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MEMORANDUM

TO: Chris Parent, Project Manager
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FROM: Patty W. Wong-Yim, Ph.D.
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DATE: August 3, 2005

SUBJECT: Draft – Risk Assumptions Document, Former Benicia Arsenal, Benicia, California. Document Dated May 2005.

PCA: 14740 Site: 201114-47

BACKGROUND

Document Reviewed: In response to your email on May 11, 2005, the Human and Ecological Risk Division (HERD) has reviewed a Draft – Risk Assumptions Document, Former Benicia Arsenal, Benicia, California. Document was prepared by US Army Corps of Engineers (USACE) and was dated May 2005.

Location and Setting: The Benicia Arsenal is a formerly used defense site (FUDS), located on 2,728 acres in Benicia, California. It functioned as an arsenal from 1849 to 1964. According to records of primary Department of Defense (DoD) land uses, the Former Benicia Arsenal (Arsenal) comprised five areas; Area W (Warehouse Area), Area I (Industrial/Manufacturing Area), Area R (Revetment/Explosives Holding Area), Area M (Motor Pool and Historical Ordnance Storage Area), and Area S (Magazine Storage Expansion Area).

Previous Activities: On February 27, 2004, HERD provided our comments to an Expanded Site Inspection (SI) Draft Field Site Investigation Plan (FSIP) for the Arsenal. On June 22, 2005, HERD participated in a Restoration Advisory Board (RAB) meeting. On July 15, 2005, HERD reviewed a Draft Expanded Site Inspection (ESI) Report for Environmental Investigation at the Arsenal.

GENERAL COMMENTS

1. **Scope of Review:** HERD has primarily confined its review of the document to those sections concerning risk assessment. Any future changes or additions to the document should be clearly identified.

2. **Objective of Project:** In accordance with the FUDS program guidance, the USACE performed an ESI to identify the presence of DOD-related chemicals that may have impacted the environment at the Arsenal. The Draft Risk Assumptions Document presents assumptions and methodology adopted for performance of a baseline human health risk assessment (BHHRA) for the Arsenal.

3. **Background Data:**
3.1. Background Soil Data: Section 2.3.1 describes statistical analyses used in inorganic COPC screening. The document cites a Preliminary Data Characterization for Metals Concentrations in Soil (Brown and Caldwell, 2003) as a source of background soil data. HERD will review the document to decide whether the data are suitable for BHHRA purposes.

3.2. Background Groundwater Data: The document provides no information on background groundwater data. In the absence of an established groundwater data set, the BHHRA must include all detected inorganics as COPCs.

4. **Human Health Risk Assessment Methodology and Criteria:**
4.1. Baseline Human Health Risk Assessment: Based on the following reasons, HERD disagrees that a single BHHRA can adequately cover the entire Arsenal:
- large acreage of the Arsenal,
- complex hydrological and geological properties among the Areas, and
- diverse site histories and complex current land uses onsite.

4.2. Potential Human Receptors: We do not concur with the BHHRA evaluating exclusively intrusive industrial workers (construction workers and utility workers) at the Arsenal. HERD's policy requires the inclusion of both current and future potential human receptors in risk assessment (DTSC, 1994a). Although the report states, "*Current land use throughout Benicia is industrial*", it proposes conducting only a construction worker risk assessment (Section 2.1.3). Moreover, residential use, industrial use, mixed uses, and a child care facility are currently present within boundary of the Arsenal. No land use restrictions are current imposed in the area. Taken together, we recommend including all the potential human receptors (listed in Table 1) in the BHHRA.

4.3. Conceptual Site Model: We recommend revising the conceptual site model (Figure 2.1) to reveal all the potential exposure pathways (including soil depth) for each human receptor listed in Table 1.

Table 1. Recommended Potential Human Receptors, Exposure Pathways, and Environmental Medium of Concern for the BHHRA.

Potential Human Receptor	Complete Exposure Pathway	Environmental Medium of Concern
Current Residents	Soil: – incidental ingestion – inhalation of soil particulates in ambient air – inhalation volatiles in indoor air (vapor intrusion) – direct dermal contact Groundwater: – consumption of drinking water – inhalation of volatiles during domestic uses of groundwater – inhalation of volatiles in indoor air (vapor intrusion) – dermal contact during bathing	surface soil subsurface soil groundwater soil gas
Current Industrial Workers	Soil: – incidental ingestion – inhalation of soil particulates in ambient air – inhalation of volatiles in indoor air (vapor intrusion) – direct dermal contact Groundwater: – consumption of drinking water – inhalation of volatiles in indoor air (vapor intrusion)	surface soil groundwater soil gas
Future Residents	same as Current Residents	surface soil subsurface soil groundwater soil gas
Future Industrial Workers	same as Current Industrial Workers	surface soil subsurface soil groundwater soil gas
Future Construction Workers (performing construction, utility install/repair, and excavation activities)	Soil: – incidental ingestion – inhalation of soil particulates in ambient air – inhalation of volatiles in outdoor air – direct dermal contact Groundwater: – consumption of drinking water – inhalation of volatiles in indoor air (vapor intrusion) – direct dermal contact	surface soil subsurface soil groundwater soil gas

4.4. Chemical of Potential Concern Identification: Section 2.3 describes steps adopted in COPC screening.

4.4.1. *Essential Nutrients*: HERD typically allows elimination of macro-nutrients (including sodium, potassium, calcium, magnesium, and phosphate) as chemicals of potential concern (COPCs). However, we do not accept screening out micro-nutrients (e.g. **boron**, chromium, cobalt, **iron**, manganese, molybdenum, nickel, selenium, and zinc etc.) based on reasons other than site concentrations below site-specific background levels. Despite being essential for human health, these micro-nutrients pose toxicity at high concentrations. Therefore, the BHHRA must include iron and boron, if their site concentrations are above the established site-specific background levels. In order to address risk contributed by naturally occurring inorganics in soil and groundwater, we strongly recommend including total risk from all COPCs, background inorganic risk, and incremental risk in the BHHRA.

4.4.2. *Toxicity Criteria*: HERD does not allow elimination of chemicals from risk assessment based on site concentrations below any risk-based toxicity criteria. Additionally, we do not accept the use of USDA Food Safety and Inspection Service upper intake levels (ULs), Federal or California maximum contaminant levels for drinking water (MCLs), and Benicia screening levels (BSLs) in risk assessments. MCLs are not risk based numbers. They reflect risk management considerations, which are not suitable for risk assessment. Also, we have not approved the use of BSLs in risk assessment. HERD does approve the use of USEPA Region IX Preliminary Remediation Goals (PRGs); only in screening level risk assessment and in accordance with our memorandum (DTSC, 1994b).

4.4.3. *Other Inorganic Chemical of Potential Concern and Statistical Analysis*: Irrespective to data distributions, the document suggests using a Wilcoxon rank-sum (WRS) test to compare site data and background concentrations for inorganics (other than essential nutrients) COPC identification.

4.4.3.1. Parametric Test: According to the DTSC background guidance (DTSC, 1997), we recommend using parametric tests (e.g. Students' t test) on inorganics with site data and background data of the same and defined distribution (i.e. both normal or both lognormal).

4.4.3.2. Non-Parametric Test: We suggest using non-parametric tests to compare data of different distributions or undefined distributions. Be aware that the WRS test is valid only on data sets with moderate non-detects (i.e. less than 40% of the data are non-detects; Gilbert, 1987 and DTSC, 1997). Also, unlike the Students' t test, which analyzes data dispersion, the WRS test compares only relative data ranking. As a result, the WRS may overlook outliers or extremes, which are critical in identification of hotspots. Therefore, we recommend including probability plots and box-and-whisker plots of both site and background data in the BHHRA report.

4.4.3.3. Threshold Method: The USACE needs to clarify if the BHHRA will present any statistical analysis on data sets of more than 40% non-detects. We often recommend a

simple comparison between site maximum concentrations and the 95th percentile of background concentrations. For background data with undefined distribution, we generally suggest a default lognormal distribution assumption to provide a conservative estimation on the 95th percentile concentrations.

4.5. Exposure Assessment:

4.5.1. *Indoor Air Risk Evaluation*: We disagree that the BHHRA will not quantitatively evaluate indoor air risks because the Johnson and Ettinger Vapor Intrusion Models were designed for residential risk estimation. We urge the USACE to follow the DTSC indoor air guidance (DTSC, 2005) for specific information on use of the DTSC-modified Johnson and Ettinger Vapor Intrusion Models in site-specific (industrial and residential) indoor air risk evaluations. In addition, we disagree that the BHHRA is "an industrial risk assessment". The Arsenal currently encompasses residential, industrial, and mixed uses. There are no land use restrictions within the site boundary. We consider the vapor intrusion pathway as one of the major exposure pathway for both industrial workers and residents.

4.5.2. *Exposure Point Concentration*: The BHHRA will provide a reasonable maximum exposure (RME) and a central tendency (CT) evaluations.

4.5.2.1. Maximum Concentration: We find it inappropriate to use maximum soil concentrations over the entire Arsenal area as soil exposure point concentrations (EPCs, Section 3.1.1). The Arsenal encompasses over 2000 acres and was involved to a wide spectrum of military activities. We recommend performing individual risk assessment for each site, or sites with similar contamination and in close proximity.

4.5.2.2. Ninety-Fifth Percentile of the Upper Confidence Limit of the Mean: When adequate data are available, the BHHRA will derive 95th percentiles of the upper confidence limit of the mean (UCL95s, in place of the maximum Arsenal concentrations) as soil EPCs in the RME evaluation. The BHHRA will determine UCL95s by grouping data from within "*refined exposed areas delineated based on a review of the site-characterization data*". Please define the "*refined exposed areas*". In the absence of this information, we defer our comments on the UCL95 calculation until we review the BHHRA.

4.5.2.3. Mean Concentration: The BHHRA will use mean concentrations from "*representative data*" in the CT evaluation. Please specify the criteria for choosing these "*representative data*". More importantly, the mean concentrations and hence the central tendency evaluation may not be protective of sensitive populations. Therefore, we do not recommend using results from the CT evaluation to support risk management decisions for the Arsenal.

4.5.2.4. Groundwater Exposure Point Concentrations: We disagree that the BHHRA will use groundwater EPCs calculated by averaging concentrations from monitoring wells defining center of groundwater plumes over the Industrial Area. Considering the multiple (discrete or commingled) plumes with various contaminants at various concentrations in the Industrial Area, we recommend performing groundwater risk

calculations for each discrete groundwater plume. We also suggest deriving the UCL95s from the most current groundwater data collected near/at the center of each plume. The BHHRA should use the UCL95s as groundwater EPCs in the RME evaluation. Because of the presence of inherent uncertainties in indoor air risk modeling, future building locations, and potential occurrence of remediation activities at hotspots, the UCL95s must also be used as source concentrations in the indoor air risk evaluations. Furthermore, the document should provide information on calculation of groundwater EPCs for the CT evaluation.

4.5.3. *Dermal Exposure Assessment*: For risk assessment purposes, we recommend following the most current guidance. The document reveals that the BHHRA will adopt the USEPA dermal guidance (USEPA, 2001) in dermal exposure evaluations. Please be aware that the USEPA recently issued the final dermal guidance (USEPA, 2004). In addition, HERD is reviewing USEPA recommendation on use of gastrointestinal oral absorption factors in oral toxicity criteria adjustment during dermal risk evaluation. In the meantime, we advise not adjusting the oral toxicity criteria because of uncertainty in these factors.

4.5.4. *Default Exposure Parameters*: Unless site-specific information is available, we recommend the following DTSC and USEPA guidance on default exposure parameters for each human receptor.

4.5.4.1. Exposure Frequency: We typically recommend an exposure frequency (EF) of 250 days/year in combination of an exposure duration (ED) of one year and 25 years for construction and industrial workers, respectively. Length of construction activities vary from days to years. We disagree that a 60 days/year is a high-end estimate of the EF (Tables 3.1, 3.2), especially if it is not based on any scientific statistics or site-specific information.

4.5.4.2. Soil Ingestion Rate: Table 3.1 lists an average soil ingestion rate of 215 mg/kg for construction workers, while Section 3.3.6.1 indicates an average value of 200 mg/day. None of these sections provide references to support their values. We recommend editing the document for internal consistency and also provide a proper reference to support the average soil ingestion rate for construction workers.

4.5.4.3. Direct Dermal Contact to Soil: We recommend a surface skin area of 5700 cm^2 and a soil adherence factor of 0.8 mg/cm^2 for direct dermal soil contact of construction workers (DTSC, 2000).

4.5.4.4. Average Time: According to the USEPA (USEPA, 1989) and DTSC risk assessment guidance (DTSC, 1994a), average times (AT_c) for carcinogenic effect and non-carcinogenic effect (AT_{nc}) are calculated as below:

Carcinogenic effect: AT_c = 70 year X 365 day/year
Non-carcinogenic effect: AT_{nc} = ED X 365 day/year

Where, ED represents exposure duration (years) which equals to one year for construction workers. Please amend the equations in Sections 3.2.1, 3.2.2, 3.2.3, 5.1, and 5.2.

4.6. Toxicity Assessment:
4.6.1. *Toxicity Criteria Hierarchy*: The Arsenal is a formally used defense facility. We recommend the following toxicity criteria hierarchy for all California Military Facilities (DTSC, 1994a):
- Cal/EPA Toxicity Criteria (OEHHA database, internet)
- USEPA Toxicity Criteria (IRIS database, internet)
- USEPA Region IX PRGs Table (USEPA, 2004)
- USEPA Preliminary Peer-Reviewed Toxicity Values (PPRTVs)
- ATSDR Minimum Risk Levels (ATSDR, internet)

4.6.2. *Toxicity Criteria for Iron*: Although the USEPA Region IX PRG (USEPA, 2004) for iron may be controversial for risk assessment purposes, the USEPA Region IX recommends it as a toxicity criterion for risk assessment of Superfund sites. Therefore, we believe that the USEPA Region IX PRGs (USEPA, 2004) are more appropriate than the USDA ULs for the BHHRA. We understand uncertainties and limitations occasionally present in risk assessment. We encourage the USACE includes these discussions in the uncertainty section of the BHHRA. Should iron become a risk management issue, HERD will discuss the limitation of the PRG with the risk manager.

4.6.3. *Point of Departure for Risk Assessment*: Cancer risks in the range of 10^{-4} to 10^{-6} are in the risk management range where the risk managers reach a decision on an appropriate action within the range of risk. HERD does not agree that all risks less than 10^{-4} necessarily represent acceptable risks. The National Contingency Plan (NCP) point of departure is 10^{-6} when determining whether a human receptor is "at risk" as per Risk Assessment Guidance for Superfund (RAGS) Volume I- Human Health Evaluation Model (USEPA, 1989) and Part B, Development of Risk-Based Preliminary Remediation Goals (USEPA, 1991). As stated in 40 CFR 300.430: "*For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound life time cancer risk to an individual between 10^{-4} to 10^{-6} using information on the relationship between dose and response. The 10^{-6} risk level shall be used as the point of departure for determining remediation goals for alternatives when ARARS are not sufficiently protective because of the presence of multiple contaminants at a site or multiple pathways of exposure.*" The 10^{-6} risk level is the point of departure. Acceptable risk levels are generally between 10^{-4} and 10^{-6}, however the actual level of acceptable risk is a site-specific risk management decision. Therefore, in concordance with the NCP, 10^{-6} is the point of departure for acceptable risk in human health risk assessment for all potential human receptors.

5. **Ecological Risk Assessment**: HERD's policy requires the preparation of an ecological risk assessment at all sites with viable habitat for ecological receptors. If the site does not possess such habitat, then documentation for this assertion must be provided to the Department. Based on HERD site visits and proximity of the Arsenal to Suisun Bay, HERD's opinion is that the Arsenal provides viable habitat. The USACE

should meet with a HERD ecotoxicologist to discuss the preparation of a workplan for an ecological risk assessment. This should probably occur following a site visit. The Draft Risk Assumptions Document contains no information on the ecological risk assessment of the Arsenal. In order to support risk management decisions, the USACE must consider potential impacts to both human health and the environment on each site.

DISCUSSION and CONCLUSIONS

This memorandum provides HERD's comments on revisions and additions to the Draft Risk Assumptions Document. As stated above, significant deficiencies are present in assumptions on human receptors, exposure pathways, and default parameters that we cannot accept the document at this time. In addition, the USACE should meet with a HERD ecotoxicologist to obtain guidance on the preparation of a workplan for an ecological risk assessment. We strongly recommend that the USACE responds to our comments before preparing the risk assessment document.

If you have any questions or concerns, please contact me at (916) 255-6438.

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