



TETRA TECH EM INC.

November 17, 2006

Dear RAB Members,

On behalf of the Navy, enclosed please find the October 4, 2006 final RAB meeting minutes for your information and records.

If there are any questions regarding the enclosed minutes, please contact Carolyn Hunter at (415) 222-8297 or [Carolyn.hunter@ttemi.com](mailto:Carolyn.hunter@ttemi.com).

Sincerely,

Carolyn Hunter  
Community Relations Specialist  
Tetra Tech EMI

**FINAL**  
**MEETING MINUTES**  
**RESTORATION ADVISORY BOARD**  
**NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD**  
**CONCORD, CALIFORNIA**  
**OCTOBER 4, 2006**

These minutes reflect general issues raised, agreements reached, and action items identified at the Restoration Advisory Board (RAB) meeting for Naval Weapons Station Seal Beach Detachment Concord (NAVWPNSTA Seal Beach Det Concord), California. The meeting was held from 6:30 p.m. to 8:30 p.m. on October 4, 2006, at the Concord Library Meeting Room in Concord, California. Agreements and action items are described by topic under Sections I through V and are summarized in Section VI. A list of participants and their affiliations is included as Attachment A, and the meeting agenda is included as Attachment B.

**I. WELCOME, INTRODUCTIONS, PUBLIC COMMENT, AND AGENDA APPROVAL**

**Welcome and Introductions**

The RAB Community Co-Chair, Mary Lou Williams (Concord resident) called the RAB meeting to order and initiated a round of introductions for attendees.

**Public Comments**

Ms. Williams opened the floor to public comments. Ray O'Brien (Bay Point Resident) stated that he is concerned about the munitions found in the Tidal Area Site 1 Landfill. Mr. O'Brien requested that the Navy consider removing the contents of the landfill and restoring the marsh. Mr. O'Brien stated that the landfill should be restored to a wetland area. Mr. O'Brien requested that the RAB members vote at the November 1, 2006, meeting to reopen the Tidal Area Landfill Site 1 Record of Decision (ROD) in order to reconsider the current alternative.

**November 2006 RAB Agenda Approval**

Kim Jacobsen (U.S. Navy [Navy] RAB Co-chair) reviewed the proposed agenda for the RAB meeting on November 1, 2006. The Navy plans to provide the following presentations for the November 2006 RAB meeting:

- Outcome of the Litigation Area Informal Dispute
- The Findings Discussed in the Draft Final Military Munitions Response Program Preliminary Assessment
- Site 1 Landfill Update

Igor Skaredoff (Martinez Resident) stated that the RAB should take some time at the November RAB meeting to discuss Mr. O'Brien's concerns on reopening the Tidal Area Site 1 ROD. Kent Fickett (Mount Diablo Audubon Society) agreed that there should be ample time dedicated at the November RAB meeting to discuss the community concerns on the Tidal Area Site 1 Landfill. Mr. Fickett requested that Environmental Protection Agency (EPA) provide the RAB an update on their perspective of the Site 1 Landfill cleanup alternative. Phillip Ramsey (EPA) stated that he will work with the Navy on preparing an update on the Tidal Area Site 1 Landfill cleanup alternative. Mr. Skaredoff agreed with Mr. O'Brien that the RAB should discuss this matter at the November meeting.

Ms. Jacobsen indicated that time for the Site 1 landfill discussion would be added to the agenda and asked the RAB to approve the November 2006 agenda. The RAB voted to approve the November 1, 2006 meeting agenda.

## **II. SEPTEMBER 2006 RAB MEETING MINUTES APPROVAL**

Ms. Jacobsen asked the RAB for comments on the minutes from the meetings held on September 6, 2006. The RAB voted to approve the meeting minutes.

### **Action Item**

1. The Navy will finalize and distribute the September 6, 2006 RAB meeting minutes.

## **III. COMMITTEE REPORTS AND ANNOUNCEMENTS**

Ms. Williams opened the floor for committee reports and announcements. Ms. Jacobsen introduced Angie Lind (Navy), who will be taking over as the Navy's new RAB Co-chair and Lead Remedial Project Manager for the Tidal Area sites. Ms. Jacobsen will lead a planning team for Naval Amphibious Base Coronado, California, beginning in November 2006.

Ms. Jacobsen stated that the Navy has been working on a general fact sheet that can be handed out at community functions. The Navy is currently making some final changes and will provide copies of it to the RAB at the November 2006 meeting.

Ms. Williams solicited input on the RAB's interest in having a winter celebration in place of a December meeting. The RAB agreed to have a winter celebration on December 6, 2006. More information will be available on the winter celebration at the November 2006 RAB meeting.

Mr. Skaredoff recommended that the Navy insert a complete discussion on the protection remedies at the front of the SWMU 2, 5, 8 and 18 pilot study work plan report. Mr. Skaredoff is interested in receiving more information on the methods that are proposed to protect the site. Rick Weissenborn (Navy) stated that the Navy was assessing the possibility of using anaerobic and aerobic technologies as a cleanup alternative.

Ric Notini (City of Concord) announced that the City of Concord is hosting a public reuse meeting which includes a briefing from the Navy on the cleanup and transfer process on October 10, 2006 at the Senior Center. There is an open reception from 5:30 p.m. to 6:30 p.m. The meeting will begin at 6:30 p.m. Jim Pinasco (Department of Toxic Substances Control [DTSC]) stated that he would send the e-mail announcement he received on this meeting to the RAB.

Ms. Jacobsen stated that the Navy is developing a schedule for RAB presentations in 2007 that will be distributed to the RAB for comment at the November 1, 2006 meeting.

### **Action Items**

2. Mr. Pinasco will send the RAB the e-mail announcing the City of Concord public meeting occurring on October 10, 2006.
3. The Navy will prepare and distribute the list of proposed RAB presentation topics for 2007.

## **IV. REMEDIAL PROJECT MANAGER (RPM) UPDATE**

### **Navy Update**

Ms. Jacobsen reviewed the Navy RPM update (Attachment C).

Mr. Fickett asked if any of the Tidal Area Site 1 Landfill winterization activities will impact any of the concerns brought up by Mr. O'Brien. Mr. O'Brien asked what the Navy is doing to explore presence of munitions at depth in the landfill. Ms. Jacobsen stated that there are not any technologies available for the Navy to use to explore the presence of munitions at depth in the landfill, as the metal scrap and debris in the landfill interferes with detection methods. Mr. O'Brien asked about the depth of the excavated area that the Navy will be filling in during the winterization process. Doug Bielskis (Engineering/Remediation Resources Group) stated that depth is four feet. Bill Schaal (TN & Associates) stated that the winterization process begins with a site walk to make sure there are no more munitions exposed at the landfill.

### **EPA Update**

Mr. Ramsey stated that EPA submitted comments to the Navy on the Site 22 Remedial Investigation (RI) on September 14, 2006. Mr. Ramsey stated that EPA's comments were fairly minor. EPA is requesting that the Navy conduct long term groundwater monitoring at Building 7SH5.

Mr. Ramsey stated that EPA submitted comments on the draft final Site Management Plan (SMP) on September 18, 2006. The Navy provided EPA responses to their comments on Site 22. The Navy will initiate a schedule for Site 22A which includes the four magazine areas. Mr. Ramsey stated that EPA wants to see the Navy develop the Site 22 feasibility study (FS) in coordination with the City of Concord's reuse plan.

Mr. Ramsey stated that EPA participated in a meeting to discuss the informal dispute of the Litigation Area FS on September 13, 2006. The Navy is going to revise the draft final Litigation Area FS in order to address EPA's concerns. Ms. Jacobsen stated that the Navy is revising the Litigation Area FS to be more realistic and less conservative. The Navy and EPA are going to work closely to revise the FS.

### **DTSC Update**

Mr. Pinasco stated that DTSC issued comments on the Site 22 RI. DTSC is requesting that the Navy continue to monitor groundwater at Site 22.

### **Water Board Update**

Alan Friedman (Water Board) stated that the Water Board participated in the meeting to discuss the informal dispute of the Litigation Area FS on September 13, 2006. The RPMs have scheduled a follow up meeting to occur in the middle of October 2006.

Mr. Friedman participated in the Underground Storage Tank (UST) RPM meeting on September 19, 2006. The Water Board is currently preparing closure letters for four USTs for the Navy.

**V. ARSENIC PRESENCE IN THE ENVIRONMENTAL MEDIA AND THE ASSOCIATED RISKS TO HUMAN HEALTH AND ECOLOGICAL RECEPTORS PRESENTATION**

Cris Williams (Tetra Tech EM Inc. [TtEMI]) provided a presentation on the arsenic presence in the environmental media and the associated risk to human health and ecological receptors. The presentation is included as Attachment D.

Mr. Fickett asked if the Navy assessed risk to salamanders and toads in the Site 22 RI. Mr. Ramsey stated that Site 22 is not an area that has amphibians inhabiting it. Mr. Fickett stated that amphibians have a tendency to migrate. He added that because salamanders and toads are native to the Concord area and have moist skin, he was concerned that they could uptake arsenic, and suggested that the Navy assess their risk at Site 22. Mr. Weissenborn stated that the Navy did an ecological assessment of what animals are present at the site.

Harry Byrne (Concord Resident) stated that he is concerned with arsenic migrating into the groundwater. Mr. Byrne stated that there are local residents who live near Site 22 that have water wells. Mr. Weissenborn stated that arsenic has not been elevated in site groundwater, and is confined to surface soil.

**VI. NEXT MEETING AND ACTION ITEMS**

The next RAB meeting is scheduled for 6:30 to 8:30 p.m. on Wednesday, November 1, 2006 at the Concord Library Meeting Room.

The following action items were generated during the RAB meeting on October 4, 2006:

<b>No.</b>	<b>Action Item</b>	<b>Target Date for Completion</b>	<b>Completion Date (or Status)</b>
1	The Navy will finalize and distribute the September 6, 2006 RAB meeting minutes.	10/20/06	This action item was completed on 10/18/06.
2	Mr. Pinasco will send the RAB the e-mail announcing the City of Concord public meeting occurring on October 10, 2006.	10/10/06	
3.	The Navy will prepare and distribute the list of proposed RAB presentation topics for 2007.	11/1/06	This action item was completed on 10/25/06.

**ATTACHMENT A**  
**ATTENDEES AND AFFILIATIONS**  
**RESTORATION ADVISORY BOARD MEETING**  
**NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD, CALIFORNIA**

**OCTOBER 4, 2006**

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**ATTENDEES AND AFFILIATIONS  
RESTORATION ADVISORY BOARD MEETING  
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD, CALIFORNIA**

**OCTOBER 4, 2006**

<u>Name</u>	<u>Affiliation</u>	<u>Telephone</u>
Wayne Akiyama	Shaw Group	(925) 288-2003
Luis Garcia-Bakarich	EPA	(415) 972-3237
Doug Bielskis	ERRG	(925) 726-4119
Beth Byrne	Concord Resident	(925) 686-4815
Harry Byrne	Concord Resident	(925) 686-4815
Joanna Canepa	TtEMI	(425) 673-3652
Diana Davis	EMS	(925) 939-0120
Kent Fickett*	Mount Diablo Audubon Society	(925) 254-5156
Alan Friedman	Water Board	(510) 622-2347
Greg Glaser*	Danville Resident	(925) 363-5570
Jessica Hamburger*	CCRCD	(925) 672-6522 X118
Carolyn Hunter	TtEMI	(415) 222-8297
Kim Jacobsen	U.S. Navy, NAVFAC Southwest	(619) 532-1448
John Kaiser	Water Board	(510) 622-2368
Sylwester Kosowski	U.S. Navy, NAVFAC Southwest	(619) 532-1027
Angie Lind	U.S. Navy, NAVFAC Southwest	(619) 532-4228
Rick Notini	City of Concord	(925) 671-3024
Ray O'Brien	Bay Point Resident	(415) 385-9220
Jim Pinasco	DTSC	(916) 255-3719
Phillip Ramsey	EPA	(415) 972-3006
Anna Rikkelman	Concord Resident	(925) 689-2662
Bill Schaal	TN and Associates	(415) 760-6624
Igor Skaredoff*	Martinez Resident	(925) 229-1371
Michelle Trotter	DTSC	(916) 255-6441
Rick Weissenborn	U.S. Navy BRAC PMO West	(619) 532-0952
Cindy Welles*	Clyde Resident	(925) 685-2698
Cris Williams	TtEMI	(850) 385-9866
Mary Lou Williams*	Concord Resident	(925) 685-1415

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Notes:

*	Community Restoration Advisory Board (RAB) Member
CCRCD	Contra Costa Resource Conservation District
DTSC	Department of Toxic Substances Control
EMS	Environmental Management Services
EPA	U.S. Environmental Protection Agency
ERRG	Engineering/Remediation Resources Group
PMO West	U.S. Navy Project Manager Office West
TtEMI	Tetra Tech EM Inc.
Water Board	San Francisco Bay Regional Water Quality Control Board

**ATTACHMENT B**

**AGENDA**

**RESTORATION ADVISORY BOARD MEETING  
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD, CALIFORNIA**

**OCTOBER 4, 2006**

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## AGENDA

### NAVAL WEAPONS STATION SEAL BEACH (NWSSB) DETACHMENT CONCORD RESTORATION ADVISORY BOARD (RAB) MEETING

Wednesday, October 4, 2006  
6:30 p.m. – 8:30 p.m.

Location: Concord Library Meeting Room  
2900 Salvio Street, Concord, CA 94519

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- 6:30 – 6:40      Call to Order
- Welcome
  - Introductions
  - Public Comments
  - November Agenda Approval
- Lead: Community Co-chair
- 6:40 – 6:50      Approval of September 2006 Meeting Minutes  
Review Unresolved Business  
Lead: Navy Co-chair
- 6:50 - 7:30      Committee Reports/Announcements
- RAB Announcements, Reports or other business
  - Remedial Project Managers' Update (Navy/EPA/DTSC/RWQCB)
- 7:30 – 7:40      Break
- 7:40 – 8:30      Presentation: Arsenic presence in the environmental media and the associated risks to human health and ecological receptors  
Presenter: Cris Williams (Tetra Tech EM Inc.)
- 8:30              Adjourn

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*NWSSB DETACHMENT CONCORD RAB Meetings are held the first Wednesday of every month, unless changed. Information regarding the Environmental Restoration program at NWSSB Detachment Concord can be found at:*

*- Tidal and Inland prior to December 2005 - <http://www.sbeach.navy.mil/Programs/Environmental/IR/IR.htm>*

*- Tidal after December 2005 – will be*

*[https://portal.navy.mil/portal/page?\\_pageid=181,1&\\_dad=portal&\\_schema=PORTAL](https://portal.navy.mil/portal/page?_pageid=181,1&_dad=portal&_schema=PORTAL)*

*- Inland after December 2005 - <http://www.navybracpmo.org/brac2005/bracbases/ca/concord/default.aspx>;*

*In addition, a public voicemail is available for questions at (925) 246-4020*

*NAVFAC Public Affairs Officer: Mr. Lee Saunders, (619) 532-3100, [lee.saunders@navy.mil](mailto:lee.saunders@navy.mil)*

*Lead RPM Tidal Area and Navy RAB Co-Chair: Mrs. Kim Jacobsen, (619) 532-1448, [kimberly.jacobsen@navy.mil](mailto:kimberly.jacobsen@navy.mil)*

*BRAC Environmental Coordinator: Mr. Rick Weissenborn (619) 532-0952, [richard.weissenborn@navy.mil](mailto:richard.weissenborn@navy.mil)*

*Community RAB Co-Chair: Mary Lou Williams, [Mlou1015@aol.com](mailto:Mlou1015@aol.com)*

**ATTACHMENT C**

**NAVY REMEDIAL PROJECT MANAGER'S UPDATE  
RESTORATION ADVISORY BOARD MEETING  
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD, CALIFORNIA**

**OCTOBER 4, 2006**

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***Navy RPM/BCT Update for 4 October 2006 Meeting of Naval Weapons Station Seal Beach, Detachment Concord Restoration Advisory Board (RAB)***

Summary of Navy Remedial Project Manager (RPM) Activities since the last RAB Meeting held on Wednesday, 6 September 2006.

**Tidal Area**

- **13 September 2006** – Navy met by phone with the project manager from USEPA, DTSC, DFG, and the SFBRWQCB to discuss the Litigation Area Feasibility Study informal dispute resolution. It was decided that a managers meeting was required.
- **20 September 2006** – Navy, USEPA, DTSC, DFG, and the SFBRWQCB Program Managers held their regular meeting which included discussion of the Litigation Area Feasibility Study informal dispute resolution. It was decided that project managers should continue working on informal dispute, which is still on-going.
- **28 September 2006** – Navy received approval of Explosive Safety Submittal (ESS) Waiver from Naval Ordnance Safety and Security Agency (NOSSA) for Site 1 Landfill Cap project site winterization. The following is the current schedule for winterization and returning to site to complete the Site 1 Landfill Cap:
  - 4 -10 October 2006 ..... TTECI will conduct UXO survey of site
  - 10 October – 10 November..... TN&A winterizes site
  - Every two weeks..... TN&A Maintain work site through winter
  - Winter 2006 – Spring 2007..... TTECI, TN&A, and Navy develop ESS and plans to restart construction
  - Spring – Summer 2007 ..... Complete landfill cap construction
  - September 2007-April 2008 ... Vegetation Establishment
  - April 2008..... Begin Long Term Post Closure Maintenance and Monitoring
- **4 October 2006** – Navy announces Ms. Angie Lind as new Lead RPM for NWS Concord Tidal Area starting 16 October 2006. Contact information is:
  - Commanding Officer
  - Naval Facilities Engineering Command, Southwest
  - Attn: Angie Lind, LRP, Desert IPT, Code OPDE.AL
  - 1220 Pacific Hwy
  - San Diego, CA 92132
  - Phone (619) 532-4228, email [angela.lind@navy.mil](mailto:angela.lind@navy.mil)

**Inland Area**

- **14 September 2006** – Navy issued the work plan for the SWMUs 2, 5, 7, 18 AS/SVE Pilot Test

**Tidal and Inland Areas**

- **18 September 2006** –Navy received comments on the Draft Final SMP from USEPA and has been working with them to finalize the 2006 Annual SMP Update.
- **19 September 2006** – Navy met with RWQCB to discuss UST program status. This was a regularly scheduled bi-monthly meeting.
- **22 September 2006** –Navy distributed draft Meeting Minutes for September 6, 2006 RPM meeting by email to agencies.
- **28 September 2006** –Navy distributed draft Agendas for October 4, 2006 and November, 1 RAB meetings and draft Meeting Minutes for September 6, 2006 RAB meeting by email to agencies and RAB.
- **4 October 2006** –Navy met with the project managers from USEPA, DTSC, DFG, and the SFBRWQCB. This was our regular monthly meeting.

**ATTACHMENT D**

**ARSENIC PRESENCE IN THE ENVIRONMENTAL MEDIA AND THE ASSOCIATED  
RISKS TO HUMAN HEALTH AND ECOLOGICAL RECEPTORS PRESENTATION  
RESTORATION ADVISORY BOARD MEETING  
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT CONCORD, CALIFORNIA**

**OCTOBER 4, 2006**

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## ARSENIC

**BRAC  
PMO**

### **Presence in the Environment and Risks to Human Health and Ecological Receptors**

**By:**

Cris Williams, Ph.D.  
Tetra Tech EM, Inc.

**To:**

**Restoration Advisory Board**  
Naval Weapons Station Seal Beach Concord Detachment  
October 4, 2006



## INTRODUCTION

**BRAC  
PMO**

### **Tonight's Discussion**

**Toxicology – What Is It?**

**Risk Assessment – What Is It?**

**Arsenic – What Is It?**

**Assessing Arsenic Human Health and Ecological Risks**

**Site 22 Arsenic Risks**

**Questions**

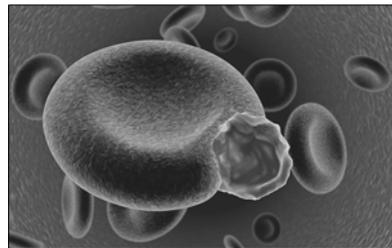


## TOXICOLOGY – WHAT IS IT?

**BRAC  
PMO**

### **Toxicology – the science of poisons**

- Not a new science
- Formalized beginnings at Dow in the 1930's
- The study of the negative effects of chemicals on living organisms
- Modern toxicology uses chemicals as tools to understand molecular/cellular biology



## TOXICOLOGY – WHAT IS IT?

**BRAC  
PMO**

### **Toxicologists work to develop an understanding of how chemicals affect living systems**

- Safer chemical products
- Safer drugs
- Safer foods
- Determine risks for chemical exposures
- Develop treatments for chemical exposures
- Forensics



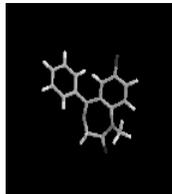


## TOXICOLOGY – WHAT IS IT?

**BRAC  
PMO**

### Toxicology Concepts

- Exposure
- Dose and dose-response
- Risk and risk assessment

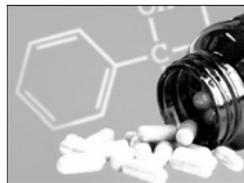


## TOXICOLOGY – WHAT IS IT?

**BRAC  
PMO**

### Exposure – the opportunity for contact

- Environmental
- Occupational
- Dietary
- Therapeutic
- Voluntary vs. involuntary



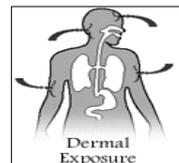
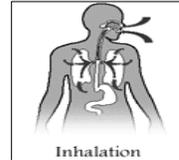


## TOXICOLOGY – WHAT IS IT?

**BRAC  
PMO**

### Exposure routes

- Three routes
  - Inhalation
  - Ingestion (oral)
  - Dermal (skin)
- Route is an important determinant of effect
  - Local (point-of-contact)
  - Systemic (throughout body)
- Duration and frequency also determine effects



## TOXICOLOGY – WHAT IS IT?

**BRAC  
PMO**

### Dose – a key concept in toxicology



Father of Modern Toxicology  
Paracelsus (b. 1493)

*"All things are poisonous, only the dose makes it non-poisonous."*

(Dose alone determines toxicity)

- Dose = amount of chemical at the target tissue
- The magnitude of the toxic response is proportional to dose
- Not the same as exposure



## TOXICOLOGY – WHAT IS IT?

**BRAC  
PMO**

**Dose determines whether a chemical will be beneficial or poisonous**

	<b>Beneficial Dose</b>	<b>Toxic Dose</b>
aspirin	300 – 1,000 mg	1,000 – 30,000 mg
Vitamin A	5,000 units/day	50,000 units/day
oxygen	20% in air	50% - 80% in air



## TOXICOLOGY – WHAT IS IT?

**BRAC  
PMO**

**Risk – the likelihood of injury or disease resulting from exposure to a potential hazard**

- 1996 National Research Council Definition – a concept used to give meaning to things, forces, or circumstances that pose danger to people or to what they value
- Different types of risk
  - natural vs. anthropogenic
  - voluntary vs. involuntary
  - acceptable vs. unacceptable
- Environmental risk
  - background risk
  - incremental lifetime cancer risk
  - non-cancer risks





## TOXICOLOGY – WHAT IS IT?

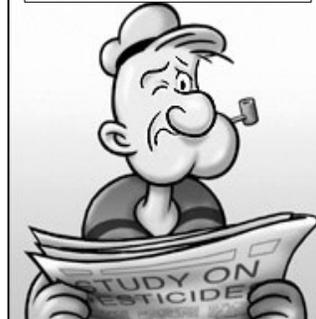
**BRAC  
PMO**

### Risks vs. benefits\*

The study found the highest levels of pesticide residues in peaches, apples, pears.....



**AND Spinach.**



\*Slide material courtesy of the Society of Toxicology



## RISK ASSESSMENT – WHAT IS IT?

**BRAC  
PMO**

### Risk assessment – quantitative estimate of incremental risks due to environmental exposures

- Multidisciplinary field – geology, statistics, toxicology, epidemiology
- High level of uncertainty and variability
- Conservative by design
- 4 steps – human health (ecological)

hazard identification (or problem formulation)

exposure assessment (or exposure analysis)

toxicity assessment (or ecological effects analysis)

risk characterization



## ARSENIC – WHAT IS IT?

**BRAC  
PMO**

### Arsenic is all around us

- Naturally occurring in soil
  - 3-4 mg/kg nationwide average (ATSDR)
  - 7.2 mg/kg (<0.1 – 97 mg/kg range; USGS)
  - 1.8 – 31.0 mg/kg (City of Oakland Survey)
- Site background range – 2.4-26.6 mg/kg (Inland Area Sites 13 and 22)
- Naturally occurring in food (ATSDR)
  - up to 60 mg/kg in fish
  - 0.31 – 1.8 µg/kg/day mean daily intake from food
- 2.1 µg/kg provisional tolerable daily intake (FAO/WHO);
- Some evidence of beneficial effects (decreased weight gain in As-deficient diets in animals)
- Even though As is everywhere, it is not readily absorbed from soil (low bioavailability)



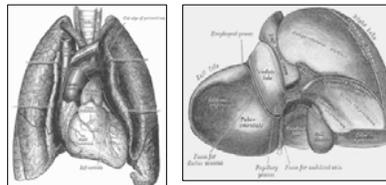
## ARSENIC – WHAT IS IT?

**BRAC  
PMO**

### A little more about “background” As



- Tobacco contains 1.5 mg/kg As (1.5 µg/cigarette) and mainstream (inhaled) tobacco smoke contains 1.4 µg/cigarette (EPA)
- Up to 12.6 mg/kg for indoor house dust from community with history of lead arsenate use (Wolz et al. 2003)
- Up to 107,000 mg/kg in homeopathic medicines (Chan 1994)
- Up to 3.77 mg/kg in dietary supplements purchased in DC-area retailers (Dolan et al. 2003)
- 3 – 4 mg typical As body burden





## ARSENIC – WHAT IS IT?

**BRAC  
PMO**

### As bioavailability

- Bioavailability = ability of the body to absorb a substance from an environmental source (e.g., soil)
- Typically assume that all As is absorbed from environmental source – i.e. 100% bioavailability
- Site 22 risk human health risk assessment assumed 100% bioavailability
- As bioavailability studies say no!

22.7% “bioaccessibility” for Site 22 soils  
20% – 28% bioavailability in monkeys (Freeman et al. 1995)  
10.7% – 24.7% bioavailability in monkeys (Roberts et al. 2002)



## ARSENIC – WHAT IS IT?

**BRAC  
PMO**

### As toxicology – health effects (ATSDR; EPA)

- Irritation of stomach and intestines – 0.3 to 30 ppm via oral route
- Skin effects/changes  
“Blackfoot” disease, hyperpigmentation, and keratosis from  
170  $\mu\text{g/L}$  in well water in Taiwan  
>100  $\mu\text{g/m}^3$  in air also causes skin effects
- EPA and IARC classify As as “carcinogenic to humans” and as a “known human carcinogen”  
Large epi study showing increased skin cancer in persons exposed to high concentrations of As in well water  
Also increased lung cancers in arsenic smelters



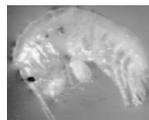


## ARSENIC – WHAT IS IT?

**BRAC  
PMO**

### As ecotoxicology (ORNL)

- Historical use as a defoliant and pesticide – toxic to plants
- One of the most toxic elements to fish – acute exposures resulting in immediate death
- Micronutrient requirement for As in mammals (<0.05 mg/kg in diet results in growth retardation)
- Birds relatively resistant – LD<sub>50</sub>s up to 3,300 mg/kg body weight



## SITE 22 ARSENIC HEALTH RISKS

**BRAC  
PMO**

### Determined using the 4-step process

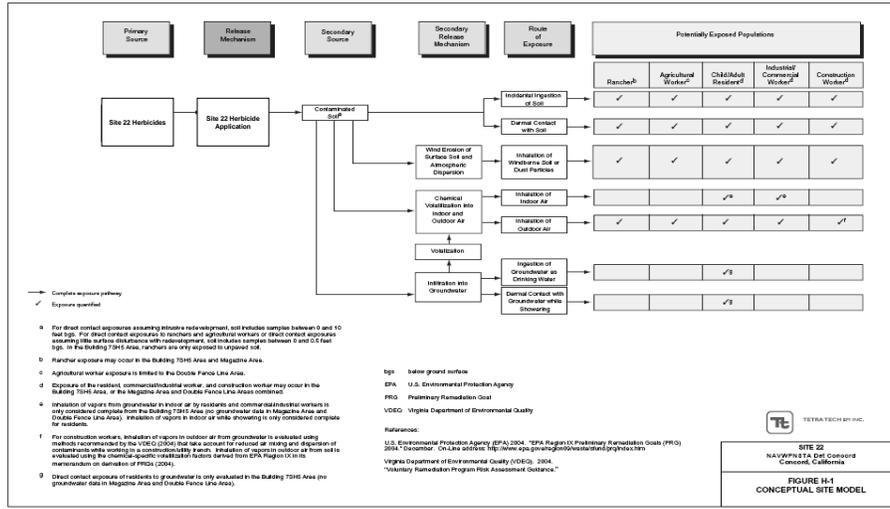
1. Hazard evaluation – analyzing existing site data (soil, groundwater, modeled vapor concentrations) and deriving a list of chemicals of potential concern (COPCs)
2. Exposure assessment – evaluating the nature (e.g., land use assumptions; exposure scenarios and pathways) and magnitude (frequency; duration) of potential exposures to site COPCs; calculating exposure point concentrations (EPCs) and chemical intakes
3. Toxicity assessment – selecting EPA and DTSC toxicity values for arsenic and all other COPCs
4. Risk characterization – determining site-related excess lifetime cancer risks and noncancer hazards for arsenic and the other COPCs for the exposures determined in Steps 1 and 2, using the toxicity values from Step 3; includes an analysis of uncertainties



# SITE 22 ARSENIC HEALTH RISKS

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## Exposure Assessment - Conceptual Site Model



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## Exposure Assessment – Chemical Intakes

$$I = \frac{C \times CR \times EF \times ED}{BW \times AT} \quad (H-1)$$

where

- $I$  = Intake: the amount of chemical at the exchange boundary (in milligrams per kilogram per day)
- $C$  = Chemical concentration: the exposure point concentration (for example, milligrams per kilogram for soil)
- $CR$  = Contact rate: the amount of contaminated medium contacted per unit of time or event; may be the ingestion rate, inhalation rate, or dermal contact rate (for example, milligram per day for the ingestion rate of soil)
- $EF$  = Exposure frequency: as previously defined (days per year)
- $ED$  = Exposure duration: as previously defined (years)
- $BW$  = Body weight: as previously defined (kilograms)
- $AT$  = Averaging time: as previously defined (days)



## SITE 22 ARSENIC HEALTH RISKS

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### Risk Characterization

- For cancer risks

$$\text{Chemical-Specific Cancer Risk} = \text{Intake (mg/kg-day)} \times \text{Slope Factor (mg/kg-day)}^{-1}$$

$$\text{Pathway-Specific Cancer Risk} = \sum \text{Chemical-Specific Cancer Risk}$$

For noncancer hazards

$$\text{Hazard Quotient} = \frac{\text{Intake (mg/kg-day)}}{\text{Reference Dose (mg/kg-day)}}$$

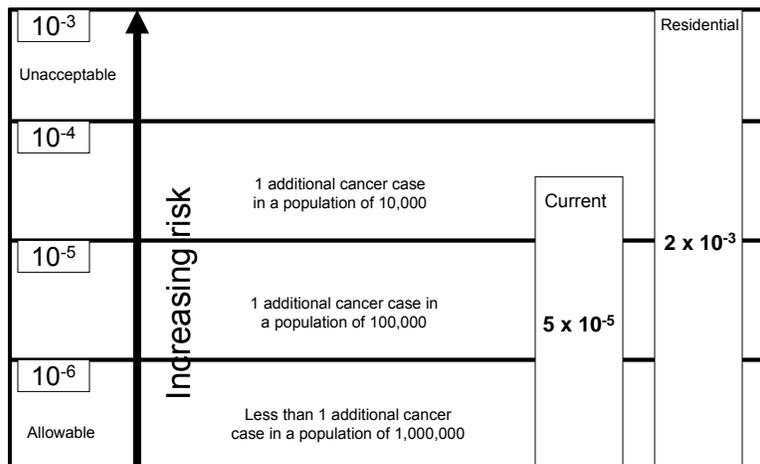
$$\text{Hazard Index} = \sum \text{Hazard Quotient}$$



## SITE 22 HEALTH RISKS

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### Results – Highest Cancer Risks for Current and Residential Land-Use Scenarios\*



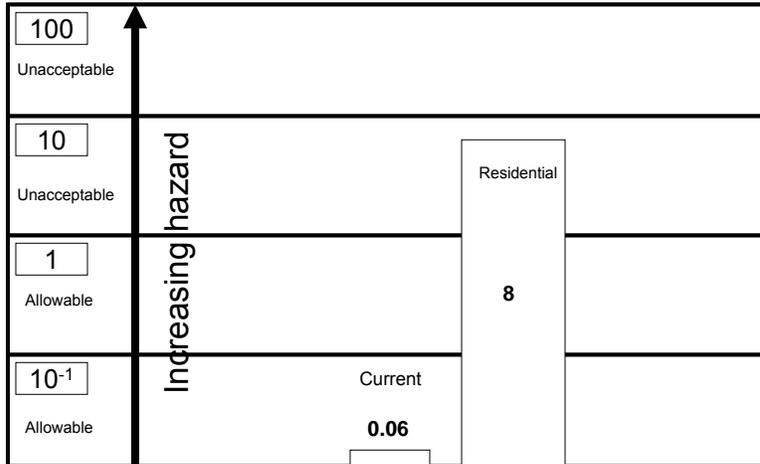
\*Residential is used for a conservative estimate.



# SITE 22 HEALTH RISKS

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## Results – Highest Noncancer Hazards for Current and Residential Land-Use Scenarios\*



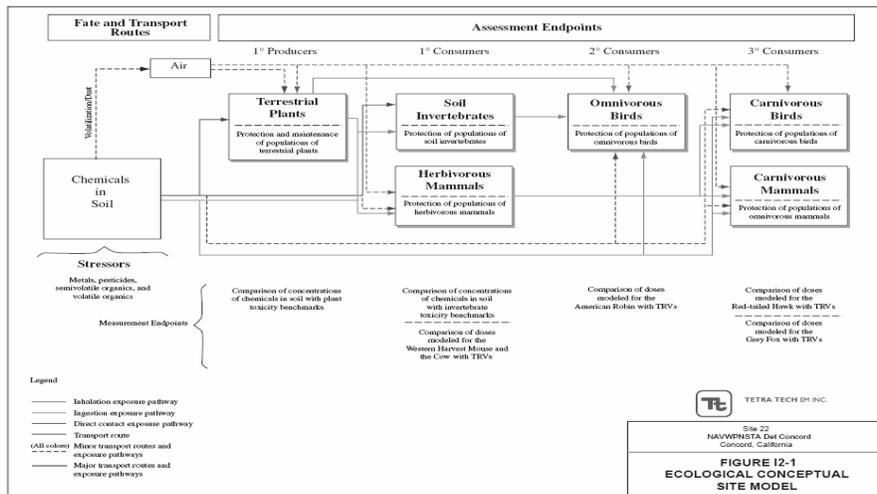
\*Arsenic responsible for the majority of the hazard.



# SITE 22 ECOLOGICAL RISKS

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## Screening-level Ecological Risk Assessment (SLERA)





## SITE 22 ECOLOGICAL RISKS

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### SLERA Exposure Assessment – Chemical Intakes

$$\text{Dose}_{\text{total}} = \frac{([\text{IR}_{\text{prey}} \times \text{C}_{\text{prey}}] + [\text{IR}_{\text{soil}} \times \text{C}_{\text{soil}}]) \times \text{SUF}}{\text{BW}}$$

where:

- $\text{Dose}_{\text{total}}$  = Estimated dose from ingestion (milligrams per kilogram body weight-day [mg/kg/day])
- $\text{IR}_{\text{prey}}$  = Ingestion rate of prey (kilograms per day [kg/day])
- $\text{C}_{\text{prey}}$  = Concentration in dry weight of COPEC in prey (mg/kg)
- $\text{IR}_{\text{soil}}$  = Ingestion rate of soil (kg/day)
- $\text{C}_{\text{soil}}$  = Concentration in dry weight of COPEC in soil (mg/kg)
- $\text{SUF}$  = Site use factor (unitless)
- $\text{BW}$  = Adult body weight (kilogram)



## SITE 22 ECOLOGICAL RISKS

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### SLERA Risk Characterization

$$HQ = \frac{\text{Dose}}{\text{TRV}} = \frac{(\text{mg} / \text{kg} - \text{day})}{(\text{mg} / \text{kg} - \text{day})}$$

where:

- HQ = Hazard quotient (unitless)
- Dose = COPEC-, receptor-, and site-specific daily dose estimate (mg/kg/day)
- TRV = COPEC- and receptor-specific toxicity reference value (mg/kg/day)

**SLERA risk characterization indicated need for BERA  
– baseline ecological risk assessment**



## SITE 22 ECOLOGICAL RISKS

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### BERA As Results

#### For plants

- HQ's > 1 but As not detected in plant tissue samples from site
- Conclude minimal risk to plants

#### For invertebrates

- Some HQs > 1 but low confidence in benchmarks
- Conclude minimal risk to invertebrates

#### For avian species

- HQs < 1
- Conclude As does not pose unacceptable risk to omnivorous birds

#### For mammalian species

- HQs < 1
- Conclude As does not pose unacceptable risk to herbivorous or omnivorous mammals



## QUESTIONS

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