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MOFFETT FIELD
SSIC NO. 5090.3

INTERNATIONAL TECHNOLOGY CORPORATION

January 26, 1993

Ms. Paula Pritz
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Draft Responses to OU2 RI Report Baseline Risk Assessment Comments by Regulatory Agencies, NAS Moffett Field RI/FS, Task Order K-04; IT Project No. 409729

Dear Paula:

Three copies of the draft responses to OU2 RI Baseline Risk Assessment (BRA) comments are enclosed. These comment responses and BRA revisions also address input from HAZWRAP and the Navy. By copy of this letter, I am also distributing these responses as noted.

Please let me know if you have any questions or if we can provide you assistance in your review.

Sincerely yours,

C. Keith Bradley
Project Manager

CKB:bf
Enclosures

cc: Lt. Susanne Openshaw, NAS Moffett Field (3 copies)
Stephen Chao, WESTDIV (2 copies)
Joseph LeClaire, JMM (1 copy)
Josh Marvil, PRC (1 copy)
Roberta Blank, EPA (1 copy)
Elizabeth Adams, RWQCB (1 copy)
Cyrus Shabahari, DTSC (1 copy)
Fred Molloy, SAIC (1 copy)

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TECHNICAL REVIEW OF

DRAFT FINAL

BASELINE RISK ASSESSMENT

OPERABLE UNIT 2:

SITES 3-11, 13, 14, 16-19 SOILS

NAVAL AIR STATION, MOFFETT FIELD

MOUNTAIN VIEW, CALIFORNIA

AUGUST 28, 1992

Submitted to:

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION IX
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Submitted by:

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EPA CONTRACT NO. 68-W9-0008
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SAIC/TSC PROJECT NO. 06-0794-03-0630

TECHNICAL REVIEW OF
DRAFT FINAL
BASELINE RISK ASSESSMENT
OPERABLE UNIT 2:
SITES 3-11, 13, 14, 16-19 SOILS
NAVAL AIR STATION, MOFFETT FIELD
MOUNTAIN VIEW, CALIFORNIA

GENERAL COMMENTS

1. The purposes of this baseline risk assessment (BRA) are to qualitatively and quantitatively evaluate the actual and potential risks to human health and the environment posed by Operable Unit 2 (OU2) at NAS Moffett Field in the absence of remedial action, and to assess the uncertainties associated with the BRA. This document was reviewed with the following EPA guidance documents: Risk Assessment Guidance for Superfund (RAGS, 1989), *CERCLA Compliance with Other Laws Manual*, EPA 1988; *Superfund Exposure Assessment Manual*, EPA 1988, *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions*, EPA April 1991; *Human Health Evaluation Manual Supplemental Guidance*: "Standard Default Factors," EPA May 1991; *Human Health Evaluation Manual, Part B*: "Development of Risk-based Preliminary Remediation Goals," EPA December 1991; *Human Health Evaluation Manual, Part C*: "*Risk Evaluation of Remedial Alternatives*," EPA, December 18, 1991; *Draft Risk Assessment Guidance for Superfund Ecological Assessments/Region IX*, EPA 1989; *Risk Assessment Guidance for Superfund*, Volume II, *Environmental Evaluation Manual*, EPA 1988; *Ecological Assessment of Superfund Site an Overview*, *ECO Updates*, Volume 1 1991, and other guidance, and directives, such as *Dermal Exposure Assessment: Principles and Applications*, *EPA 1991*.

2. This reviewer could not verify the carcinogenic risk estimates and the hazard quotient (HQ) estimates from the data presented in Tables 20.3-20 through 20.3-49. Additional tables should be submitted with the report that contain <u>all</u> of the following information: the chemical concentration, exposure factor intake, daily intake, toxicity value (cancer potency factor or reference dose), and risk estimate (carcinogenic risk or a noncarcinogenic HQ).

3 The depth of soil samples is of utmost importance in the BRA. For evaluation of the residential exposure pathway, the surface soil samples must be collected at a depth of 0-6 inches. Apparently, surface soil samples (0-6 inches) were not collected for OU2. Soil samples collected at the sites which make up OU2 were composited from large sections of soil borings and this data was used to calculate both the mean contaminant concentrations and the upper 95% confidence level contaminant concentrations. These concentrations were used for all exposure pathway scenarios in the risk assessment. Composite soil sample data do not qualify as surface soil data, and its use for evaluation in a residential exposure scenario is inappropriate. Information in Volume 3, Appendix A, Analytical Data, of the August 1992 version Draft Final RI for OU2 presents soil sample data by depth of sample. It is recommended that this data be reviewed, and the shallowest soil samples used for the evaluation of the residential exposure pathway.

Also, information regarding the depth of soil samples used in the risk calculations should be included in Chapter 20 of the BRA, and only data from the appropriate depth should be used to evaluate potential exposure pathways.

4 The toxicity screen methods found in Appendix E are not appropriate to deselect chemicals of concern based on low toxicity, because they lack information regarding the chemicals' percent contribution to the total carcinogenic or noncarcinogenic risk for OU2. Generally, a concentration-toxicity screen is used to reduce the number of chemicals carried through the risk assessment when an excessive amount of chemicals of concern have been identified. However, this screen is unnecessary for this OU because there are fewer than 20 chemicals of concern for each site.

The toxicity profiles for essential nutrients, Appendix E.5, are not adequate to evaluate the concentration-toxicity of these chemicals or provide the rationale for their elimination as chemicals of concern.

It is recommended that all chemicals deselected because of low toxicity or as essential nutrients be included in the risk assessment evaluation.

5. Many of the specific comments were "agreed to" and it was stated "the requested change has been made"; however, several of these changes were not found within the text. Please incorporate the agreed to changes for specific comments 7, 9, 10, 13, 14, 16, 31, 32, 42, and 57.

6. The response to general comment 3 and specific comments 40, 46, 47, 56, 58, 59, 60, 63, and 66 were adequate. However, these responses should be included in the text of the BRA.

7. Table 20.2-1 under Frequency of Detection presents the total number of samples analyzed for as 62. However, data taken from Appendix A gives a maximum of 53 samples analyzed for. Please explain this discrepancy.

8. For the ingestion of homegrown vegetables, it is not clear how the chemical concentration in produce was determined. Please clarify how this determination was made.

9. The summary and conclusions regarding the actual and potential health effects associated with exposure to OU2 could not be evaluated by the reviewer because the information needed to verify the health risk associated with exposure to OU2 was not clearly and concisely presented.

10. The environmental assessment lacks identification of the contaminants of ecological concern for OU2 and their known adverse effects. While a comprehensive environmental assessment will be completed as part of the sitewide comprehensive RI/FS, identification of the ecological contaminants of concern for OU2 now will provide information necessary to conduct a qualitative evaluation of the potential risk to the environment that is affiliated with OU2.

SPECIFIC COMMENTS

The paragraph number refers to the paragraph within the specific section. However, when a section covers several pages, the paragraph number refers to the location on the page.

1. <u>Page 20-14, Section 20.2.2</u>

This paragraph states that chemicals classified as Group A carcinogens were not eliminated as chemicals of concern regardless of their frequency of detection or concentration. The reviewer suggests that chemicals of concern for all sites in OU2 be reviewed and corrected as necessary.

2. <u>Page 20-52, Section 20.4.1</u>

EPA's lead biokinetics uptake model should be used to evaluate the toxicity of lead.

3. <u>Page 20-45, Section 20.3.3.2</u>

Specific exposure equations with the appropriate parameters must be presented for each pathway.

4. <u>Page 20-73, Section 20.6, Paragraph 2</u>

Tables 20.6-1 through 20.6-4 present the risk at background and should be referenced in this discussion. Also, the carcinogenic risk estimates and the HQ estimates could not be verified from the data presented. Additional tables should be submitted with the report that contain <u>all</u> of the following information: the chemical concentration, exposure factor intake, daily intake, toxicity value (cancer potency factor or reference dose), and risk estimate (carcinogenic risk or a noncarcinogenic HQ).

5 Tables 20.2-1 through 20.2-13 present information regarding the contract laboratory required detection limit (CLRDL), the frequency of detection,

the concentration range, background, mean concentration, the upper 95% confidence limit concentration, whether a chemical is considered a chemical of concern (COC), and the reason for deselection as a COC for these sites. These tables present a lot of information vital to the BRA. They should be clear and concise. However, these tables contain major discrepancies regarding background concentrations, upper 95% confidence limit concentrations and chemicals of concern at each site.

For example, in Table 20.2-1, background concentrations for inorganics are not consistent with information presented in Chapter 3 of this report: for TCE, the upper 95% confidence limit concentration is higher than the maximum concentration and, therefore, the maximum concentration should be used as the reasonable maximum exposure (RME) concentration; and iron, lead, magnesium, manganese, and nickel all have 95% confidence limit concentrations above background concentrations.

In Table 20.2-2, anthracene, benzo(a)anthracene, benzo(g,h,i)perylene, 2-hexanone, indeno(1,2,3-c,d)pyrene, and PCB 1260 have upper 95% confidence limit concentrations higher than the maximum concentration and, therefore, the maximum concentration should be used as the RME concentration; and copper, iron, magnesium, manganese, and potassium all have upper 95% confidence limit concentrations above background concentrations.

In Table 20.2-3, background concentrations for inorganics are not consistent with information presented in Chapter 3 of this report: iron, manganese, and nickel all have 95% confidence limit concentrations above background concentrations; and benzo(k)fluoranthene, chrysene, and di-n-butylphthalate all have 95% confidence limit concentrations higher than the maximum concentration and, therefore, the maximum concentration should be used as the RME concentration.

In Table 20.2-4, the CLRDL for JP-5 is not given; for calcium, magnesium, and potassium, the upper 95% confidence limit concentration is higher than background concentrations.

In Table 20.2-5, di-n-butylphthalate, phenanthrene, and thallium all have upper 95% confidence limit concentrations higher than the maximum concentrations and, therefore, the maximum concentration should be used as the RME concentration; and magnesium, manganese, and nickel all have 95% confidence limit concentrations higher than background concentrations.

In Table 20.2-6, 4,6 dinitro-2-methylphenol, 2,4,6-trichlorophenol, TCE, phenol, and 2,4-dinitrophenol all have upper 95% confidence limit concentrations higher than their maximum concentrations and, therefore, the maximum concentration should be used as the RME concentration; and calcium, iron, magnesium, manganese, and nickel all have 95% upper confidence limit concentrations higher than background.

In Table 20.2-7, chrysene, di-n-octylphthalate, diethylphthalate, 2,4-dimethylphenol, and 4-methylphenol all have upper 95% confidence limit concentrations higher than their maximum concentrations and, therefore, the maximum concentration should be used as the RME concentration; and beryllium, calcium, magnesium, and manganese all have 95% upper confidence limit concentrations higher than background.

In Table 20.2-8, magnesium, manganese, and nickel all have 95% upper confidence limit concentrations higher than background.

In Table 20.2-9, benzoic acid, dibenzofuran, 2-methylnaphthalene, and napthalene all have upper 95% confidence limit concentrations higher than their maximum concentrations and, therefore, the maximum concentration should be used as the RME concentration; and beryllium, calcium, and copper all have their 95% upper confidence limit concentrations higher than background.

In Table 20.2-10, calcium, copper, and iron all have 95% upper confidence limit concentrations higher than background.

In Table 20.2-11, di-n-butylphthalate, naphthalene, and phenanthrene all have upper 95% confidence limit concentrations higher than their maximum

concentrations and, therefore, the maximum concentration should be used as the RME concentration.

In Table 20.2-12, cadmium, calcium, copper, and iron all have 95% upper confidence limit concentrations higher than background.

In Table 20.2-13, nickel has a mean concentration value higher than background concentration.

In Table 20.2-14, no mean concentrations or upper 95% confidence limit concentrations are given for tetrachloroethene and toluene.

In Table 20.2-15, background concentrations for inorganics are not consistent with information presented in Chapter 3 of this report; di-n-butylphthalate and pyrene have upper 95% confidence limit concentrations higher than their maximum concentrations and, therefore, the maximum concentration should be used as the RME concentration; cadmium, calcium, copper, iron, magnesium, manganese, and nickel all have 95% upper confidence limit concentrations higher than background.

6. <u>Tables 20.3-16 - 20.3-18</u>

The reviewer suggests that for the occupational soil ingestion scenario the soil ingestion rate parameter of 480 mg/kg be used.

For dermal contact with soil, the absorption factor (0.0046) and matri factor (0.15) are unnecessary; the EPA guidance, *Dermal Exposur Assessment: Principles and Applications* (EPA/600/8-91/011B) should b consulted. In Table 20.3-18, please explain how the exposure time of 1 is used?

MOFFETT OU2 RESPONSE TO COMMENTS - BASELINE RISK ASSESSMENT

General Comments

1. Comment noted.

2. Revised tables have been prepared which present the requested information: chemical concentration, intake factor, estimaed daily intake, toxicity value, and risk estimate. These revised tables are numbered 20.3-15 through 20.3-114 and include results for both the average and RME scenarios.

3. True surface samples (0-6 inches) were not taken at Moffett at the request of the regulatory agencies. Samples taken from 0 to 10 feet were used in the risk assessment because this is considered the most likely depth for contact. Most of the sites which make up OU2 are either covered (by pavement or structures) or the suspected source is underground (e.g. underground storage tanks). Therefore, for contact to occur, subsurface soil would have to be excavated and placed on the surface. This is considered possible since future land-use is uncertain. Deeper excavation is not expected due to the shallow water table in this area.

   A discussion of the depth of the soil samples used for the baseline risk assessment has been added to the text of Section 20.2.

4. Para. 1. This method was used because several chemicals were detected only once but in less than 20 samples. The total number of chemicals involved was not large enough to warrant using the toxicity screen suggested in RAGS. At the request of the reviewer the organic chemicals eliminated based on this toxicity screen have been added to the list of chemicals of potential concern and carried through the quantitative risk assessment.

   Para. 2. These metals (calcium, iron, magnesium, potassium, and sodium) have been eliminated as suggested in RAGS because of their extremely low toxicity. Essential nutrients with higher potential toxicities (e.g. zinc, selenium) are carried through the risk assessment. At the request of the reviewer, expanded profiles have been provided.

   Para. 3. As noted above the organic chemicals eliminated based on the toxicity screen have

been added to the baseline risk assessment as chemicals of potential concern. The low toxicity essential nutrients are not carried through the risk assessment.

5. 7. The references sentence does not exist in the current document.

9. JP-5 and Aroclor/PCB are used throughout the RI report and are generally recognized terms. These terms have been further defined in the text.

A description of the potential uncertainties associated with the CRQLs as well as an evaluation of the potential contribution to risk by chemicals not detected at OU2 was previously added to the text.

As previously noted on the Tables, all concentrations for organics are reported as µg/kg and all inorganics are reported as mg/kg.

10. Local background has been added to the risk assessment in addition to the U.S.G.S. data.

13. The text and tables for the selection of chemicals of potential concern have been revised.

14. Aroclor and PCB are used interchangeably throughout the RI. The table has been changed to read Aroclor for clarity.

16. All of the tables for the selection of chemicals of potential concern have been revised.

31. Site 17 overlies the regional plume and has been eliminated from this baseline risk assessment.

32. Site 18 overlies the regional plume and has been eliminated from this baseline risk assessment.

42. A more complete explaination of how grass cover impacts the release of fugitive dust and VOC emissions has been added to the text.

57. The table has been revised as requested.

6. 3. This comment response has been added to the text of the document.

40. This comment response has been added to the text of the document.

46. This comment response was previously in the text of the document.

47. This comment response has been added to the text of the document.

56. This comment response has been added to the text of the document.

58. This comment response has been added to the text of the document.

59. This comment response has been added to the text of the document.

60. This comment response has been added to the text of the document.

63. This comment response was previously in the text of the document.

66. This comment response was previously in the text of the document.

7. An error was made in the original data query. The data base has been re-queried and the tables have been corrected as necessary.

8. The model used for accumulation of chemicals in vegetables has been added to Appendix E.

9. See general comment #2.

10. A complete environmental assessment is not included in this OU2 report. A complete environmental assessment will be included in the OU6 (marshland and site-wide environmental) and site-wide RIs. It is not appropriate to select chemicals of potential concern for OU2 because this selection would have to be re-evaluated for the quantitative assessment in OU6 and the site-wide. A qualitative discussion has been added to inform

the reader that the chemicals of potential concern for the environmental assessment may differ from those used in the human health risk assessment.

Specific Comments

1. Class A carcinogens were not eliminated based on their frequency of detection. Class A carcinogens which may be naturally occurring in the environment, such as arsenic, were eliminated if they were present within background levels. This has been clarified in the text and tables.

2. The California state lead uptake model will be used to evaluate potential risks associated with lead at the Station. The currently available version of the U.S. EPA model contains errors in the code and is being corrected.

3. The equations have been clarified as agreed to in the response to old comment numbers 59 and 60.

4. The tables have been revised as requested.

5. An error was made in the original data query. The data base has been re-queried and the tables have been corrected as necessary.

6. Para. 1. The ingestion rate has been changed to 480 mg/day for the excavation scenario. This number is applicable only for construction work, therefore, the ingestion rate of 50 mg/day has been retained for the other occupational scenarios.

   Para. 2. The absorption factors used are current as of the time the report was initiated. The studies used to determine these parameters are included in the EPAs new dermal guidance issued after initiation of this report. The new EPA dermal guidance is clear for aqueous absorption but for absorption from soil it lacks consideration of the soil matrix or of the time dependant nature of dermal absorption (while acknowledging that these processes are important). Therefore the time and matrix dependant absorption rates used in this risk assessment are considered to be appropriate and consistent with EPA guidance.

and risk assessment statistics along with nonestimated data. Rejected data were used for qualitative insights only.

Following data review, data quality is considered good. Analytical precision and accuracy were good with more than 90 percent of duplicate and spike analyses being within the CLP method limits. Data are complete because more than 95 percent of the data are usable. Data are representative because the accepted and prescribed methods presented in the IT Moffett Field Work Plan were followed.

20.2.2 General Selection Process for Chemicals of Potential Concern

All chemicals detected at OU2 were screened to determine if they met the given criteria for chemicals of potential concern. Only original samples (no duplicates) were used. Data reported with a "J" or "J" equivalent qualifier (indicating an estimated concentration) were included with other positive detections. Data with an "R" or "R" equivalent qualifier (indicating rejected data) were not included in the data set. Data from the Phase I and II investigations were used. For this baseline risk assessment, samples taken from a depth of 0 to 10 feet below the surface were evaluated together unless the water table was encountered above 10 feet. Contamination is not expected at the ground surface because most sites are paved and/or the potential source of contamination is underground (e.g. underground storage tanks). Therefore, exposure will require excavation to expose the subsurface soil at the surface. An excavation depth of 10 feet was selected as representative for California (ref). As noted previously, less than 10 feet of soil was used if the water table encountered at a shallower depth. Complete data are contained in Appendix A of this report.

The following criteria, from U.S. EPA's ***Risk Assessment Guidance for Superfund: Human Health Evaluation Manual*** (1989b), were applied to select the chemicals of potential concern for OU2:

- ***Blank (QC) Contamination.*** Because of the presence of several laboratory contaminants in virtually all environmental sampling efforts, the U.S. EPA has developed guidance for eliminating these contaminants from consideration as chemicals of potential concern. As part of the data validation process, a chemical was not considered further if the maximum sample concentration did not exceed ten times the highest blank for all common laboratory contaminants (2-butanone, acetone, methylene chloride, toluene, and phthalates) or five times the highest blank for other chemicals. This criterion was developed by the U.S. EPA to prevent the inclusion of chemicals that are most likely sampling or analytical artifacts.

- ***Comparison with Background.*** Inorganic chemicals are naturally present in soils. If inorganic constituents were present at naturally-occurring background levels, they were eliminated from the risk assessment. Specifically, a chemical was not considered further if the upper 95 percent confidence limit of the sample concentrations was within the range of background concentrations reported for this area. A complete discussion of the background sources used is given in Section 3.5 of this RI Report.

- ***Frequency of Detection.*** Chemicals that are infrequently detected may be artifacts in the data due to sampling, analytical, or other problems. Chemicals were eliminated if they were detected in 5 percent or less of the on-site samples.

- ***Essential Nutrients.*** Iron, magnesium, calcium, sodium, and potassium are essential and are generally toxic only at very high doses. These constituents were, therefore, eliminated as chemicals of potential concern. A discussion of the potential toxicity of these constituents is given in Appendix E. Other essential nutrients, such as selenium and zinc, which have a greater potential for toxicity were carried through the risk assessment unless eliminated by the other criteria listed above. The general soil parameters phosphorus, sulfate, and carbonate, are also generally toxic only at very high doses and have not been carried through the risk assessment. The potential toxicity of these constituents is also described in Appendix E.

In addition to the above criteria, the weight-of-evidence of carcinogens as classified by the U.S. EPA (U.S. EPA, 1991b and 1992) was also considered. Chemicals classified as Group A (known human carcinogens) were not eliminated from the final list of chemicals of potential concern regardless of their frequency of detection. Class A carcinogens were eliminated if they were present within naturally occurring background concentrations. The Jet fuel JP5 was analyzed for as a total petroleum hydrocarbon. The potentially toxic components of JP5 (e.g. naphthalene, benzene, ethylbenzene, toluene, xylene) were also analyzed for separately. Therefore, the individual components have been considered for this risk assessment. Total JP5 is not one chemical and has not been carried through the risk assessment as a chemical of potential concern. The data used for this baseline risk assessment are summarized in Tables 20.2-1 through 20.2-~~15~~9.

20.2.3 Chemicals of Potential Concern at Site 3

All constituents detected in the soil at Site 3 are listed in Table 20.2-1. A total of 42 constituents were detected in the soil at Site 3 including 21 organics and 21 metals. Constituents were excluded from the list of chemicals of potential concern for the following reasons:

- Benzo(g,h,i)perylene, carbon disulfide, carbon tetrachloride, chrysene, di-N-butylphthalate, 1,2-Dichloroethene, trans-1,3-dichloropropene, diethyl phthalate, fluoranthene, hexanone, phenanthrene, Indeno(1,2,3-c,d)pyrene, methylene chloride, N-nitroso-di-n-dipropylamine, pyrene, and TCE were each detected in 5 percent or less of the samples analyzed.

- Aluminum, arsenic, barium, cadmium, chromium, ~~cobalt,~~ copper, lead, mercury, vanadium, and zinc were all detected within naturally occurring background levels.

- Calcium, iron, magnesium, potassium, and sodium are all essential nutrients.

There are ~~13~~14 chemicals of potential concern identified at Site 3:

<u>Organics</u>		
2-Butanone	Bis(2-ethylhexyl)phthalate	PCE
Acetone	Butylbensylphthalate	Toluene
Diethylphthenlate		Aroclor-1260
<u>Metals</u>		
Antimony	Beryllium	Silver
Manganese	Cobalt	
	Nickel	

These metals may also be present as a result of natural background; however, the limited background data do not allow for their elimination on this basis. Past practices at OU2 do not suggest that these metals are site related.

20.2.4 Chemicals of Potential Concern at Site 4

All constituents detected in the soil at Site 4 are listed in Table 20.2-2. A total of 56 constituents have been detected in the soil at Site 4 including 33 organics and 23 metals. Constituents have been excluded from the list of chemicals of potential concern for the following reasons:

- 1,1,1-TCA, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 2-hexanone, 4-methylphenol, acenaphthalene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chlorobenzene,

chrysene, fluorene, indeno(1,2,3,c,d)pyrene, methylene chloride, Aroclor (PCB) - 1260, thallium, cadmium, selenium, and TCE were each detected in 5 percent or less of the samples analyzed.

- Aluminum, arsenic, barium, fluoranthene, pyrene, chromium, ~~cobalt,~~ lead, mercury, vanadium, and zinc were all detected within background levels.

- Calcium, iron, magnesium, potassium, and sodium are all essential nutrients.

There are 189 chemicals of potential concern identified at Site 4:

Organics

1,2-Dichlorobenzene	Diethyl phthalate	Phenanthrene
2-Butanone	JP-5	PCE
2-Methylnaphthalene	Toluene	
Acetone	Naphthalene	Xylenes (total)
Bis(2-ethylhexyl)phthalate		

Metals

Antimony	Nickel	Silver
Beryllium	Copper	Manganese

These metals may also be present as a result of natural background; however, the limited background data do not allow for their elimination on this basis. Past practices at OU2 do not suggest that these metals are site related.

20.2.5 Chemicals of Potential Concern at Site 5

All constituents detected in the soil at Site 5 are listed in Table 20.2-3. A total of 54 constituents have been detected in the soil at Site 5 including 31 organics and 23 metals. Constituents were excluded from the list of chemicals of potential concern for the following reasons:

- 1,1,1-TCA, 2-butanone, benzo(a)anthracene, benzo(k)fluoranthene, carbon disulfide, chlorobenzene, chloroform, chrysene, di-N-butylphthalate, di-N-octylphthalate, ethyl benzene, fluoranthene, fluorene, naphthalene, phenanthrene, pyrene, PCE, xylenes (total), 2-methylnaphthalene, Aroclor (PCB) -1016, -1221, -1232, -1242, -1248, -1254, -1260, selenium, thallium, were each detected in 5 percent or less of the samples analyzed.

- Aluminum, arsenic, barium, cadmium, chromium, ~~cobalt,~~ copper, lead, mercury, vanadium, and zinc were all detected within naturally occurring background levels.

- Calcium, iron, magnesium, potassium, and sodium are all essential nutrients.

There are ~~ten~~ eleven potential chemicals of concern at Site 5:

Organics		
Acetone	Diethyl phthalate	Toluene
Bis(2-ethylhexyl)phthalate	JP-5	

Metals		
Antimony	Beryllium	Silver
Manganese	Cobalt	
	Nickel	

These metals may also be present as a result of natural background; however, the limited background data do not allow for their elimination on this basis. Past practices at OU2 do not suggest that these metals are site related.

20.2.6 Chemicals of Potential Concern at Site 6

All constituents detected in the soil at Site 6 are listed in Table 20.2-4. A total of 35 constituents have been detected in the soil at Site 6 including 15 organics and 20 metals. Constituents were excluded from the list of chemicals of potential concern for the following reason:

- Aluminum, arsenic, barium, beryllium, cadmium, chromium, ~~cobalt,~~ copper, lead, manganese, vanadium, zinc, and pyrene were all detected within background levels.

- Calcium, iron, magnesium, potassium, and sodium are all essential nutrients.

There are ~~14~~15 potential chemicals of concern at Site 6:

Organics		
1,2-Dichloroethene (total)	2-Butanone	Bis(2-ethylhexyl)phthalate
Phenanthrene	2-Methylnaphthalene	Diethyl phthalate
Toluene	4-Methylphenol	Naphthalene
Ethyl benzene	Xylenes (total)	Acetone
Fluorene	JP-5	

Metals		
Antimony	Nickel	Silver
Cobalt		

These metals may also be present as a result of natural background; however, the limited background data do not allow for their elimination on this basis. Past practices at OU2 do not suggest that these metals are site related.

20.2.7 Chemicals of Potential Concern at Site 7

All constituents detected in the soil at Site 7 are listed in Table 20.2-5. A total of 34 constituents have been detected in the soil at Site 7 including 13 organics and 21 metals. Constituents were excluded from the list of chemicals of potential concern for the following reasons:

- Butylbenzylphthalate, carbon disulfide, di-N-butylphthalate, phenanthrene, and 1,1,2,2-tetrachloroethane were each detected in less than 5 percent of the samples analyzed.
- Aluminum, arsenic, barium, chromium, cobalt, lead, mercury, and vanadium were all detected within naturally occurring background levels.
- Calcium, iron, magnesium, potassium, and sodium are all essential nutrients.

There are ten chemicals of potential concern identified at Site 7:

Organics		
2-Butanone	Bis(2-ethylhexyl)phthalate	Xylenes (total)
Acetone	Ethylbenzene	JP5
Toluene		

Metals	
Antimony	Thallium
Beryllium	Manganese
Copper	Nickel
Silver	Zinc

These metals may also be present as a result of natural background; however, the limited background data do not allow for their elimination on this basis. Past practices at OU2 do not suggest that these metals are site related.

20.2.8 Chemicals of Potential Concern at Site 8

All constituents detected in the soil at Site 8 are listed in Table 20.2-6. A total of 4 constituents have been detected in the soil at Site 8 including 26 organics and 23 metals.

Constituents were excluded from the list of chemicals of potential concern for the following reasons:

- Benzo(a)pyrene, butylbenzylphthalate, dibenzo(a,h)anthracene, ethylbenzene 1,3-dichlorobenzene, JP5, n-nitrosodiphenylamine, 4,6-dinitro-2-methylphenol, 2,4,6-trichlorophenol, 2,4-dinitrophenol, mercury, naphthalene, 2-nitrophenol, phenol, PCE, and TCE were each detected in 5 percent or less of the samples analyzed.

- Aluminum, arsenic, barium, cadmium, chromium, ~~cobalt,~~ lead, selenium, and vanadium were all detected within naturally occurring background levels.

- Calcium, iron, magnesium, potassium, and sodium are all essential nutrients.

There are ~~19~~20 chemicals of potential concern identified at Site 8:

Organics		
2-Butanone	Bis(2-ethylhexyl)phthalate	Methylene chloride
Acetone	Carbon disulfide	Toluene
Benzene	Diethyl phthalate	Xylenes (total)
Benzoic acid	di-N-butylphthalate	

Metals		
Antimony	Manganese	Thallium
Beryllium	Nickel	Zinc
Copper	Silver	
Cobalt		

These metals may also be present as a result of natural background; however, the limited background data do not allow for their elimination on this basis. Past practices at OU2 do not suggest that these metals are site related.

~~20.2.9 Chemicals of Potential Concern at Site 9~~

~~All constituents detected in the soil at Site 9 are listed in Table 20.2-7. A total of 45 constituents have been detected in the soil at Site 9 including 43 organics and 23 metals. Constituents were excluded from the list of chemicals of potential concern for the following reasons:~~

- ~~1,1,2,2-Tetrachloroethane, 1,1-DCA, 2,4-dimethylphenol, 2-hexanones, bromoform, carbon disulfide, di-N-octylphthalate, dibromochloromethane, diethyl phthalate, methylene chloride, ethylbenzene, were each detected in 5 percent or less of the samples analyzed.~~

- ~~Aluminum, arsenic, barium, beryllium, cadmium, chromium, cobalt, lead, mercury, selenium, vanadium, and zinc were all detected within naturally occurring background levels.~~

- ~~Calcium, iron, magnesium, potassium, and sodium are all essential nutrients.~~

~~There are 19 chemicals of potential concern identified at Site 9:~~

~~Organics~~

~~1,2 DCE (total)~~	~~di-N-butylphthalate~~	~~TCE~~
~~2-Butanone~~	~~Toluene~~	~~Acetone~~
~~Benzene~~	~~Xylenes (total)~~	~~Bis(2-ethylhexyl)phthalate~~ ~~PCE~~

~~Metals~~

~~Antimony~~	~~Nickel~~
~~Copper~~	~~Silver~~
~~Manganese~~	~~Thallium~~

~~These metals may also be present as a result of natural background; however, the limited background data do not allow for their elimination on this basis. Past practices at OU2 do not suggest that these metals are site related.~~

~~20.2.10 Chemicals of Potential Concern at Site 10~~

~~All constituents detected in the soil at Site 10 are listed in Table 20.2-8. A total of 24 constituents have been detected in the soil at Site 10 (Runway Area) including 3 organics and 21 metals. Constituents were excluded from the list of chemicals of potential concern for the following reasons:~~

- ~~Aluminum, arsenic, barium, chromium, cobalt, lead, mercury, vanadium, and zinc were all detected within naturally occurring background levels.~~

- ~~Calcium, iron, magnesium, potassium, and sodium are all essential nutrients.~~

~~There are eight chemicals of potential concern identified at Site 10:~~

~~Organics~~

~~Acetone~~	~~Bis(2-ethylhexyl)phthalate~~	~~JP-5~~

~~Metals~~

~~Antimony~~	~~Nickel~~
~~Beryllium~~	~~Silver~~
~~Copper~~	~~Thallium~~
~~Manganese~~	

~~These metals may also be present as a result of natural background; however, the limited background data do not allow for their elimination on this basis. Past practices at OU2 do not suggest that these metals are site related. No chemicals of potential concern were identified at the Chase Park Area.~~

20.2.~~11~~9 Chemicals of Potential Concern at Site 11

All constituents detected in the soil at Site 11 are listed in Table 20.2-79. A total of 43 constituents have been detected in the soil at Site 11 including 21 organics and 22 metals. Constituents were excluded from the list of chemicals of potential concern for the following reasons:

- 2-Butanone, 1,3-dichlorobenzene, benzo(a)anthracene, benzo(k)fluoranthene, benzoic acid, JP-5, phenanthrene, thallium, and toluene were each detected in 5 percent or less of the samples analyzed.

- Benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, pyrene, aluminum, arsenic, barium, beryllium, cadmium, chromium, ~~cobalt,~~ lead, mercury, vanadium, and zinc were all detected within naturally occurring background levels.

- Cadmium, calcium, iron, magnesium, potassium, and sodium are all essential nutrients.

There are ~~11~~12 chemicals of potential concern identified at Site 11:

<u>Organics</u>

1,1,1-TCA	Carbon disulfide	Acetone
di-N-butylphthalate	Bis(2-ethylhexyl)phthalate	N-nitrosodiphenylamine

<u>Metals</u>

Antimony	Nickel
Copper	Manganese
Cobalt	
Silver	

These metals may also be present as a result of natural background; however, the limited background data do not allow for their elimination on this basis. Past practices at OU2 do not suggest that these metals are site related.

20.2.~~12~~10 Chemicals of Potential Concern at Site 13

All constituents detected in the soil at Site 13 are listed in Table 20.2-~~8~~10. A total of 24 constituents have been detected in the soil at Site 13 including 4 organics and 20 metals. Constituents were excluded from the list of chemicals of potential concern for the following reasons:

- Aluminum, arsenic, barium, chromium, ~~cobalt,~~ mercury, and vanadium were all detected within naturally occurring background levels.
- Calcium, iron, magnesium, potassium, and sodium are all essential nutrients.

There are 12 chemicals of concern identified at Site 13:

<u>Organics</u>	
di-N-butylphthalate	Toluene
Bis(2-ethylhexyl)phthalate	JP-5
<u>Metals</u>	
Antimony	Nickel
Cadmium	Silver
Cobalt	
Copper	Lead
Zinc	Manganese

These metals may also be present as a result of natural background; however, the limited background data do not allow for their elimination on this basis. Past practices at OU2 do not suggest that these metals are site related.

~~*20.2.13 Chemicals of Potential Concern at Site 14*~~

~~All constituents detected in the soil at Site 14 are listed in Table 20.2-11. A total of 36 constituents have been detected in the soil at Site 14 including 13 organics and 23 metals. Constituents were excluded from the list of chemicals of potential concern for the following reasons:~~

- ~~Butylbenzylphthalate, methylene chloride, naphthalene, phenanthrene, and PCE were each detected in 5 percent or less of the samples analyzed.~~
- ~~Aluminum, barium, cadmium, chromium, cobalt, lead, mercury, vanadium, and zinc were all detected within naturally occurring background levels.~~
- ~~Calcium, iron, magnesium, potassium, and sodium are all essential nutrients.~~

~~There are 15 chemicals of potential concern identified at Site 14:~~

~~Organics~~

~~1,1,1-TCA~~	~~Bis(2-ethylhexyl)phthalate~~	~~N-nitrosodiphenylamine~~
~~2-Butanone~~	~~di-N-butylphthalate~~	~~Toluene~~
~~Acetone~~	~~PCE~~	

~~Metals~~

~~Antimony~~	~~Copper~~	~~Silver~~
~~Arsenic~~	~~Manganese~~	~~Nickel~~
~~Thallium~~	~~Beryllium~~	~~Selenium~~

~~These metals may also be present as a result of natural background; however, the limited background data do not allow for their elimination on this basis. Past practices at OU2 do not suggest that these metals are site related.~~

~~20.2.14 Chemicals of Potential Concern at Site 16~~

~~No samples were taken at Site 16 during Phase I or II. Some data were collected during the removal of the USTs. Samples were analyzed for a limited number of VOCs, SVOCs, BTEX, and metals. Constituents detected in soil at Site 16 are listed in Table 20.2-12. A total of 24 constituents have been detected in the soil at Site 16 including 3 organics and 21 metals. Constituents were excluded from the list of chemicals of potential concern for the following reasons:~~

- ~~Arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, vanadium, and zinc were all detected within naturally occurring background levels.~~
- ~~1,2,4-trichlorobenzene was detected in only one sample at a low concentration and was found nowhere else at Moffett Field. A toxicity screen for this chemical is shown in Appendix E.~~
- ~~Calcium, iron, magnesium, potassium, and sodium are all essential nutrients.~~

~~There are seven chemicals of potential concern identified at Site 16:~~

~~Organics~~

~~Toluene~~	~~Xylenes~~

~~Metals~~

~~Aluminum~~	~~Selenium~~
~~Manganese~~	~~Silver~~
~~Nickel~~	

~~These metals may also be present as a result of natural background; however, the limited background data do not allow for their elimination on this basis. Past practices at OU2 do not suggest that these metals are site related.~~

~~20.2.15 Chemicals of Potential Concern at Site 17~~

~~No samples were taken at Site 17 during Phase I and II. Some data were collected during the removal of the USTs. Samples were analyzed for a limited number of VOCs, SVOCs, BTEX, and metals. Constituents detected in soil at Site 17 are listed in Table 20.2-13. A total of 18 constituents have been detected in the soil at Site 17 including 2 organics and 16 metals. Of these, three chemicals of concern have been identified for Site 17: toluene, xylenes, and cadmium.~~

~~Cadmium is probably not site related but could not be eliminated based on the available background information.~~

~~20.2.16 Chemicals of Potential Concern at Site 18~~

~~No samples were taken at Site 18 during Phase I and II. Some data were collected during the removal of these USTs. Samples were analyzed for a limited number of VOCs, SVOCs, BTEX, and metals. Constituents detected in soil at Site 18 are listed in Table 20.2-14. Two organic constituents have been detected in the soil at Site 18: toluene and PCE. Both were included as chemicals of potential concern for this site.~~

20.2.~~17~~11 Chemicals of Potential Concern at Site 19

All constituents detected in the soil at Site 19 are listed in Table 20.2-~~15~~9. A total of 33 constituents have been detected in the soil at Site 19 including 11 organics and 22 metals. This includes detections from all the tank sites. Constituents were excluded from the list of chemicals of potential concern for the following reasons:

- 1,1-DCA and pyrene were detected in less than 5 percent of the samples analyzed.
- Aluminum, arsenic, barium, cadmium, chromium, ~~cobalt,~~ lead, mercury, vanadium, and zinc were all detected within naturally occurring background levels.
- Calcium, iron, magnesium, potassium, and sodium are all essential nutrients.

There are 16 chemicals of potential concern at Site 19.

Organics

1,2-DCE	2-Butanone	PCE
Bis(2-ethylhexyl)phthalate	Carbon disulfide	TCE
Acetone	Butylbenzylphthalate	Toluene

Metals

Antimony	Nickel
Beryllium	Silver
Cobalt	
Copper	Thallium
Manganese	

20.2.18 Summary of Chemicals of Potential Concern

Chemicals of potential concern have been selected for OU2 using U.S. EPA (1989b) selection criteria. Solvents and fuel-related constituents are the primary types of chemicals of potential concern, as expected. Metals were also found in most samples. The majority of these metals are related to natural background. The chemicals selected in this section will be quantitatively evaluated in the exposure assessment.

Fourteen metals have been excluded as chemicals of potential concern on at least one site because they were considered to represent naturally occurring background concentrations. These metals are listed below and have been carried through the quantitative risk assessment to provide an estimate of "background risk":

Metals

Aluminum	Lead
Antimony	Manganese
Arsenic	Mercury
Barium	Nickel
Chromium	Selenium
Cobalt	Vanadium
Copper	Zinc

20.2.19 Uncertainties

Uncertainties associated with the collection and laboratory analysis of the sampling data may impact the results of the selection process. These uncertainties result from contamination of samples during collection, preparation, or analysis, and normal error in the analytical techniques. Uncertainties are addressed by the selection process for chemicals of potential concern. Compounds detected infrequently (5 percent of the time or less) or at levels close to those in the associated blanks were assumed to be artifacts produced during sample collection or analysis and were deleted from the final list of chemicals of potential concern. This results

in a list of chemicals of potential concern that have been found most consistently and at the highest concentrations. The selection process used is consistent with current U.S. EPA guidance (U.S. EPA, 1989b).

Due to analytical constraints, it is possible for chemicals that have not been detected only sporadically to contribute significantly to potential risks if they are actually present in more samples below the CRQL. Chemicals that have CRQLs associated with potential risks above the lower limit of acceptable risk have been carried through the risk assessment separately. The results of this assessment of potential false negatives (PFN) are presented in Section 20.6 along with the results for the chemicals of potential concern. Naturally occurring (background) concentrations of metals may present a risk at some sites. Therefore, all metals excluded as chemicals of potential concern have also been carried through the risk assessment separately from the chemicals of potential concern. These "background risks" are also presented in Section 20.6.

20.3 Exposure Assessment

The estimation of potential exposures of human and environmental receptors to chemicals found at the site is presented in this section. Exposure is defined as the contact of a receptor with a chemical. Exposure assessment is the estimation of the magnitude, frequency, duration, and route of exposure. The magnitude of an exposure is determined by estimating the amount of a chemical available at the receptor exchange boundaries (lungs, gastrointestinal tract, or skin) during a specified time period. The general procedure for conducting an exposure assessment is (U.S. EPA, 1989b):

- Characterization of exposure setting
- Identification of exposure pathways
- Estimation of exposure.

20.3.1 Characterization of Exposure Setting

This section provides a description of the physical characteristics of OU2 as well as the populations, both human and environmental, living on or near OU2 that may be affected by the site. A complete physical description of OU2 is given in Chapter 3.0 of this report. A brief summary is given here.

20.3.1.1 Physical Setting

Moffett Field's proximity to the San Francisco Bay and the Pacific Ocean is a major component in the climatology, hydrology, biota, and, to a lesser degree, physiography of the

Approximately 1,500 acres of land at Moffett Field are used for operations, training, ordnance storage, maintenance facilities, personnel support facilities, and single-person and family housing (WESTDIV, 1985). An additional 160 acres are leased for agricultural use as part of Moffett Field's ongoing land management planning program. Land uses at Moffett Field are divided in half by the runway system. The aircraft and flight operations are on the east side of the runway, and the personnel support operations and housing are on the west side (WESTDIV, 1985).

Moffett Field has been listed for closure in the future; therefore, future land use will differ from the current military use. The most likely future use is as an expanded facility for NASA ARC. Potential future uses include use as an airport with aircraft maintenance, industrial development, or residential development. Because definitive information does not exist to indicate that future development will not be residential, a residential scenario has been used as a worst-case assumption for future land use at OU2.

20.3.2 Identification of Potential Exposure Pathways

For exposures to occur, complete exposure pathways must exist. A complete exposure pathway requires (U.S. EPA, 1989b):

- A source and mechanism for release of the chemical
- A transport medium
- A point of potential human or environmental contact
- An exposure route at the exposure point.

If any one of these four components is missing, the pathway is generally not complete. The transport medium may be missing and the pathway still be complete if the point of contact is directly at the release of the chemical.

20.3.2.1 Sources and Receiving Media

The potential source areas that make up OU2 at Moffett Field are described in Section 20.1-4. OU2 is defined as the soils (above the water table) at these sites. The primary release mechanisms for chemicals in soil are:

- Fugitive dust generation and deposition
- Tracking of soils by foot or vehicle traffic
- Volatilization
- Surface runoff following precipitation
- Leaching to groundwater
- Uptake by biota.

Fugitive dust generation and deposition, tracking, and surface runoff all contribute to the movement of chemicals from the source areas to nearby surface soils. A discussion of the extent of contamination from each source area is given in Chapters 4.0 through 18.0 of this RI.

In some cases, if the complete extent of contamination has not been determined, and the risk assessment shows significant risks associated with a source area, it may be necessary to further characterize the extent to which the contaminated soils have been carried. For those sources that represent significant risks, remediation of the source will prevent further soil movement.

Chemicals may be released to the air via utilization or fugitive dust. The potential for these releases to adversely impact potential receptors is discussed in Section 20.3.2.3. Chemicals in soil may act as a source for releases to groundwater as a result of leaching. The presence of a large regional groundwater contaminant plume at Moffett Field makes the evaluation of possible past leaching from OU2 soils difficult. Future leaching may be evaluated through the use of mathematical models as described in Section 20.3.2.2.

Chemicals in soil may be released to surrounding biota as a result of direct contact/dermal absorption (especially for plants and soil dwelling fauna such as earthworms), ingestion of the soil or plants growing in the soil, or inhalation of fugitive dust or volatiles. Directly exposed plants and animals may then act as a source to other biota.

20.3.2.2 Fate and Transport

After a chemical is released to the environment, it may be:

- Transported
- Physically transformed (e.g., volatilization, precipitation)
- Chemically transformed (e.g., photolysis, hydrolysis, oxidation, reduction, etc.)
- Biologically transformed (e.g., biodegradation)
- Accumulated in one or more media.

The potential fate and transport of the chemicals of potential concern identified at Moffett Field OU2 is described in Chapter 19.0 of this RI Report. The most important transport mechanism for the chemicals in the soil at OU2 is leaching to groundwater as a result of rainfall and percolation through the soil. The potential for chemicals to leach to groundwater may be estimated through the use of mathematical models. These models range from simple screening level models, which require very little site-specific data and give "worst-case"

estimates of leaching potential, to sophisticated numerical simulations that require large amounts of site-specific data and provide more realistic estimates of leaching potential. All mathematical models have varying levels of concentrations associated with their use.

For the soils at Moffett OU2, a screening level approach was used. The Summers model described in Chapter 19.0 was used to estimate an acceptable soil concentration (that would not result in groundwater contamination above MCLs) at each site. This model is designed to result in overestimates of leaching potential by disregarding loss mechanisms such as chemical/biological decay and volatilization and by assuming that 100 percent of the local precipitation is available for chemical transport (none is lost to evapotranspiration, plant uptake, or surface runoff). Leaching potential is further overestimated by assuming that the entire area of each site is contaminated at the upper 95 percent confidence limit concentration for each chemical of potential concern. The purpose of this overestimation is to compensate for the uncertainties inherent in the modeling and to provide a screening level for chemicals in soil that is sufficiently health-protective. By using this conservative model, it can be assumed that any site that has estimated soil concentrations below the screening level set by the model will not result in significant risks as a result of groundwater contamination.

20.3.2.3 Potential Exposure Pathways

Once all potential exposure pathways have been identified, the potentially significant ones are selected for a more detailed evaluation. U.S. EPA guidance for performing risk assessments (U.S. EPA, 1989b), suggests eliminating an exposure pathway from detailed analysis when there is sound justification for elimination (e.g., based on the results of a screening analysis). U.S. EPA risk assessment guidance offers examples of justification for eliminating exposure pathways, including (U.S. EPA, 1989b):

- "The exposure resulting from the pathway is much less than that from another pathway involving the same medium at the same exposure point."
- "The potential magnitude of exposure from a pathway is low."
- "The probability of the exposure occurring is very low and the risks associated with the occurrence are not high."

Potentially complete exposure pathways are dependent upon a large number of site-specific circumstances including:

- The types of chemicals detected at the site. For example, if the chemicals of potential concern at a site do not include any volatile compounds, inhalation of VOCs is not applicable at that site.

- The type of groundcover present at the site. If the site is covered with asphalt or concrete there may be no completed pathways. If the site is grass covered (or heavily vegetated with some other cover) fugitive dust may not be applicable because fugitive dust emissions are greatly dependent on the type and quantity of vegetative groundcover. Gravel cover will also inhibit the release of fugitive dust and generally prevent direct contact but will not prevent VOC emissions.

- The type of activities at the site. For example, even if an area has vegetative or gravel groundcover if heavy equipment (e.g. tanks) is used fugitive dust may be an important pathway.

All of these factors have been taken into account in selecting the exposure pathways which may be complete at each site. As recommended by RAGs, some pathways may be complete but their contribution to total exposure is negligible compared to other pathways. These pathways are discussed in the risk assessment but not quantified.

Fugitive dust is comprised of particulates of different aerodynamic diameters some of which are respirable (generally < 10 m diameter). The larger particulate fraction is not considered to be respirable into the deep lung. In this risk assessment, the conservative assumption was made that all fugitive dust is of a respirable size.

There are two types of exposure pathways for chemicals in soil:

- Direct Pathways - Receptors may be exposed to chemicals in surface soils via incidental ingestion of contaminated soil or direct external contact with contaminated soil.

- Secondary Pathways - Receptors may be exposed to airborne constituents from soil. The transport of chemicals from soil to the air begins with either the resuspension of contaminated particulates or the emission of volatile chemicals from the soil. Airborne chemicals are subsequently dispersed in the environment by winds.

  Exposure may also occur via consumption of produce grown on contaminated soil, and meat and milk from livestock that ingest contaminated soil, or crops

grown in this soil. In addition, exposures may occur via contact with other media contaminated through erosive forces (i.e., surface water) or water percolation and leaching of contaminants from the soil to groundwater.

The direct pathways are important only for surface or near surface soils. Near surface soils available for contact may be defined as being up to 10 feet deep. This includes soils that may be contacted during construction activities. The incidental ingestion pathway is especially important for children under the age of 6 years because they have the greatest tendency to ingest soil. This juvenile exposure is only expected to involve soils down to 1 foot deep because young children are not expected to be present at construction sites.

The food chain pathways are also applicable only for surface or near surface soils. Volatile chemicals may migrate to the surface from any soil depth; however, the emission rate at the surface drops off sharply with the depth of the contaminated soil and becomes negligible for contaminated soil more than 1 to 3 feet deep. Leaching of chemicals to groundwater may occur regardless of the depth of contamination.

There are currently no livestock at Moffett Field OU2; therefore, this pathway will not be considered further for current exposures at any of the sites. There are also no crops currently being grown for human consumption at OU2; therefore, this pathway will not be considered further. Vegetable ingestion is considered as a possibility if there is future residential development; however, current residential land use development around Moffett Field tends toward condominiums and other multiple occupancy dwellings. These types of housing generally do not have gardening plots available. This assumption is based on inspections of the area and aerial photographs.

All identified potential exposure pathways for OU2 are summarized in Tables 20.3-1 through 20.3-~~1~~59. A brief explanation of the rationale for the inclusion or exclusion of each pathway in the quantitative risk assessment for each site is given in the following sections.

Site 3 - Marriage Road Ditch. The potential exposure pathways at Site 3 are summarized in Table 20.3-1. Given the present conditions at the site, potentially exposed populations may include occupational populations such as personnel working in the Marriage Road Ditch and construction crews working within an excavation at the site. Marriage Road Ditch transects a golf course; therefore, children or adults may be in the area and may be exposed to site-related chemicals (recreational exposure).

Exposure pathways for occupational populations include dermal contact and incidental ingestion of the soils as the result of hand-to-mouth activity. Personnel working in the ditch or within an excavation may come in direct contact with sediments or chemical-bearing soils. Children playing in Marriage Road Ditch may also be exposed via these pathways.

Potential exposure via dermal exposure with the water in the ditch may occur at this site; however, the chemicals present in the water would consist primarily of inorganics because the organic compounds present in the soils are not readily soluble in water. Inorganics are not readily absorbed through the skin; therefore, potential exposure via dermal contact to chemicals in the water is not considered to be significant relative to uptake via other pathways. The water in the ditch is not deep enough to allow swimming; therefore, children are not likely to be exposed via inadvertent ingestion of water while swimming.

Chemicals of potential concern in the near-surface soils include metals and semivolatile organics, such as PCBs and phthalates. These organic compounds are not volatile, and given the grass and water that are present in the ditch and the open area surrounding the ditch, it is unlikely that the semivolatile organics are released in concentrations that would have a significant impact upon human health. The grass and water present in the ditch would also prevent wind erosion from occurring; therefore, potential exposure via inhalation of windborne particulates is not considered to be a viable pathway. Potential exposure via inhalation would be limited to inhalation of organic compounds by individuals working within an excavation. Persons working within an excavation may be exposed to organic chemicals vaporizing from the surrounding soils. Inhalation of fugitive dust has historically been an insignificant exposure pathway for a limited excavation scenario.

Future land use at this site is not likely to include development as a residential area or for industrial use; however, as a conservative measure, future residential and industrial uses are assumed in this assessment. Exposure pathways that may be present under a residential exposure scenario include dermal contact with soils, inadvertent ingestion of soils, and potential exposure via consumption of foods grown at the site. Adults or children living in the area of the site may come in direct contact with the soils located in their yard or near their residence. This would result in exposure via dermal uptake of organics and inadvertent ingestion of the soils. If a garden is planted at this site, fruits and vegetables may bioaccumulate site-related compounds, resulting in exposure via consumption of the homegrown food. If the site is developed for residential use, the area would be covered either by structures or grass. Vegetative groundcover reduces the potential for fugitive dust emissions from soils for several reasons:

- The root structure stabilizes the soil making greater wind force necessary for emissions.
- Vegetation reduces the wind velocity at the ground surface.
- Vegetation reduces evaporative water loss from the soil. Increased moisture decreases the potential for fugitive dust emissions.

Therefore fugitive dust is not considered a significant exposure pathway where groundcover is present. It is known that solid cover (such as grass) will profoundly reduce fugitive dust emissions.(GRI, 1986)

VOC emissions are dependent upon the volatility of the individual chemicals, the absorption of the chemicals to the soil, and the air and soil temperature. Soil moisture can affect the absorption of chemicals to the soil particles and chemicals may absorb or be taken up by plant roots, therefore vegetative groundcover may also have some effect on VOC emissions. However, the magnitude of this effect is unknown. Therefore, exposure via inhalation of windborne particulates is unlikely for a future residential scenario however, inhalation of VOCs may occur where significant VOC contamination is present.

Chemicals present in the soils may leach into groundwater. If the groundwater in the A-aquifer zone underlying the site is used as a residential water source, inhabitants may be exposed to site-related chemicals via drinking water.

Site 4 - Former Wastewater Holding Pond. The potential exposure pathways at Site 4 are summarized in Table 20.3-2. Current potentially exposed populations at this site would be restricted to occupational populations. Individuals working at the site may be exposed via dermal contact with the soils, inadvertent ingestion of soils, inhalation of organics volatilized from the soils, or inhalation of chemicals absorbed onto windborne particulates. Given the distance of the site from residential areas on the site and the type of operations in the area, it is unlikely that a nonmilitary resident at Moffett Field would be exposed to site-related chemicals.

Individuals working at the site may come in direct contact with chemicals in the surficial soils, resulting in exposure via dermal contact or inadvertent ingestion of soils. Organic compounds vaporizing from the soils may result in the exposure via inhalation of these organic vapors. Chemicals bound to soils may become airborne as the result of wind erosion. This may result in exposure through inhalation of these airborne particulates.

~~ingestion of soils, and inhalation of VOCs. A person working in the area may also be exposed via inhalation of chemical-bearing particulates that have become suspended as a result of wind erosion.~~

~~Residential receptors may be exposed to site-related chemicals that are absorbed onto windborne particulates; however, it is unlikely that such a receptor would be in the area of the runway. Both areas may be used for housing developments in the future.~~

~~Individuals living in the area of the runway in the future may be exposed to site-related chemicals via dermal contact with the soils, inadvertent ingestion of soils, inhalation of volatile organics, and potential consumption of homegrown foods from this site. If the site is developed for residential use, the area would be covered either by structures or grass; therefore, exposure via inhalation of windborne particulates is unlikely. Chemicals in the soils may leach into groundwater, resulting in exposure via drinking water should the A- or B-aquifer zone be used as a drinking water source.~~

Site 11 - Engine Test Stand Area. The potential exposure pathways at Site 11 are summarized in Table 20.3-9. Given the present conditions at the site, potentially exposed populations may include occupational populations such as personnel working at the area and construction crews working within an excavation at the site. Potential exposure pathways include dermal contact with the soils and inadvertent ingestion of soils. The compounds detected in the soils included PAHs, oils, greases, metals, and phthalates. These organic compounds are not volatile; therefore, it is unlikely that they will volatilize into the atmosphere. The size of the area impacted is approximately 75 feet by 45 feet; therefore, the contribution of particulate material to the atmosphere resulting from wind erosion at this site is not expected to be significant.

Should this site be developed as a residential area, future potential exposure pathways may include dermal contact with soils, inadvertent ingestion of soils, and ingestion of site-related chemicals via bioaccumulation into homegrown fruits and vegetables. If the site is developed for residential use, the area would be covered either by structures or grass; therefore, exposure via inhalation of windborne particulates is unlikely. ~~Given the proximity of this site to San Francisco Bay, it is unlikely that the groundwater under this site would be~~ The TDS concentrations in monitoring wells at site 11 exceeded the upper detection limit of 20,000 mg/L. Potable water is defined as having less than 3000 mg/L TDS ~~potable (i.e., below 3,000 mg/L total dissolved solids [TDS]) as defined~~ by the California State Water Resources

Control Board (CSWRCB) (Resolution No. 88-63); therefore, potential exposure resulting from chemicals leaching into groundwater is not likely to occur at this site.

Site 13 - Equipment Parking Area (Building 142). The potential exposure pathways at Site 13 are summarized in Table 20.3-10. Given the industrial nature of the activities occurring in the area surrounding this site, potential receptors would be limited to occupational populations. These individuals may be exposed as a result of dermal contact with soils, inadvertent ingestion of soils, and inhalation of windborne particulates bearing site-related chemicals. Organic site-related chemicals include phthalates, PAHs, oils, and grease. These compounds are unlikely to vaporize into the atmosphere in significant quantities to cause adverse human health effects.

Future land use at this site may include development as a residential area. Should this occur, potential receptors may be exposed via dermal contact with soils, inadvertent ingestion of soils, and inhalation of volatile organics. If the site is developed for residential use, the area would be covered either by structures or grass; therefore, exposure via inhalation of wind-borne particulates is unlikely.

Chemicals present in the soils may leach into groundwater. If the A-aquifer zone underlying the site is used as a residential water source, receptors may be exposed to site-related chemicals via drinking water.

~~Sites 14, 16, 17, 18, and~~ 19 - Underground Storage Tanks~~ and Sumps~~. The potential exposure pathways at Sites~~ 14, 16, 17, 18, and~~ 19 are summarized in Tables 20.3-11 through 20.3-15. ~~The following sites consist of USTs and sumps:~~

~~• Site 14 - Abandoned Tanks 19, 20, 67, and 68~~
~~• Site 16 - Public Works Steam Cleaning Rack Sump 60~~
~~• Site 17 - Paint Shop Sump 61~~
~~• Site 18 - Dry Cleaners' Sump 66~~
~~• Site 19 - Tanks 2, 14, 43, and 53.~~

~~The potential exposure pathways and receptor populations for all of these sites this site would be the same because the source of the chemicals stems from underground; therefore, all of these sites will be addressed together.~~

A potential receptor for th~~ese sites~~is site would be limited to an individual working within an excavation. The depth of all soil samples is given in Appendix A. The source of

contamination at this site is underground. Construction or maintenance personnel working within an excavation may be exposed via dermal contact with the soils, inadvertent ingestion of the soils, or inhalation of organic vapors resulting from volatilization of organic compounds.

Should these areasis area be developed as a residential community, chemicals in the subsurface soils would be isolated and the potential for exposure via direct contact and inhalation of volatiles would be unlikely; however, chemicals in the soils may leach into groundwater. If the A-aquifer zone at these sites is used as a drinking water source, inhabitants of the area may be exposed to site-related chemicals via drinking water.

Background Metals and PFNs. All potential occupational and residential exposure pathways evaluated for at least one site for current or potential future land-use were included in the evaluation of background metals and PFNs.

20.3.3 Estimation of Exposure

This section describes the estimation of exposures for each of the site-related chemicals of potential concern that may be contacted by human receptors. The process involves:

- Determining the concentration of each chemical in the identified environmental media at the point of human exposure
- Identifying applicable human exposure models and input parameters
- Estimating human intakes.

For each identified pathway, a Reasonable Maximum Exposure (RME) scenario has been developed to give a reasonable upper-bound estimate of the potential magnitude of an individual exposure to chemicals from the site. The intent of the RME as defined by the U.S. EPA (1989b) is to estimate a conservative exposure case (i.e., well above the average case) that is still within the possible range of exposures. This RME approach supersedes the previous U.S. EPA recommendation for evaluating both an average and worst-case scenario. This RME is estimated from a combination of average and upper-bound exposure assumptions to result in a reasonable maximum.

20.3.3.1 Exposure Models

Three exposure routes were evaluated in this risk assessment: ingestion, inhalation, and dermal contact. The exposure models used are from the ***Risk Assessment Guidance for Superfund - Volume I: Human Health Evaluation Manual*** (U.S. EPA, 1989b) and are shown below.

Ingestion (of soil, water, or produce)

$$\text{Intake} = [(C_i)(IR)(F)(EF)(ED)]/[(BW)(AT)]$$

where:

Intake	=	Intake of chemical; through ingestion of medium (mg/kg-day)
C_i	=	Chemical concentration in medium i (mg/kg or mg/L)
IR	=	Ingestion rate for medium i (kg/day or L/day)
F	=	Fraction of ingested medium from contaminated source (unitless)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time, period over which exposure is averaged (days)

Inhalation

$$\text{Intake} = (C_i)(BA)(IR)(ET)(EF)(ED)/(BW)(AT)$$

where:

C_i	=	Chemical specific air concentration (mg/m^3)
BA	=	Bioavailability factor (unitless)
IR	=	Inhalation rate (m^3)
ET	=	Exposure time (hours/day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time, period over which exposure is averaged (days)

Dermal Absorption

$$AD = (C_i)(AdF)(Abs)(CF)(SA)(EF)(ED)/(BW)(AT)$$

where:

AD	=	Absorbed dose (mg/kg-day)
C_i	=	Chemical specific soil concentration (mg/kg)
AdF	=	Soil to skin adherence factor (mg/cm^2)
Abs	=	Skin absorption factor (unitless)
CF	=	Conversion factor (kg/mg)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time, period over which exposure is averaged (days)
SA	=	Skin surface area available for contact (cm^2/day)

20.3.3.2 Exposure Parameters

There are three types of parameters that are used to estimate intake (U.S. EPA, 1989b):

- Chemical-related parameters (i.e., exposure concentrations)
- Parameters that describe the exposed population (e.g., contact rate, exposure frequency and duration, and body weight)
- Toxicity-related parameters (i.e., averaging time).

The exposure parameters are summarized in Tables 20.3-16 through 20.3-18. The selection of average or upper-bound values is explained in the following sections. Upper-bound values are generally 90th or 95th percentile values depending on data availability for that parameter. A combination of RME and average exposure parameters has been used in each scenario to result in a combined RME.

Occupational Exposure Parameters. Four occupational scenarios were evaluated for this baseline risk assessment. These scenarios are based on potential current and future worker exposures at Moffett Field. These exposure pathways are: incidental ingestion of soil, dermal exposure to soil, inhalation of volatiles, and inhalation of fugitive dust.

Exposure concentrations are chemical-related parameters for the constituents of potential concern. The concentrations for chemicals detected in the OU2 soils are listed in Tables 20.2-1 through 20.2-15. An RME concentration was estimated as the upper 95th percent confidence limit of the arithmetic mean of the sampling data for each chemical of potential concern unless the upper 95th percent confidence limit value was greater than the maximum detected value. In this case, the maximum detected value was used for the RME. For samples with no detectable concentration of a chemical, a value of one-half the detection limit was used to estimate the mean and upper 95th percent confidence limit. Concentrations in air due to volatilization and fugitive dust were modeled from soil concentrations as shown in Appendix E of this report. The upper 95th percent confidence limit of the soil concentrations was used as the starting concentration in these models.

The population-specific parameters for all scenarios were based on U.S. EPA Guidance (U.S. EPA, 1989b, 1989c, and 1991a). Population-specific exposure parameters are shown in Table 20.3-16. For soil ingestion, an occupational soil ingestion rate of 50 mg/day was used for general occupational activities. Where construction activities occur, ingestion may be higher. Therefore, the occupational excavation scenario is a soil ingestion rate of 480 mg/day. The exposure frequency and exposure duration were site-dependant because of the different

5 years was used, assuming that military personnel would be transferred to another assignment after 5 years based on proposed base closure.

20.3.4 Results

The results of the quantitative exposure assessment are shown in Tables 20.3-20 through 20.3-49. In general, the highest predicted exposures for current land use are associated with inhalation of VOCs where highly volatile compounds are present. For less volatile constituents, incidental ingestion of soil has the greatest contribution to predicted intakes. Ingestion at construction sites involving earth moving may result in higher intakes. The estimated intakes for dermal exposure are similar to those predicted for ingestion but in most cases are slightly lower. When inhalation of fugitive dust is a complete exposure pathway, its contribution to total intake is negligible compared to the other exposure routes.

The highest predicted exposures for future land use are associated with ingestion of vegetables grown in contaminated soil. This is due, in large part, to the conservative nature of the uptake model used. The relative contribution to total intake from the other exposure pathways (inhalation of VOCs, soil ingestion, dermal contact, and inhalation of fugitive dust) is similar to those described previously for current land use.

20.3.5 Uncertainties

Three major types of uncertainties should be considered when reviewing the results of the exposure assessment: uncertainties associated with predicting future land use, uncertainties associated with estimating chemical concentrations at receptor locations, and uncertainties associated with assumptions used in the exposure models. Physiological (e.g., body weight, inhalation rate, etc.) and behavioral (e.g., average time spent in one place, amount of soil ingested) values used to model the RME are a combination of average and upper-bound levels taken from reliable sources. The use of upper-bound estimates will tend to overestimate exposure. This provides a conservative health-protective approach for the risk assessment.

20.4 Toxicity Assessment

To understand the potential health risk associated with a potentially hazardous chemical, information on chemical-specific toxicity is required. Toxicity information is used in conjunction with the results of the exposure assessment to characterize potential health risks at OU2. The U.S. EPA provides information on the toxicity of chemicals in two forms: for carcinogens, a cancer slope factor (CSF) is used to describe the dose-response relationship; for noncarcinogenic toxicants a threshold dose, or reference dose (RfD), is used to describe the dose above which adverse health effects may be observed. For carcinogens the end point

of concern is always cancer. For noncarcinogens, the toxic end point (e.g., kidney effects) may vary among chemicals and routes of exposure (e.g., ingestion and inhalation).

The process used by the U.S. EPA to evaluate potential chemical carcinogens assumes that no threshold levels exist below which a carcinogen will not cause cancer; that is, any exposure to a carcinogen results in the possibility of cancer. This is a conservative assumption because many potential human carcinogens, especially chlorinated solvents, appear to be cancer promoters and will increase the possibility of contracting cancer in the presence of a cancer initiator. Using the no-threshold linearized multi-stage model, the U.S. EPA determines slope factors to describe the potency of a carcinogen. A larger slope factor indicates a greater potency. In addition, the U.S. EPA qualitatively evaluates potential carcinogens according to weight-of-evidence from epidemiological studies and animal studies. The classes are:

- Class A - Human carcinogen
- Class B1 - Probable human carcinogen, limited evidence of carcinogenicity in animals
- Class B2 - Probable human carcinogen, sufficient evidence in animals, inadequate evidence in humans
- Class C - Possible human carcinogen, limited evidence in animals
- Class D - Not classifiable.

In general, it is assumed that for noncancer-causing toxicants, a threshold intake exists below which no toxic effects can be seen. This intake, or dose, can be determined by reviewing data from human exposures (usually in occupational settings) or animal exposures to chemicals. From these studies, a no-observed-adverse-effect-level (NOAEL) or lowest-observed-adverse-effect-level (LOAEL) can be determined. Once an NOAEL or LOAEL dose has been established, the U.S. EPA applies uncertainty factors to ensure the safety of human health. Uncertainty factors of 10 each may be applied if the NOAEL study was an animal study, if a subchronic study is used to understand chronic exposures in order to protect sensitive human populations, and if an LOAEL is used in lieu of an NOAEL.

This section provides information on the toxicity of the chemicals of potential concern at Moffett Field. Evaluation of available dose-response data has been made by the U.S. EPA and is provided on the ***Integrated Risk Information System (IRIS)*** (U.S. EPA, 1992), and in the ***Health Effects Assessment Summary Tables*** (U.S. EPA, 1991b). CSFs and RfDs are taken from these data bases. The chronic and acute toxicity values from these sources, along

with the critical effect or target organ, carcinogenic weight of evidence, uncertainty factors, species tested and their solubilities, vapor pressure, and log K_{ow} are given in Tables 20.4-1 and 20.4-2 for all chemicals of potential concern. None of the chemicals of concern has any known toxic effect via the dermal route, which is different from the oral; thus the oral and inhalation values only are shown. For those chemicals for which no RfD was available from U.S. EPA, an evaluation of their possible toxicity is described below. Chemicals that lacked data on carcinogenicity were assumed not to be carcinogenic.

20.4.1 Lead

U.S. EPA has published no oral or inhalation RfDs for lead because its toxicity is not thought to demonstrate a threshold. The California DTSC (1992) model (the California lead model) for estimating blood lead concentration has therefore been used for assessing the potential health risks from inorganic lead in the soil at Moffett OU2. The DTSC (1992) established a blood lead concentration in children or adults of 10 µg/dl as the concentration of concern, and further specified that a 0.01 risk of exceeding this value is the point of departure for risk management.

20.4.1.1 Overview of the Model

The California lead model is a set of equations that have been formatted to a computer spreadsheet. The equations estimate the contribution to blood lead concentration resulting from exposure to lead by five separate pathways, each of which is discussed below. The output of the model, total blood lead concentration, is computed as the sum of the contributions from each of the five pathways. Three receptors are considered: an adult, a one-year-old child, and a one-year-old child whose lead intake is increased by pica.

The output of the model is the 50th and the upper 90th, 95th, 98th, and 99th percentile blood lead levels for the three receptors described above. The distributional presentation is consistent with the observation that blood lead concentrations are generally log-normally distributed, with a geometric standard deviation of approximately 1.42 (U.S. EPA, 1989a). In order to protect the most sensitive members of the population, DTSC (1992) uses the blood lead concentration of the upper 99th percentile as the basis for initiating risk management. DTSC (1992) notes that the distribution reflects the variation in all the parameters (presumably including the default parameters), and that it is inappropriate to choose upper bound or reasonable maximum values because doing so would distort the distribution.

20.4.1.2 Exposure Pathways

Dietary Uptake Pathway

The contribution to total blood lead concentration of the gastrointestinal (GI) uptake of dietary lead is computed as the product of the concentration of lead in the diet, the contact (or diet ingestion) rate and dietary constants (different values for adults and children) that represent the contribution to blood lead concentration resulting from the daily ingestion of 1 μg of lead in the diet. The model provides default values for dietary lead concentration, diet ingestion rate, and the dietary constant. It also provides the opportunity to model a contribution from produce grown on contaminated soils. In this case it is assumed that home-grown produce constitutes 5.5% of the diet, and that the lead concentration in home-grown produce is 0.045% of the lead concentration in the soil on which it is grown.

The default dietary intake of 1.3 kg/day for a one-year-old child, which would weigh approximately 10 kg (U.S. EPA, 1987), seems unusually high. It may include ingestion of ≈0.4 l of drinking water, which is also considered in a separate pathway (see Drinking Water Uptake Pathway).

Drinking Water Uptake Pathway

The contribution to total blood lead concentration of GI uptake of lead from drinking water is computed as the product of the concentration of lead in drinking water, the contact (or water ingestion) rate and the dietary constants described previously. The model provides default values for drinking water intake, and permits input of the concentration of lead in drinking water.

In the absence of site-specific drinking water lead concentration data, however, DTSC (1992) recommends defaulting to 15 μg/L, which is the U.S. EPA (1992) action level at the tap for lead in drinking water. This federal action level, however, represents a worst-case or maximum exposure scenario. As discussed in previously, DTSC (1992) notes that the distributional approach provides for variation in the model parameters, and that choosing worst-case or maximum values is inappropriate.

Analytical studies of lead in water supplies showed that concentrations generally have not exceeded 50-60 μg/L (Tsuchiya, 1986, van der Leeden et al., 1991). Concentrations for the 100 largest cities in the U.S. ranged from not detected to 62 μg/L, with a median of 3.7 μg/L.

The median lead concentration of 3.7 μg/L is a more appropriate default than the federal action level of 15μ g/L.

Soil and Dust Ingestion Uptake Pathway

The model treats soil and dust as a single entity, known as soil. The contribution to total blood lead concentration of GI uptake of lead from ingested soil is computed as the product of the concentration of lead in soil, the contact (or soil ingestion) rate and a soil constant that represents the contribution to blood lead concentration resulting from the daily ingestion of 1 μg of lead in the soil. The model permits entry of a site-specific value for soil lead concentration and provides default values for soil ingestion. The default soil ingestion rates for an adult and a normal one-year-old child, 25 and 55 mg/day, respectively, are consistent with guidance provided by the U.S. EPA (1989b, c).

The model also estimates blood lead levels for a one-year-old child with soil pica, which is defined as deliberate soil ingestion. For this receptor, which differs from the normal child only in the amount of soil ingested, soil ingestion defaults to 790 mg/day.

Data evaluated by U.S. EPA (1989c) suggest that the one-year-old child is an inappropriate receptor for which to model pica. U.S. EPA (1989c) notes that all children mouth or ingest non-food substances. This behavior is a normal, but temporary, phase of childhood development. When this behavior persists beyond 18 months of age, which is uncommon, the child is said to be practicing pica. The condition usually does not persist beyond six to seven years of age. A more defensible receptor for which to model pica would be a child of 18 months to seven years of age; a four-year-old (arithmetic average of 1.5 and 6.5 years) child might be a reasonable choice. The GI uptake and fate kinetics of lead are expected to be quite different in a one- compared with a four-year-old child.

Inhalation Uptake Pathway

The contribution to total blood lead concentration of respiratory tract uptake of lead from inhalation of contaminated air is computed as the product of the concentration of lead in air and an inhalation constant that represents the contribution to blood lead concentration resulting from the daily inhalation of 1μg of lead in air. Presumably the inhalation constant contains a factor for contact (or inhalation) rate, because a separate term for contact rate is not provided. The term for lead concentration in air may be input as a measured site-specific value (the concentration of lead in air from all sources), or may be input as the sum of local

or regional ambient air lead concentration (background) and lead in airborne dust arising from the soil on the site. In the latter case, the model multiplies the concentration of lead in soil by the concentration of dust in air. The concentration of dust in air may be input (input zero if site-specific air lead concentrations are available) or allowed to default to 50 $\mu g/m^3$.

Dermal Contact Uptake Pathway

The contribution to total blood lead concentration of uptake of lead from dermal contact with contaminated soil is computed as the product of the soil concentration of lead, the contact rate and a soil constant that represents the contribution to blood lead concentration resulting from dermal contact with 1 μg of soil-borne lead. Dermal contact is the least important pathway in the model, accounting for ≤2% of the total blood lead concentration.

20.4.1.3 Application of the Model

Several runs of the model were performed. Figure 20.4-1 presents the run using the measured soil lead concentration of 257.61 $\mu g/g$ and the recommended default values for the other parameters: 0.18 μg lead/m^3 in air, 15 μg lead/l in water and 50 μg of airborne soil (dust)/m^3 in air.

20.4.2 Copper

The U.S. EPA approved MCL for copper in water is 1.3 mg/L. This was converted to a risk-based acceptable exposure as shown:

$$AE = \frac{(MCL)(IR)}{(BW)}$$

where:

AE = Acceptable exposure (mg/kg-day)
MCL = Maximum contaminant level in drinking water (mg/L)
IR = Ingestion rate for water (L/day)
= 2 L/day for adults (IEM/4/98)
BW = Body weight (kg)
= 70 kg for adults (IEM/4/50).

The resulting acceptable exposure is 0.037 mg/kg-day for both the oral and inhalation routes. Data are not currently available to determine a separate acceptable exposure for inhalation.

10^{-9}, 2.1×10^{-9}, 2.1×10^{-10}, 5.5×10^{-8}, 1.2×10^{-8} and 0. The total average case ILCR is 7.0×10^{-8}. For the RME case, the respective ILCR for these pathways are 6.0×10^{-9}, 2.7×10^{-9}, 2.9×10^{-7}, 9.2×10^{-8} and 0. The total RME case ILCR is 3.9×10^{-7}. These totals fall below the lower bound of the risk range specified by NCP.

The HIs for juvenile soil ingestion, adult soil ingestion, dermal contact, and consumption of homegrown vegetables are ~~8.2×10^{-1}, 8.6×10^{-7}, and $3.4 \times 10^{+1}$, respectively~~3.4×10^{-1}, 3.9×10^{-2}, 1.3×10^{-1}, 2.1×10^{0}, and 3.0×10^{-10}, respectively for the average case, and 4.5×10^{-1}, 5.2×10^{-2}, 1.5×10^{-1}, 4.2×10^{0}, and 3.4×10^{-10}, for the RME case, respectively. This HI for vegetable ingestion is based on an extremely conservative vegetable uptake model and assumes that a potential future receptor maintains a well-stocked vegetable garden at this site for 30 years. The total average case HI and RME HI for all other pathways ~~is 8.2×10^{-1}~~are 5.1×10-1 and 6.5×10^{-1}, respectively. ~~This is~~ These values are below the target value of unity; therefore, chemicals present in soils are not likely to have a significant impact upon human health.

Blood lead concentrations have been estimated using the California lead model. Several runs of the model were performed. Figure ~~1~~20.4-1 presents the run using the measured soil lead concentration of 257.61 µg/g and the recommended default values for the other parameters: 0.18µg lead/m ^{3} in air, 15µg lead/l in water and 50µg of airborne soil (dust)/m ^{3} in air. Ingestion of lead in home-grown produce was not considered a likely pathway. As shown, the only valid receptor showing an unacceptable blood lead level (99th percentile >10.0 µg/dl) was the normal child, for which the 99th percentile blood lead concentration was 10.1 µg/dl. The pica child showed unacceptable blood lead concentrations at all distributions (50th through 99th percentile). As discussed in Section 2.4, however, the pica condition imposed on a one-year-old child is probably inappropriate. Figure ~~2~~20.6-1 shows that reducing soil lead concentration from 257.61 to 256 µg/g, with no changes in any of the other parameters, results in acceptable blood lead concentrations in all receptors except the pica child. In Figure ~~3~~20.6-2, all of the parameters were as described in Figure ~~1~~20.4-1, except a drinking water lead concentration of 3.7 µg/L was used, as discussed in Section 2.3. Blood lead levels were acceptable for all receptors except the pica child.

Further evidence that the pica condition imposed on a one-year-old is inappropriate is provided by the model itself. Figure 420.6-3, generated using the default values recommended by DTSC (1992), except that ingestion of lead in home grown produce was not considered, shows that soil lead concentration would need to be ≤18 µg/g to obtain acceptable blood lead concentrations. This is considerably below the background concentration of 110

μg/g measured at the site, and is below the concentrations (30 and 70 μg/g) for two samples in Santa Clara County obtained by the USGS (1981). The alternative interpretation, equally valid and far more practical, is to acknowledge that the environment cannot be made safe for the pica child, probably also for many reasons unrelated to lead ingestion. Safety for the pica child depends on limited and supervised contact with his environment, and behavioral modification, until the condition is outgrown.

These results indicate that the lead detected in soils at Site 13 is not likely to have a significant impact upon human health.

Future receptor populations may be exposed to chemicals in soils as a result of leaching into groundwater. The maximum acceptable soil concentration for selected chemicals of concern are given in Table 20.3-19. The upper concentrations were below the maximum acceptable limits. The chemicals at the site do not present unacceptable risks to current and future populations.

~~***Site 14 - Tanks 19, 20, 67, and 68.*** Current potential receptor populations at this site include individuals working within an excavation. These receptors may be exposed via soil ingestion, dermal contact, and inhalation of VOCs. The ILCRs for these exposure pathways are 6.7×10^{-8}, 7.0×10^{-13}, and 1.1×10^{-11}, respectively. The total ILCR for these chemicals is 6.7×10^{-8}, which is over an order of magnitude below the lower bound of the range specified in the NCP.~~

~~The HIs for soil ingestion, dermal contact, and inhalation of VOCs are 4.8×10^{-2}, 2.7×10^{-6}, and 1.7×10^{-4}, respectively. The total HI for all the exposure pathways is 4.0×10^{-2}. This value is over an order of magnitude below unity. Therefore, it is unlikely that chemicals at this site present a significant potential risk to human health given the present receptor populations.~~

~~Potential exposure of future receptor populations is limited to individuals exposed to compounds that have leached into drinking water. The maximum acceptable soil concentrations for selected chemicals of concern are given in Table 20.3-19. All of the compounds evaluated (acetone, bis[2-ethylhexyl]phthalate, di-N-butylphthalate, toluene, and silver) are more than an order of magnitude below the maximum acceptable soil concentrations. Therefore, it is unlikely that chemicals in soils will impact groundwater.~~

~~The chemicals at the site do not present unacceptable risks to current and future populations. Concentrations of these chemicals should not have a significant effect on groundwater.~~

An environmental assessment evaluates the potential for site-related contamination to adversely affect environmental receptors.

The soils that make up OU2 at Moffett Field are located at isolated sites (e.g., Site 9, the Old Fuel Farm and Old NEX Gas Station). With the possible exception of rare plants (which are not present at any of the OU2 sites), environmental receptors are rarely confined to a single site. For this reason, the environmental assessment for OU2 is limited to a review of potential receptors and a qualitative assessment of the potential for adverse impacts. A more complete environmental assessment will be included in the OU6 and site-wide RIs. The site-wide risk assessment is the most appropriate form for a comprehensive environmental assessment because it covers the entire area, including the marshlands and bay, and includes all potentially contaminated media.

20.7.1 Chemicals of Potential Concern - Environmental

Specific chemicals of potential concern will be selected site-wide in the OU6 assessment. In general, the chemicals of potential concern for the soils will be the same as those selected for the human health risk assessment. Some metals eliminated because they are essential nutrients and/or have very low toxicity for human receptors may be included in the environmental assessment.

20.7.2 Receptor Assessment - Environmental

This environmental receptor assessment identifies potential environmental populations that may be exposed to site-related chemicals at Moffett Field OU2 under current and future land use conditions.

2.7.2.1 Flora

Most of Moffett Field that is not covered by buildings or other structures is either paved or planted with typical urban ornamental plants. Approximately 160 acres of land is under agricultural cultivation. The northwestern portion of Moffett Field contains some areas where vegetation grows in a wild state (ENVIRON, 1981).

The area just north of Moffett Field is within the historic margin of San Francisco Bay and was once open to tidal action. Because the area is now bordered by commercial salt evaporation ponds and dikes on the bayside and contains no open slough channels, regular tidal action has been eliminated.

Appendix E

E.1.0 Models

Revised Summer's Model

References:

U.S. Environmental Protection Agency (U.S. EPA), 1989, ***Determining Soil Response Action Levels Based on Potential Contaminant Migration to Groundwater: A Compendium of Examples***. EPA/540/2-89/057, October 1989.

Summers, K. S., Gherini, and C. Then, Tetra Tech Inc., ***Methodology to evaluate the Potential for Groundwater Contamination from Geothermal Fluid Release***, EPA-600/7-80-117, 1980 as modified by EPA Region IV.

Method:

The concentration of a chemical in groundwater is a function of the amount of the chemical infiltrating through the soil column to the aquifer. The chemical concentration is also determined by the volume of water into which it is dissolved. This was described by Summers, et al. (1989):

$$Cgw = \frac{(QpCp) + (QaCa)}{Qp + Qa} \qquad (1)$$

where:

Cgw	=	Target contaminant concentration in groundwater (µg/L)
Qp	=	Volumetric flow rate of infiltration into the aquifer (ft^3/day)
	=	VdzAp
Vdz	=	Darcy velocity in downward direction (ft/day)
Ap	=	Horizontal area of spill (ft^2)
Cp	=	Concentrations of pollutant in the infiltration at the unsaturated-saturated zone interface (µg/L)
Qa	=	Volumetric flow rate of groundwater (ft^3/day)
	=	VDhw
Vd	=	Darcy velocity in aquifer (ft/day)
h	=	Aquifer thickness (ft)
w	=	Width of spill perpendicular to flow direction in aquifer (ft)
Ca	=	Initial or backward concentration of pollutant in aquifer (µg/L)

Concentration in Vegetables

The following model was used to estimate potential concentrations of chemicals in vegetables due to uptake from contaminated soil:

$$C_v = (C_s)(B)(CF)$$

where:

C_v = concentration in vegetables (mg/kg)

B = chemical-specific root uptake factor -- transfer to vegetative portion of plant. For inorganic chemicals of potential concern root uptake factors are taken from Baes et. al., 1984). For organic chemicals of potential concern root uptake factors were estimated from the K_{ow} of the chemical using the following relationship (Travis and Arms, 1988):

$$B = (1.588) - 0.578(\log K_{ow})$$

CF = Dry to wet weight conversion factor (mg/kg).

It was assumed that vegetables will be eaten raw and unwashed, thus eliminating these potential removal mechanisms.

~~E.3.0 Concentration/Toxicity Screen for Chemicals of Potential Concern~~

~~Infrequently detected chemicals (<5 percent frequency of detection) were excluded as chemicals of potential concern. However, if a chemical was analyzed for in less than 20 samples at a site, a single positive hit would result in greater than 5 percent detection; therefore, chemicals with fewer than 20 samples analyzed were evaluated on a case by case basis. The chemicals' toxicity and concentration were considered in this evaluation.~~

~~Chemicals were evaluated by estimating a potential ILCR and/or HQ for a worst case residential exposure to the maximum concentration of that chemical at the site. Intakes were estimated for direct soil ingestion by adults and children using the equations shown in Section 20.3.3.1. For carcinogens, intakes were estimated for a combined exposure of an adult and child to maximize both the intake rate and exposure duration. For systemic toxicants, intakes were estimated for a child only to maximize the intake rate. Exposure duration is not important for systemic toxicants as long as the exposure is long enough to qualify as chronic. The exposure parameters are shown below:~~

~~Parameter~~	~~Value~~	~~Reference~~
~~Adult and Juvenile Soil Ingestion (Carcinogens)~~		
~~Soil ingestion rate~~	~~1×10^{-4} kg/day~~	~~U.S. EPA, 1991a~~
~~Exposure frequency~~	~~365 days/yr~~	~~Worst case assumption~~
~~Exposure duration~~	~~70 years~~	~~Worst case assumption~~
~~Body weight~~	~~70 kg~~	~~U.S. EPA, 1991a~~
~~Averaging time~~	~~25,550 days~~	~~U.S. EPA, 1989a~~
~~Juvenile Soil Ingestion (Noncarcinogens)~~		
~~Soil ingestion rate~~	~~2×10^{-4} kg/day~~	~~U.S. EPA, 1991a~~
~~Exposure frequency~~	~~365 days/yr~~	~~Worst case assumption~~
~~Exposure duration~~	~~6 years~~	~~U.S. EPA, 1991a~~
~~Body weight~~	~~16 kg~~	~~U.S. EPA, 1991a~~
~~Averaging time~~	~~2190 days~~	~~U.S. EPA, 1989a~~

~~Five chemicals were excluded because they were detected only once at a site and had very low toxicity at the detected concentration. The results of the toxicity screen for these chemicals is shown below:~~

~~Chemical~~	~~Exposure Concentration[a] (mg/kg)~~	~~Estimated Intake (mg/kg/day)~~	~~RfD (mg/kg/day)~~	~~HQ~~
~~1,2-Dichloroethene (Site 6)~~	~~2.50×10^{-3}~~	~~3.1×10^{-8}~~	~~1.00×10^{-2}~~	~~3.1×10^{-6}~~
~~Fluorene (Site 6)~~	~~1.65×10^{-1}~~	~~2.1×10^{-6}~~	~~4.00×10^{-2}~~	~~5.2×10^{-5}~~
~~Naphthalene (Site 6)~~	~~5.60×10^{-1}~~	~~7.0×10^{-6}~~	~~4.00×10^{-2}~~	~~1.7×10^{-4}~~
~~Pyrene (Site 6)~~	~~1.65×10^{-1}~~	~~2.1×10^{-6}~~	~~3.00×10^{-2}~~	~~6.9×10^{-5}~~
~~1,2,4-Trichlorobenzene (Site 16)~~	~~4.10×10^{-1}~~	~~5.1×10^{-6}~~	~~1.31×10^{-3}~~	~~3.9×10^{-3}~~

~~None of these five chemicals are suspected carcinogens. The estimated HQs for all of these chemicals are three to six orders of magnitude below unity under this worst-case scenario.~~

E.5.0 Toxicity Profiles for Essential Nutrients

~~***Calcium.*** Acute single ingestions of calcium salts may product mild gastrointestinal distress; calcium chloride is more irritating and may cause hemorrhage. hypercalcemia or other toxicity has not been reported from acute ingestion. Chronic ingestion of calcium carbonate may cause hypercalcemia, alkalosis, and renal impairment.~~

~~Chronic administration of 4 to 60 grams per day of calcium carbonate for 2 to 60 days has produced the "milk-alkali" syndrome. Chronic renal failure patients on hemodialysis may develop hypercalcemia with lower amounts.~~

~~No toxicity values (e.g., RfD, MCL_) are available for calcium.~~

~~***Iron.*** Exposure to iron may result in vomiting, diarrhea, minor lethargy, and hyperglycemia. More severe exposure may result in stupor, shock, acidosis, hematemesis, bloody, diarrhea, or coma. No toxicity values are available for iron.~~

~~***Magnesium.*** Hypermagnesiumenia leads to hypotension, ECG changes, and impairment of neuromuscular transmission. Magnesium dust can irritate the eyes and mucous membranes of the upper respiratory tract causing atrophic nasopharyngitis.~~

~~Insufficient data exists in the literature to assess the range of toxicity following acute overdose. In hypomagnesiumemia, 2 to 4 g/day may be tolerated orally.~~

~~No toxicity values are available for magnesium.~~

~~***Potassium.*** Toxicity from oral ingestion of potassium salts is slight because potassium is readily excreted in the urine. In overdose situations, symptoms may range from vomiting and diarrhea, through listlessness and muscular cramps, to hypotension and arrhythmias.~~

~~No toxicity values are available for potassium.~~

~~***Sodium.*** Death has followed the use of chloride as a emetic. Symptoms may include vomiting, diarrhea, restlessness, thirst, dizziness, headache, convulsions, coma, tachycardia, hypotension, and respiratory arrest.~~

~~One level tablespoon (17.85 grams) is approximately 305 mEq of sodium, and if retained, would raise serum levels by 30.5 mEq/L in a 3-year old child (estimating 10 L of extracellular fluid volume).~~

~~Central nervous system symptoms are common above 150 to 160 mEq/L. At these levels there is a 10 percent change of convulsions which increases when levels reach 160 to 185 mEq/L. Death is frequent occurrence above 185 mEq/L. An ingestion of 0.5 to 1 g/kg will be toxic in most patients.~~

~~No toxicity values are available for sodium.~~

E.5.1 Calcium

E.5.1.1 Occurrence

Calcium is an alkaline-earth metal in Group IIA of the periodic table (Sax and Lewis, 1987). It occurs in nature only in the combined form, most commonly as calcite (Budavari, 1989). It constitutes ≈3.6 percent (by weight) of the earth's crust, and is the fifth most abundant element. Concentrations in natural water were 600 mg/L in some western U.S. streams and 75,000 mg/L in brines (van der Leeden et al., 1991). Concentrations in finished public water supplies in the 100 largest cities in the U.S. ranged from 0-145 mg/L, with a median of 26 mg/L.

E.5.1.2 Physiology

Accounting for ≈2 percent of the body weight, calcium is the fifth most abundant element in the body (Haynes and Murad, 1980). Calcium is a necessary component of bone and tooth (Petersen and Freilich, 1992). It also plays an integral role in the biochemistry of nerve transmission and protein stabilization (Birch, 1988; Petersen and Freilich, 1992). Calcium is considered a nutritionally essential mineral (Sax and Lewis, 1987). The current recommended dietary allowances (RDAs) are: 400-600 mg/day for infants ≤1 year old, 800-1200 mg/day for persons 1-24 years old, 800 mg/day for adults ≥25 years of age, and 1200 mg/day for pregnant and lactating women (NRC, 1989). Average daily intakes for eight age-sex groups in the U.S. for 1982-1989, based on a survey of core foods in the U.S. food supply, ranged from 511-1141 mg/day (60-118 percent of the RDA), but the distributions about the averages were not reported (Pennington and Young, 1991).

Calcium homeostasis is closely controlled by regulation of intestinal absorption, renal excretion and skeletal deposition or resorption (Haynes and Murad, 1980). Parathyroid hormone and vitamin D increase GI absorption, reduce renal excretion, and increase skeletal resorption of calcium. Calcitonin increases renal excretion of calcium. Generally, ≈30 percent of dietary calcium is absorbed, although the absorption efficiency increases in cases of calcium deficiency.

E.5.1.3 Toxicity

Excessive plasma concentrations of calcium (hypercalcemia) increase the excitatory threshold of nerve and muscle, resulting in muscle weakness, lethargy, and eventually coma (Birch, 1988; Haynes and Murad, 1980). Hypercalcemia is usually the result of endocrinologic dysfunction (e.g., hyperparathyroidism, hypervitaminosis D, adrenocortical deficiency) or the use of certain pharmaceuticals (e.g., calcium ionophores, chelating agents, calcium channel blockers), and is unlikely to be due to ingestion of large quantities of calcium, except in persons with hypothyroidism. Conditions that increase calcium absorption from the GI tract may induce kidney stone formation without inducing hypercalcemia (Birch, 1988). The ability of the normal body to closely regulate gastrointestinal absorption and renal excretion renders calcium virtually nontoxic to healthy humans (Birch, 1988; Hibbins, 1992).

E.5.1.4 Health-Based Toxicity Values

There are no verified or provisional toxicity values or water quality criteria for elemental or ionic calcium (U.S. EPA, 1992a, b). Calcium is virtually nontoxic to healthy humans, because GI absorption and renal excretion are closely controlled (Birch 1988; Haynes and Murad, 1980; Hibbins, 1992). Particularly sensitive subpopulations consist of individuals with congenital or acquired defects in the homeostatic regulation of calcium, or those treated with megadoses of vitamin D or pharmaceuticals that increase GI uptake and decrease renal excretion or otherwise disrupt normal calcium homeostasis. Deriving a health-based toxicity value for calcium, however, would not provide protection for sensitive subpopulations, because their sensitivity arises from their altered physiologic state and is not related to the amount of calcium ingested.

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E.5.2 Iron

E.5.2.1 Occurrence

Iron is a metal in Group VIII of the periodic table (Budavari, 1989; Sax and Lewis, 1987). It is the second most abundant metal, comprising about 5 percent of the earth's crust. Chemically, iron is a strong reducing agent. Because of its reactivity, it occurs primarily as oxides in ores. In water, it generally occurs in the divalent or trivalent state (WHO, 1984). Fully aerated water generally contained <0.5 mg iron/L (van der Leeden et al., 1991). Ground water with a pH <8.0 may contain 10 mg/L, or rarely as much as 50 mg/L. Acid water from thermal springs, mine wastes or industrial wastes may contain >6000 mg/L. Concentrations in finished public water supplies in the 100 largest cities in the U.S. ranged from 0.002-1.7 mg/L, with a median of 0.043 mg/L. The use of iron or steel distribution pipes, and the use of iron salts in the production of potable water may contribute to iron in drinking water (WHO, 1984).

E.5.2.2 Physiology

Iron is a necessary component of many proteins, including hemoglobin, myoglobin, and enzymes such as the catalases, the cytochromes and peroxidases (Spivey Fox and Rader, 1988). Its biological role derives from its ability to undergo reversible oxidation-reduction reactions. About 67 percent of the 3-5 g of iron in the body is bound to hemoglobin, ≈10 percent is bound to myoglobin and various enzymes and the remainder is bound to ferritin and hemosiderin, which are storage proteins for iron (Goyer, 1991).

Iron is an essential trace element (NRC, 1989). The current RDAs are: 6 mg/day for infants 0-0.5 years of age, 10 mg/day for infants 0.5-1 years, for children 1-10 years, for adult males 19-50 years, and for adults of either sex ≥51 years, 12 mg/day for males 11-18 years, 15 mg/day for females 11-50 years, and 30 mg/day for pregnant women (NRC, 1989). The primary physiological concern regarding iron is iron deficiency anemia, which may result from inadequate intake or excessive blood loss (Finch, 1980). Average daily intakes for eight age-sex groups in the U.S. for 1982-1989, based on a survey of core foods in the U.S. food supply, ranged from 8.9-15.1 mg/day (71-162 percent of the RDA), but the distributions about the averages were not reported (Pennington and Young, 1991).

Iron homeostasis of the body is controlled by regulating the active transport mechanisms involved in GI absorption (Goyer, 1991; Knoebel, 1971; Spivey Fox and Rader, 1988). Generally, ≈2-15 percent of dietary iron is absorbed. GI absorption of iron increases when

body stores, i.e., when intestinal mucosal stores of ferritin iron, are low, and decreases when body stores are ample. In cases of iron-deficiency anemia, as much as 40 percent of the iron in nutritional supplements may be absorbed (Finch, 1980). Other factors that influence GI uptake of iron are age, the chemical form of iron in the diet (the ferrous form is more readily absorbed), and other dietary factors. High dietary levels of phosphate, cobalt, copper or zinc depress GI uptake. Ascorbic acid and other organic acids increase GI absorption of iron.

When luxury amounts of iron are available, hepatic ferritin formation is increased (Goyer, 1991). In the case of frank iron overload, ferritin is converted to hemosiderin, which is a more stable and less available storage form . Both ferritin and hemosiderin protect the cells from the toxicity of excess iron by maintaining the iron in a bound form.

E.5.2.3 Toxicity

Both acute and chronic toxicity syndromes occur from the ingestion of excess iron (Goyer, 1991). The acute form usually involves the accidental ingestion of iron-containing medicines, often candy-coated tablets, by children 1-5 years old. Ingestion of ≥500 mg of iron (2500 mg ferrous sulfate) leads to vomiting, sever ulceration of the GI tract, metabolic acidosis and shock, liver damage, and blood coagulation defects (Finch, 1980). Sequelae may include renal failure and liver cirrhosis. Doses of 1000-2000 mg may cause death.

Chronic iron toxicosis, known as hemochromatosis, may result from a congenital defect that increases iron absorption from the gut (Goyer, 1991). High dietary concentrations, or excess ingestion of tonics or medicines containing iron, may contribute to iron overload, but the dose required to induce disease was not reported. The disease is characterized by hemosiderin deposits in soft tissues, which may interfere with liver function, induce diabetes mellitus or other endocrinologic dysfunction, or damage the heart. At the cellular level, lipid peroxidation is increased, which results in damage to the membranes of intracellular organelles. The usual oral dose of iron to treat iron deficiency or blood-loss anemia, 200 mg, was associated with a low level of disturbances of the GI tract, including nausea, upper abdominal pain, and constipation or diarrhea, but was not associated with iron overload (Finch, 1980).

E.5.2.4 Health-Based Toxicity Values

There are no verified or provisional toxicity values or primary (health-based) drinking water quality criteria for iron (U.S. EPA, 1992a, b). WHO (1984) recommended a drinking water quality guideline of 0.3 mg/L to prevent precipitation of ferric hydroxide, which settles out as a rust-colored silt.

It would be inappropriate to develop a health-based toxicity value from the usual 200 mg/day oral dose of iron used to treat iron-deficiency anemia, because the patients for whom this dose is intended represent a subpopulation with altered health state and iron homeostasis. Although excessive iron intake can induce hemochromatosis, the intake required to induce disease was not quantified (Goyer, 1991). Underwood (1977), however, reported that daily doses of 25-75 mg, or even much greater, have been consumed without harmful effects.

A chronic oral RfD may be derived for iron from the dose of 75 mg/day, the high end of the range of daily intake consumed without adverse effect (Underwood, 1977), which is a NOAEL for normal humans. An uncertainty factor of 1, applied to the NOAEL of 75 mg/day, yields an RfD of 75 mg/day, or 1 mg/kg-day. The uncertainty factor of 1 is appropriate for a NOAEL in normal humans. Presumably, the most sensitive subpopulation consists of individuals with congenital hemochromatosis. No uncertainty factor is applied to protect these individuals, however, because they represent a group with altered physiological state who would suffer disease from daily intakes in the range of normal dietary amounts. Application of an uncertainty factor of 10 to provide protection for sensitive individuals would result in an RfD below the current RDA.

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E.5.3 Magnesium

E.5.3.1 Occurrence

Magnesium is an alkaline earth metal in Group IIA of the periodic table (Sax and Lewis, 1987). It comprises about 2.1 percent of the earth's crust by weight, and occurs in nature in the combined form, particularly in magnesite, dolomite, sea water and brines (Budavari, 1989). Concentrations in natural water were several hundred mg/L in some western U.S. streams (van der Leeden et al., 1991). Ocean water contains >1000 mg/L, and brines may contain up to 57,000 mg/L. Concentrations in finished public water supplies in the 100 largest cities in the U.S. ranged from 0-120 mg/L, with a median of 6.25 mg/L.

E.5.3.2 Physiology

Magnesium is a nutritionally essential element required for many enzyme systems, particularly those involved in phosphate transfer, and for proper functioning of the neuromuscular and cardiovascular systems (Mudge, 1980; Selkurt, 1971). The average adult body contains ≈2000 mEq (24 g), 50 percent of which is located in the skeleton. The average U.S. adult ingests 20-40 mEq (240-490 mg)/day, and absorbs about one third of the ingested amount, probably by an active transport system identical with or closely related to that which effects absorption of calcium. The extent of absorption appears to increase in cases of increased requirement (Birch, 1988). The current RDAs are 40-60 mg/day for infants up to one year of age, 80-170 mg/day for children 1-10 years, 270-400 mg/day for children 11-18 years, and 280-350 mg/day for adults (NRC, 1989).

Magnesium salts are used as saline cathartics and gastric antacids (Birch, 1988; Fingle, 1980; Harvey, 1980). When used as cathartics, the usual doses are 15 g of magnesium sulfate (≈3 g magnesium) or 40-160 mEq (0.5-2 g) magnesium from magnesium hydroxide (milk of magnesia).

E.5.3.3 Toxicity

Hypermagnesemia may result from consumption of very large quantities of magnesium by persons with renal failure (Birch, 1988). Ingestion of large doses of magnesium usually induces vomiting in humans, which limits the toxic hazard. Symptoms of hypermagnesemia include muscle weakness, hypotension, electrocardiographic changes, sedation, confusion, and possibly loss of deep tendon reflexes and respiratory arrest. When used as a laxative, as little as 5 g magnesium sulfate (1 g magnesium) can induce a significant laxative effect (Fingle, 1980). Prolonged use of magnesium hydroxide as an antacid may rarely cause fecal stones composed of magnesium carbonate and magnesium hydroxide (Harvey, 1980).

E.5.3.4 Health-Based Toxicity Values

There are no verified or provisional toxicity values or water quality criteria for magnesium (U.S. EPA, 1992a, b). Intake of a single 1 g dose of magnesium may induce a significant laxative effect (Mudge, 1980). Prolonged high intake may induce hypermagnesemia, but only in persons in whom excretion of magnesium is compromised because of kidney damage, or may induce the formation of fecal stones (Harvey, 1980; Mudge, 1980), but the dose associated with these effects is not known.

In the absence of quantitative chronic toxicity data, the high end of the range of normal dietary values, 490 mg/day (Mudge, 1980), may be considered a NOAEL for normal humans and selected as the basis for an RfD for chronic oral exposure to magnesium. Application of an uncertainty factor of 1 yields an RfD of 490 mg/day, or 7 mg/kg-day. The uncertainty factor of 1 is appropriate for a NOAEL in normal humans. Presumably, the most sensitive subpopulation consists of individuals with renal failure. No uncertainty factor is applied to protect these individuals, however, because application of an uncertainty factor of 10 would yield an RfD below the RDA for magnesium.

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E.5.4 Potassium

E.5.4.1 Occurrence

Potassium is an alkali metal in Group IA of the periodic table (Sax and Lewis, 1987). It occurs in nature mainly as the chloride, and comprises ≈2.6 percent (by weight) of the earth's crust (Budavari, 1989). Potassium is one of the most chemically active metals, reacting vigorously with oxygen and water.

Natural waters generally contained <10 mg/L, although up to 100 mg/L was found in hot springs and 25,000 mg/L was found in brines (van der Leeden et al., 1991). Concentrations in finished public water supplies in the 100 largest cities in the U.S. ranged from 0-30 mg/L, with a median of 1.6 mg/L.

E.5.4.2 Physiology

Potassium is the most abundant intracellular ion in animals and functions as a charge carrier and as a carrier of osmotic potential (Birch and Karim, 1988). It regulates membrane potential, osmotic balance and intracellular pH, and functions in the polarization-depolarization cycle of nerve and muscle cells (Birch and Karim, 1988; Selkurt, 1971). Although RDAs are not available for potassium, the NRC listed safe and adequate levels of 350-1275 mg/day for infants, 550-4575 mg/day for children and adolescents, and 1875-5625 mg/day for adults (Danforth and Munro, 1980).

The normal oral intake of potassium is ≈50-100 mEq (2-4 g)/day (Mudge, 1980). Ingested potassium is virtually completely absorbed from the GI tract (Mudge, 1980; Birch and Karim, 1988). Active transport systems maintain the intracellular concentration/plasma concentration

ratio at ≈35. Potassium homeostasis is maintained by renal mechanisms under the control of the mineralocorticoids, and, to a lesser extent, by uptake by the tissues, particularly muscle and liver.

E.5.4.3 Toxicity

Hyperkalemia may result from intravenous administration of potassium-containing salts, or from a number of abnormal physiologic conditions, including severe tissue trauma, acute or chronic acidosis, or adrenal insufficiency (Mudge, 1980; Birch and Karim, 1988). Hyperkalemia induces muscle weakness and paralysis, and cardiac irregularity leading to heart block. Acute toxicity may result from a large oral overdose of potassium, because potassium is virtually completely absorbed from the GI tract regardless of dose (Mudge, 1980; Birch and Karim, 1988). Chronic exposure of healthy persons to levels of potassium that are not acutely toxic is not likely to induce hyperkalemia, because renal excretion would compensate by increasing excretion.

E.5.4.4 Health-Based Toxicity Values

There are no verified or provisional toxicity values or primary drinking water quality criteria for potassium (U.S. EPA, 1992a, b). Sufficient toxicity data are not available to derive a chronic oral RfD. Lacking sufficient toxicity data, the high end of the range of normal dietary intake, 4 g/day (Mudge, 1980), may be selected as the basis for an RfD for chronic oral exposure to magnesium. Application of an uncertainty factor of 1 yields an RfD of 4000 mg/day, or 57 mg/kg-day. The uncertainty factor of 1 is appropriate for a NOAEL in normal humans. Presumably, the most sensitive subpopulation consists of individuals with severe tissue trauma, acute or chronic acidosis, or adrenal insufficiency. No uncertainty factor is applied to protect these individuals, however, because they represent a group with an altered health state who could suffer disease from daily intakes in the range of normal dietary amounts.

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E.5.5 Sodium

E.5.5.1 Occurrence

Sodium is an alkali metal in Group IA of the periodic table (Budavari, 1989; Sax and Lewis, 1987). It occurs combined in nature and comprises ≈2.8 percent (by weight) of the earth's crust (Budavari, 1989). Sodium is one of the most chemically active metals, reacting violently with oxygen and water.

Concentrations up to 1000 mg/L were found in some western U.S. streams (van der Leeden et al., 1991). Sea water may contain >1000 mg/L and brine may contain ≈25,000 mg/L. Concentrations in drinking water ranged from 6-130 mg/L (WHO, 1984). Concentrations in

finished public water supplies in the 100 largest cities in the U.S. ranged from 1.1-198 mg/L, with a median of 12 mg/L (van der Leeden et al., 1991).

E.5.5.2 Physiology

Sodium is the most abundant extracellular ion in animals, and functions to regulate the distribution and content of body water (Mudge, 1980). By participating in sodium-potassium exchange, it helps to maintain correct intra- and intercellular concentrations of potassium, and its movement across cell membranes functions in the polarization-depolarization cycle of nerve and muscle cells (Birch and Karim, 1988; Selkurt, 1971).

The normal intake of sodium, including food and discretionary salt, is ≈ 4-5 g/day (Selkurt, 1971). Average daily intakes for 1982-1989, based on a survey of core foods in the U.S. food supply (no discretionary salt), ranged from 696-3263 mg/day for eight age-sex groups in the U.S., but the distributions about the averages were not reported (Pennington and Young, 1991). Intakes of 1.6-9.6 g/day are considered to have no adverse effects on the health of normal humans (WHO, 1984). Ingested sodium is virtually completely absorbed from the GI tract (Mudge, 1980; Birch, 1988). Sodium homeostasis is maintained by renal mechanisms under the control of the mineralocorticoids. Although RDAs are not available for sodium, the NRC listed safe and adequate levels of 115-750 mg/day for infants, 325-2700 mg/day for children and adolescents, and 1100-3300 mg/day for adults (Danforth and Munro, 1980).

E.5.5.3 Toxicity

Hypernatremia may result from a number of abnormal physiologic conditions, including intravenous administration of sodium-containing salts, or the ingestion of a large dose of sodium (Mudge, 1980; Birch, 1988). Hypernatremia induces an increase in extracellular fluid volume, relative dehydration of the cells, and cardiac hemodynamic overload. Acute toxicity may result from an oral overdose of sodium, because sodium is virtually completely absorbed from the GI tract regardless of dose. Chronic exposure of healthy persons to more moderate levels of sodium is not likely to be toxic, because renal excretion would compensate.

E.5.5.4 Health-Based Toxicity Values

There are no verified or provisional toxicity values for sodium (U.S. EPA, 1992a, b). U.S. EPA (1985, 1992c) recommended adopting as guidance the American Heart Association's suggestion that drinking water contain not more than 20 mg sodium/L to accommodate individuals on a sodium-restricted diet.

Sufficient toxicity data are not available to derive a chronic oral RfD. Several normal human intake values are available, however, that may serve as the basis for an RfD. Selkurt (1971) reported that the normal oral intake of sodium, including food and discretionary salt, is ≈ 4000-5000 mg/day. Pennington and Young (1991) reported average daily intakes from food alone of 696-3263 mg/day. WHO (1984) considered that sodium intakes of 1.6-9.6 g/day have no adverse effects on the health of normal humans. The high end of the range of normal sodium intake reported by Selkurt (1971), 5000 mg/day appears to be a well documented and conservative oral NOAEL for healthy humans. Application of an uncertainty factor of 1 yields an RfD of 5000 mg/day, or 70 mg/kg-day. The uncertainty factor of 1 is appropriate for a NOAEL in normal humans. Presumably, the most sensitive subpopulation consists of individuals on a sodium-restricted diet. No uncertainty factor is applied to protect these individuals, however, because they represent a group with an altered health state who would be at risk from daily intakes in the range of normal dietary amounts.

E.5.5.5 References

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Table 20.2-1

Evaluation of Chemicals of Potential Concern Moffett Field: Site 3

Concentrations in Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason For Exclusion
Organics (µg/Kg)								
1,2-Dichloroethene (Total)	5	1/53	2.5 - 4	NA	2.53	2.59	NO	Low frequency of detection
2-Butanone	10	3/53	3 - 6	NA	4.98	5.07	YES	
Acetone	10	10/53	5 - 72	NA	8.98	12.65	YES	
Benzo(g,h,i)perylene	330	1/53	165 - 250	900 - 47,000	166.6	169.82	NO	Low frequency of detection
Bis(2-ethylhexyl)phthalate	330	18/53	53 - 41000	NA	1242.21	2834.61	YES	
Butylbenzylphthalate	330	3/53	165 - 850	NA	189.62	222.92	YES	
Carbon disulfide	5	2/53	2.5 - 3	NA	2.52	2.55	NO	Low frequency of detection
Chrysene	330	1/53	165 - 540	251 - 640	172.08	186.27	NO	Low frequency of detection
Di-n-butylphthalate	330	1/53	165 - 480	NA	170.94	182.86	NO	Low frequency of detection
Diethylphthalate	330	3/53	64 - 510	NA	169.13	182.85	YES	
Fluoranthene	330	3/53	165 - 2500	200 - 166,000	240.19	338.38	NO	Background
Indeno(1,2,3-cd)pyrene	330	1/53	165 - 190	8,000 - 61,000	165.47	166.42	NO	Low frequency of detection
JP-5	NA	3/53	5 - 420	NA	17.23	34.05	NO	Evaluated by component
Methylene chloride	5	1/53	2.5 - 33	NA	3.08	4.23	NO	Low frequency of detection
N-Nitroso-di-n-dipropylamine	330	1/53	165 - 250	NA	166.6	169.82	NO	Low frequency of detection

Table 20.2-1

(Page 2 of 3)

Concentrations in Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason For Exclusion
Aroclor-1260	160	4/53	80 - 630	NA	102.26	127.55	YES	
Phenanthrene	330	2/53	165 - 600	NA	181.23	204.03	NO	Low frequency of detection
Pyrene	330	2/53	165 - 1100	145 - 147,000	191.23	230.29	NO	Low frequency of detection
Tetrachloroethene	5	3/53	1 - 4	NA	2.49	2.57	YES	
Toluene	5	14/53	1 - 8	NA	2.78	3.12	YES	
Trichloroethene	5	1/53	1 - 2.5	NA	2.47	2.53	NO	Low frequency of detection
Inorganics (mg/Kg)								
Aluminum	20	53/53	7350 - 37200	70,000	18355.66	19723.51	NO	Background
Antimony	6	17/53	3 - 9	NA	4.06	4.52	YES	
Arsenic	1	35/53	.5 - 6.8	5.6 - 11	2.55	3.05	NO	Background
Barium	20	53/53	82.9 - 531	700	185.56	207.55	NO	Background
Beryllium	0.5	50/53	.25 - 6.5	0.7 - 1.2	2.04	2.48	YES	
Cadmium	0.5	23/53	.25 - 18.2	0.7 - 4	1.93	2.85	NO	Background
Calcium	500	53/53	5520 - 125000	14,800	46249.43	55355.09	NO	Essential nutrient
Chromium	1	53/53	33.5 - 153	17 - 150	62.85	67.95	NO	Background
Cobalt	5	53/53	3.8 - 25	15	15.43	16.60	YES	
Copper	2.5	53/53	22.2 - 92	15 - 47	39.71	43.66	NO	Background
Iron	10	53/53	11300 - 96800	30,000	29126.42	32348.06	NO	Essential nutrient

Table 20.2-1

Concentrations in Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason For Exclusion
Lead	0.5	53/53	4.8 - 490	19 - 110	50.68	78.76	NO	Background
Magnesium	500	53/53	2710 - 49800	15,000	16181.89	17964.23	NO	Essential nutrient
Manganese	1.5	53/53	26.5 - 1470	500	512.05	571.07	YES	
Mercury	0.02	17/53	.01 - .5	0.1 - 1.3	0.08	0.11	NO	Background
Nickel	4	53/53	32.9 - 107	30 - 58	66.29	70.11	YES	
Potassium	500	53/53	229 - 3070	15,500	1360.64	1536.61	NO	Essential nutrient
Silver	1	19/53	.5 - 4.8	0.2 - 0.8	1.07	1.33	YES	
Sodium	500	53/53	152 - 4760	15,000	746.28	969.69	NO	Essential nutrient
Vanadium	5	52/53	2.5 - 102	150	58.45	62.54	NO	Background
Zinc	2	53/53	44 - 359	31 - 110	84.52	101.21	NO	Background

[a]CLRDL U.S. EPA Contract Laboratory Required Detection Limits.
[b]Inorganics from USGS, 1986; PAHs from ASTDR, 1990b.
[c]Arithmetic mean and upper 95 percent confidence limit using 1/2 the detection limit for nondetects.
[d]Chemicals were eliminated if the upper 95% confidence limit of the sample concentrations was within the range of background concentrations (Section 20.2.2).
ND Non-detect
NA Not applicable, all organics were assumed to be site-related with the exception of PAHs.

Table 20.2-2

Evaluation of Chemicals of Potential Concern Moffett Field: Site 4

Concentrations in Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason For Exclusion
Organics (µg/Kg)								
1,1,1-Trichloroethane	5	1/42	2.5 - 30	NA	3.26	4.69	NO	Low frequency of detection
1,2-Dichlorobenzene	330	3/42	120 - 230000	NA	5912.38	17229.72	YES	
1,3-Dichlorobenzene	330	1/42	165 - 2700	NA	228.38	353.21	NO	Low frequency of detection
1,4-Dichlorobenzene	330	1/42	165 - 14000	NA	510.88	1192.14	NO	Low frequency of detection
2-Butanone	10	7/42	2 - 52	NA	7.34	10.11	YES	
2-Hexanone	10	1/42	2 - 5	NA	4.93	5.08	NO	Low frequency of detection
2-Methylnaphthalene	330	6/42	165 - 22000	NA	1868.25	3540.21	YES	
4-Methylphenol	330	1/42	165 - 400	NA	170.88	182.45	NO	Low frequency of detection
Acenaphthylene	330	1/42	165 - 390	NA	170.63	181.71	NO	Low frequency of detection
Acetone	10	11/42	4 - 140	NA	19.28	29.41	YES	
Anthracene	330	1/42	56 - 165	NA	162.28	167.65	NO	Low frequency of detection
Benzo(a)anthracene	330	2/42	84 - 190	169 - 59,000	163.6	167.80	NO	Low frequency of detection
Benzo(a)pyrene	330	2/42	99 - 200	165 - 220	164.23	167.95	NO	Low frequency of detection
Benzo(b)fluoranthene	330	2/42	160 - 190	15,000 - 62,000	165.5	166.76	NO	Low frequency of detection
Benzo(g,h,i)perylene	330	1/42	98 - 165	900 - 47,000	163.33	166.63	NO	Low frequency of detection

Table 20.2-2

Concentrations in Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason For Exclusion
Benzo(k)fluoranthene	330	1/42	165 - 200	300 - 26,000	165.88	167.60	NO	Low frequency of detection
Bis(2-ethylhexyl)phthalate	330	15/42	38 - 6000	NA	491.64	827.41	YES	
Chlorobenzene	5	2/42	2.5 - 24000	NA	574.24	1727.42	NO	Low frequency of detection
Chrysene	330	2/42	100 - 230	251 - 640	165	169.58	NO	Low frequency of detection
Diethylphthalate	330	5/42	47 - 290	NA	163.56	175.19	YES	
Fluoranthene	330	4/42	67 - 430	200 - 166,000	166.54	180.96	NO	Background
Fluorene	330	2/42	165 - 1800	NA	225.24	313.62	NO	Low frequency of detection
Indeno(1,2,3-cd)pyrene	330	1/42	100 - 165	8,000 - 61,000	163.41	166.57	NO	Low frequency of detection
JP-5	NA	6/42	5 - 6760	NA	190.88	515.46	NO	Evaluated by component
Methylene chloride	5	2/42	2.5 - 19	NA	2.98	3.79	NO	Low frequency of detection
Naphthalene	330	6/42	165 - 36000	NA	1880.12	3821.28	YES	
Aroclor-1260	160	1/30	65 - 80	NA	79.38	80.52	NO	Low frequency of detection
Phenanthrene	330	6/42	68 - 330	NA	170.51	183.28	YES	
Pyrene	330	3/42	79 - 420	145 - 147,000	168.27	181.59	NO	Background
Tetrachloroethene	5	4/42	2 - 5	NA	2.57	2.70	YES	
Toluene	5	13/42	1 - 380	NA	12.46	30.58	YES	
Trichloroethene	5	1/42	2.5 - 7	NA	2.61	2.82	NO	Low frequency of detection
Total Xylenes	5	5/42	2.5 - 1300	NA	35.61	97.93	YES	

Table 20.2-2

Concentrations in Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason For Exclusion
Inorganics (mg/Kg)								
Aluminum	20	40/40	14400 - 32500	70,000	20522.5	21965.74	NO	Background
Antimony	6	18/40	3 - 57.2	NA	10.29	14.90	YES	
Arsenic	1	34/40	.5 - 5.1	5.6 - 11	2.66	3.04	NO	Background
Barium	20	40/40	62.1 - 291	700	188.53	203.10	NO	Background
Beryllium	0.5	37/40	.23 - 2.5	0.7 - 1.2	1.04	1.25	YES	
Cadmium	0.5	1/40	.25 - 4.7	0.7 - 4	0.36	0.58	NO	Low frequency of detection
Calcium	500	40/40	9270 - 121000	14,800	42741.75	52708.97	NO	Essential nutrient
Chromium	1	40/40	43.1 - 86.7	17 - 150	62.92	66.09	NO	Background
Cobalt	5	40/40	12 - 20.1	15	15.79	16.53	YES	
Copper	2.5	40/40	25.9 - 96	15 - 47	44.38	48.92	YES	
Iron	10	40/40	20000 - 298000	30,000	34245	47977.49	NO	Essential nutrient
Lead	0.5	40/40	3.8 - 56.3	19 - 110	13.63	17.36	NO	Background
Magnesium	500	40/40	10900 - 26200	15,000	16937.5	18105.38	NO	Essential nutrient
Manganese	1.5	40/40	302 - 725	500	500.73	535.96	YES	
Mercury	0.02	3/40	.01 - .19	0.1 - 1.3	0.02	0.04	NO	Background
Nickel	4	40/40	43.2 - 82	30 - 58	65.53	68.82	YES	
Potassium	500	40/40	641 - 2700	15,500	1471.78	1635.74	NO	Essential nutrient

Table 20.2-2

Concentrations in Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason For Exclusion
Selenium	0.5	1/40	.25 - .72	<0.3 - 0.4	0.26	0.28	NO	Low frequency of detection
Silver	1	19/40	.5 - 4.8	0.2 - 0.8	1.22	1.52	YES	
Sodium	500	40/40	141 - 904	15,000	284.63	329.43	NO	Essential nutrient
Thallium	1	1/40	.27 - .5	<0.2	0.49	0.50	NO	Low frequency of detection
Vanadium	5	40/40	44.6 - 80.1	150	61.62	64.13	NO	Background
Zinc	2	40/40	44.8 - 92.8	31 - 110	64.65	68.50	NO	Background

[a]CLRDL U.S. EPA Contract Laboratory Required Detection Limits.
[b]Inorganics from USGS, 1986; PAHs from ASTDR, 1990b.
[c]Arithmetic mean and upper 95 percent confidence limit using 1/2 the detection limit for nondetects.
[d]Chemicals were eliminated if the upper 95% confidence limit of the sample concentrations was within the range of background concentrations (Section 20.2.2).
ND Non-detect
NA Not applicable, all organics were assumed to be site-related with the exception of PAHs.

Table 20.2-3

Evaluation of Chemicals of Potential Concern Moffett Field: Site 5

Concentrations in Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason For Exclusion
Organics (µg/Kg)								
1,1,1-Trichloroethane	5	1/137	2.5 - 4	NA	2.51	2.53	NO	Low frequency of detection
2-Butanone	10	5/137	5 - 190	NA	6.48	9.22	NO	Low frequency of detection
2-Methylnaphthalene	330	6/138	99 - 3600	NA	214.7	272.35	NO	Low frequency of detection
Acetone	10	21/137	5 - 740	NA	15.63	27.42	YES	
Benzo(a)anthracene	330	2/138	61 - 380	169 - 59,000	165.82	169.29	NO	Low frequency of detection
Benzo(k)fluoranthene	330	1/138	100 - 165	300 - 26,000	164.52	165.46	NO	Low frequency of detection
Bis(2-ethylhexyl)phthalate	330	37/138	6 - 6500	NA	253.7	350.84	YES	
Carbon disulfide	5	3/137	1 - 3	NA	2.49	2.51	NO	Low frequency of detection
Chlorobenzene	5	1/137	1 - 2.5	NA	2.49	2.51	NO	Low frequency of detection
Chloroform	5	1/137	1 - 2.5	NA	2.49	2.51	NO	Low frequency of detection
Chrysene	330	2/138	54 - 165	251 - 640	163.78	165.56	NO	Low frequency of detection
Di-n-butylphthalate	330	3/138	2 - 165	NA	162.39	165.49	NO	Low frequency of detection
Di-n-octylphthalate	330	1/138	165 - 210	NA	165.33	165.98	NO	Low frequency of detection
Diethylphthalate	330	14/138	46 - 4500	NA	207.13	270.58	YES	
Ethylbenzene	5	1/137	2.5 - 2700	NA	22.19	61.13	NO	Low frequency of detection

Table 20.2-3

Concentrations in Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason For Exclusion
Fluoranthene	330	2/138	140 - 400	200 - 166,000	166.54	169.95	NO	Low frequency of detection
Fluorene	330	3/138	43 - 780	NA	167.98	177.14	NO	Low frequency of detection
JP-5	NA	19/138	5 - 1460	NA	62.55	99.04	NO	Evaluated by component
Naphthalene	330	4/138	63 - 1700	NA	176.8	199.25	NO	Low frequency of detection
Aroclor-1016	80	3/99	40 - 100	NA	41.8	43.83	NO	Low frequency of detection
Aroclor-1221	80	3/99	40 - 100	NA	41.8	43.83	NO	Low frequency of detection
Aroclor-1232	80	3/99	40 - 100	NA	41.8	43.83	NO	Low frequency of detection
Aroclor-1242	80	3/99	40 - 100	NA	41.8	43.83	NO	Low frequency of detection
Aroclor-1248	80	3/99	40 - 100	NA	41.8	43.83	NO	Low frequency of detection
Aroclor-1254	160	3/99	80 - 210	NA	83.78	88.04	NO	Low frequency of detection
Aroclor-1260	160	3/99	80 - 210	NA	83.78	88.04	NO	Low frequency of detection
Phenanthrene	330	3/138	74 - 1200	NA	172.13	187.14	NO	Low frequency of detection
Pyrene	330	3/138	98 - 370	145 - 147,000	165.68	168.87	NO	Low frequency of detection
Tetrachloroethene	5	2/137	1 - 2.5	NA	2.49	2.51	NO	Low frequency of detection
Toluene	5	16/137	1 - 9	NA	2.6	2.73	YES	
Total Xylenes	5	1/137	2.5 - 850	NA	8.69	20.92	NO	Low frequency of detection
Inorganics (mg/Kg)								
Aluminum	20	133/133	10400 - 36200	70,000	21652.63	22523.93	NO	Background

Table 20.2-3

(Page 3 of 4)

Concentrations in Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason For Exclusion
Antimony	6	44/133	3 - 91.2	NA	8.53	11.30	YES	
Arsenic	1	94/133	.5 - 16	5.6 - 11	2.64	2.98	NO	Background
Barium	20	133/133	33 - 322	700	189.13	199.04	NO	Background
Beryllium	0.5	125/133	.23 - 5.8	0.7 - 1.2	1.68	1.90	YES	
Cadmium	0.5	56/133	.25 - 3.6	0.7 - 4	1.07	1.25	NO	Background
Calcium	500	128/133	250 - 87400	14,800	29304.36	32638.58	NO	Essential nutrient
Chromium	1	133/133	27.8 - 197	17 - 150	69.09	72.14	NO	Background
Cobalt	5	133/133	8.4 - 34.4	15	17.14	17.79	YES	
Copper	2.5	117/133	1.25 - 114	15 - 47	39.78	43.49	NO	Background
Iron	10	133/133	13600 - 44600	30,000	30998.5	31949.07	NO	Essential nutrient
Lead	0.5	126/133	.25 - 224	19 - 110	11.19	14.54	NO	Background
Magnesium	500	133/133	7770 - 25000	15,000	15975.86	16555.12	NO	Essential nutrient
Manganese	1.5	133/133	289 - 1070	500	550.03	573.65	YES	
Mercury	0.02	29/133	.01 - .68	0.1 - 1.3	0.06	0.08	NO	Background
Nickel	4	133/133	38.5 - 121	30 - 58	73.12	75.56	YES	
Potassium	500	116/133	250 - 3860	15,500	1536.69	1670.36	NO	Essential nutrient
Selenium	0.5	3/133	.25 - .78	<0.3 - 0.4	0.25	0.26	NO	Low frequency of detection
Silver	1	32/133	.5 - 3.2	0.2 - 0.8	0.77	0.86	YES	

Table 20.2-3

(Page 4 of 4)

Concentrations in Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason For Exclusion
Sodium	500	114/133	36.3 - 1350	15,000	339.64	371.59	NO	Essential nutrient
Thallium	1	5/133	.25 - .55	<0.2	0.5	0.51	NO	Low frequency of detection
Vanadium	5	127/133	2.5 - 115	150	65.74	68.97	NO	Background
Zinc	2	127/133	1 - 188	31 - 110	64.22	68.10	NO	Background

[a]CLRDL U.S. EPA Contract Laboratory Required Detection Limits.
[b]Inorganics from USGS, 1986; PAHs from ASTDR, 1990b.
[c]Arithmetic mean and upper 95 percent confidence limit using 1/2 the detection limit for nondetects.
[d]Chemicals were eliminated if the upper 95% confidence limit of the sample concentrations was within the range of background concentrations (Section 20.2.2).
ND Non-detect
NA Not applicable, all organics were assumed to be site-related with the exception of PAHs.

Table 20.2-4

Evaluation of Chemicals of Potential Concern Moffett Field: Site 6

(Page 1 of 3)

Concentrations in Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason For Exclusion
Organics (µg/Kg)								
1,2-Dichloroethene (Total)	5	1/8	1 - 2.5	NA	2.31	2.74	YES	
2-Butanone	10	1/8	5 - 27	NA	7.75	14.09	YES	
2-Methylnaphthalene	330	2/8	93 - 960	NA	255.38	488.41	YES	
4-Methylphenol	330	2/8	165 - 2000	NA	431.25	954.85	YES	
Acetone	10	8/8	14 - 150	NA	64	103.04	YES	
Bis(2-ethylhexyl)phthalate	330	3/8	90 - 1000	NA	255.63	501.84	YES	
Diethylphthalate	330	4/8	61 - 250	NA	143.88	193.49	YES	
Ethylbenzene	5	2/8	2.5 - 29	NA	8	16.53	YES	
Fluorene	330	1/8	130 - 165	NA	160.63	170.72	YES	
JP-5	NA	3/8	5 - 420	NA	69.88	188.29	NO	Evaluated by component
Naphthalene	330	1/8	165 - 560	NA	214.38	328.24	YES	
Phenanthrene	330	2/8	40 - 260	NA	161.25	209.52	YES	
Pyrene	330	1/8	69 - 165	145 - 147,000	153	180.67	NO	Background
Toluene	5	8/8	2 - 90	NA	19.88	45.38	YES	
Total Xylenes	5	2/8	2.5 - 290	NA	59.38	149.14	YES	

Table 20.2-4

(Page 2 of 3)

Concentrations in Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason For Exclusion
Inorganics (mg/Kg)								
Aluminum	20	8/8	15200 - 22000	70,000	18887.5	20898.03	NO	Background
Antimony	6	2/8	3 - 9.9	NA	4.18	6.19	YES	
Arsenic	1	5/8	.5 - 3.2	5.6 - 11	1.76	2.71	NO	Background
Barium	20	8/8	121 - 198	700	164.13	189.27	NO	Background
Beryllium	0.5	8/8	.41 - .84	0.7 - 1.2	0.6	0.71	NO	Background
Cadmium	0.5	3/8	.25 - 1.5	0.7 - 4	0.67	1.14	NO	Background
Calcium	500	8/8	12600 - 80100	14,800	33287.5	51545.02	NO	Essential nutrient
Chromium	1	8/8	53.2 - 74.4	17 - 150	63.15	68.93	NO	Background
Cobalt	5	8/8	13.4 - 21.8	15	16.39	18.43	YES	
Copper	2.5	8/8	22.5 - 41.3	15 - 47	30.7	35.63	NO	Background
Iron	10	8/8	22600 - 29500	30,000	26487.5	28558.06	NO	Essential nutrient
Lead	0.5	8/8	6.1 - 25.8	19 - 110	10.94	16.26	NO	Background
Magnesium	500	8/8	12000 - 24700	15,000	15137.5	18630.90	NO	Essential nutrient
Manganese	1.5	8/8	392 - 559	500	445.63	496.43	NO	Background
Nickel	4	8/8	55.1 - 81.1	30 - 58	64.88	72.45	YES	
Potassium	500	8/8	1380 - 2330	15,500	1707.5	1976.20	NO	Essential nutrient
Silver	1	8/8	1.3 - 2.4	0.2 - 0.8	2	2.28	YES	

Table 20.2-4

(Page 3 of 3)

Concentrations in Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason For Exclusion
Sodium	500	8/8	215 - 360	15,000	277.63	321.11	NO	Essential nutrient
Vanadium	5	8/8	47.2 - 68.6	150	62.06	68.35	NO	Background
Zinc	2	8/8	44.4 - 64.6	31 - 110	55.39	61.72	NO	Background

[a]CLRDL U.S. EPA Contract Laboratory Required Detection Limits.
[b]Inorganics from USGS, 1986; PAHs from ASTDR, 1990b.
[c]Arithmetic mean and upper 95 percent confidence limit using 1/2 the detection limit for nondetects.
[d]Chemicals were eliminated if the upper 95% confidence limit of the sample concentrations was within the range of background concentrations (Section 20.2.2).
ND Non-detect
NA Not applicable, all organics were assumed to be site-related with the exception of PAHs.

Table 20.2-5

Evaluation of Chemicals of Potential Concern Moffett Field: Site 7

Concentrations in Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason For Exclusion
Organics (µg/Kg)								
1,1,2,2-Tetrachloroethane	5	1/27	2.5 - 180	NA	9.07	22.56	NO	Low frequency of detection
2-Butanone	10	7/26	2 - 11	NA	5.04	5.77	YES	
Acetone	10	5/26	3 - 72	NA	12.35	19.85	YES	
Bis(2-ethylhexyl)phthalate	330	21/26	64 - 2000	NA	422.12	623.93	YES	
Butylbenzylphthalate	330	1/26	46 - 165	NA	160.42	169.83	NO	Low frequency of detection
Carbon disulfide	5	1/26	1 - 2.5	NA	2.44	2.56	NO	Low frequency of detection
Di-n-butylphthalate	330	1/26	89 - 165	NA	162.08	168.09	NO	Low frequency of detection
Ethylbenzene	5	2/26	2 - 3	NA	2.5	2.56	YES	
JP-5	NA	2/26	5 - 160	NA	15	29.52	NO	Evaluated by component
Phenanthrene	330	1/26	120 - 165	NA	163.27	166.83	NO	Low frequency of detection
Toluene	5	8/26	2 - 7	NA	2.62	3.01	YES	
Trichloroethene	5	1/26	2.5 - 3	NA	2.52	2.56	NO	Low frequency of detection
Total Xylenes	5	2/26	2.5 - 16	NA	3.38	4.66	YES	
Inorganics (mg/Kg)								
Aluminum	20	26/26	8130 - 32600	70,000	16867.69	19035.51	NO	Background

Table 20.2-5

(Page 2 of 3)

Concentrations in Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason For Exclusion
Antimony	6	7/26	3 - 24	NA	5.15	7.06	YES	
Arsenic	1	20/26	.5 - 4.7	5.6 - 11	2.22	2.73	NO	Background
Barium	20	26/26	87.9 - 278	700	170.57	191.02	NO	Background
Beryllium	0.5	15/26	.25 - 3.4	0.7 - 1.2	1.18	1.60	YES	
Calcium	500	26/26	7990 - 146000	14,800	40071.92	53354.27	NO	Essential nutrient
Chromium	1	26/26	28.6 - 88.4	17 - 150	54.86	60.30	NO	Background
Cobalt	5	26/26	6.7 - 21.1	15	13.41	14.91	NO	Background
Copper	2.5	26/26	19.8 - 20500	15 - 47	830.8	2448.02	YES	
Iron	10	26/26	15500 - 39300	30,000	26646.15	29017.42	NO	Essential nutrient
Lead	0.5	25/26	.25 - 12.5	19 - 110	7.76	8.87	NO	Background
Magnesium	500	26/26	6490 - 27900	15,000	15106.92	17212.85	NO	Essential nutrient
Manganese	1.5	26/26	250 - 1010	500	490.38	550.33	YES	
Mercury	0.02	4/26	.01 - .2	0.1 - 1.3	0.04	0.07	NO	Background
Nickel	4	26/26	34.4 - 85.7	30 - 58	61.88	67.26	YES	
Potassium	500	25/26	181 - 2580	15,500	936.65	1173.93	NO	Essential nutrient
Silver	1	10/26	.5 - 12.4	0.2 - 0.8	2.11	3.36	YES	
Sodium	500	26/26	106 - 417	15,000	258.96	291.35	NO	Essential nutrient
Thallium	1	4/26	.42 - .57	<0.2	0.5	0.51	YES	

Table 20.2-5

(Page 3 of 3)

Concentrations in Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason For Exclusion
Vanadium	5	26/26	30.8 - 85.6	150	53.52	58.53	NO	Background
Zinc	2	26/26	44.1 - 8660	31 - 110	393.45	1073.15	YES	

[a]CLRDL U.S. EPA Contract Laboratory Required Detection Limits.
[b]Inorganics from USGS, 1986; PAHs from ASTDR, 1990b.
[c]Arithmetic mean and upper 95 percent confidence limit using 1/2 the detection limit for nondetects.
[d]Chemicals were eliminated if the upper 95% confidence limit of the sample concentrations was within the range of background concentrations (Section 20.2.2).
ND Non-detect
NA Not applicable, all organics were assumed to be site-related with the exception of PAHs.

Table 20.2-6

Evaluation of Chemicals of Potential Concern Moffett Field: Site 8

(Page 1 of 3)

Concentrations in Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason For Exclusion
Organics (µg/Kg)								
1,3-Dichlorobenzene	330	2/50	71 - 430	NA	168.42	179.79	NO	Low frequency of detection
2,4,6-Trichlorophenol	330	1/50	47 - 165	NA	162.64	167.38	NO	Low frequency of detection
2,4-Dinitrophenol	1600	1/50	240 - 800	NA	788.09	811.29	NO	Low frequency of detection
2-Butanone	10	23/62	4 - 70	NA	11.84	15.33	YES	
2-Nitrophenol	330	1/50	43 - 165	NA	162.51	167.46	NO	Low frequency of detection
4,6-Dinitro-2-methylphenol	1600	1/50	69 - 800	NA	783.39	814.69	NO	Low frequency of detection
Acetone	10	44/62	5 - 900	NA	100.24	133.47	YES	
Benzene	5	1/62	2 - 2.5	NA	2.49	2.51	YES	Low frequency of detection Class A
Benzo(a)pyrene	330	1/50	64 - 165	165 - 220	162.98	167.04	NO	Low frequency of detection
Benzoic acid	1600	4/50	150 - 2000	NA	789	852.76	YES	
Bis(2-ethylhexyl)phthalate	330	22/50	43 - 2100	NA	233.2	321.61	YES	
Butylbenzylphthalate	330	1/50	47 - 165	NA	162.64	167.38	NO	Low frequency of detection
Carbon disulfide	5	20/62	1 - 11	NA	2.77	3.13	YES	
Di-n-butylphthalate	330	9/50	48 - 840	NA	172.5	204.01	YES	
Dibenzo(a,h)anthracene	330	1/50	99 - 165	NA	163.68	166.33	NO	Low frequency of detection
Diethylphthalate	330	6/50	44 - 520	NA	161.46	178.88	YES	
Ethylbenzene	5	2/62	2 - 2.5	NA	2.48	2.50	NO	Low frequency of detection

Table 20.2-6

Concentrations in Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason For Exclusion
JP-5	NA	2/62	5 - 380	NA	11.9	24.08	NO	Evaluated by component
Methylene chloride	5	9/62	2.5 - 120	NA	7.65	12.06	YES	
N-Nitrosodiphenylamine	330	1/50	53 - 165	NA	162.76	167.26	NO	Low frequency of detection
Naphthalene	330	1/50	165 - 520	NA	172.1	186.36	NO	Low frequency of detection
Phenol	330	1/50	51 - 165	NA	162.72	167.30	NO	Low frequency of detection
Tetrachloroethene	5	2/62	2 - 3	NA	2.5	2.52	NO	Low frequency of detection
Toluene	5	26/62	1 - 8	NA	2.4	2.64	YES	
Trichloroethene	5	1/62	1 - 2.5	NA	2.48	2.53	NO	Low frequency of detection
Total Xylenes	5	4/62	2 - 6	NA	2.6	2.73	YES	
Inorganics (mg/Kg)								
Aluminum	20	50/50	12300 - 34500	70,000	22086	23662.86	NO	Background
Antimony	6	31/50	3 - 24	NA	6.96	8.16	YES	
Arsenic	1	26/50	.48 - 11.1	5.6 - 11	2.39	3.08	NO	Background
Barium	20	50/50	59.7 - 503	700	230.57	253.47	NO	Background
Beryllium	0.5	24/50	.25 - 4.8	0.7 - 1.2	1.69	2.15	YES	
Cadmium	0.5	7/50	.25 - 1.6	0.7 - 4	0.38	0.47	NO	Background
Calcium	500	50/50	9950 - 150000	14,800	45101	52754.93	NO	Essential nutrient
Chromium	1	50/50	37 - 85.4	17 - 150	64.06	68.03	NO	Background
Cobalt	5	50/50	8.1 - 23.5	15	16.44	17.39	YES	
Copper	2.5	50/50	23 - 21600	15 - 47	676.76	1623.04	YES	

Table 20.2-6

Concentrations in Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason For Exclusion
Iron	10	50/50	18500 - 42600	30,000	31794	33599.13	NO	Essential nutrient
Lead	0.5	50/50	4.3 - 61.6	19 - 110	10.49	12.78	NO	Background
Magnesium	500	50/50	9690 - 33500	15,000	18769.8	20138.81	NO	Essential nutrient
Manganese	1.5	50/50	320 - 777	500	535.96	567.10	YES	
Mercury	0.02	2/50	.01 - .29	0.1 - 1.3	0.02	0.03	NO	Low frequency of detection
Nickel	4	50/50	40.2 - 111	30 - 58	70.54	75.35	YES	
Potassium	500	38/50	53.4 - 2030	15,500	825.81	972.69	NO	Essential nutrient
Selenium	0.5	5/50	.25 - .74	<0.3 - 0.4	0.28	0.31	NO	Background
Silver	1	25/50	.5 - 5	0.2 - 0.8	1.2	1.20	YES	
Sodium	500	50/50	148 - 23300	15,000	858.3	1779.81	NO	Essential nutrient
Thallium	1	3/50	.46 - .5	<0.2	0.5	0.50	YES	
Vanadium	5	50/50	34.7 - 103	150	65.21	69.57	NO	Background
Zinc	2	50/50	44.6 - 8710	31 - 110	325.2	705.45	YES	

[a]CLRDL U.S. EPA Contract Laboratory Required Detection Limits.
[b]Inorganics from USGS, 1986; PAHs from ASTDR, 1990b.
[c]Arithmetic mean and upper 95 percent confidence limit using 1/2 the detection limit for nondetects.
[d]Chemicals were eliminated if the upper 95% confidence limit of the sample concentrations was within the range of background concentrations (Section 20.2.2).
ND Non-detect
NA Not applicable, all organics were assumed to be site-related with the exception of PAHs.

Table 20.2-7

Evaluation of Chemicals of Potential Concern Moffett Field: Site 11

(Page 1 of 3)

Concentration In Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason for Exclusion
Organics (µg/Kg)								
1,1,1-Trichloroethane	5	7/21	1 - 16	NA	3.1	4.47	YES	
1,3-Dichlorobenzene	330	1/49	165 - 1100	NA	184.08	222.43	NO	Low frequency of detection
2-Butanone	10	1/21	5 - 15	NA	5.48	6.47	NO	Low frequency of detection
Acetone	10	5/21	5 - 200	NA	34.48	61.16	YES	
Benzo(a)anthracene	330	2/49	140 - 310	169 - 59,000	167.45	173.50	NO	Low frequency of detection
Benzo(a)pyrene	330	4/49	100 - 330	165 - 220	168.88	178.23	NO	Background
Benzo(b)fluoranthene	330	6/49	120 - 470	15,000 - 62,000	177.24	194.31	NO	Background
Benzo(g,h,i)perylene	330	4/49	120 - 530	900 - 47,000	176.22	193.58	NO	Background
Benzo(k)fluoranthene	330	2/49	130 - 220	300 - 26,000	165.41	168.11	NO	Low frequency of detection
Benzoic acid	1600	1/49	42 - 800	NA	784.53	815.62	NO	Low frequency of detection
Bis(2-ethylhexyl)phthalate	330	24/49	49 - 4500	NA	313.22	498.96	YES	
Carbon disulfide	5	2/21	2.5 - 5	NA	2.64	2.89	YES	
Chrysene	330	5/49	61 - 430	251 - 640	167.65	180.32	NO	Background
Di-n-butylphthalate	330	5/49	33 - 840	NA	169.71	199.15	YES	
Fluoranthene	330	7/49	63 - 950	200 - 166,000	190.67	226.09	NO	Background

Table 20.2-7

(Page 2 of 3)

Concentration In Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason for Exclusion
Indeno(1,2,3-cd)pyrene	330	3/49	95 - 380	8,000 - 61,000	167.04	176.57	NO	Background
JP-5	NA	2/49	5 - 300	NA	13.57	26.61	NO	Evaluated by component
N-Nitrosodiphenylamine	330	3/48	84 - 165	NA	161.67	166.22	YES	
Phenanthrene	330	2/49	150 - 450	NA	170.51	182.23	NO	Low frequency of detection
Pyrene	330	9/49	56 - 820	145 - 147,000	191.73	226.80	NO	Background
Toluene	5	1/21	2 - 2.5	NA	2.48	2.53	NO	Low frequency of detection
Inorganics (mg/Kg)								
Antimony	6	18/49	3 - 21	NA	5.86	7.20	YES	
Arsenic	1	42/49	.5 - 25.2	5.6 - 11	5.56	6.77	NO	Background
Barium	20	49/49	48.7 - 1470	700	205.12	262.21	NO	Background
Beryllium	0.5	17/49	.14 - 5.5	0.7 - 1.2	0.78	1.15	NO	Background
Cadmium	0.5	13/49	.25 - 5.1	0.7 - 4	0.73	1.01	NO	Background
Calcium	500	49/49	4700 - 154000	14,800	33217.76	39891.43	NO	Essential nutrient
Chromium	1	49/49	32.8 - 102	17 - 150	66.53	70.64	NO	Background
Cobalt	5	49/49	7.9 - 36	15	16.1	17.33	YES	
Copper	2.5	49/49	29.9 - 109	15 - 47	47.97	52.58	YES	
Iron	10	49/49	15000 - 59300	30,000	31293.88	33513.95	NO	Essential nutrient
Lead	0.5	49/49	2.4 - 126	19 - 110	28.8	35.14	NO	Background

Table 20.2-7

(Page 3 of 3)

Concentration In Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason for Exclusion
Magnesium	500	49/49	7240 - 29100	15,000	15661.43	16890.08	NO	Essential nutrient
Manganese	1.5	49/49	315 - 957	500	536.31	571.38	YES	
Mercury	0.02	24/49	.01 - 1.4	0.1 - 1.3	0.19	0.27	NO	Background
Nickel	4	49/49	36.3 - 90.9	30 - 58	68.02	71.71	YES	
Potassium	500	48/49	250 - 3640	15,500	1974.37	2198.15	NO	Essential nutrient
Silver	1	17/49	.5 - 3.2	0.2 - 0.8	0.79	0.95	YES	
Sodium	500	49/49	127 - 8780	15,000	1373.02	1850.87	NO	Essential nutrient
Thallium	1	2/49	.42 - .66	<0.2	0.5	0.51	NO	Low frequency of detection
Vanadium	5	49/49	31.3 - 152	150	66.02	71.32	NO	Background
Zinc	2	49/49	52.8 - 159	31 - 110	85.61	92.09	NO	Background

[a]CLRDL U.S. EPA Contract Laboratory Required Detection Limits.
[b]Inorganics from USGS, 1986; PAHs from ASTDR, 1990b.
[c]Arithmetic mean and upper 95 percent confidence limit using 1/2 the detection limit for nondetects.
[d]Chemicals were eliminated if the upper 95% confidence limit of the sample concentrations was within the range of background concentrations (Section 20.2.2).
ND Non-detect
NA Not applicable, all organics were assumed to be site-related with the exception of PAHs.

Table 20.2-8

Evaluation of Chemicals of Potential Concern Moffett Field: Site 13

(Page 1 of 2)

Concentrations in Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason For Exclusion
Organics (µg/Kg)								
Bis(2-ethylhexyl)phthalate	330	8/8	84 - 650	NA	258.25	415.59	YES	
Di-n-butylphthalate	330	2/8	40 - 165	NA	136.75	179.72	YES	
JP-5	NA	1/8	5 - 110	NA	18.13	48.39	NO	Evaluated by component
Toluene	5	5/8	2 - 3	NA	2.44	2.78	YES	
Inorganics (mg/Kg)								
Aluminum	20	8/8	17900 - 27900	70,000	22537.5	25358.04	NO	Background
Antimony	6	5/8	3 - 9	NA	5.75	7.83	YES	
Arsenic	1	8/8	2.3 - 10.2	5.6 - 11	3.88	5.99	NO	Background
Barium	20	8/8	172 - 447	700	248.63	320.64	NO	Background
Cadmium	0.5	5/8	.25 - 6.8	0.7 - 4	2.74	4.99	YES	
Calcium	500	8/8	9220 - 26100	14,800	17353.75	22848.77	NO	Essential nutrient
Chromium	1	8/8	66.9 - 116	17 - 150	83.18	95.21	NO	Background
Cobalt	5	8/8	14.3 - 20.3	15	16.38	18.07	YES	
Copper	2.5	8/8	33 - 55.8	15 - 47	42.46	48.52	YES	
Iron	10	8/8	29400 - 43800	30,000	34925	38707.31	NO	Essential nutrient

Table 20.2-8

(Page 2 of 2)

Concentrations in Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason For Exclusion
Lead	0.5	8/8	11 - 462	19 - 110	123.29	257.61	YES	
Magnesium	500	8/8	12700 - 16500	15,000	14612.5	15816.62	NO	Essential nutrient
Manganese	1.5	8/8	416 - 700	500	577	652.59	YES	
Mercury	0.02	2/8	.01 - .3	0.1 - 1.3	0.07	0.16	NO	Background
Nickel	4	8/8	70.7 - 92.2	30 - 58	78.84	84.61	YES	
Potassium	500	8/8	1280 - 2860	15,500	1888.75	2358.51	NO	Essential nutrient
Silver	1	3/8	.5 - 1.6	0.2 - 0.8	0.74	1.08	YES	
Sodium	500	8/8	218 - 389	15,000	328.63	379.90	NO	Essential nutrient
Vanadium	5	8/8	62.4 - 86.7	150	72.26	78.72	NO	Background
Zinc	2	8/8	57.6 - 198	31 - 110	106.78	145.16	YES	

[a]CLRDL U.S. EPA Contract Laboratory Required Detection Limits.
[b]Inorganics from USGS, 1986; PAHs from ASTDR, 1990b.
[c]Arithmetic mean and upper 95 percent confidence limit using 1/2 the detection limit for nondetects.
[d]Chemicals were eliminated if the upper 95% confidence limit of the sample concentrations was within the range of background concentrations (Section 20.2.2).
ND Non-detect
NA Not applicable, all organics were assumed to be site-related with the exception of PAHs.

Table 20.2-9

Evaluation of Chemicals of Potential Concern Moffett Field: Site 19

(Page 1 of 3)

Concentrations in Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason For Exclusion
Organics (µg/Kg)								
1,1-Dichloroethane	5	1/26	2 - 2.5	NA	2.48	2.52	NO	Low frequency of detection
1,2-Dichloroethene (Total)	5	2/26	2 - 5	NA	2.58	2.78	YES	
2-Butanone	10	6/26	3 - 7	NA	4.73	5.08	YES	
Acetone	10	4/26	5 - 120	NA	13.62	23.67	YES	
Bis(2-ethylhexyl)phthalate	330	13/26	43 - 1200	NA	245.62	350.25	YES	
Butylbenzylphthalate	330	2/26	48 - 165	NA	158	168.40	YES	
Carbon disulfide	5	2/26	1 - 4	NA	2.5	2.67	YES	
Pyrene	330	1/26	39 - 165	145 - 147,000	160.15	170.11	NO	Low frequency of detection
Tetrachloroethene	5	6/26	2 - 7	NA	2.77	3.19	YES	
Toluene	5	14/26	1 - 5	NA	2.42	2.69	YES	
Trichloroethene	5	8/26	2 - 110	NA	10.69	20.33	YES	
Inorganics (mg/Kg)								
Aluminum	20	26/26	2980 - 30100	70,000	18668.85	21360.92	NO	Background
Antimony	6	22/26	3 - 50.6	0.4 - 1	10.86	14.77	YES	
Arsenic	1	15/26	.5 - 7.8	0.4 - 11	1.77	2.42	NO	Background

Table 20.2-9

(Page 2 of 3)

Concentrations in Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason For Exclusion
Barium	20	26/26	125 - 270	700	183.31	199.86	NO	Background
Beryllium	0.5	21/26	.23 - 3.5	0.7 - 1.2	1.78	2.22	YES	
Cadmium	0.5	7/26	.25 - 9.4	0.7 - 4	1.05	1.86	NO	Background
Calcium	500	26/26	8640 - 266000	14,800	52943.85	80746.24	NO	Essential nutrient
Chromium	1	26/26	30.9 - 88.2	17 - 150	62.32	68.60	NO	Background
Cobalt	5	26/26	4.7 - 21.6	15	14.91	16.20	YES	
Copper	2.5	26/26	27.8 - 98.9	15 - 47	48.07	55.79	YES	
Iron	10	26/26	6000 - 67600	30,000	30646.54	35418.02	NO	Essential nutrient
Lead	0.5	26/26	2.5 - 75.8	19 - 110	13.82	21.02	NO	Background
Magnesium	500	26/26	2540 - 22600	15,000	13226.46	15251.40	NO	Essential nutrient
Manganese	1.5	26/26	147 - 1860	500	523.88	644.41	YES	
Mercury	0.02	7/26	.01 - .5	0.1 - 1.3	0.08	0.13	NO	Background
Nickel	4	26/26	33.3 - 203	30 - 58	71.84	84.03	YES	
Potassium	500	25/26	250 - 3160	15,500	1426.46	1650.00	NO	Essential nutrient
Silver	1	5/26	.5 - 7.7	0.2 - 0.8	1.11	1.78	YES	
Sodium	500	26/26	79.4 - 3220	15,000	483.67	791.31	NO	Essential nutrient
Thallium	1	2/26	.44 - .5	<0.2	0.5	0.50	YES	
Vanadium	5	26/26	54.2 - 169	150	75.6	85.63	NO	Background

Table 20.2-9

Concentrations in Soil								
Chemical	CLRDL[a]	Frequency of Detection	Concentration Range (µg/Kg)	Background Concentration[b]	Mean Concentration[c]	Upper 95% Confidence Limit[c]	Chemical of Concern	Reason For Exclusion
Zinc	2	26/26	50.7 - 122	31 - 110	74.67	82.27	NO	Background

[a]CLRDL U.S. EPA Contract Laboratory Required Detection Limits.
[b]Inorganics from USGS, 1986; PAHs from ASTDR, 1990b.
[c]Arithmetic mean and upper 95 percent confidence limit using 1/2 the detection limit for nondetects.
[d]Chemicals were eliminated if the upper 95% confidence limit of the sample concentrations was within the range of background concentrations (Section 20.2.2).
ND Non-detect
NA Not applicable, all organics were assumed to be site-related with the exception of PAHs.

Table 20.3-8

Summary of Potential Exposure Pathways
Moffett Field: Site 13

(Page 1 of 2)

Potentially Exposed Populations	Exposure Pathway	Inclusion in Risk Assessment	Reason for Selection or Exclusion
Current Land Use			
Moffett Residents	Incidental soil ingestion	No	Residents are not expected to be present at the site.
Moffett Residents	Dermal contact	No	Residents are not expected to be present at the site.
Moffett Residents	Inhalation of fugitive dust	No	Residents are not expected to be present at the site.
Moffett Residents	Inhalation of VOCs	No	Residents are not expected to be present at the site.
Moffett Workers	Incidental soil ingestion	Yes	Base workers may come in contact with soils.
Moffett Workers	Dermal contact	Yes	Base workers may come in contact with soils.
Moffett Workers	Inhalation of fugitive dust	Yes	Base workers may be working in the area of the site.
Moffett Workers	Inhalation of VOCs	Yes	Base workers may be working in the area of the site.

Table 20.3-8

(Page 2 of 2)

Potentially Exposed Populations	Exposure Pathway	Inclusion in Risk Assessment	Reason for Selection or Exclusion
Future Land Use			
Residents	Incidental soil ingestion	Yes	Potential residential development of Base property after closure. Resident may be exposed to soils.
Residents	Dermal contact	Yes	Potential residential development of Base property after closure. Resident may be dermally exposed to soils.
Residents	Inhalation of volatiles from soil	Yes	Potential residential development of Base property after closure.
Residents	Inhalation of fugitive dust	No	Future development will likely result in soils being covered by either grass or structures. Therefore potential exposure via windborne particulates is unlikely.
Residents	Ingestion of homegrown fruits or vegetables	Yes	Potential residential development of Base property after Base closure. Residents may have gardens.
Residents	Domestic water use	Yes	Potential residential development of Base property after Base closure. Groundwater may be used as a potential drinking water source.
Workers	All pathways	No	All potential exposure pathways will be addressed under the worst case scenario which is a residential exposure. Therefore this exposure scenario will not be evaluated.

Table 20.3-10

RME Parameters Used to Estimate Current Exposure, Moffett Field: OU2

Parameter	Value	Rationale
Occupational		
Ingestion of Soil at Sites 3, 5, 6, 7, 19 (short-term excavation)		
Adult soil ingestion rate (mg/day)	480	Standard exposure factor (U.S. EPA, 1991a)
Exposure frequency (days/year)	20	Assumes a worker in an excavation for 5 days/week for 4 weeks
Exposure duration (years)	1	Assumption for excavation exposure
Body weight (kg)	70	Standard exposure factor (U.S. EPA, 1989a)
Averaging time for noncarcinogenic effects (days)	365	1 year x 365 days/years = 365 days (U.S. EPA, 1989a)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989a)
Ingestion of Soil at Sites 4, 8, 11, 13 (long-term occupation)		
Adult soil ingestion rate (mg/day)	50	Standard exposure factor (U.S. EPA, 1991a)
Exposure frequency (days/year)	250	Standard exposure factor (U.S. EPA, 1991a)
Exposure duration (years)	25	Standard exposure factor (U.S. EPA, 1991a)
Body weight (kg)	70	Standard exposure factor (U.S. EPA, 1989b)
Averaging time for noncarcinogenic effects (days)	9,125	25 years x 365 days/years = 9,125 days (U.S. EPA, 1989b)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)

Table 20.3-10

Parameter	Value	Rationale
Dermal Contact with Soil at Sites 3, 5, 6, 7, 19 (short-term excavation)		
Surface area (cm^2)	3120	Adult arms and hands (U.S. EPA, 1989c)
Exposure time (hours/day)	8	Standard workday
Exposure frequency (days/year)	20	Assumes a worker in an excavation for 5 days/week for 4 weeks (Driver, et al., 1989)
Adherence factor (mg/cm^2)	1.05	(Driver, et al., 1989)
Absorption factor (hr^{-1})	0.0046	(Hawley, 1985)
Matrix factor (unitless)	0.15	(Hawley, 1985)
Exposure duration (years)	1	Short-term excavation scenario
Body weight (kg)	70	Standard exposure factor (U.S. EPA, 1989b)
Averaging time for noncarcinogenic effects (days)	365	1 year x 365 days/year = 365 days (U.S. EPA, 1989b)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)
Dermal Contact with Soil at Sites 4, 8, 11, 13 (long-term occupation)		
Surface area (cm^2)	3120	Adult arms and hands (U.S. EPA, 1989c)
Exposure time (hours/day)	8	Standard exposure factor (U.S. EPA, 1991a)
Exposure frequency (days/year)	250	Standard exposure factor (U.S. EPA, 1991a)
Adherence factor (mg/cm^2)	1.05	(Driver, et al., 1989)
Absorption factor (hr^{-1})	0.0046	(Hawley, 1985)
Matrix factor (unitless)	0.15	(Hawley, 1985)
Exposure duration (years)	25	Standard exposure factor (U.S. EPA, 1991a)
Body weight (kg)	70	Standard exposure factor (U.S. EPA, 1989b)

Table 20.3-10

Parameter	Value	Rationale
Averaging time for noncarcinogenic effects (days)	9,125	25 years x 365 days/year = 9,125 days (U.S. EPA, 1989b)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)
Inhalation of VOCs at Sites 3, 5, 6, 7, 19 (short-term excavation)		
Inhalation rate (m^3/hour)	1.4	Assumes a worker spends 50% of his time in heavy activity and 50% in moderate activity (U.S. EPA, 1989c)
Exposure time (hours/day)	8	Standard workday
Exposure frequency (days/year)	20	Assumes a worker in an excavation 5 days/week for 4 weeks
Exposure duration (years)	1	Short-term excavation scenario
Body weight (kg)	70	Standard exposure factor (U.S. EPA, 1989b)
Averaging time for noncarcinogenic effects (days)	365	1 year x 365 days/year = 365 days (U.S. EPA, 1989b)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)
Inhalation of VOCs at Sites 4, 8, 11, 13 (long-term occupation)		
Inhalation rate (m^3/hour)	1.4	Assumes a worker spends 50% of his time in heavy activity and 50% in moderate activity (U.S. EPA, 1989c)
Exposure time (hours/day)	8	Standard workday
Exposure frequency (days/year)	250	Standard exposure factor (U.S. EPA, 1991a)
Exposure duration (days)	25	Standard exposure factor (U.S. EPA, 1991a)
Body weight (kg)	70	Standard exposure factor (U.S. EPA, 1989b)
Averaging time for noncarcinogenic effects (days)	9,125	25 years x 365 days/year = 9,125 days (U.S. EPA, 1989b)

Table 20.3-10

Parameter	Value	Rationale
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)
Inhalation of Fugitive Dust at Sites 4, 8, 11, 13 (long-term occupation)		
Inhalation rate (m^3/hour)	1.4	Assumes a worker spends 50% of his time in heavy activity and 50% in moderate activity (U.S. EPA, 1989c)
Dust loading rate (Kg/m^3)	6×10^{-7}	Excavation is assumed (DOE 1983)
Exposure time (hours/day)	8	Standard workday
Exposure frequency (days/year)	250	Standard exposure factor (U.S. EPA, 1991a)
Exposure duration (days)	25	Standard exposure factor (U.S. EPA, 1991a)
Body weight (kg)	70	Standard exposure factor (U.S. EPA, 1989b)
Averaging time for noncarcinogenic effects (days)	9,125	25 years x 365 days/year = 9,125 days (U.S. EPA, 1989b)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)
Recreational		
Ingestion of Soil (Recreational Scenario)		
Juvenile soil ingestion rate (mg/day)	140	Standard exposure factor (U.S. EPA, 1989c)
Exposure frequency (days/year)	50	Assumes 1 visit/week to site. Parameter accounts for time spent away from home (U.S. EPA, 1991a)
Exposure duration (years)	5	Assumption
Body weight (kg)	25	Average weight juvenile between ages 5 and 10 (U.S. EPA, 1989c)
Averaging time for noncarcinogenic effects (days)	1,825	5 years x 365 days/years = 1,825 days (U.S. EPA, 1989b)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)

Table 20.3-10

Parameter	Value	Rationale
Dermal Contact with Soil		
Surface area (cm^2)	275	Arms, hands, and legs child age 5 to 10 (U.S. EPA, 1989c)
Exposure time (hours/day)	8	Assumption
Adherence factor (mg/cm^2)	1.05	(Driver, et al., 1989)
Adsorption factor (hr^{-1})	0.0046	(Hawley, 1985)
Matrix factor (unitless)	0.15	(Hawley, 1985)
Exposure frequency (days/year)	50	Assumes 1 visit/week to site. Parameter accounts for time spent away from home (U.S. EPA, 1991a)
Exposure duration (years)	5	Assumption
Body weight (kg)	25	Average weight juvenile between ages 5 and 10 (U.S. EPA, 1989c)
Averaging time for noncarcinogenic effects (days)	1,825	5 years x 365 days/years = 1,825 days (U.S. EPA, 1989b)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)
Residential		
Inhalation of VOCs		
Adult inhalation rate (m^3/hour)	0.83	20 m^3/day (U.S. EPA, 1989b)
Exposure time (hours/day)	24	worst-case
Exposure frequency (days/year)	350	Parameter accounts for time spent away from home (U.S. EPA, 1991a)
Exposure duration (years)	5	Assumption
Body weight (kg)	70	Standard exposure factor (U.S. EPA, 1989b)
Averaging time for noncarcinogenic effects (days)	1,825	5 years x 365 days/year = 1,825 days (U.S. EPA, 1989b)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)

Table 20.3-10

Parameter	Value	Rationale
Inhalation of Fugitive Dust		
Adult inhalation rate (m^3/hour)	0.83	20 m^3/day (U.S. EPA, 1989b)
Dust loading rate (kg/m^3)	1×10^{-7}	Residents will be exposed to a small amount of dust from excavation and foot traffic (NCRP 1984a)
Exposure time (hours/day)	24	worst-case
Exposure frequency (days/year)	350	Parameter accounts for time spent away from home (U.S. EPA, 1991a)
Exposure duration (years)	5	Assumption
Body weight (kg)	70	Standard exposure factor (U.S. EPA, 1989b)
Averaging time for noncarcinogenic effects (days)	1,825	5 years x 365 days/year = 1,825 days (U.S. EPA, 1989b)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)

Table 20.3-11

MEAN Parameters Used to Estimate Current Exposure, Moffett Field: OU2

Parameter	Value	Rationale
Occupational		
Ingestion of Soil at Sites 3, 5, 6, 7, 19 (short-term excavation)		
Adult soil ingestion rate (mg/day)	480	Standard exposure factor (U.S. EPA, 1991a)
Exposure frequency (days/year)	20	Assumes a worker in an excavation for 5 days/week for 4 weeks
Exposure duration (years)	1	Assumption for excavation exposure
Body weight (kg)	70	Standard exposure factor (U.S. EPA, 1989a)
Averaging time for noncarcinogenic effects (days)	365	1 year x 365 days/years = 365 days (U.S. EPA, 1989a)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989a)
Ingestion of Soil at Sites 4, 8, 11, 13 (long-term occupation)		
Adult soil ingestion rate (mg/day)	50	Standard exposure factor (U.S. EPA, 1991a)
Exposure frequency (days/year)	235	Standard exposure factor (U.S. EPA, 1991a)
Exposure duration (years)	20	Standard exposure factor (U.S. EPA, 1991a)
Body weight (kg)	70	Standard exposure factor (U.S. EPA, 1989b)
Averaging time for noncarcinogenic effects (days)	7,300	20 years x 365 days/years = 7,300 days (U.S. EPA, 1989b)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)

Table 20.3-11

Parameter	Value	Rationale
Dermal Contact with Soil at Sites 3, 5, 6, 7, 19 (short-term excavation)		
Surface area (cm^2)	3120	Adult arms and hands (U.S. EPA, 1989c)
Exposure time (hours/day)	8	Standard workday
Exposure frequency (days/year)	20	Assumes a worker in an excavation for 5 days/week for 4 weeks (Driver, et al., 1989)
Adherence factor (mg/cm^2)	1.05	(Driver, et al., 1989)
Absorption factor (hr^{-1})	0.0046	(Hawley, 1985)
Matrix factor (unitless)	0.15	(Hawley, 1985)
Exposure duration (years)	1	Short-term excavation scenario
Body weight (kg)	70	Standard exposure factor (U.S. EPA, 1989b)
Averaging time for noncarcinogenic effects (days)	365	1 year x 365 days/year = 365 days (U.S. EPA, 1989b)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)
Dermal Contact with Soil at Sites 4, 8, 11, 13 (long-term occupation)		
Surface area (cm^2)	3120	Adult arms and hands (U.S. EPA, 1989c)
Exposure time (hours/day)	8	Standard exposure factor (U.S. EPA, 1991a)
Exposure frequency (days/year)	235	Standard exposure factor (U.S. EPA, 1991a)
Adherence factor (mg/cm^2)	1.05	(Driver, et al., 1989)
Absorption factor (hr^{-1})	0.0046	(Hawley, 1985)
Matrix factor (unitless)	0.15	(Hawley, 1985)
Exposure duration (years)	20	Standard exposure factor (U.S. EPA, 1991a)
Body weight (kg)	70	Standard exposure factor (U.S. EPA, 1989b)

Table 20.3-11

Parameter	Value	Rationale
Averaging time for noncarcinogenic effects (days)	7,300	20 years x 365 days/year = 7,300 days (U.S. EPA, 1989b)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)
Inhalation of VOCs at Sites 3, 5, 6, 7, 19 (short-term excavation)		
Inhalation rate (m^3/hour)	1.4	Assumes a worker spends 50% of his time in heavy activity and 50% in moderate activity (U.S. EPA, 1989c)
Exposure time (hours/day)	8	Standard workday
Exposure frequency (days/year)	20	Assumes a worker in an excavation 5 days/week for 4 weeks
Exposure duration (years)	1	Short-term excavation scenario
Body weight (kg)	70	Standard exposure factor (U.S. EPA, 1989b)
Averaging time for noncarcinogenic effects (days)	365	1 year x 365 days/year = 365 days (U.S. EPA, 1989b)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)
Inhalation of VOCs at Sites 4, 8, 11, 13 (long-term occupation)		
Inhalation rate (m^3/hour)	1.4	Assumes a worker spends 50% of his time in heavy activity and 50% in moderate activity (U.S. EPA, 1989c)
Exposure time (hours/day)	8	Standard workday
Exposure frequency (days/year)	235	Standard exposure factor (U.S. EPA, 1991a)
Exposure duration (days)	20	Standard exposure factor (U.S. EPA, 1991a)
Body weight (kg)	70	Standard exposure factor (U.S. EPA, 1989b)
Averaging time for noncarcinogenic effects (days)	7,300	20 years x 365 days/year = 7,300 days (U.S. EPA, 1989b)

Table 20.3-11

Parameter	Value	Rationale
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)
Inhalation of Fugitive Dust at Sites 4, 8, 11, 13 (long-term occupation)		
Inhalation rate (m^3/hour)	1.4	Assumes a worker spends 50% of his time in heavy activity and 50% in moderate activity (U.S. EPA, 1989c)
Dust loading rate (Kg/m^3)	6×10^{-7}	Excavation is assumed (DOE 1983)
Exposure time (hours/day)	8	Standard workday
Exposure frequency (days/year)	235	Standard exposure factor (U.S. EPA, 1991a)
Exposure duration (days)	20	Standard exposure factor (U.S. EPA, 1991a)
Body weight (kg)	70	Standard exposure factor (U.S. EPA, 1989b)
Averaging time for noncarcinogenic effects (days)	7,300	20 years x 365 days/year = 7,300 days (U.S. EPA, 1989b)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)
Recreational		
Ingestion of Soil (Recreational Scenario)		
Juvenile soil ingestion rate (mg/day)	140	Standard exposure factor (U.S. EPA, 1989c)
Exposure frequency (days/year)	25	Assumes 1 visit/two weeks to site. Parameter accounts for time spent away from home (U.S. EPA, 1991a)
Exposure duration (years)	5	Assumption
Body weight (kg)	25	Average weight juvenile between ages 5 and 10 (U.S. EPA, 1989c)
Averaging time for noncarcinogenic effects (days)	1,825	5 years x 365 days/years = 1,825 days (U.S. EPA, 1989b)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)

Table 20.3-11

Parameter	Value	Rationale
Dermal Contact with Soil		
Surface area (cm^2)	275	Arms, hands, and legs child age 5 to 10 (U.S. EPA, 1989c)
Exposure time (hours/day)	8	Assumption
Adherence factor (mg/cm^2)	1.05	(Driver, et al., 1989)
Adsorption factor (hr^{-1})	0.0046	(Hawley, 1985)
Matrix factor (unitless)	0.15	(Hawley, 1985)
Exposure frequency (days/year)	25	Assumes 1 visit/week to site. Parameter accounts for time spent away from home (U.S. EPA, 1991a)
Exposure duration (years)	5	Assumption
Body weight (kg)	25	Average weight juvenile between ages 5 and 10 (U.S. EPA, 1989c)
Averaging time for noncarcinogenic effects (days)	1,825	5 years x 365 days/years = 1,825 days (U.S. EPA, 1989b)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)
Residential		
Inhalation of VOCs		
Adult inhalation rate (m^3/hour)	0.63	15 m^3/day (U.S. EPA, 1989b)
Exposure time (hours/day)	17	average-case
Exposure frequency (days/year)	350	Parameter accounts for time spent away from home (U.S. EPA, 1991a)
Exposure duration (years)	5	Assumption
Body weight (kg)	70	Standard exposure factor (U.S. EPA, 1989b)
Averaging time for noncarcinogenic effects (days)	1,825	5 years x 365 days/year = 1,825 days (U.S. EPA, 1989b)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)

Table 20.3-11

Parameter	Value	Rationale
Inhalation of Fugitive Dust		
Adult inhalation rate (m^3/hour)	0.63	15 m^3/day (U.S. EPA, 1989b)
Dust loading rate (kg/m^3)	1×10^{-7}	Residents will be exposed to a small amount of dust from excavation and foot traffic (NCRP 1984a)
Exposure time (hours/day)	17	average-case
Exposure frequency (days/year)	350	Parameter accounts for time spent away from home (U.S. EPA, 1991a)
Exposure duration (years)	5	Assumption
Body weight (kg)	70	Standard exposure factor (U.S. EPA, 1989b)
Averaging time for noncarcinogenic effects (days)	1,825	5 years x 365 days/year = 1,825 days (U.S. EPA, 1989b)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)

Table 20.3-12

RME Parameters Used to Estimate Future Residential Exposure, Moffett Field: OU2

Parameter	Value	Rationale
Adult Ingestion of Soil		
Adult soil ingestion rate (mg/day)	100	Standard exposure factor (U.S. EPA, 1991a)
Exposure frequency (days/year)	350	Parameter accounts for time spent away from home (U.S. EPA, 1991a)
Exposure duration (years)	24	Upper 90th percentile for time spent in one residence (U.S. EPA, 1991a)
Body weight (kg)	70	Standard exposure factor (U.S. EPA, 1989c)
Averaging time for noncarcinogenic effects (days)	8,760	24 years x 365 days/years = 8,760 days (U.S. EPA, 1989b)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)
Juvenile Ingestion of Soil		
Juvenile soil ingestion rate (mg/day)	200	Standard exposure factor (U.S. EPA, 1991a)
Exposure frequency (days/year)	350	Parameter accounts for time spent away from home (U.S. EPA, 1991a)
Exposure duration (years)	6	Upper 90th percentile for time spent in one residence (U.S. EPA, 1991a)
Body weight (kg)	16	Assumes 16 kg child and 70 kg adult (U.S. EPA, 1989c)
Averaging time for noncarcinogenic effects (days)	2,190	6 years x 365 days/years = 2,190 days (U.S. EPA, 1989b)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)

Table 20.3-12

Parameter	Value	Rationale
Dermal Contact with Soil		
Surface area	8170	Adult arms, hands, and legs (U.S. EPA, 1989c)
Exposure time (hours/day)	0.45	Average time spent outdoors at home (U.S. EPA, 1989c)
Adherence factor (mg/cm^2)	1.05	(Driver, et al., 1989)
Adsorption factor (hr^{-1})	0.0046	(Hawley, 1985)
Matrix factor (unitless)	0.15	(Hawley, 1985)
Exposure frequency (days/year)	350	Parameter accounts for time spent away from home (U.S. EPA, 1991a)
Exposure duration (years)	30	Upper 90th percentile for time spent in one residence (U.S. EPA, 1991a)
Body weight (kg)	70	Standard exposure factor (U.S. EPA, 1989b)
Averaging time for noncarcinogenic effects (days)	10,950	30 years x 365 days/years = 10,950 days (U.S. EPA, 1989b)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)
Inhalation of VOCs		
Adult inhalation rate (m^3/hour)	0.83	20 m^3/day (U.S. EPA, 1989b)
Exposure time (hours/day)	17	Parameter accounts for time spent away from home (U.S. EPA, 1989c)
Exposure frequency (days/year)	350	Parameter accounts for time spent away from home (U.S. EPA, 1991a)
Exposure duration (years)	30	Upper 90th percentile for time spent in one residence (U.S. EPA, 1991a)
Body weight (kg)	70	Standard exposure factor (U.S. EPA, 1989b)
Averaging time for noncarcinogenic effects (days)	10,950	30 years x 365 days/year = 10,950 days (U.S. EPA, 1989b)

Table 20.3-12

Parameter	Value	Rationale
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)
Ingestion of Contaminated Vegetables		
Vegetable Ingestion rate (g/day)	80	Standard exposure factor (U.S. EPA, 1991a)
Fraction ingested from contaminated source (unitless)	1	30% and 40% diet fractions for fruits and vegetables; respectively, are averaged into ingestion rate (U.S. EPA, 1991a)
Exposure frequency (days/year)	350	Standard exposure factor (U.S. EPA, 1991a)
Exposure duration (years)	30	Upper 90th percentile for time spent in one residence (U.S. EPA, 1991a)
Body weight (kg)	70	Standard exposure factor (U.S. EPA, 1991a)
Averaging time for noncarcinogenic effects (days)	10,950	30 years x 365 days/year = 10,950 days (U.S. EPA, 1989b)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)

Table 20.3-13

AVERAGE Parameters Used to Estimate Future Residential Exposure, Moffett Field: OU2

Parameter	Value	Rationale
Adult Ingestion of Soil		
Adult soil ingestion rate (mg/day)	100	Standard exposure factor (U.S. EPA, 1991a)
Exposure frequency (days/year)	350	Parameter accounts for time spent away from home (U.S. EPA, 1991a)
Exposure duration (years)	3	(U.S. EPA, 1991a)
Body weight (kg)	70	Standard exposure factor (U.S. EPA, 1989c)
Averaging time for noncarcinogenic effects (days)	1,095	3 years x 365 days/years = 1,095 days (U.S. EPA, 1989b)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)
Juvenile Ingestion of Soil		
Juvenile soil ingestion rate (mg/day)	200	Standard exposure factor (U.S. EPA, 1991a)
Exposure frequency (days/year)	350	Parameter accounts for time spent away from home (U.S. EPA, 1991a)
Exposure duration (years)	6	Upper 90th percentile for time spent in one residence (U.S. EPA, 1991a)
Body weight (kg)	16	Assumes 16 kg child and 70 kg adult (U.S. EPA, 1989c)
Averaging time for noncarcinogenic effects (days)	2,190	6 years x 365 days/years = 2,190 days (U.S. EPA, 1989b)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)
Dermal Contact with Soil		
Surface area (cm^2)	8170	Adult arms, hands, and legs (U.S. EPA, 1989c)

Table 20.3-13

Parameter	Value	Rationale
Exposure time (hours/day)	0.45	Average time spent outdoors at home (U.S. EPA, 1989c)
Adherence factor (mg/cm^2)	1.05	(Driver, et al., 1989)
Adsorption factor (hr^{-1})	0.0046	(Hawley, 1985)
Matrix factor (unitless)	0.15	(Hawley, 1985)
Exposure frequency (days/year)	350	Parameter accounts for time spent away from home (U.S. EPA, 1991a)
Exposure duration (years)	9	(U.S. EPA, 1991a)
Body weight (kg)	70	Standard exposure factor (U.S. EPA, 1989b)
Averaging time for noncarcinogenic effects (days)	3,285	9 years x 365 days/years = 3,285 days (U.S. EPA, 1989b)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)
Inhalation of VOCs		
Adult inhalation rate (m^3/hour)	0.83	20 m^3/day (U.S. EPA, 1989b)
Exposure time (hours/day)	17	Parameter accounts for time spent away from home (U.S. EPA, 1989c)
Exposure frequency (days/year)	350	Parameter accounts for time spent away from home (U.S. EPA, 1991a)
Exposure duration (years)	9	(U.S. EPA, 1991a)
Body weight (kg)	70	Standard exposure factor (U.S. EPA, 1989b)
Averaging time for noncarcinogenic effects (days)	3,285	9 years x 365 days/year = 3,285 days (U.S. EPA, 1989b)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)
Ingestion of Contaminated Vegetables		
Vegetable Ingestion rate (g/day)	61	Standard exposure factor (U.S. EPA, 1991a)

Table 20.3-13

Parameter	Value	Rationale
Fraction ingested from contaminated source (unitless)	1	30% and 40% diet fractions for fruits and vegetables; respectively, are averaged into ingestion rate (U.S. EPA, 1991a)
Exposure frequency (days/year)	350	Standard exposure factor (U.S. EPA, 1991a)
Exposure duration (years)	9	(U.S. EPA, 1991a)
Body weight (kg)	70	Standard exposure factor (U.S. EPA, 1991a)
Averaging time for noncarcinogenic effects (days)	3,285	9 years x 365 days/year = 3,285 days (U.S. EPA, 1989b)
Averaging time for carcinogenic effects (days)	25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989b)

TABLE 20.3-57

Estimated Mean Daily Intakes and Hazard Quotients (HQ) for Current Occupational Exposures: Site 13 NAS Moffett Field OU2

Chemical	Concentration (mg/kg or mg/m^3)[a]	Intake Factor (day^{-1} or m^3/kg-day)[b]	Estimated Daily Intake (mg/kg-day)	RfD[c] (mg/kg-day)	Hazard Quotient
Soil Ingestion					
Antimony	5.75E+00	4.60E-07	2.64E-06	4.00E-04	6.61E-03
Cadmium	2.74E+00	4.60E-07	1.26E-06	1.00E-03	1.26E-03
Copper	4.25E+01	4.60E-07	1.95E-05	3.70E-02	5.28E-04
Manganese	5.77E+02	4.60E-07	2.65E-04	1.00E-01	2.65E-03
Nickel	7.88E+01	4.60E-07	3.63E-05	2.00E-02	1.81E-03
Silver	7.40E-01	4.60E-07	3.40E-07	5.00E-03	6.81E-05
Zinc	1.07E+02	4.60E-07	4.91E-05	2.00E-01	2.46E-04
Bis(2-ethylhexyl)phthalate	2.58E-01	4.60E-07	1.19E-07	2.00E-02	5.94E-06
Di-n-butylphthalate	1.37E-01	4.60E-07	6.29E-08	1.00E-01	6.29E-07
Toluene	2.44E-03	4.60E-07	1.12E-09	2.00E-01	5.61E-09
TOTAL					**1.32E-02**
Dermal Absorption from Soil					
Antimony	5.75E+00	3.01E-07	1.73E-06	4.00E-04	4.33E-03
Cadmium	2.74E+00	3.01E-08	8.26E-08	6.00E-05	1.38E-03
Copper	4.25E+01	3.01E-07	1.28E-05	1.85E-02	6.92E-04
Manganese	5.77E+02	3.01E-07	1.74E-04	1.00E-01	1.74E-03
Nickel	7.88E+01	3.01E-07	2.38E-05	1.00E-03	2.38E-02
Silver	7.40E-01	3.01E-07	2.23E-07	5.00E-03	4.46E-05
Zinc	1.07E+02	3.01E-07	3.22E-05	1.00E-01	3.22E-04
Bis(2-ethylhexyl)phthalate	2.58E-01	3.01E-05	7.78E-06	2.00E-02	3.89E-04
Di-n-butylphthalate	1.37E-01	3.01E-05	4.12E-06	8.50E-02	4.85E-05
Toluene	2.44E-03	9.04E-07	2.21E-09	2.00E-01	1.10E-08
TOTAL					**3.27E-02**
Inhalation of Fugitive Dust					
Antimony	5.75E+00	6.18E-08	3.55E-07	4.00E-04	8.88E-04
Cadmium	2.74E+00	6.18E-08	1.69E-07	1.00E-03	1.69E-04
Copper	4.25E+01	6.18E-08	2.62E-06	3.70E-02	7.09E-05
Manganese	5.77E+02	6.18E-08	3.57E-05	1.10E-04	3.24E-01
Silver	7.40E-01	6.18E-08	4.57E-08	5.00E-03	9.15E-06
Zinc	1.07E+02	6.18E-08	6.60E-06	2.00E-01	3.30E-05

Table 20.3-57

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Chemical	Concentration (mg/kg or mg/m^3)[a]	Intake Factor (day^{-1} or m^3/kg-day)[b]	Estimated Daily Intake (mg/kg-day)	RfD[c] (mg/kg-day)	Hazard Quotient
Bis(2-ethylhexyl)phthalate	2.58E-01	6.18E-08	1.60E-08	2.00E-02	7.98E-07
Di-n-butylphthalate	1.37E-01	6.18E-08	8.45E-09	1.00E-01	8.45E-08
Toluene	2.44E-03	6.18E-08	1.51E-10	1.10E-01	1.37E-09
TOTAL					**3.25E-01**
Inhalation of VOCs					
Toluene	1.68E-10	1.03E-01	1.73E-11	1.10E-01	1.57E-10
TOTAL ALL PATHWAYS					**3.71E-01**

[a] Concentration in soil and produce for ingestion and dermal pathways is in mg/kg. Concentration in air for inhalation pathways is mg/m^3.

[b] Intake factor for ingestion and dermal exposure pathways is day^{-1}. Intake factor for inhalation pathways is m^3/kg-day.

[c] Reference Dose

TABLE 20.3-58

Estimated RME Daily Intakes and Hazard Quotients (HQ) for Current Occupational Exposures: Site 13 NAS Moffett Field OU2

Chemical	Concentration (mg/kg or mg/m^3)[a]	Intake Factor (day^{-1} or m^3/kg-day)[b]	Estimated Daily Intake (mg/kg-day)	RfD[c] (mg/kg-day)	Hazard Quotient
Soil Ingestion					
Antimony	7.83E+00	4.89E-07	3.83E-06	4.00E-04	9.58E-03
Cadmium	4.99E+00	4.89E-07	2.44E-06	1.00E-03	2.44E-03
Copper	4.85E+01	4.89E-07	2.37E-05	3.70E-02	6.42E-04
Manganese	6.53E+02	4.89E-07	3.19E-04	1.00E-01	3.19E-03
Nickel	8.46E+01	4.89E-07	4.14E-05	2.00E-02	2.07E-03
Silver	1.08E+00	4.89E-07	5.30E-07	5.00E-03	1.06E-04
Zinc	1.45E+02	4.89E-07	7.10E-05	2.00E-01	3.55E-04
Bis(2-ethylhexyl)phthalate	4.16E-01	4.89E-07	2.03E-07	2.00E-02	1.02E-05
Di-n-butylphthalate	1.80E-01	4.89E-07	8.79E-08	1.00E-01	8.79E-07
Toluene	2.78E-03	4.89E-07	1.36E-09	2.00E-01	6.81E-09
TOTAL					**1.84E-02**
Dermal Absorption from Soil					
Antimony	7.83E+00	3.21E-07	2.51E-06	4.00E-04	6.27E-03
Cadmium	4.99E+00	3.21E-08	1.60E-07	6.00E-05	2.67E-03
Copper	4.85E+01	3.21E-07	1.56E-05	1.85E-02	8.41E-04
Manganese	6.53E+02	3.21E-07	2.09E-04	1.00E-01	2.09E-03
Nickel	8.46E+01	3.21E-07	2.71E-05	1.00E-03	2.71E-02
Silver	1.08E+00	3.21E-07	3.47E-07	5.00E-03	6.94E-05
Zinc	1.45E+02	3.21E-07	4.65E-05	1.00E-01	4.65E-04
Bis(2-ethylhexyl)phthalate	4.16E-01	3.21E-05	1.33E-05	2.00E-02	6.66E-04
Di-n-butylphthalate	1.80E-01	3.21E-05	5.76E-06	8.50E-02	6.78E-05
Toluene	2.78E-03	9.62E-07	2.68E-09	2.00E-01	1.34E-08
TOTAL					**4.02E-02**
Inhalation of Fugitive Dust					
Antimony	7.83E+00	6.58E-08	5.15E-07	4.00E-04	1.29E-03
Cadmium	4.99E+00	6.58E-08	3.28E-07	1.00E-03	3.28E-04
Copper	4.85E+01	6.58E-08	3.19E-06	3.70E-02	8.62E-05

TABLE 20.3-58

Chemical	Concentration (mg/kg or mg/m^3)[a]	Intake Factor (day^{-1} or m^3/kg-day)[b]	Estimated Daily Intake (mg/kg-day)	RfD[c] (mg/kg-day)	Hazard Quotient
Manganese	6.53E+02	6.58E-08	4.29E-05	1.10E-04	3.90E-01
Silver	1.08E+00	6.58E-08	7.12E-08	5.00E-03	1.42E-05
Zinc	1.45E+02	6.58E-08	9.54E-06	2.00E-01	4.77E-05
Bis(2-ethylhexyl)phthalate	4.16E-01	6.58E-08	2.73E-08	2.00E-02	1.37E-06
Di-n-butylphthalate	1.80E-01	6.58E-08	1.18E-08	1.00E-01	1.18E-07
Toluene	2.78E-03	6.58E-08	1.83E-10	1.10E-01	1.66E-09
TOTAL					**3.92E-01**
Inhalation of VOCs					
Toluene	1.92E-10	1.10E-01	2.10E-11	1.10E-01	1.91E-10
TOTAL ALL PATHWAYS					**4.50E-01**

[a] Concentration in soil and produce for ingestion and dermal pathways is in mg/kg. Concentration in air for inhalation pathways is mg/m^3.

[b] Intake factor for ingestion and dermal exposure pathways is day^{-1}. Intake factor for inhalation pathways is m^3/kg-day.

[c] Reference Dose

TABLE 20.3-59

Estimated Mean Daily Intakes and Hazard Quotients (HQ) for Future Residential Juvenile Exposures: Site 13 NAS Moffett Field OU2

Chemical	Concentration (mg/kg)	Intake Factor (day^{-1})	Estimated Daily Intake (mg/kg-day)	RfD[a] (mg/kg-day)	Hazard Quotient
Soil Ingestion					
Antimony	5.75E+00	1.20E-05	6.89E-05	4.00E-04	1.72E-01
Cadmium	2.74E+00	1.20E-05	3.28E-05	1.00E-03	3.28E-02
Copper	4.25E+01	1.20E-05	5.09E-04	3.70E-02	1.38E-02
Manganese	5.77E+02	1.20E-05	6.92E-03	1.00E-01	6.92E-02
Nickel	7.88E+01	1.20E-05	9.45E-04	2.00E-02	4.73E-02
Silver	7.40E-01	1.20E-05	8.87E-06	5.00E-03	1.77E-03
Zinc	1.07E+02	1.20E-05	1.28E-03	2.00E-01	6.40E-03
Bis(2-ethylhexyl)phthalate	2.58E-01	1.20E-05	3.10E-06	2.00E-02	1.55E-04
Di-n-butylphthalate	1.37E-01	1.20E-05	1.64E-06	1.00E-01	1.64E-05
Toluene	2.44E-03	1.20E-05	2.92E-08	2.00E-01	1.46E-07
TOTAL					**3.43E-01**

[a] Reference Dose

TABLE 20.3-60

Estimated Mean Daily Intakes and Hazard Quotients (HQ) for Future Residential Adult Exposures: Site 13 NAS Moffett Field OU2

Chemical	Concentration (mg/kg or mg/m^3)[a]	Intake Factor (day^{-1} or m^3/kg-day)[b]	Estimated Daily Intake (mg/kg-day)	RfD[c] (mg/kg-day)	Hazard Quotient
Soil Ingestion					
Antimony	5.75E+00	1.37E-06	7.88E-06	4.00E-04	1.97E-02
Cadmium	2.74E+00	1.37E-06	3.75E-06	1.00E-03	3.75E-03
Copper	4.25E+01	1.37E-06	5.82E-05	3.70E-02	1.57E-03
Manganese	5.77E+02	1.37E-06	7.90E-04	1.00E-01	7.90E-03
Nickel	7.88E+01	1.37E-06	1.08E-04	2.00E-02	5.40E-03
Silver	7.40E-01	1.37E-06	1.01E-06	5.00E-03	2.03E-04
Zinc	1.07E+02	1.37E-06	1.46E-04	2.00E-01	7.31E-04
Bis(2-ethylhexyl)phthalate	2.58E-01	1.37E-06	3.54E-07	2.00E-02	1.77E-05
Di-n-butylphthalate	1.37E-01	1.37E-06	1.87E-07	1.00E-01	1.87E-06
Toluene	2.44E-03	1.37E-06	3.34E-09	2.00E-01	1.67E-08
TOTAL					**3.93E-02**
Dermal Absorption from Soil					
Antimony	5.75E+00	1.18E-06	6.76E-06	4.00E-04	1.69E-02
Cadmium	2.74E+00	1.18E-07	3.22E-07	6.00E-05	5.37E-03
Copper	4.25E+01	1.18E-06	4.99E-05	1.85E-02	2.70E-03
Manganese	5.77E+02	1.18E-06	6.78E-04	1.00E-01	6.78E-03
Nickel	7.88E+01	1.18E-06	9.26E-05	1.00E-03	9.26E-02
Silver	7.40E-01	1.18E-06	8.70E-07	5.00E-03	1.74E-04
Zinc	1.07E+02	1.18E-06	1.25E-04	1.00E-01	1.25E-03
Bis(2-ethylhexyl)phthalate	2.58E-01	1.18E-04	3.03E-05	2.00E-02	1.52E-03
Di-n-butylphthalate	1.37E-01	1.18E-04	1.61E-05	8.50E-02	1.89E-04
Toluene	2.44E-03	3.53E-06	8.60E-09	2.00E-01	4.30E-08
TOTAL					**1.27E-01**
Ingestion of Home Grown Vegetables					
Antimony	5.75E+00	3.78E-05	2.18E-04	4.00E-04	5.44E-01
Cadmium	2.74E+00	1.49E-04	4.07E-04	1.00E-03	4.07E-01
Copper	4.25E+01	2.01E-04	8.54E-03	3.70E-02	2.31E-01
Manganese	5.77E+02	5.56E-05	3.21E-02	1.00E-01	3.21E-01
Nickel	7.88E+01	4.51E-05	3.55E-03	2.00E-02	1.78E-01

Table 20.3-60

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Chemical	Concentration (mg/kg or mg/m^3)[a]	Intake Factor (day^{-1} or m^3/kg-day)[b]	Estimated Daily Intake (mg/kg-day)	RfD[c] (mg/kg-day)	Hazard Quotient
Silver	7.40E-01	1.02E-04	7.56E-05	5.00E-03	1.51E-02
Zinc	1.07E+02	7.30E-04	7.79E-02	2.00E-01	3.90E-01
Bis(2-ethylhexyl)phthalate	2.58E-01	2.52E-05	6.50E-06	2.00E-02	3.25E-04
Di-n-butylphthalate	1.37E-01	2.87E-05	3.92E-06	1.00E-01	3.92E-05
Toluene	2.44E-03	8.11E-04	1.98E-06	2.00E-01	9.89E-06
TOTAL					**2.09E+00**
Inhalation of VOCs					
Toluene	1.68E-10	1.94E-01	3.26E-11	1.10E-01	2.97E-10
TOTAL ALL PATHWAYS					**2.25E+00**

[a] Concentration in soil and produce for ingestion and dermal pathways is in mg/kg. Concentration in air for inhalation pathways is mg/m^3.
[b] Intake factor for ingestion and dermal exposure pathways is day^{-1}. Intake factor for inhalation pathways is m^3/kg-day.
[c] Reference Dose

TABLE 20.3-61

Estimated RME Daily Intakes and Hazard Quotients (HQ) for Future Residential Juvenile Exposures: Site 13 NAS Moffett Field OU2

Chemical	Concentration (mg/kg)	Intake Factor (day^{-1})	Estimated Daily Intake (mg/kg-day)	RfD[a] (mg/kg-day)	Hazard Quotient
Soil Ingestion					
Antimony	7.83E+00	1.20E-05	9.38E-05	4.00E-04	2.35E-01
Cadmium	4.99E+00	1.20E-05	5.98E-05	1.00E-03	5.98E-02
Copper	4.85E+01	1.20E-05	5.82E-04	3.70E-02	1.57E-02
Manganese	6.53E+02	1.20E-05	7.82E-03	1.00E-01	7.82E-02
Nickel	8.46E+01	1.20E-05	1.01E-03	2.00E-02	5.07E-02
Silver	1.08E+00	1.20E-05	1.30E-05	5.00E-03	2.59E-03
Zinc	1.45E+02	1.20E-05	1.74E-03	2.00E-01	8.70E-03
Bis(2-ethylhexyl)phthalate	4.16E-01	1.20E-05	4.98E-06	2.00E-02	2.49E-04
Di-n-butylphthalate	1.80E-01	1.20E-05	2.15E-06	1.00E-01	2.15E-05
Toluene	2.78E-03	1.20E-05	3.34E-08	2.00E-01	1.67E-07
TOTAL					**4.51E-01**

[a] Reference Dose

TABLE 20.3-62

Estimated RME Daily Intakes and Hazard Quotients (HQ) for Future Residential Adult Exposures: Site 13 NAS Moffett Field OU2

Chemical	Concentration (mg/kg or mg/m^3)[a]	Intake Factor (day^{-1} or m^3/kg-day)[b]	Estimated Daily Intake (mg/kg-day)	RfD[c] (mg/kg-day)	Hazard Quotient
Soil Ingestion					
Antimony	7.83E+00	1.37E-06	1.07E-05	4.00E-04	2.68E-02
Cadmium	4.99E+00	1.37E-06	6.84E-06	1.00E-03	6.84E-03
Copper	4.85E+01	1.37E-06	6.65E-05	3.70E-02	1.80E-03
Manganese	6.53E+02	1.37E-06	8.94E-04	1.00E-01	8.94E-03
Nickel	8.46E+01	1.37E-06	1.16E-04	2.00E-02	5.80E-03
Silver	1.08E+00	1.37E-06	1.48E-06	5.00E-03	2.97E-04
Zinc	1.45E+02	1.37E-06	1.99E-04	2.00E-01	9.94E-04
Bis(2-ethylhexyl)phthalate	4.16E-01	1.37E-06	5.69E-07	2.00E-02	2.85E-05
Di-n-butylphthalate	1.80E-01	1.37E-06	2.46E-07	1.00E-01	2.46E-06
Toluene	2.78E-03	1.37E-06	3.81E-09	2.00E-01	1.91E-08
TOTAL					**5.15E-02**
Dermal Absorption from Soil					
Antimony	7.83E+00	1.18E-06	9.20E-06	4.00E-04	2.30E-02
Cadmium	4.99E+00	1.18E-07	5.86E-07	6.00E-05	9.77E-03
Copper	4.85E+01	1.18E-06	5.70E-05	1.85E-02	3.08E-03
Manganese	6.53E+02	1.18E-06	7.67E-04	1.00E-01	7.67E-03
Nickel	8.46E+01	1.18E-06	9.94E-05	1.00E-03	9.94E-02
Silver	1.08E+00	1.18E-06	1.27E-06	5.00E-03	2.54E-04
Zinc	1.45E+02	1.18E-06	1.71E-04	1.00E-01	1.71E-03
Bis(2-ethylhexyl)phthalate	4.16E-01	1.18E-04	4.88E-05	2.00E-02	2.44E-03
Di-n-butylphthalate	1.80E-01	1.18E-04	2.11E-05	8.50E-02	2.48E-04
Toluene	2.78E-03	3.53E-06	9.81E-09	2.00E-01	4.90E-08
TOTAL					**1.48E-01**
Ingestion of Home Grown Vegetables					
Antimony	7.83E+00	5.52E-05	4.32E-04	4.00E-04	1.08E+00
Cadmium	4.99E+00	2.17E-04	1.08E-03	1.00E-03	1.08E+00
Copper	4.85E+01	2.94E-04	1.42E-02	3.70E-02	3.85E-01
Manganese	6.53E+02	8.11E-05	5.29E-02	1.00E-01	5.29E-01

TABLE 20.3-62

(Page 2 of 2)

Chemical	Concentration (mg/kg or mg/m^3)[a]	Intake Factor (day^{-1} or m^3/kg-day)[b]	Estimated Daily Intake (mg/kg-day)	RfD[c] (mg/kg-day)	Hazard Quotient
Nickel	8.46E+01	6.58E-05	5.56E-03	2.00E-02	2.78E-01
Silver	1.08E+00	1.49E-04	1.61E-04	5.00E-03	3.23E-02
Zinc	1.45E+02	1.07E-03	1.55E-01	2.00E-01	7.73E-01
Bis(2-ethylhexyl)phthalate	4.16E-01	3.67E-05	1.53E-05	2.00E-02	7.63E-04
Di-n-butylphthalate	1.80E-01	4.19E-05	7.52E-06	1.00E-01	7.52E-05
Toluene	2.78E-03	1.18E-03	3.29E-06	2.00E-01	1.65E-05
TOTAL					**4.16E+00**
Inhalation of VOCs					
Toluene	1.92E-10	1.94E-01	3.72E-11	1.10E-01	3.38E-10
TOTAL ALL PATHWAYS					**4.36E+00**

[a] Concentration in soil and produce for ingestion and dermal pathways is in mg/kg. Concentration in air for inhalation pathways is mg/m^3.

[b] Intake factor for ingestion and dermal exposure pathways is day^{-1}. Intake factor for inhalation pathways is m^3/kg-day.

[c] Reference Dose

TABLE 20.3-107

Estimated Mean Daily Intakes and Incremental Lifetime Cancer Risks (ILCR) for Current Occupational Exposures: Site 13 NAS Moffett Field OU2

Chemical	Concentration (mg/kg or mg/m^3)[a]	Intake Factor (day^{-1} or m^3/kg-day)[b]	Estimated Daily Intake (mg/kg-day)	CSF[c] (mg/kg-day)$^{-1}$	ILCR
Soil Ingestion					
Bis(2-ethylhexyl)phthalate	2.58E-01	1.31E-07	3.39E-08	1.40E-02	4.75E-10
Dermal Absorption from Soil					
Bis(2-ethylhexyl)phthalate	2.58E-01	8.61E-06	2.22E-06	1.40E-02	3.11E-08
Inhalation of Fugitive Dust					
Cadmium	2.74E+00	1.77E-08	4.84E-08	1.50E+01	7.26E-07
Nickel	7.88E+01	1.77E-08	1.39E-06	9.10E-01	1.27E-06
Bis(2-ethylhexyl)phthalate	2.58E-01	1.77E-08	4.56E-09	1.40E-02	6.38E-11
TOTAL					**2.00E-06**
TOTAL ALL PATHWAYS					**2.03E-06**

[a] Concentration in soil and produce for ingestion and dermal pathways is in mg/kg. Concentration in air for inhalation pathways is mg/m^3.

[b] Intake factor for ingestion and dermal exposure pathways is day^{-1}. Intake factor for inhalation pathways is m^3/kg-day.

[c] Cancer Slope Factor

TABLE 20.3-108

Estimated RME Daily Intakes and Incremental Lifetime Cancer Risks (ILCR) for Current Occupational Exposures: Site 13 NAS Moffett Field OU2

Chemical	Concentration (mg/kg or mg/m^3)[a]	Intake Factor (day^{-1} or m^3/kg-day)[b]	Estimated Daily Intake (mg/kg-day)	CSF[c] (mg/kg-day)$^{-1}$	ILCR
Soil Ingestion					
Bis(2-ethylhexyl)phthalate	4.16E-01	1.75E-07	7.26E-08	1.40E-02	1.02E-09
Dermal Absorption from Soil					
Bis(2-ethylhexyl)phthalate	4.16E-01	1.14E-05	4.76E-06	1.40E-02	6.66E-08
Inhalation of Fugitive Dust					
Cadmium	4.99E+00	2.35E-08	1.17E-07	1.50E+01	1.76E-06
Nickel	8.46E+01	2.35E-08	1.99E-06	9.10E-01	1.81E-06
Bis(2-ethylhexyl)phthalate	4.16E-01	2.35E-08	9.76E-09	1.40E-02	1.37E-10
TOTAL					**3.57E-06**
TOTAL ALL PATHWAYS					**3.64E-06**

[a] Concentration in soil and produce for ingestion and dermal pathways is in mg/kg. Concentration in air for inhalation pathways is mg/m^3.

[b] Intake factor for ingestion and dermal exposure pathways is day^{-1}. Intake factor for inhalation pathways is m^3/kg-day.

[c] Cancer Slope Factor

TABLE 20.3-109

Estimated Mean Daily Intakes and Incremental Lifetime Cancer Risks (ILCR) for Future Residential Juvenile Exposures: Site 13 NAS Moffett Field OU2

Chemical	Concentration (mg/kg)	Intake Factor (day^{-1})	Estimated Daily Intake (mg/kg-day)	CSF [a] $(mg/kg\text{-}day)^{-1}$	ILCR
Soil Ingestion					
Bis(2-ethylhexyl)phthalate	2.58E-01	1.03E-06	2.65E-07	1.40E-02	3.71E-09

[a] Cancer Slope Factor

TABLE 20.3-110

Estimated Mean Daily Intakes and Incremental Lifetime Cancer Risks (ILCR) for Future Residential Adult Exposures: Site 13 NAS Moffett Field OU2

Chemical	Concentration (mg/kg)	Intake Factor (day^{-1})	Estimated Daily Intake (mg/kg-day)	CSF[a] $(mg/kg\text{-}day)^{-1}$	ILCR
Soil Ingestion					
Bis(2-ethylhexyl)phthalate	2.58E-01	5.87E-08	1.52E-08	1.40E-02	2.12E-10
Dermal Absorption from Soil					
Bis(2-ethylhexyl)phthalate	2.58E-01	1.51E-05	3.90E-06	1.40E-02	5.46E-08
Ingestion of Home Grown Vegetables					
Bis(2-ethylhexyl)phthalate	2.58E-01	3.23E-06	8.35E-07	1.40E-02	1.17E-08
TOTAL ALL PATHWAYS					**6.65E-08**

[a] Cancer Slope Factor

TABLE 20.3-111

Estimated RME Daily Intakes and Incremental Lifetime Cancer Risks (ILCR) for Future Recreational Exposures: Site 13 NAS Moffett Field OU2

Chemical	Concentration (mg/kg)	Intake Factor (day^{-1})	Estimated Daily Intake (mg/kg-day)	CSF[a] $(mg/kg\text{-}day)^{-1}$	ILCR
Soil Ingestion					
Bis(2-ethylhexyl)phthalate	4.16E-01	1.03E-06	4.27E-07	1.40E-02	5.98E-09

[a] Cancer Slope Factor

TABLE 20.3-112

Estimated RME Daily Intakes and Incremental Lifetime Cancer Risks (ILCR) for Future Residential Adult Exposures: Site 13 NAS Moffett Field OU2

Chemical	Concentration (mg/kg)	Intake Factor (day^{-1})	Estimated Daily Intake (mg/kg-day)	CSF [c] $(mg/kg\text{-}day)^{-1}$	ILCR
Soil Ingestion					
Bis(2-ethylhexyl)phthalate	4.16E-01	4.70E-07	1.95E-07	1.40E-02	2.73E-09
Dermal Absorption from Soil					
Bis(2-ethylhexyl)phthalate	4.16E-01	5.04E-05	2.09E-05	1.40E-02	2.93E-07
Ingestion of Home Grown Vegetables					
Bis(2-ethylhexyl)phthalate	4.16E-01	1.57E-05	6.54E-06	1.40E-02	9.15E-08
TOTAL ALL PATHWAYS					**3.87E-07**

[a] Cancer Slope Factor