N00221_000820
MARE ISLAND
SSIC NO. 5090.3.A

Department of Toxic Substances Control

Dan Skopec
Acting Secretary
Cal/EPA

Maureen F. Gorsen, Director
8800 Cal Center Drive
Sacramento, California 95826-3200

Arnold Schwarzenegger
Governor

April 26, 2006

Mr. Jerry Dunaway
Base Closure Manager
BRAC Program Management Office West
1455 Frazee Road, Suite 900
San Diego, California 92108-4310

Dear Mr. Dunaway:

DRAFT REMEDIAL INVESTIGATION REPORT, INSTALLATION RESTORATION PROGRAM SITES WITHIN INVESTIGATION AREA F1 FORMER MARE ISLAND SHIPYARD, SOLANO COUNTY

Thank you for providing the Department of Toxic Substances Control (DTSC) the opportunity to review the *"Draft Remedial Investigation Report (RI Report) Installation Restoration Program Sites Within investigation Area F1, Former Mare Island Naval Shipyard"* dated February 2005. The RI Report was prepared by Sullivan Consulting Group and Tetra Tech EM on behalf of the South West Division, Naval Facilities Engineering Command. DTSC comments are provided in three parts. First, comments below address the RI Report as a whole. The other two attached parts are from our Human and Ecological Risk Division on the human health risk assessment and the Ecological risk assessment.

In General the RI Report requires considerable additional effort for it to be complete. As noted in the review comments, the RI Report does not address all of the sites within Investigation Area F1. A considerable area within investigation Area F1 will require additional investigations. We understand that a preliminary assessment / site investigation (PA/SI) is being proposed for these areas. We suggest that the PA/SI address the entire site including data gaps identified. Once the data is collected, the PA/SI needs to be incorporated into the RI and the risks to the human health and ecological hazards must be re-evaluated before the RI Report is resubmitted for review.

General Comments:

1. Comprehensiveness of the RI report: The RI Report breaks apart Investigation Area F1 into six sectors. Some areas and sites remain unassigned to a sector. Summary data for the six sectors is provided. However, no information is provided for the remaining sites outside these six sectors. The RI report does not state why these areas were not investigated or when will be addressed. DTSC considers the RI Report to be incomplete without the evaluation of these sites.

   Additionally, the RI Report does not provide data or rational for eliminating buildings/Areas for further investigation within the sectors. The RI should either present the historical data and rational for eliminating these buildings/area for further evaluation or should be listed as areas of concern for future investigation.

2. Scope of the RI Report: The executive summary states that "the primary objective of the RI for Investigation Area F1 is to characterize the nature and extend of the contamination resulting from past activities at the site." We agree with the above objectives. However the RI report limits its scope to chemical investigation and does not address or leaves out certain parts including radiological sites, munitions and explosives of concern (MEC), polychlorinated Biphenyl sites, and underground tanks.

   We understand that some of the above issues are being addressed in separate programs. The final determination of these programs including the risk hazards should be presented in the RI for evaluation or present a process for incorporating these programs into the process.

3. Human Health Risk Assessment: The RI Report should present the risk data for the potential future residents along with the construction and commercial/industrial worker. This information will be needed to complete the feasibility study and determine if cleanup to unrestricted reuse is necessary.

4. Risk Management Range: The RI Report states that the risks between one in ten thousand (10^{-4}) and one in one million (10^{-6}) is in the risk management range and risk management decisions or an evaluation of remedial or removal action alternatives may be warranted.

   DTSC policy is that a remedy resulting in cumulative site risk of lower than or equal to10^{-6} is acceptable for unrestricted use. A remedy resulting in a

cumulative site risk between 10^{-6} and 10^{-4} may be acceptable, with justification acceptable to DTSC, for unrestricted use. Each remedy proposed within that risk range must be evaluated individually to ensure that it is acceptable with regard to human health and the environment. The individual risks of all the contaminants of concern are used to calculate the cumulative risk for a site. DTSC is conservative in making risk management decisions, and requires substantial justification to accept a cumulative site risk of more than one in one million (10^{-6}).

Additional evaluation and justification is required for sites that have risks that fall within the risk range 10^{-6} and 10^{-4}. Depending on the evaluation in the Feasibility Study stage, remediation measures maybe required for the protection of the human health. Sites can not be eliminated in the RI stage.

5. Data and figures from previous investigations: The RI Report provides a summary discussion of the previous investigations. However, data and figures from these investigations are not presented. Historical information should be presented in the RI Report as it aids the reader in understanding the rational used for choosing the sampling locations in the RI.

6. Decision Summary and Data Gap Evaluations: One of the key questions identified in the data quality objectives is to answer whether the lateral and vertical extent of contamination is adequately defined. In all cases for each sector, the RI Report provides a generic statement that the chemicals of concern within the sector are adequately characterized. DTSC disagrees with this conclusion that the contaminate plumes have been adequately characterized. For Example in Sector 2, TCE was detected at 4,300µg/L and the source and the extent was not adequately explained. The RI Report must thoroughly check whether each contaminant of concern has been adequately characterized to make a risk management decision.

7. Conclusions and recommendations: DTSC will not comment on the conclusions and recommendations portion of the RI Report until the additional information is provided and included as part of the RI.

Specific Comments:

1. Section 1.0, Introduction, Page1-2: The text states "Results of the Group II/III accelerated study identified 39 buildings that either were not recommended for further investigation under the RI or warranted no further action. These buildings, along with the building identified during the PA/SI for ordnance sites

that did not warrant further investigation, were excluded for investigation under this RI. These buildings will be addressed separately under a PA/SI." The above text is not clear if all buildings are accounted for. State whether further investigation is warranted or closure documentation exist stating that they require no further action. At a minimum, the RI Report should have a complete listing of all buildings/areas of concern within the IA-F1. The list should indicate the status of each building/area.

2. Section 1.4.4, Selection of Comparison Criteria, Page 1-26: The text states that only those chemicals detected at concentrations above comparison criteria are discussed the RI Report and chemicals detected below comparison criteria are not discussed because they are not expected to pose a significant risk to human health or the environment. It is necessary to include, discuss and post all the data on maps so that the reader can analyze the data and determine if adequate investigation is provided.

3. Section 1.2.3.11, Additional Sampling at IA F1, 2003: The results of the additional sampling from the PA/SI should be incorporated in the RI Report. DTSC considers the RI Report as incomplete without the PA/SI being incorporated.

4. Section 1.8, Applicable or Relevant and Appropriate Requirement (ARARs), Page 1-40: DTSC will submit the ARARs in a separate submittal for the IA-F1.

5. Section 3.3.3.3, Summary of Soil and Groundwater Sample Results: The extent of the trichloroethene (TCE) contamination in soil has not been adequately characterized. Additional sampling may be required along the areas north and south of the eastern portion of the building. It is not clear if any samples were taken along the floor drains and exit points.

6. Section 3.4.2, Groundwater Investigation, Page 3-13: Please revise the error on this page. Last sentence of the page should state "Groundwater in Subarea 2 does not pose risk to ecological receptors."

7. Section 3.4.3, Decision Summary: DTSC disagrees that the extent of the TCE contamination is adequately characterized in soil and groundwater. Lateral extend of TCE in soil must be bounded and the single hit of high concentration of TCE in the groundwater grab sample must be further explained.

8. Section 4.3.3.1, Soil Sample Results, Page 4-6: The text states that vinyl chloride was detected in soil sample collected during the MEC intrusive investigation. The report does not discuss in detail the scope of the sampling used during the MEC excavations. Please clarify if volatile organic compounds (VOCs) sampling was conducted all along the bottom and sidewalls of the excavations. If this was done, please present this information in the RI Report.

9. Section 4.3.3.3, Summary of Soil and Groundwater Sample Results. The text states that the extent of vinyl chloride is delineated in soil and groundwater. DTSC can not make this determination based on the information provided. The report should present all data for soil and groundwater including maps indicating locations of the detected hits.

10. Section 4.4.2, Groundwater Investigation, Page 4-10: Please discuss how the risks to future commercial/industrial worker for indoor air were calculated.

11. Section 5.4.3, Decision Summary, Page 5-15: The text states that no further action is required to address the human health risks even though the risk for the Subarea 4 is greater than 10^{-6}. DTSC requires additional measures to be taken when risk are greater 10^{-6}. Please review general comments for more details.

12. Section 6.3.3.3, Summary of Soil and Groundwater Sample results, Page 6-11: The text on top of the page erroneously states that lead was above comparison criteria in two soil samples. The table on Page 6-7 indicates that four different locations had soil sample results above the comparison criteria. Please conduct a review of the data and present the accurate information. Also, review the Human Health Risk Assessment Summary section regarding the number of lead hit occurrences and its impact for human risks.

If you have questions regarding these comments/recommendations, feel free to contact me at (916) 255-3610 or via email at RGhazi@dtsc.ca.gov.

Sincerely,

Rizgar A. Ghazi, P.E.
Project Manager
Office of Military Facilities

Attachments

cc: Mr. Dennis Kelly
Tetra Tech EM, Inc.
135 Main Street, Suite 1800
San Francisco, California 94105

Ms. Carolyn d'Almeida
U.S. Environmental Protection Agency
413 Poppyfield Drive
American Canyon, California 94503

Mr. George Leyva
Regional Water Quality Control Board
San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, California 94612

bcc: Mr. Chip Gribble
Department of Toxic Substances Control
Office of Military Facilities
700 Heinz Avenue, Suite 200
Berkeley, California 94710-2721

Department of Toxic Substances Control

Dan Skopec
Acting Secretary
Cal/EPA

8800 Cal Center Drive
Sacramento, California 95826-3200

Arnold
Schwarzenegger
Governor

MEMORANDUM

TO: Rizgar Ghazi
Office of Military Facilities (OMF)
8800 Cal Center Drive
Sacramento, CA 95826-3200

FROM: John P. Christopher, Ph.D., D.A.B.T.
Staff Toxicologist
Human & Ecological Risk Division (HERD)
JChristo@dtsc.ca.gov 916.255.6630

DATE: 10 April 2006

SUBJECT: Mare Island: Draft Remedial Investigation Report for Investigation Area F1
PCA: 18040 Site: 201208-18

BACKGROUND

The former Mare Island Naval Shipyard is a closed military facility in Contra Costa County. Cleanup operations are being managed by Naval Facilities Engineering Command, Southwest Division. Investigation Area F1 (IA-H1) is on the southeastern portion of Mare Island, bordering on Mare Island Strait. This parcel is intended for eventual transfer to the City of Vallejo; re-use is currently scheduled to be light industrial. Area F1 is constructed of artificial fill, mainly dredge spoil from local sediments. Munitions were manufactured and stored in Area F1 for more than 100 years prior to base closure. The current document describes investigations of ordnance and explosives in 15 existing buildings. This memorandum contains comments on the human health risk assessment; ecological hazards are addressed in a companion memorandum from Dr. James Polisini of HERD.

DOCUMENT REVIEWED

We reviewed "Draft Remedial Investigation Report, Installation Restoration Program Sites within Investigation Area F1, Mare Island, Vallejo, California", dated February 2005. The report was prepared by Sullivan Consulting Group, Inc., and TetraTech EM Inc, contractors to the Navy. We focused our attention mainly on Appendix I, "Human Health Risk Assessment".

GENERAL COMMENTS

1. **Overall:** This risk assessment is very clearly presented. In particular, the methods used are very

well presented and explained. Cancer risks and non-cancer hazards for future workers at Area F1 are somewhat underestimated. The Navy's method of eliminating some COPC by comparison to screening criteria is not acceptable to DTSC. We require that the Navy include all chemicals of potential concern (COPC) and present complete estimates of concern risk and non-cancer hazard. After all COPC are included and the Navy presents new estimates of risk and hazard, we expect that Sub-Areas 1, 2, 3, 4, and 6 will present no significant non-cancer hazard for future workers and cancer risks will still fall within or below the risk management range of 1 E-6 to 1 E-4. Estimated cancer risks for future workers at Sub-Area 5 are at least as high as 4 E-5. Once all COPC are included, new estimates of cancer risk for future workers at Sub-Area 5 might exceed 1 E-4.

2. **Format of Report:** We thank the Navy for adding the very helpful hot links to the Adobe portable data file (pdf); these greatly aided our review. Unfortunately, in Appendix I, the Human Health Risk Assessment, links to references were only partially operational, and links to tables, figures, and sections of text did not work at all.

3. **Surrogate Chemicals:** The text and tables in the human health risk assessment used acceptable surrogate chemicals for detected chemicals with no published toxicity criteria, except for picric acid, as discussed below. However, text in Sections 2, 3, 4, and 5 of the main text states that chemicals with no toxicity criteria were not evaluated (*e.g.*, Sub-Area 1, "PAH Compounds in Soil", p. 2-6. Please correct the main text to reflect what was done in the risk assessment.

   Picric acid or 2,4,6-trinitrophenol was detected in soil in all sub-areas. This chemical has no published toxicity criteria, and the Navy chose not to select a surrogate chemical for it. The Navy should use an oral RfD of 5 E-4 mg/kg-day, which is the value in IRIS for 2,4,6-trinitrotoluene (TNT). Other possible surrogates for picric acid were 1,3,5-trinitrobenzene and 2,4-dintro-phenol. We chose TNT because it is at least as similar in structure as the other two candidates and has the lowest RfD.

4. **Screening of Chemicals:** DTSC guidance permits <u>sites</u> to be screened, but <u>not individual chemicals</u> (DTSC, 1994a,b). USEPA has similar guidance (USEPA, 2004) for the use of its Preliminary Remediation Goals, many of which are cited as screening values in the current document. Navy guidance on this subject, cited in this report as "Navy, 2001a", is not acceptable. We have notified the Navy of this fact of many prior occasions. The Navy has presented its assessment as though each chemical were present *in vacuo*. Receptors are exposed to the entire mixture of contaminants at a each site, not just to one chemical at a time. In Tables I-2.1 through I-2.15, the Navy presents comparisons of maximum detected concentrations (C_{MAX}) to screening values, but does not calculate ratios of the two, nor do they present a sum or such ratios. A site may be screened out as presenting no significant risk if the sum of those ratios is less than the benchmark of 1.0. Such sums of ratios should be presented separately for carcinogenic and non-carcinogenic effects. Similarly, cancer risks and non-cancer hazards due to volatile chemicals were not summed for the indoor air pathway, and the indoor air pathway was not summed with other pathways. This flaw in method must be corrected in the next draft of the risk assessment.

SPECIFIC COMMENTS

1. **Acceptable Risk, Sec. 1.3.5, p. 1-22:** This section seems to indicate that remedial options will be considered only if estimated cancer risks exceed 1 E-4 or non-cancer hazard exceeds 1.0. In fact, DTSC considers estimated cancer risks less than 1 E-6 to be acceptable. Risks in the range of 1 E-6 to 1 E-4 must be considered on a case-by-case basis (the "risk management range"). Risks greater than 1 E-4 typically require remedial action. Text in this section should agree with the correct presentation in Table 1-2.

2. **Ambient Levels of PAH, Sec. 1.4.4.1, p. 1-27:** All detected PAH must remain as COPC. DTSC does not accept elimination of PAH by comparison to "background" levels. Ambient levels of PAH might be valuable in risk management decisions, but they have no place in the risk assessment itself.

3. **Appendix K, Fate and Transport Modeling:** The Navy states that conservative assumptions were employed for modeling fate and transport in groundwater. However, we do not understand how health-protectiveness is maintained when the Navy assumes that a release occurred at the monitoring well farthest from the point of exposure within a sub-area. This practice would seem to minimize rather maximize the opportunity for any receptor to be exposed within that sub-area.

   Regarding degradation of chlorinated ethenes (p. K-3), DTSC requires a demonstration that biodegradation is occurring *in situ* before we will allow such degradation to influence the exposure point concentration. Although the Navy found conditions that could favor reductive dehydrocholorination of substances such as trichloroethylene, we require some attempt at constructing a mass balance between the parent contaminant and the by-products of degradation. This requires some knowledge of the mass of contaminant at the time of release. This could include attempts at measuring the extent of complete dechlorination to ethene or ethane, such as was performed by the Navy at NAS Point Mugu, IRP Sites 6 and 24.

   The text and a table on page K-8 show that sensitivity analysis included variation in three model parameters: velocity of groundwater flow (V), longitudinal dispersivity (α_X), and retardation factor (r). The table on page K-8 seems to suggest that values for V or α_X were held constant in the sensitivity analysis and only two trial values for r, yet five resultant exposure point concentrations are shown. What has occurred here?

   We are very interested in the BIOSCREEN model from the Air Force Center for Environmental Excellence, but the Navy presents virtually no descriptive text on how this model works. Please enlighten us.

4. **Potability of Groundwater, Sec. I.5.3, p. I-13:** The Navy states that shallow groundwater beneath Area F1 is non-potable due to high total dissolved solids. Only the San Francisco Bay Regional Water Quality Control Board can define the beneficial uses of California waters. We will assume for the purposes of this risk assessment that shallow groundwater beneath Area F1 is not drinkable, and that the pathway of domestic use of groundwater is not complete. However, the

Navy must eventually supply the Water Board's written confirmation of this to DTSC.

5. **Fisher's Exact Test, Sec. I.6.1.3, p. I-23:** Comparison of the proportions of detected values at a site to the same proportion in the ambient data set has no probative value whatsoever for selecting inorganic chemicals of potential concern (COPC). This portion of the otherwise excellent Navy guidance (Navy, 2002) should be ignored.

6. **Receptors, Sec. I.7.2.1, p. I-25:** We agree with the Navy that risk management decisions for Area F1 should be based on the construction and commercial/industrial exposure settings. Risks for potential future residents are presented in the report, but these are not highlighted.

7. **Comparing Site Concentrations to Screening Values in Sub-Area 1, Sec. I.10.1, p. I-42 & Table I-2.1:** [See General Comment 4 above.] The following comment applies to all sub-areas. The Navy states on page I-42 that no COPC were identified in Sub-Area 1. However, the method did not include consideration of possible additive effects of contaminants. The Navy's procedure does not follow DTSC guidance for screening risk assessments (DTSC, 1994a,b), and it is therefore not acceptable. The screening of COPC shown in Tables I-2.1 through I-2.15 is incomplete and must be re-done. This incorrect screening leads to underestimation of carcinogenic risk and non-cancer hazard in all sub-areas.

8. **Risk Characterization for Sub-Areas 1, 2, 3, 4, Sec. I.10.1 though I.10.4, pp. I-42 ff.:** The Navy estimates cancer risks in the range of 1 E-7 to 5 E-6 for future workers at Sub-Areas 1 through 4. Non-cancer hazard is estimated at ~1 E-3 for each sub-area, which is far below the benchmark of 1.0. Because some chemicals were screened out inappropriately and not included in the summation of cancer risk and non-cancer hazard, these values are underestimates, probably by <10-fold. Thus, cancer risks for future workers at the various sub-areas fall into the risk management range of 1 E-6 to 1 E-4, and non-cancer hazards are <1.0.

9. **Risk Characterization for Sub-Area 5, Sec. 10.5, pp. I-47 - I-48:** The Navy estimates cancer risks for soil pathways in the range of 2 E-7 to 2 E-6 for future workers at Sub-Area 5. Non-cancer hazard is estimated at ~2 E-2 for this sub-area, which is well below the benchmark of 1.0. Cancer risk to future workers due to intrusion of volatile chemicals from subsurface into indoor air is estimated at 4 E-5, driven mainly by perchloroethylene (PCE). Because some chemicals were screened out inappropriately and not included in the summation of cancer risk and non-cancer hazard, these are underestimates of risk and hazard, probably by <10-fold. The Navy concludes that cancer risks for Sub-Area 5 are within the risk management range of 1 E-6 to 1 E-4. However, we caution against accepting this conclusion until all COPC are included and all pathways are summed.

10. **Risk Characterization for Sub-Area 6, Attachment I3, pp. I3-1 ff.:** Estimates of cancer risk at Sub-Area 6 are driven by polychlorinated biphenyls (PCB) and PAH, especially benzo(a)pyrene. The non-cancer hazard index was estimated at 0.31, which is less than the benchmark of 1.0. This value is underestimated by an uncertain amount, due to inappropriate screening out of some COPC. Cancer risks for Sub-Area 6 were estimated to be 7 E-6. Even after inclusion of any missing carcinogenic COPC, this value is not likely to exceed the risk man-

agement range of 1 E-6 to 1 E-4. For comparison, the Navy estimates ambient non-cancer risk and hazard at 2 E-5 and 0.26, respectively, driven almost entirely by arsenic.

11. **Lead Exposures, Sec. I.10.7, pp. I-50 ff.:** Lead in soil was not encountered at concentrations higher than USEPA Region 9 Industrial PRG of 750 mg/kg. Therefore, levels of lead in soil are acceptable for future commercial or industrial use of the property.

12. **Residential Setting, Attachment I7, pp. I-1 ff.:** Residential development for Investigation Are F1 is not anticipated at this time. For Sub-Areas 1 through 5, the Navy estimates cancer risks in the range of 1 E-7 to 3 E-4. Non-cancer hazards are all <0.2. Estimated cancer risks of 2 E-4 at Sub-Area 4 and 3 E-4 at Sub-Area 5 were driven by trichloroethylene (TCE) in indoor air and used a cancer potency factor for TCE now retracted by USEPA. When the lower Cal/EPA cancer potency fact or was used for TCE, these estimates were reduced to 2 E-5 at Sub-Area 4 and 3 E-5 at Sub-Area 5.

13. **Modeling Vapor Intrusion with Soil Gas, Attachment I8, Sec. I.8.2.3, p. I8-4:** The Navy presents two estimates of concentrations of volatile organic chemicals in indoor air, one based on measurements in groundwater and the other based on soil gas. We recommend using the former and excluding the latter. From the many other sites we have seen at Mare Island, we have learned that groundwater is present at quite a shallow depth, 1-8 ft bgs, depending on the season. We have also learned that the artificial fill covering Area F1 and many other areas of Mare Island has a relatively low hydraulic conductivity. From these two factors, one can surmise that the capillary fringe above the shallow groundwater is probably quite thick, perhaps reaching almost to the surface. These subsurface conditions do not match the description of the vadose zone modeled by Johnson and Ettinger (Johnson, 2002; DTSC, 2005).

CONCLUSION AND RECOMMENDATIONS

1. The Navy may not eliminate COPC by comparison to PRGs. Risks and hazards for all organic chemicals detected and all inorganic constituents present at concentrations exceeding ambient conditions.

2. For COPC with no published toxicity criteria, the Navy must use surrogate chemicals of similar structure which do have published criteria. Please consult DTSC if any of the recommendations in the comments above are not clear.

3. DTSC requires that biodegradation be demonstrated *in situ*, rather than being inferred from the presence of possible degradation products in a medium.

4. Exposure point concentrations must be derived from data which maximize rather then minimize the probability of exposure occurring.

5. After all COPC are included and the Navy presents new estimates of risk and hazard, we expect that Sub-Areas 1, 2, 3, 4, and 6 will present no significant non-cancer hazard for future workers and cancer risks will still fall within or below the risk management range of 1 E-6 to 1 E-4. Es-

timated cancer risks for future workers at Sub-Area 5 are at least as high as 4 E-5. Once all COPC are included, new estimates of cancer risk for future workers at Sub-Area 5 might exceed 1 E-4.

6. Vapor intrusion to indoor air should be modeled using groundwater as a source term for all of Area F1, because groundwater is so shallow and the hydraulic condictivity of the surface soils is low.

Reviewed by: Michael J. Wade, Ph.D., D.A.B.T.
Senior Toxicologist, HERD

cc: Chip Gribble, OMF, Berkeley

REFERENCES

DTSC (1994a), "Preliminary Endangerment Assessment Guidance Manual", State of California Environmental Protection Agency, Department of Toxic Substances Control, January 1994 http://www.dtsc.ca.gov/SiteCleanup/Brownfields/upload/SMP_REP_PEA_CH1.pdf, http://www.dtsc.ca.gov/SiteCleanup/Brownfields/upload/SMP_REP_PEA_CH2.pdf, http://www.dtsc.ca.gov/SiteCleanup/Brownfields/upload/SMP_REP_PEA_CH3.pdf, and http://www.dtsc.ca.gov/SiteCleanup/Brownfields/upload/SMP_REP_PEA_Appendix.pdf.

DTSC (1994b), "Recommended Outline for Using U. S. Environmental Protection Agency Region IX Preliminary Remediation Goals in Screening Risk Assessments at Military Facilities", memorandum from Michael J. Wade, Laura M. Valoppi, and John P. Christopher, Office of Scientific Affairs, to Ken Smith, Chief Office of Military Facilities, 28 October 1994.

DTSC (2005), "Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air", Department of Toxic Substances Control, California Environmental Protection Agency, December 15, 2004, (Revised February 7, 2005), http://www.dtsc.ca.gov/AssessingRisk/upload/HERD_POL_Eval_Subsurface_Vapor_Intrusion_interim_final.pdf.

Johnson, P. C. (2002), "Identification of critical parameters for the Johnson and Ettinger (1991) vapor intrusion model", American Petroleum Institute, Technical Bulletin No. 17, May 2002.

Navy (2002), "Guidance for Environmental Background Analysis Volume I: Soil", prepared by Battelle Memorial Institute, Earth Tech, Inc, and Newfields, Inc., contractors to Naval Facilities Engineering Command, April 2002, http://enviro.nfesc.navy.mil/erb/erb_a/restoration/methodologies/bg_soil_guide.pdf.

SFRWQCB (2005), Screening For Environmental Concerns at Sites With Contaminated Soil and Groundwater (Interim Final - February 2005)", an San Francisco Bay Regional Water Quality Con-

trol Board, http://www.waterboards.ca.gov/rwqcb2/esl.htm .

USEPA (2004), "Users' Guide and Background Technical Document for USEPA Region 9's Preliminary Remediation Goals (PRG) Table", United States Environmental Protection Agency, Region 9, San Francisco, November 2004, http://www.epa.gov/region09/waste/sfund/prg/files/04usersguide.pdf)

Alan C. Lloyd, Ph.D.
Agency Secretary
Cal/EPA

Department of Toxic Substances Control

Arnold Schwarzenegger
Governor

Maureen Gorsen, Director
1011 North Grandview Avenue
Glendale, California 91201

TO: Rizgar Ghazi, DTSC Project Manager
Office of Military Facilities
8800 Cal Center Drive
Sacramento, CA 95826

Chip Gribble, DTSC Project Manager
Henry Chui, DTSC Project Manager
OMF Berkeley Office
700 Heinz Street, Second Floor
Berkeley, CA 94704

FROM: James M. Polisini, Ph.D.
Staff Toxicologist, HERD
1011 North Grandview Avenue
Glendale, CA 91201

DATE: April 14, 2006

SUBJECT: MARE ISLAND NAVAL SHIPYARD INVESTIGATION AREA (IA) F1 DRAFT REMEDIAL INVESTIGATION (RI) REPORT [SITE 201208-18 PCA 18040 H:56]

BACKGROUND

HERD reviewed the document titled *Draft Remedial Investigation Report, Installation Restoration Program Sites within Investigation Area F1, Mare Island, Vallejo, California*, dated February 2006. This document was prepared by Sullivan Consulting Group, Inc. of San Diego, California and Tetra Tech EM, Inc. of San Diego, California. The CD-ROM containing this document was received by HERD-Glendale on March 24, 2006. This review is in response to your verbal request.

IA F1 occupies about 62 acres along the eastern side of Mare Island. IA F1 is bordered to the north by IA F2, to the east by Mare Island Strait, to the south by IA G, and to the west by Railroad Avenue. The site is partially paved with asphalt, much of which is severely cracked and rutted.

Since the beginning of naval operations at Mare Island, ordnance was manufactured and stored at IA F1. The primary purpose of the Mare Island ordnance facility between 1857 and 1935 was to store and process the ammunition used aboard naval ships. Black-powder-loaded munitions were emptied and refilled while ships were being overhauled at the shipyard. In the 1890s, the Navy added facilities for loading gun cotton, and by 1916, the loading of Explosive D (ammonium picrate) was in full operation.

The area was upgraded to a Naval Ammunition Depot (NAD) in 1936. In 1957, NAD operations merged with the Naval Magazine Port Chicago, located across the Carquinez Strait at Bay Point, near the City of Concord. The consolidated installation was named "Naval Weapons Station (NWS) Concord." As a result, the area of munitions storage and maintenance operations at Mare Island was commonly referred to as the "Concord Annex."

In 1973, ordnance production activities in the Concord Annex ended. Many key production buildings, magazines, and warehouses were subsequently used to store inert materials and ordnance-related supplies. Some buildings were converted for use as office space (for example, the U.S. Coast Guard station in Building A228).

Mare Island Naval Shipyard (MINSY) was the first naval station on the Pacific Coast, where shipbuilding began in 1854. The former MINSY is located on a peninsula approximately 30 miles northeast of San Francisco. The peninsula is bounded to the east, south, and west by the Napa River (Mare Island Strait), Carquinez Strait, and San Pablo Bay, respectively. Mare Island was originally an island of approximately 1,000 acres with surrounding wetlands of approximately 300 acres. Fill material was added to enlarge Mare Island and connect it to the mainland. MINSY has been in operation under Navy control from approximately 1853 until the recent transfer to the City of Vallejo through the State Lands Commission.

GENERAL COMMENTS

This memorandum addresses only the Ecological Risk Assessment (ERA) portions of the IA-F1 Draft Remedial Investigation Report. HERD comments on the Human Health Risk Assessment (HHRA) will be furnished in a separate memorandum.

HERD is participating in development of the Offshore Data Gaps work plan and Data Quality Objectives (DQOs) for MINSY. Subarea 6 within IA-F1 is an area HERD has identified as requiring additional vertical sediment characterization to investigate deposition over time. No final decision should be made on IA-F1 Subarea 6 until this additional characterization if finished and evaluated.

Ecological ARARs have apparently not been submitted for IA-F1. Ecological ARARs for upland and non-tidal wetlands have been submitted for IA-H1. These ecological ARARs would seem applicable to IA-F1.

Several issues in the ERA methodology for vertebrate representative species require revision or further justification.

An additional set of Hazard Quotients (HQs) for vertebrate receptors is presented based on attempts to estimate the "bioavailable" fraction of Contaminants of Ecological Concern (COECs) rather than total concentrations. HERD recommends that the "bioavailable' estimate be used as additional information and not be the sole basis for IA-F1 remedial decisions.

SPECIFIC COMMENTS

1. In 2004, the Navy conducted data gap assessments on the presence of PCBs in 67 buildings at Mare Island. The goal of the PCB assessments was to evaluate the past PCB investigations and cleanups at these sites. Twenty-two of these sites are within the boundary of IA F1, and 13 of the 22 sites were recommended for further assessment. A summary table of the results of PCB confirmation sampling (SULLIVAN and Tetra Tech 2004) is contained in this document (Section 1.2.3.12, page 1-13). This comment is meant for the DTSC Project Manager and no response is required from the Navy or Navy contractor.

2. Nineteen USTs were suspected of being within IA F1. Of these 19 tanks, twelve were removed, 5 were not located, and 2 were concluded to not be USTs. Five of the 19 sites were designated closed (Section 1.2.3.2, page 1-9). Ordnance-related buildings originally in Investigation Area (IA) F2 were transferred to IA F1. Samples originally collected as site characterization for IA F2 were used in the risk assessment of IA F1 (Section 1.2.3.3, page 1-10). This comment is meant for the DTSC Project Manager and no response is required from the Navy or Navy contractor.

3. Although a HHRA comment, the current release, dated 2004, of the U.S. EPA Region 9 Preliminary Remediation Goals (PRGs) should be utilized rather than the 2002 release (Section 1.4.4.1, page 1-27). The 2004 trivalent and hexavalent chromium residential and industrial PRGs referenced were checked and found to be identical to those listed in the 2004 release. Please amend the citation in the text.

4. IA F1 is located predominantly on filled land. Ambient concentrations for fill soils were defined as the 95th percentiles of concentrations within a data set of ambient soil concentrations (Section 1.4.4.1, page 1-27). Please document the inclusion of filled land samples in the Mare Island Naval Shipyard soil background investigation (Tetra Tech, 2002) as justification for using soil background concentrations for all fill materials whether terrestrial or intertidal (i.e., sediment).

5. Ecological Applicable or Relevant and Appropriate Requirements (ARARs) have apparently yet to be furnished for IA F1 by the State regulatory agencies and resource trustees (Section 1.8, page 1-40). ARARs have been furnished for the Ecological Risk Assessment (ERA) for the IA H1 Feasibility Study (FS). Ecological habitats at IA H1 include upland and non-tidal wetland habitats. These ARARS should be applicable to IA F1.

6. Aerial photographs of Mare Island Strait indicate that IA F1, Subarea 6 (Figure 1-2), is a mudflat which appears to have developed by deposition in the period between World War II and 1970. This mudflat is directly down stream from IR Site 04, the former sand blast area. HERD has identified Subarea 6 for further sediment investigation via coring in the Offshore Data Gaps Investigation.

7. Ten of 24 species of bats extant in California are California Species of Special Concern (CSSC) (http://www.dfg.ca.gov/hcpb/species/ssc/sscmamml/sscmamml.shtml). Abandoned buildings, hillside shelves and upland trees in IA F1 would appear to offer significant bat roosting potential. Bats should be listed as potentially present in IA-F1 (Table 1-1 and J-1).

8. The term residue is applied to residue in drains (Section 5.1.1, page 5-1, Building A75) or explosive powder residue (Section 6.1.1, page 6-1). Some contaminants appear to be extremely elevated in these "residue" samples. For example the lead concentration in residue samples from IA-F1 Subarea 2 (e.g., A080SD001, Table G-3, page 181) range to 73,700 mg/kg. These lead concentrations would pose an obvious ecological hazard, but residue concentrations do not appear to be discussed. Some global statement should be made regarding the samples identified as "residue" in IA-F1 and how these samples enter into, or are excluded from, the ERA.

SPECIFIC COMMENT APPENDIX J – SCREENING LEVEL ERA (SLERA)

9. HERD disagrees with the characterization of IA-F1 Subarea 6 sediments as "transient" as stated (Section 2.1.2, page J-6): "*The transient nature of*

the sediments means that they are more *likely to be affected by upstream sediments associated with Mare Island Strait than affected by surface soils from Mare Island.*". Even given the reversal of flow due to extreme high tides, during the usual flow in the Mare Island Strait IA-F1 Subarea 6 is immediately downstream of Installation Restoration (IR) Site 04, the green sand beach, in IA-F2. Aerial photographs presented during the October 21, 2005 Offshore ERA meeting indicate that significant sediment accretion occurred in Subarea 6 during the period from World War II through the 1970s. This was the period of IR 04 sand blasting operations and disposal of sand blast waste directly into Mare Island Strait. HERD proposed additional core samples in IA-F1 Subarea 6, at the October 21, 2005 meeting, as part of the Offshore ERA. The IA-F1 Subarea 6 data gaps appear to be significant enough to require delay of any IA-F1 final risk characterization conclusion on Subarea 6.

10. Please amend the text discussion of the inhalation pathway to indicate that inhalation of VOCs could be a significant pathway for burrowing vertebrates (Section 2.4.2, page J-11). This pathway may be excluded from the IA-F1 ERA if burrowing vertebrate species are not one of the vertebrate representative species considered in the IA-F1 ERA.

11. The Ecological Soil Screening Levels (EcoSSLs) available are used to screen Contaminants of Potential Ecological Concern (COPECs) for plants, soil invertebrates and vertebrate receptors (Section 2.4.3, page J-14). The 2003 posting of EcoSSLs is referenced as the source for plants, soil invertebrates and vertebrate receptors. Amendments and more recent postings are available (http://www.epa.gov/ecotox/ecossl/) as of March 15, 2005. For, example EcoSSLs for terrestrial plants were used for aluminum, cadmium, cobalt, iron, and lead (Section 3.1.2, page J-17), while additional plant EcoSSLs are available (e.g., arsenic 18 mg/kg). The most recent EcoSSLS should be used in the IA-F1 ERA where EcoSSLs are utilized.

12. The No-effect for trivalent chromium concentrations up to 500 mg/kg in sewage sludge may not applicable due to high carbon content and the extremely high number of sorption sites in sewage sludge (Section 3.2.1, page J-21) compared to in-place sediments. Toxicity results other than those associated with sewage sludge should be used for the IA-F1 ERA.

13. The statement regarding mammalian exposure to IA-F1 soils (Section 3.2.1, page J-24) is incorrectly stated. The exposure pathway from lead in soil to mammals is potentially present for IA-F1 soils. Please amend (add the underlined text) the statement to include the potential exposure relative to the adverse effect dose to read: "...but a direct pathway from

soil to mammals through plants which could potentially produce adverse effects can occur only when lead is present at very high levels in soil"

14. Relatively high molybdenum Bioaccumulation Factors (BAFs) for plants do not necessarily equate to high plant tissue concentrations of molybdenum (Section 3.2.1, page J-25). The highest plant molybdenum BAF is 3,300 for algae after a 1 hour exposure. The exposure concentration listed, however, is 0.000000005 grams/L (i.e., 0.000005 mg/L or 0.005 µg/L). This would yield a tissue concentration of only 16.5 µg/kg. Please provide the natural range of molybdenum concentrations in plant tissue, relative to 16.5 µg/kg, in support of the conclusion that "Apparently, these high concentrations of molybdenum do not harm the alga."

15. The table outlining the site-specific statistical testing against Mare Island soil background concentrations (Table J-2) appears to have some errors in the footnotes. A footnote of "c" is applied to the Probability listing under the Statistical Test column. The meaning of a footnote "c" is not presented with Table J-2. A footnote "2" states "*Calculated significance level for individual statistical tests. Reject H0 if Prob < 0.05.*" No footnote "2" is included in Table J-2. Footnote "c" also occurs in the sediment table (Table J-3) without an explanation in the footnote section. Please amend the tables to provide the correct footnotes and correct placement in the tables.

16. Soil is not in-place sediment and sediment is not soil. Comparison of sediment concentrations in IA-F1 Subarea 6 to Mare Island terrestrial soil background concentrations (Table J-3) is inappropriate for selection of COPECs. Some other data set, perhaps the sediment samples collected for the Offshore ERA which did not demonstrate toxicity, should be used to determine whether a release has occurred in IA-F1 Subarea 6.

17. A subset of the plant toxicity benchmarks (Section 3.2.2, pages J-34 through J-36 and Table J-7) were checked and found to agree with the listed source (Efroymson, et al., 1997). This comment is meant for the DTSC Project Manager and no response is required from the Navy or Navy contractor.

18. Earthworm toxicity benchmarks (Section 4.2.2, page J-55 through J-57 and Table J-9) were checked and found to be correct, or more protective. This comment is meant for the DTSC Project Manager and no response is required from the Navy or Navy contractor.

19. A subset of the ecological exposure parameters (Section 5.1, pages J-61 through J-65) were checked and found to be either the single value cited or a reasonable average of multiple potential values. This comment is

meant for the DTSC Project Manager and no response is required from the Navy or Navy contractor.

20. The food intake rate is estimated based on energy requirements (Section 5.1, pages J-61 through J-65) of free-living organisms (Nagy, 2001) using body weight as the predictor variable. The intake rate in kg_{food} /day which results from the Nagy (2001) equation is the estimated total energy requirement. In fact, the reference cited states: "*These equations should underestimate somewhat the feeding rates of free-living animals that are growing, reproducing or storing up fat.*" The intake of soil or sediment, as percent of the total ingestion rate, cannot be subtracted from this estimate and still allow the correct caloric food intake. Please amend the calculations of intake for all vertebrate species to add the contaminant soil or sediment intake to the contaminant intake in food based on 100 percent of the food intake estimate (Nagy, 2001).

21. A subset of the Toxicity Reference Values (TRVs) for vertebrate representative species (Tables J-15 through J-21) was checked and found to be arithmetically correct for the reference cited (EFAWEST, 1998 and Sample et al., 1996). Chromium, copper, lead, nickel, zinc, polychlorinated biphenyls (PCBs) and total DDT appear to be the risk drivers based on visual inspection of soil and sediment concentrations (Appendix G and Figures J-5 through J-11). TRVs were used for all these COPECs, and Hazard Quotients (HQs) were calculated, indicating that the ecological risk drivers for relatively shallow soil and sediment are adequately evaluated. Deeper sediments in Subarea 6 will be evaluated as part of the Offshore Data Gaps investigation. This comment is meant for the DTSC Project Manager and no response is required from the Navy or Navy contractor.

22. The conclusion that there is "*systematic overestimation of risk due to the bioavailability of analytes*" due to bioavailability values less than unity (Section 6.4.3, page J-87) cannot be made without measurement of the bioavailability in the original toxicity experiment used as the basis for the chemical-specific TRV. Please amend the statement to indicate that overestimation is possible, but of an unknown magnitude.

23. COPECs with a frequency of detection less than 5 percent cannot be eliminated from the Baseline Ecological Risk Assessment (BERA) for plants (Section 8.1, page J-92) unless it is demonstrated that the detected samples are not located in a small geographic area (i.e., a "hot spot").

24. Upland and wetland plant COPECs cannot be removed from further consideration based on an arbitrary HQ based on the maximum concentration (HQ_{max}) value (i.e., HQ_{max} <5) (Section 8.1, page J-92). Six

of 12 upland plant COPECs are removed from the BERA using this criterion (Section 8.1.1, page J-93). Ecological HQs do not represent a probability of ecological hazard. The average HQ based on the upper 95 percent confidence limit on the mean (HQ_{avg}) (Section 8.1, page J-92) must be presented for each plant COPEC with a HQ_{max} greater than 1.

25. Conclusions on the statistical variance of the antimony ambient concentrations cannot be made based on an assumption that the statistical variance of the ambient soil concentrations is the same as the statistical variance of the IA-F1 antimony soil concentrations (Section 8.1.1.1, page J-93). The MINSY ambient data are available. This assumption regarding the equivalent range in antimony concentrations can be tested. Unless the range of MINSY ambient soil antimony concentrations is shown to be similar to IA-F1 upland soil antimony concentrations, the statement regarding exceedances of Oak Ridge National Laboratory antimony screening concentrations should be removed.

26. HERD agrees with the upland sample locations identified in the BERA as candidates for remedial action based on elevated concentrations of chromium, lead, nickel and zinc in the discussion of hazard to plants (Section 8.1, pages J-94 and J-95; Section 8.1.3, page J-97). This comment is meant for the DTSC Project Manager and no response is required from the Navy or Navy contractor.

27. Terrestrial soil ambient concentrations for MINSY are not applicable to IA-F1 wetland sediments (Section 8.1.2, page J-96). In wetland discussions, ambient HQs, based on the MINSY terrestrial ambient soil concentrations, are useful only to demonstrate the difference in ecological hazard between wetland sediments and terrestrial soils. This comparison by itself is not sufficient justification for No Further Action (NFA) based on equivalent HQs.

28. The maximum wetland chromium concentration sample location (SM44o) should be identified as a candidate for further remedial action (Section 8.1.2.1, page J-96) just as upland sample locations with elevated concentrations are similarly identified (Section 8.1.3, page J-97).

29. The maximum wetland zinc concentration sample location (SM44o) should be identified as a candidate for further remedial action (Section 8.1.2.2, page J-96) just as upland sample locations with elevated concentrations are similarly identified (Section 8.1.3, page J-97).

30. Upland and wetland invertebrate COPECs cannot be removed from further consideration based on an arbitrary HQ based on the maximum concentration (HQ_{max}) value (i.e., HQ_{max} <5) (Section 8.1, page J-92;

Section 8.2, page J-97). Three of 7 upland invertebrate COPECs are removed from the BERA using this criterion (Section 8.2.1, page J-98). Ecological HQs do not represent a probability of ecological hazard. The average HQ based on the upper 95 percent confidence limit on the mean (HQ_{avg}) (Section 8.2, page J-97) must be presented for each invertebrate COPEC with a HQ_{max} greater than 1.

31. HERD agrees with the upland sample locations identified in the BERA as candidates for remedial action based on elevated concentrations of chromium, copper, lead and zinc in the discussion of hazard to invertebrates (Section 8.2, pages J-99 and J-100; Section 8.2.3, page J-101). This comment is meant for the DTSC Project Manager and no response is required from the Navy or Navy contractor.

32. Copper, zinc, 4,4'-DDD and total DDD are excluded as wetland invertebrate COPECs with HQ Exposure Point Concentrations (HQ_{EPC}) of 1, but less than 5 (Table J-10) with only total DDT retained (Section 8.2.2, page J-101). The location of the copper, zinc, 4,4'-DDD and total DDD maximum concentrations should be evaluated to determine if sample location SM44o is the location. Upland sample locations with elevated DDT concentrations are identified (Section 8.2.3, page J-101) for possible remedial action. The sample location (SM44o) with the maximum wetland total DDT concentration should also be identified as a candidate for possible remedial action.

33. The TRV_{low} and TRV_{high} values were developed to provide specific information to risk managers for the purposes of evaluating risk management options. The Biological Technical Assistance Group (BTAG) TRV_{low} dose (i.e., HQ_{low} =1) was meant to be an intake which would not be of ecological concern. The BTAG TRV_{high} dose (i.e., HQ_{high} =1) was meant to be an intake indicative of potential adverse ecological hazard at which point remedial alternatives should be evaluated. Given the differing magnitude of difference between the TRV_{low} and the TRV_{high} for COPECs, averaging the HQ_{low} and the HQ_{high} (Section 8.3, page J-101) removes information and should not be done. Please present the HQ_{low} and the HQ_{high} for each vertebrate receptor.

34. Multiple lines of evidence are provided for the proposed bioavailability adjustments of dose for vertebrate receptors (Section 8.3, page J-102 to J-109), mainly associated with the bioavailable fraction in abiotic media and tissue. Adjustments of the TRV require that the original toxicity experiment which served as the basis for the TRV provides measurements of absorption. With the exception of noting that lead acetate and zinc carbonate are "very soluble" (Section 8.3.2, page J-106), specific absorption rates are not provided for the original toxicity

experiments. Many assumptions and best-judgment decisions regarding equivalency of media and absorption are incorporated into the bioavailability adjusted HQs. HERD recommends that the IA-F1 HQs based on the proposed bioavailability adjustment not be the basis for any remedial decisions, but be considered only to provide a bound on the un-adjusted HQs with considerations for the Site Use Factor (SUF).

35. The Salt March Harvest Mouse (SMHM) is a protected rare, threatened or endangered (RTE) species. SMHM is meant to receive protection at the individual level, not the population level. There is no reason to present average dose exposure scenarios and/or or TRV_{high} effects characterization (Section 8.3.4, page J-108) for RTE species such as the SMHM. The average exposure and or TRV_{high} characterization should be removed from this section.

36. IA-F1 Subarea 6 sample location SM44o should be added to the "hot spot" list of locations which pose potential unacceptable risk to ecological receptors (Section 8.4, page J-109). This "hot spot" list currently contains upland locations.

37. Please state whether the visual evaluation of maps, which was used in the BERA to assess the physical distribution of COPECs (Section 8.1, page J-93), was used in support of the SLERA conclusions in the main text (Section 7.4, page 7-7). Evaluation of potential "hot spots" is required to support statements such as no COPECs exceed sediment benchmarks in more than 3 sediment samples.

38. HERD does not agree with the recommendation for No Further Action (NFA) for Subarea 6 based on the Screening Level Ecological Risk Assessment (SLERA) (Section 7.4.3, page 7-9). HERD has requested additional sampling at depth in Subarea 6 be performed in the Offshore Data Gaps Investigation. Any risk management decision regarding IA-F1 Subarea 6 should be delayed until the Offshore Data Gaps samples at depth are obtained and evaluated.

CONCLUSIONS

HERD is participating in development of the Offshore Data Gaps work plan and Data Quality Objectives (DQOs) for MINSY. Subarea 6 within IA-F1 is an area HERD has currently identified as requiring additional sediment characterization at depth. No final decision should be made on IA-F1 Subarea 6 until this additional characterization if finished and evaluated.

Several issues in the ERA methodology for vertebrate representative species require revision or further justification, particularly in the screening of

Contaminants of Ecological Concern (COECs) based on HQs less than 5 and averaging of TRV_{low} and TRV_{high} which represent different levels of ecological hazard.

An additional set of Hazard Quotients (HQs) for vertebrate receptors is presented based on attempts to estimate the "bioavailable" fraction of Contaminants of Ecological Concern (COECs), rather than total concentrations. HERD recommends that the "bioavailable' estimate be used as additional information and not be the sole basis for IA-F1 remedial decisions.

Sample location SM44o in IA-F1 Subarea 6 should be added to the "hot spot" locations listed for consideration of potential remedial alternatives.

REFERENCES

Naval Facilities Engineering Command, Engineering Field Activity West (EFAWEST). 1998. "Development of Toxicity Reference Values for Conducting Ecological Risk Assessments at Naval Facilities in California, Interim Final." San Bruno, California.

Efroymson, R.A. M. E. Will and G. W. Suter II. 1997. Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision. Oak Ridge National Laboratory (ORNL), Oak Ridge, Tennessee. ES/ER/TM-126/R2.

Efroymson, R. A., M. E. Will, G. W. Suter II and A. C. Wooten. 1997. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants:1997 Revision. Oak Ridge National Laboratory (ORNL), Oak Ridge, Tennessee. ES/ER/TM-85/R3.

Nagy, K.A. 2001. Food requirements of wild animals: predictive equations for free-living mammals, reptiles, and birds. *Nutrition Abstracts and Reviews, Series B* 71, 21R-31R.

Sample, B.E., D.M. Opresko, G.W. Suter, II. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. Oak Ridge National Laboratory (ORNL). Oak Ridge, Tennessee. ES/ER/TM-86/R3.

Tetra Tech EMI. 2002. *Final Compilation of Technical Memoranda on Ambient Analyses of Metals in Soils and Groundwater, Mare Island California.*

HERD Internal Reviewer: Michael Anderson, Ph.D.
Staff Toxicologist, HERD

cc: Sonce DeVries, Ph.D., BTAG Member
U.S. EPA Region IX Ecological Risk Assessor
Superfund Technical Assistance
75 Hawthorne (SFD-8-B)
San Francisco, CA 94105

Charlie Huang, BTAG Member
California Department of Fish and Game
1700 K Street, Suite 250
P.O. Box 944209
Sacramento, CA 94244-2090

James Haas, BTAG Member
U.S. Fish and Wildlife
Environmental Contaminants Section
2800 Cottage Way (W-2605)
Sacramento, CA 95825

Laurie Sullivan, BTAG Member
Coastal Resources Coordinator (H-1-2)
c/o U.S. Environmental Protection Agency
75 Hawthorne Street
San Francisco, CA 94105

Denise Klimas, BTAG Member
Human and Ecological Risk Division
8800 Cal Center Drive
Sacramento, California 95826

Mr. Gary Riley
California Regional Water Quality Control Board
San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, CA 94612

Voice 818-551-2853
Facsimile 818-551-2841
C:\Risk\MINSY\IA F1 Draft RI.doc/h:56