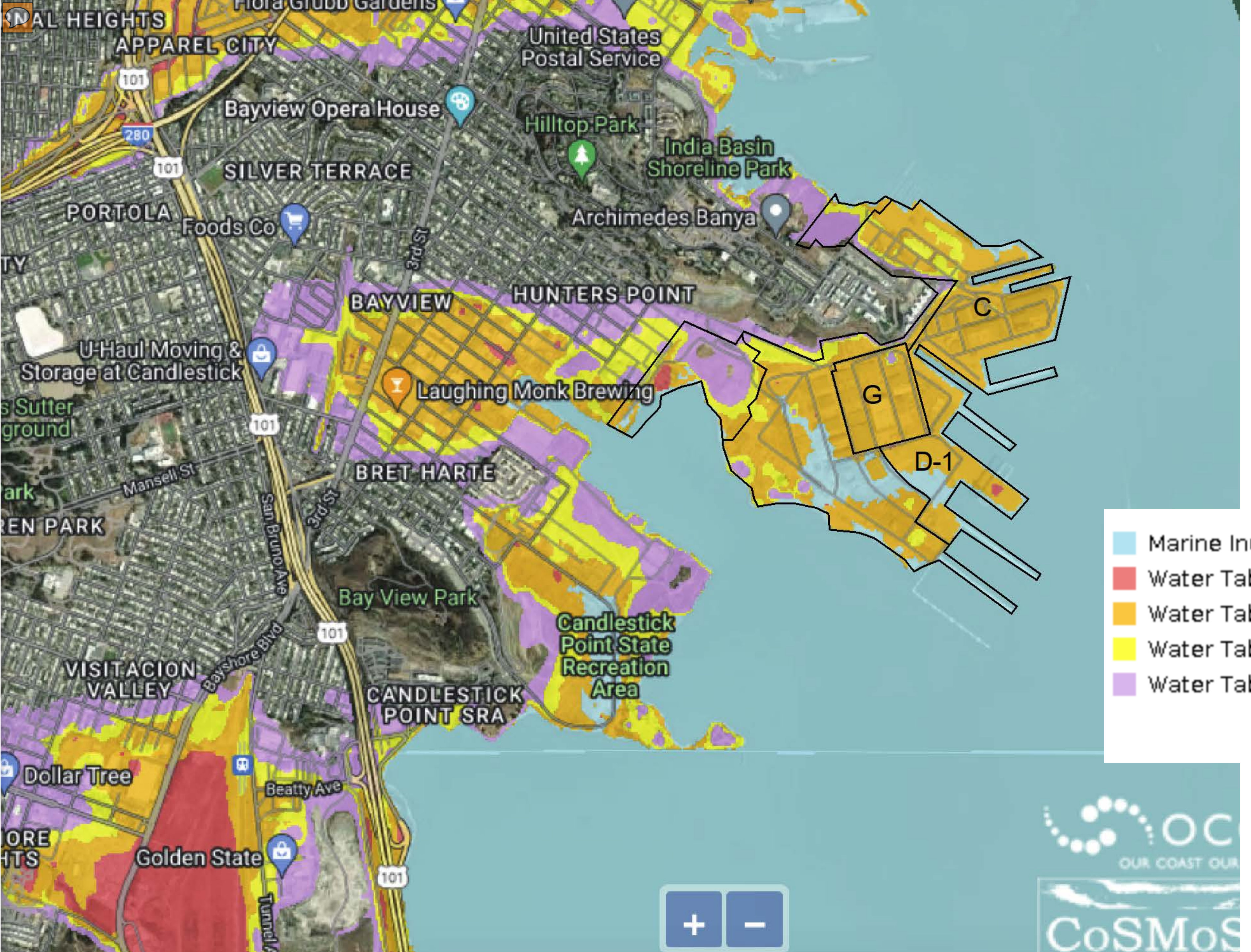


Groundwater rises from below,
wets the contaminated soil
and creates a plume.



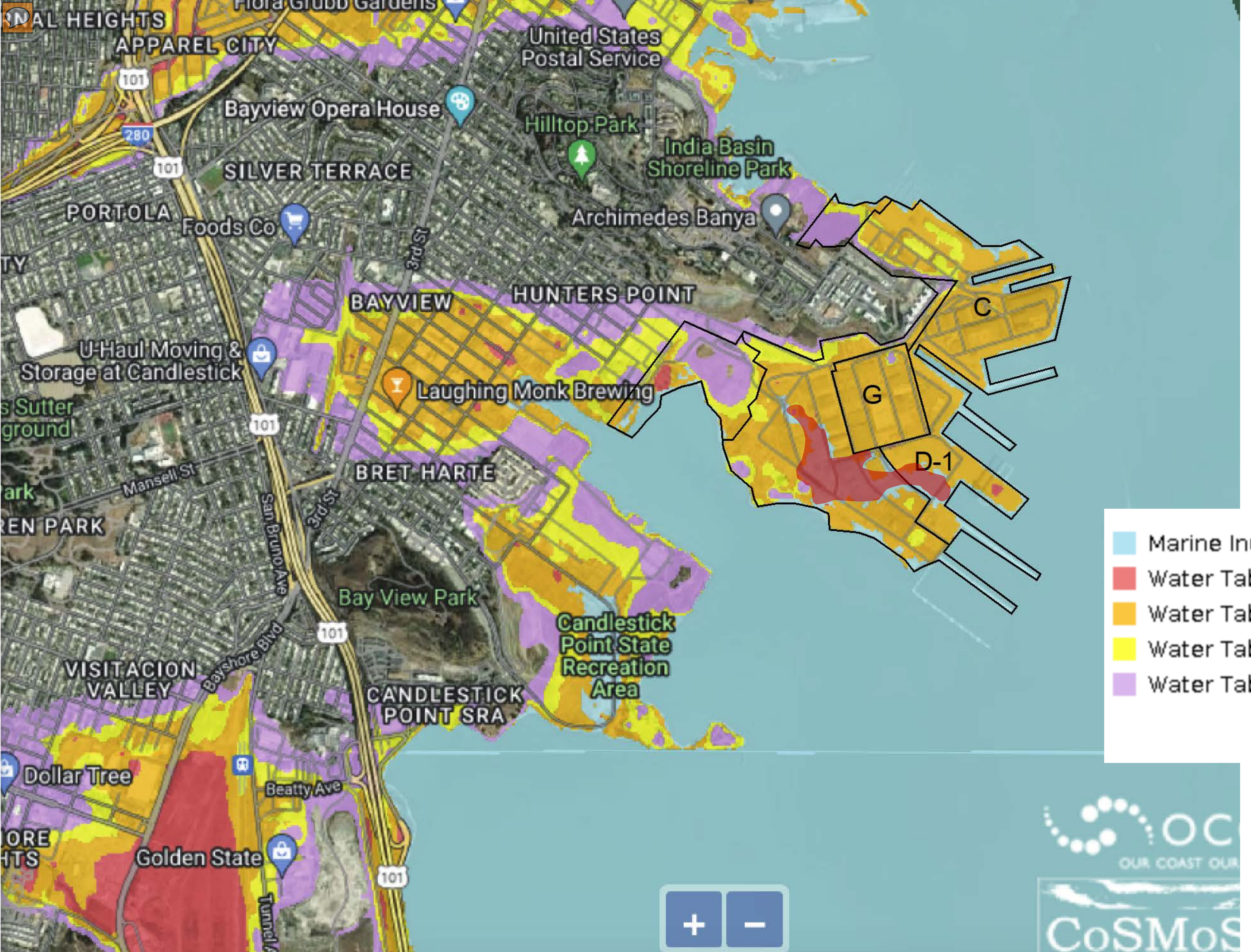
Current conditions

- Marine Inundation (MHHW sea level)
- Water Table at Surface (Emergent)
- Water Table Between 0-1m Depth (Very shallow)
- Water Table Between 1-2m Depth (Shallow)
- Water Table Between 2-5m Depth (Moderate)



3.2 feet of sea level rise

- Marine Inundation (MHHW sea level)
- Water Table at Surface (Emergent)
- Water Table Between 0-1m Depth (Very shallow)
- Water Table Between 1-2m Depth (Shallow)
- Water Table Between 2-5m Depth (Moderate)



3.2 feet of sea level rise

- Marine Inundation (MHHW sea level)
- Water Table at Surface (Emergent)
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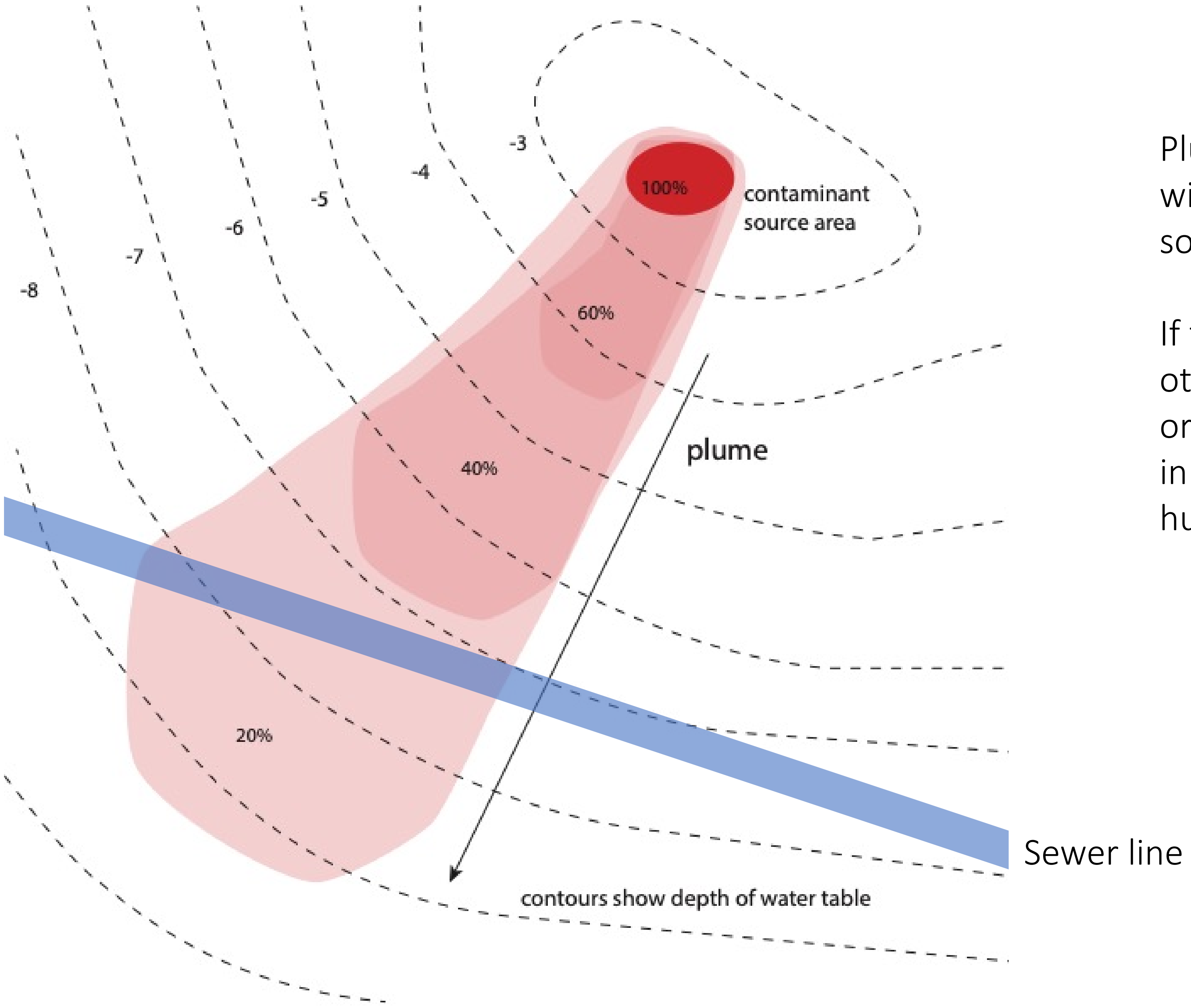

Plumes of contaminated groundwater will move at different speeds in different soil and tidal conditions.

If the plume intersects with a sewer line or other underground trenches, volatile organic chemicals (VOC's) can travel uphill in the trench or pipe and into buildings, hundreds of feet away.

Benzene and other VOC's can travel uphill

Volatile organic chemicals that flow into or around sewer pipes can enter homes, schools and workplaces through cracked plumbing seals, creating serious health hazards.