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REMEDIAL INVESTIGATION FOR OPERABLE UNIT 4 (OU 4) STUDY AREAS 12, 13 AND 14
VOLUME 1 OF 2 NTC ORLANDO FL
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HARDING LAWSON ASSOCIATES

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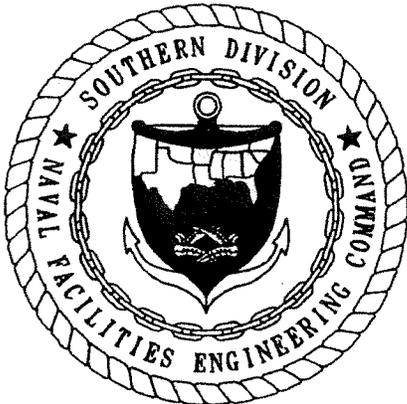
**REMEDIAL INVESTIGATION
OPERABLE UNIT 4
STUDY AREAS 12, 13, AND 14 (AREA C)**

**NAVAL TRAINING CENTER
ORLANDO, FLORIDA**

**VOLUME I: CHAPTERS 1.0 THROUGH 10.0, REFERENCES,
AND APPENDICES A THROUGH E**

**UNIT IDENTIFICATION CODE: N65928
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**SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
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January 17, 2001

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Commanding Officer
SOUTHNAVFACENCOM
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**SUBJECT: Final Remedial Investigation Report
Operable Unit (OU) 4
Naval Training Center (NTC), Orlando, Florida
Contract No.: N62467-89-D-0317/CTO 135**

Dear Barbara:

Enclosed please find two copies of the Final NTC Orlando OU 4 Remedial Investigation Report. This report includes revisions in response to comments received on the Final Draft OU 4 RI Report, as well as the redline/strikeout interim version that was issued for comment in the spring of 2000 (Appendix R). Responses to comments for the redline/strikeout RI are also attached to this letter.

The majority of comments to the redline/strikeout document were provided by USEPA, focusing primarily on the sources of inorganics, PAHs, pesticides, and PCBs in Lake Druid. After a comparison of Lake Druid data with stormwater sediments collected throughout the state of Florida, the OPT had previously agreed that the most likely sources of these compounds were urban stormwater discharges to the lake, and likely unrelated to any Navy activities at Area C.

However, in comments to the redline/strikeout document, USEPA suggested that PCBs (being flame retardant) could have been used to treat clothing laundered in Building 1100, that sources of PCBs were unlikely present in the residential neighborhoods surrounding Lake Druid, and therefore the source of PCBs in the lake was likely the Navy. We have carefully researched these possibilities, and the attached responses include considerable detail and references that we feel demonstrate PCBs were not used to treat clothing, and the likely sources of PCBs in Lake Druid include the surrounding urban environment, as well as potential atmospheric deposition. We do not believe Navy activities at Area C contributed to the PCBs in the lake.

If you have questions or comments regarding this document, please contact me at (781) 213-5652 or John Kaiser at (407) 522-7570.

Very truly yours,

HARDING LAWSON ASSOCIATES

Mark J. Salvetti, P.E.
Task Order Manager

Enclosures

cc:

W. Hansel (SDIV)	S. McCoy (Tetra Tech NUS)
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PROJECT REVIEW COMMENTS

Operable Unit 4, Study Areas 12, 13, and 14 – Area C
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General Response Preface:

Several of the following comments are related to chemicals detected in Lake Druid sediments. There is uncertainty associated with the origin of PAHs, pesticides, and PCBs detected in Lake Druid sediment. The Navy has maintained that these analytes are present primarily due to stormwater discharges to the lake from the surrounding urban development. A comparison of data collected from sediments associated with urban runoff throughout the state of Florida and Lake Druid is now included as Appendix P of the Final OU 4 RI. This comparison shows that concentrations detected in Lake Druid are consistent with what has been shown to be present in urban stormwater sediments. Based on this comparison, the Florida Department of Environmental Protection (FDEP) and the Orlando Partnering Team (OPT) have concurred that the presence of these analytes in Lake Druid is likely not due to activities conducted by the Navy at Area C and OU 4.

U.S. Environmental Protection Agency, Region 4 – Nancy Rodriguez

GENERAL COMMENTS:

1. **All statements regarding the source of constituents detected in site media should be qualified appropriately. It cannot be stated conclusively that contaminants in sediments originated from stormwater discharges versus site-related activities or that pesticides were the result of “normal application.” Changes are necessary to qualify statements on Page 9-11 (Specific Comment #2), Pages 9-73 through 9-74, Page 9-75, top bullet, Page 9-77 (bottom). The statement, “However, PAHs are not site related.” should be deleted. It is not relevant to the discussion of the uncertainty due to excessively high detection limits.**

Although the source of contaminants in sediments cannot conclusively be demonstrated to be from offsite sources, as noted above FDEP and the OPT have agreed that offsite sources are likely. We have added appropriate qualifiers to all statements regarding the source of constituents detected in site media, indicating that sources (other than VOCs) are likely from offsite.

The statement “However, PAHs are not site related” on Page 9-75 will be deleted.

2. **EPA’s screening comparison for surface water (Table 1) indicated slight exceedances of the screening values for cis-1,2-dichloroethylene, carbon disulfide, trichloroethylene, 4,4'-DDT and gamma-BHC. Screening of sediments (Table 2) revealed several constituents having maximum concentrations above screening values. These included two volatiles (1,2-dichloroethylene [total] and vinyl chloride, three semi-volatiles (fluoranthene, pyrene and bis(2-ethylhexyl)phthalate) and four pesticides/PCBs (4,4'-DDE, Aroclor-1254, endosulfan I, and alpha-chlordane).**

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TABLE 1. Screening of Chemicals of Potential Concern in Surface Water (Organics)

Analyte	Maximum Concentration, ug/L	Detected	Screening Value, ug/L	Screening Value Source
<i>cis-1,2-DCE</i>	760		590 ¹	ORNL Tier II Secondary Chronic
Acetone	6		1500	ORNL Tier II Secondary Chronic
<i>Carbon disulfide</i>	1		0.92	ORNL Tier II Secondary Chronic
PCE	19		84	AWQ Value Chronic
Toluene	0.7		175	AWQ Value Chronic
<i>TCE</i>	57		47	ORNL Tier II Secondary Chronic
Vinyl chloride	35		N.A.	N.A.
4-Methylphenol	3.5		N.A.	N.A.
<i>4,4'-DDT</i>	0.029		0.001	AWQ Value Chronic
Endrin ketone	0.01		N.A.	N.A.
<i>gamma-BHC (lindane)</i>	0.013		0.08	AWQ Value Chronic

TABLE 2. Screening of Chemicals of Potential Concern in Sediment (Organics)

Analyte	Maximum Conc., ug/kg	Detected	Screening Value, ug/kg	Screening Value Source
<i>1,2-DCE (total)</i>	1300		440	SSG Calculated by EQP ¹
Acetone	46		N.A.	N.A.
Methylene chloride	130		2000	Dutch intervention value divided by 10
PCE	19		530	EPA Ecotox threshold
Toluene	13		670	EPA Ecotox threshold
<i>TCE</i>	280		1600	EPA Ecotox threshold
<i>Vinyl chloride</i>	560		10	Dutch intervention value divided by 10
<i>Fluoranthene</i>	3500		330	EPA Region 4 Screening Value
<i>Pyrene</i>	3400		330	EPA Region 4 Screening Value
<i>bis(2-Ethylhexyl)phthalate</i>	5600		182	EPA Region 4 Screening Value
<i>4,4'-DDE</i>	7.6		3.3	EPA Region 4 Screening Value
<i>Aroclor-1254</i>	68		67	EPA Region 4 Screening Value
<i>Endosulfan I</i>	4.6		2.9	EPA Ecotox threshold
Hepachlor	2.6		N.A.	N.A.

PROJECT REVIEW COMMENTS (Continued)

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TABLE 2. Screening of Chemicals of Potential Concern in Sediment (Organics)

Analyte	Maximum Conc., ug/kg	Detected	Screening Value, ug/kg	Screening Value Source
<i>alpha-Chlordane</i>	2		1.7	EPA Region 4 Screening Value
delta-BHC	6.1		N.A.	N.A.
gamma-BHC (lindane)	2.8		3.3	EPA Region 4 Screening Value

¹A screening value in sediment for 1,2-DCE was estimated from the final chronic value for cis-1,2-DCE using the equilibrium partitioning method. The mass water content (MC) of the sediment was assumed to be 40 percent and the distribution coefficient between sediment and pore water (K_D) was assumed to be 7.1E-02 L/kg, taken from EPA's 1996 Superfund Chemical Data Matrix.

The equation used was:

where ρ_w is density of water.

When screening toxicity values are exceeded, the prudent course of action is to conduct site-specific toxicity testing. EPA recommends site-specific toxicity testing of Lake Druid surface water and sediment for OU4.

Regarding the exceedance of screening values for VOCs, the Navy will shortly begin treating contaminated site groundwater via a redesigned IRA. The new treatment system will use groundwater extraction and treatment to intercept the majority of the VOC-contaminated groundwater prior to reaching Lake Druid. VOC concentrations in Lake Druid are expected to decrease to below screening values shortly after startup. In the long-term, site closure will not be achieved until VOC concentrations in groundwater are below Florida Drinking Water Standards. The current VOC concentrations in the lake are expected to decrease, and are not representative of concentrations that will be present after remediation. Thus, toxicity testing for VOCs is unnecessary.

By agreement of FDEP and the OPT, the presence of PAHs, PCBs, and pesticides in Lake Druid above screening values is likely due to offsite sources. As the Navy is not responsible for their presence in the lake, the Navy is also not responsible for performing toxicity testing.

3. Instead of performing toxicity testing the RI report compiled literature toxicity values in Table 9-13. These values were presented as a range. The upper end of the range typically represented a 48-hour LC_{50} for daphnids or fathead minnow. The toxicity benchmarks used by the NTC team were less than conservative because they represented mortality under acute and sub-chronic exposures. Toxicity reference values for sensitive reproductive endpoints and chronic exposures are preferred in ecological risk assessment. One cannot conclude that aquatic organisms are not

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at risk based on the comparisons made in Table 9-13. Also, the receptors in the field are exposed to a mixture of chemicals, many of which share a common mode of action.

There is validity to the above comments. The toxicity benchmarks used in this ecological risk assessment represent the data that are readily available in literature, and are consistent with the literature values presented in Suter and Tsao (1996). There are very few studies available that describe chronic effects from exposure to many of the chemicals of concern at this site. This may suggest that exposures to sublethal concentrations of these chemicals do not represent a significant risk to ecological receptors. The Tier II values presented in Suter and Tsao (1996) were used solely as a tool to select ecological contaminants of concern. They are calculated based on acute toxicity values and derived or default acute to chronic ratios, and are considered too conservative to base meaningful risk conclusions. However, as noted above, toxicity testing is not the Navy's responsibility, and we believe the conclusions made in the risk assessment are adequate to demonstrate that there are likely no ecological impacts to Lake Druid due to Navy activities at Area C and OU 4.

- 4. Finally, the limited surface water monitoring may not represent the spatial variability of concentrations in Lake Druid. Justification is required for the choice of the control or reference station, which is in the same lake, less than 300 feet south of the closest site station. The site-related constituent 1,2-DCE was detected at 72 ug/L at the control station.**

The limited surface water sampling for VOCs performed during the RI was justifiable because the extent of VOC contamination in Lake Druid was previously established by close to 50 surface water and sediment samples (see RI Figures 2-4 and 2-5, and RI Appendix B, Figure B-5). The number and location of the reference samples was discussed with and approved by the OPT. A large number of full suite Lake Druid samples was not necessary, as it was believed (and subsequently demonstrated) that the only site-related contaminants of concern in the lake were VOCs.

Surface water and sediment from the control location were actually sampled twice, once in October 1997 and once in March 1998. No VOCs were detected in sediment in October (although the detection limit was a bit higher [140 ug/kg] than in March), and only 0.5 ug/l cis-1,2-DCE was detected in surface water. VOCs were detected primarily during the March sampling event, although at concentrations well below screening criteria. The variability in VOC detections suggests the control location is very close to the edge of the VOC contamination in the lake. The presence of very low concentrations of VOCs at the control location does not preclude the use of non-VOC compound results as controls, given that the presence of VOCs is unrelated to the presence of compounds such as inorganics, PAHs, and pesticides.

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SPECIFIC COMMENTS:

1. **Section 5.1, Sources of Contamination, Page 5-2, top. Include the fact that in addition to antimony, PCBs were used in flame retardant clothing (ATSDR, 1998).**

There is no evidence that PCBs were used as flame retardants in clothing. The cited reference (ATSDR, 1998) specifically states (in Section 4.3 Use), "Prior to 1974, PCBs were used... in open-end applications (e.g., plasticizers, surface coatings, inks, adhesives, flame retardants, pesticide extenders, paints, and microencapsulation of dyes for carbonless duplicating paper) (EPA 1976; IARC 1978; Safe 1984; Welsh 1995)." The reference to "flame retardants" refers to the flame retardant properties of PCBs as applied to paints, plasticizers, cable coatings, polyurethane foam, cooling oils, and hydraulic oils. A review of (EPA 1976) and (IARC 1978) supports this conclusion.

No specific reference to the use of PCBs as flame retardants in clothing was found. Nor is there a mention of PCB use in clothing on the Binational Toxics Strategy website hosted by USEPA (<http://www.epa.gov/glnpo/bnsdocs/pcbsrcce/pcbsrcce.html>).

2. **Section 9.2, Problem Formulation and Conceptual Site Model, Page 9-11. Include that PCBs may have originated from laundering of flame retardant clothing. This is the most reasonable explanation for the source of PCBs at the site.**

PCBs did not originate from the laundering of flame retardant clothing (see response to Specific Comment 1). There are numerous anthropogenic potential sources for PCBs in Lake Druid. See the detailed response to Specific Comment 14 for supporting information.

3. **Section 9.2.2, Identification of Exposure Pathways, Page 9-12, 2nd to last sentence of the first paragraph. Delete the phrase, "from normal application and paints at the DRMO." The source of the insecticides cannot be stated conclusively. The text should not falsely imply that the source can be independently verified, when there is no scientific test that can conclusively prove or disprove the source of specific detections.**

Agree, the redline text on Page 9-12, will be replaced with the following text:

A secondary exposure pathway at the site is exposure of terrestrial receptors to insecticides and metals in surface soil. The source of these contaminants is probably related to the use and storage of small quantities of insecticides and paint at the DRMO, as stated in Section 9.2 (Problem Formulation and Conceptual Site Model).

4. **Section 9.3.2.2, Exposure Assessment, Terrestrial and Semi-Aquatic Wildlife, Page 9-39. For the bullet for the great blue heron, replace the word "piscivorous" with the word "omnivorous." The term piscivorous falsely represents the diet assumed for the great blue heron as predominantly fish. Although 98 percent of the diet was assumed to be aquatic organisms, those aquatic organisms included ciliates, copepods, water fleas, mayflies, clams, shrimps, frogs, and sea**

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squirts, in addition to fish (Table F.1-3). The bioaccumulation factor (BCF) assumed for accumulation of pesticides from water into aquatic organisms incorporated a geometric mean of values in AQUIRE for all organism types. The bioaccumulation factor would have been much higher (more conservative) if only the fish data in AQUIRE were used. Also, when a biota-to-sediment accumulation factor (BSAF) value was not identified in the literature, an accumulation factor describing how constituents in soils accumulate into terrestrial invertebrates was used as a surrogate. This was a frequent necessity in the risk assessment (80% of chemicals), which decreased the resemblance to piscivores even further.

The word “piscivorous” will be changed to “omnivorous” for the great-blue heron. The BCFs for representative semi-aquatic wildlife were recalculated, using bluegill and lake trout data for 4,4'-DDT, and catfish and flagfish data for endrin keytone. These values were applied to the food chain model and risks were recalculated. A truly piscivorous wildlife receptor (i.e., the osprey) was also added to the food chain evaluation of semi-aquatic wildlife, in order to evaluate risks to a receptor that consumes only fish.

Even with the above revisions, the ecological risk assessment for OU 4 concludes that there are no risks to the environment from contaminants present at OU 4.

5. **Table 9-13, Comparison of Surface Water ECPC Exposure Concentrations to Toxicity Benchmark Values.** The footnote #8 applied to the FDEP Class II Freshwater Quality Standards indicates that the values are overly conservative for aquatic life and were not used to evaluate potential effects in the risk assessment. The FDEP values are intended for protection of piscivorous wildlife. The FDEP Freshwater Quality Standards should be used in this risk assessment to evaluate water column concentrations, given the lack of assessment of piscivorous mammals and birds in the risk assessment. The foot note should be modified to, “Based on uptake into wildlife, and is used to evaluate potential risks to piscivorous mammals and birds.”

Revisions to the footnote are not necessary, as this table was intended to present an evaluation of the effects of constituents in surface water on aquatic life including macroinvertebrates and fish, not wildlife. The Navy acknowledges that the FDEP screening values for 4,4'-DDT and endrin keytone were exceeded, suggesting that strictly piscivorous semi-aquatic wildlife would be at risk from exposures associated with contaminant uptake in the aquatic food web. An osprey was added to the food web model to evaluate risks to strictly piscivorous semi-aquatic wildlife that may use the site.

The results of the food web model for the piscivore suggest the opposite, as the HIs calculated for the osprey were less than 1.

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6. **Table 9-13, Comparison of Surface Water ECPC Exposure Concentrations to Toxicity Benchmark Values. Include Secondary Chronic Tier II values from Suter and Tsao (1996) to Table 9-13 to evaluate data gaps. Use the Tier II criteria instead of the Lowest Observed Effects Level for trichloroethene, i.e., 47 ug/L instead of 21,900 ug/L.**

Tier II values are inappropriate for this evaluation. As discussed in General Comment #3, there is uncertainty associated with using the Tier II screening values to estimate risks. In addition, the value of 21,900 ug/L is consistent with the other data for fish, invertebrates, and amphibians presented in Table 9-13 and the lowest chronic values for fish and daphnids, presented in Table 1 from Suter and Tsao (1996). The value of 47 ug/L is an estimated value, based on applying an acute to chronic ratio to a single acute toxicity test (i.e., LC50), and would likely be overly conservative for this evaluation.

7. **Section 9.4.2.2, Risk Characterization, Aquatic Receptors, 7th paragraph, Page 9-66. The tissue concentration calculations for surface water and sediment were for concentrations in mixed aquatic organisms. References to fish in the section entitled “Surface Water and Sediment” should be changed to “aquatic organisms.”**

The section title will be changed to “Aquatic Organisms”.

8. **Table 9-15, Comparison of Calculated Fish and Invertebrate Tissue Concentrations with Effects Concentrations. Change the title of Table 9-15 from Fish Tissue Concentrations to Aquatic Organism Concentrations.**

The title of Table 9-15 will be changed from Fish and Invertebrate Tissue Concentrations to Aquatic Organisms Concentrations.

9. **Section 9.5, Uncertainty Analysis. Include an explicit statement in the uncertainties section that bioaccumulation factors were based on literature values averaged over wide classes of organisms and did not take into account biomagnification or food-chain multipliers for pesticides and mercury. Include that the biomagnification factor for DDT assumed in this study was 2.6E+03 L/kg versus a value of 7.6E+04 L/kg in the Superfund Chemical Data Matrix (USEPA, 1996), a value of 1.68E+05 L/kg for the Great lakes Initiative (USEPA, 1995), and a value of 2.55E+04 L/kg in the Draft Region 6 Combustion Risk Assessment Guidance (USEPA, 1999). Based on these references, it appears very likely that bioaccumulation for pesticides was underestimated in the risk assessment by at least a factor of 10. Describe in the uncertainties section how lack of site-specific bioaccumulation data may have underestimated risk to higher trophic level organisms, especially those whose diet consists primarily of fish.**

An uncertainty will be added stating that bioaccumulation factors were based on literature values and not site specific data. Bioaccumulation factors for mercury and pesticides are presented in Tables F.1-2 and F.1-3, respectively. The bioconcentration factors (BCFs) were recalculated using

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only fish data for 4,4'-DDT and endrin keytone, the resulting BCFs are 3.4E+04 and 5.5E+03, respectively. The revised BCFs were used in the food web model to recalculate risks for the great-blue heron and osprey. The osprey was added to the food chain model to evaluate a true piscivore. The results of this reevaluation suggested that semi-aquatic omnivorous and piscivorous avian receptors would not be at risk from exposure to RME or CT concentrations at the site.

10. **Table 9-17, Potential Sources of Uncertainty in Risk Assessment. Modify the direction of effect for bioaccumulation factor estimation from “unknown” to “possibly underestimate.” Modify the direction of effects for food chain model exposure parameter assumptions from “unknown” to “underestimate.” See Specific Comment #13.**

Table 9-17 will be changed to be consistent with the comments; BAF estimation and food chain model exposure parameter assumption direction of effects will be changed to” possibly underestimate”.

11. **Section 9.5, Uncertainty Analysis. Include an explicit statement in the uncertainties section that dietary exposures to piscivorous birds and mammals were not estimated for surface water or sediment. Omnivorous birds and mammals were exclusively employed in the risk assessment.**

Dietary exposures to piscivorous birds have now been estimated. The osprey was added to the food chain model and risks were evaluated for this receptor. Based on the results of this evaluation, it is unlikely that omnivorous or piscivorous receptors at the site would be at risk from exposure to surface water or sediment at the site, as the HIs for these receptors were less than or only slightly exceed one.

12. **Section 9.5, Uncertainty Analysis. Include the list of the chemicals for which no toxicity reference values were available for either mammals or birds for food-chain analysis.**

An uncertainty will be added listing the chemicals lacking reference toxicity values for the food chain analysis. In addition, a discussion of the potential effect on the risk conclusions will be included in this uncertainty, incorporating distribution of contamination, FOD, and known fate and transport properties of these chemicals.

13. **Section 9.5, Uncertainty Analysis. Describe uncertainty in exposure assumptions for terrestrial receptors. Specifically, describe how risks to terrestrial birds and mammals have more than likely been underestimated based on the following comparison of ingestion rates with those reported in EPA’s Exposure Factors Handbook (USEPA, 1993b).**

Indicator Species	Dietary Ingestion Rate Used in Risk Assessment at OU4 (g/g-day) (Table F.2-1)	Range of Values Reported in USEPA 1993b Exposure Factors Handbook (g/g-day)
Cotton Mouse	0.12	0.19 - 0.45*

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Mourning Dove	0.12	No data
Short-Tailed Shrew	0.12	0.49 - 0.62
Woodcock	0.10	0.77
Red Fox	0.05	0.069 - 0.16

* Data for deer mouse.

A discussion will be added to the Risk Assessment Uncertainty Section that describes the potential impacts to the risk conclusions of using the assumed dietary intake parameters. An uncertainty will be added that describes the Dietary Ingestion Rates used in this risk assessment and the potential for them underestimating risks to mammalian and avian receptors.

14. **Section 9.5, Uncertainty Analysis, Page 9-73. The last bullet on the page indicates that the origin of PAHs, pesticides, and PCBs detected in Lake Druid is stormwater discharges from the surrounding urban development. While this may be true of PAHs and pesticides, EPA does not agree that PCBs are derived from stormwater from the neighboring apartment complex, etc. It is unlikely that private residents would have access to PCBs. The more likely explanation for the PCBs is their use in flame retardant clothing used by army personnel and laundered on site. Moreover, the data in Appendix P do not support a diffuse background source of PCBs. PCBs were not detected in the background sample. The statement should be modified to remove the reference to PCBs.**

As previously noted, there is no evidence that PCBs were used as flame retardants in clothing. PCBs were present in numerous consumer goods potentially present in an urban environment, including carbonless duplicating paper, plasticizers, pesticides, electrical capacitors, and paints. PCBs were also commonly found in transformer and hydraulic oils, and could have been released in the urban area due to electrical transformer failures and hydraulic fluid releases from vehicles and construction equipment.

PCBs are still present in consumer goods due to “inadvertent generation” in the manufacturing process. These goods include paints, inks, plastics, and agricultural chemicals. Detergent bars are allowed to contain up to 5 ppm PCBs. Annual average concentrations of PCBs in other consumer goods can be up to 25 ppm, with a 50 ppm maximum (<http://www.epa.gov/glnpo/bnsdocs/pcbsrce/pcbsrce.html>).

Atmospheric deposition is also a likely potential source for PCBs in Lake Druid. In 1976 it was estimated that up to one million kilograms per year of PCBs fell on the US yearly in rain and particulate matter (IARC 1976, PCBs, Section 2.2(b)). Higher concentrations of PCBs have been detected in high-altitude Rocky Mountain lake sediment (ATSDR, 1998) than were found in Lake Druid.

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The lack of a PCBs at the Lake Druid control location can be attributed to matrix effects, detection limits, or sample heterogeneity.

The presence of PCBs in Lake Druid is therefore most likely from stormwater or other anthropogenic sources other than Navy activities at OU 4. Modification of the last bullet of the uncertainty statement is not necessary.

15. **Section 9.6, Summary of Ecological Assessment for OU4, Page 9-75. Expand the summary of the ecological risk assessment. Insert text to describe each chemical and exposure pathway for which potential risk was identified. For example, a potential effect was estimated for aquatic organisms exposed to cis-1,2-dichloroethylene in ground water for both the RME and the CT exposure point concentrations in ground water (Table 9-16). Also, surface water concentrations of cis-1,2-dichloroethylene, and trichloroethene exceed Tier II Screening Values, which are the subject of Specific Comment #6. Discuss the implications of these findings.**

As noted in the response to Specific Comment #6, use of Tier II Screening Values is inappropriate. The summary of the ecological risk assessment will be expanded to include the following text, regarding potential risks under current conditions:

“The RME and CT concentrations of cis-1,2-DCE exceed the low end of the range of effect concentrations for invertebrates. However, based on the magnitude of this exceedance, population level risks to these receptors are unlikely. In addition, future impacts to invertebrate receptor populations are being addressed through the ongoing groundwater remediation at the site.”

16. **Section 9.6, Summary of Ecological Assessment for OU4, Page 9-75, bullet 2. Change the description of the “predatory mammal” and the “piscivorous” bird to the “omnivorous mammal” and the “omnivorous bird.”**

The summary will be changed to read “...adversely affect omnivorous mammal or omnivorous bird populations that occur at the site following...”

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REFERENCES:

- ATSDR 1998. *Toxicological Profile for Polychlorinated Biphenyls (Update)*, Agency for Toxic Substances and Disease Registry, Atlanta, GA. December, 1998.
- IARC 1978. IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans, Polychlorinated Biphenyls and Polybrominated Biphenyls, International Agency for Research on Cancer, Volume 18. October 1978.
- Suter, G.W. 1996. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Freshwater Biota. *Environmental Toxicology and Chemistry*, Vol. 15 (7): 1232-1241.
- Suter, G.W., and C.L. Tsao. 1996. *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota*, 1996 Revision. Oak Ridge National Laboratory, ORNL Environmental Sciences Division, ES/ER/TM-96/R2. www.hsr.d.ornl.gov/ecorisk/
- USEPA, 1976. PCBs in the United States, Industrial Use and Environmental Distribution, U.S. Environmental Protection Agency, Office of Toxic Substances, Washington, D.C., EPA 560/76-005. February 1976.
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PROJECT REVIEW COMMENTS (Continued)

Operable Unit 4, Study Areas 12, 13, and 14 – Area C
Remedial Investigation
Naval Training Center
Orlando, Florida

Florida Department of Environmental Protection – David Grabka

1. **Page 2-33, Second Paragraph.** The discussion on water level elevations with respect to determining vertical gradients and flow direction is backwards. A higher water elevation in a well screened at a shallow depth than in a well screened at a deeper depth indicates a downward vertical gradient; i.e., groundwater velocity would have a component toward a deeper zone in the aquifer.

Appropriate changes will be made to correct this error.

2. **Section 5.2.4.2 Sediment Paragraph.** I could not match the concentrations detected in sediment discussed in the text with the concentrations shown in the chem-boxes in Figure 5-11.

Concentrations have been corrected such that the values in the text and in the Chem-boxes in Figure 5-11 are consistent with the analytical results in Appendix C.

3. **Page 7-2, Table 7-1.** The column listing biodegradation potentials for tetrachloroethene (PCE) and its degradation products appears to be incorrect. The column has degradation of PCE more likely occurring in an aerobic environment. In actuality, reductive dechlorination of PCE and TCE in anaerobic environments are important processes and are likely occurring at the site. Likewise, the biodegradation potentials column has vinyl chloride being more easily degraded in an anaerobic environment than in an aerobic environment. This is contrary to my experience. Please revise this column and also check the text to make sure that the discussion on natural attenuation is accurate.

The entries in Table 7-1 have been corrected as suggested, and the table is now consistent with the corresponding text.

4. **Sections 8.2.2.3, 8.2.2.4 and 8.2.2.5.** Each section has a sentence starting that “For each sampling event not all parameters were analyzed; therefore, samples were averaged together.” This statement does not make sense to me. How can analytical parameter results be averaged if they weren’t analyzed for during each sampling event?

The sentence noted above is poorly worded and unnecessary. The sentence has been removed from each of the three sections.

5. **Figures 5-2 and 5-4 refer to FDEP Soil Cleanup Goals (SCGs).** These should be changed to Soil Cleanup Target Levels (SCTLs).

The figures have been revised.

REMEDIAL INVESTIGATION
OPERABLE UNIT 4
STUDY AREAS 12, 13, AND 14 (AREA C)

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Unit Identification Code: N65928

Contract No.: N62467-89-D-0317/135

Prepared by:

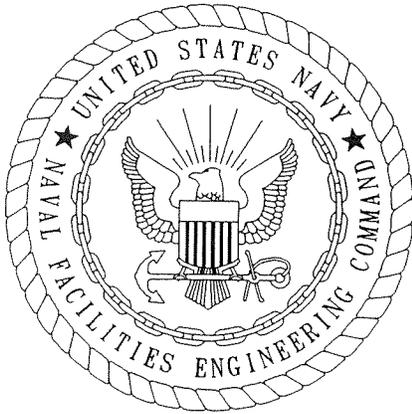
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Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29418

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April 2000



CERTIFICATION OF TECHNICAL
DATA CONFORMITY (MAY 1987)

The Contractor, Harding Lawson Associates, hereby certifies that, to the best of its knowledge and belief, the technical data delivered herewith under Contract No. N62467-89-D-0317/135 are complete and accurate and comply with all requirements of this contract.

DATE: January 16, 2001

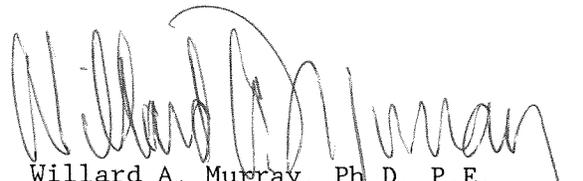
NAME AND TITLE OF CERTIFYING OFFICIAL: John Kaiser
Installation Manager

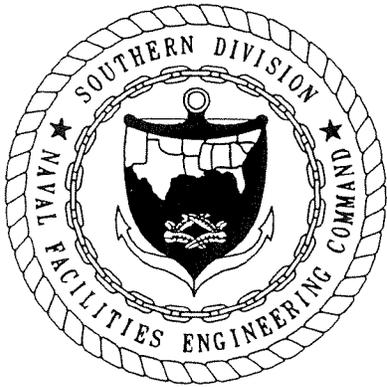
NAME AND TITLE OF CERTIFYING OFFICIAL: Mark Salvetti, P.E.
Task Order Manager

(DFAR 252.227-7036)



This document, the Remedial Investigation Report for Operable Unit (OU) 4, Naval Training Center (NTC) in Orlando, Florida, has been prepared under the direction of a registered professional engineer, registered in the State of Florida. The work, engineering evaluations, and professional opinions rendered in this report were conducted or developed in accordance with commonly accepted procedures consistent with applicable standards of practice. The document is based on the geologic investigations and associated information detailed in the text and appended to this report or referenced in public literature. Conclusions are based upon interpretations of the applicable regulatory requirements, guidelines, and relevant issues discussed with regulatory personnel during the investigation. If conditions that differ from those described are determined to exist, the undersigned should be notified to evaluate the effects of any additional information on this assessment or the conclusions of this report. This report was developed for OU 4, located on the Main Base of NTC, Orlando, Florida, and should not be construed to apply to any other site.


Willard A. Murray, Ph.D., P.E.
1/15/01
Principal Engineer
Professional Engineer No. 39866
Expires February 28, 2001



FOREWORD

To meet its mission objectives, the U.S. Navy performs a variety of operations, some of which require the use, handling, storage, and/or disposal of hazardous materials. Through accidental spills and leaks, or as a result of past conventional methods of disposal, hazardous materials may have entered the environment in ways unacceptable by current standards. As knowledge of the long-term effects of hazardous materials on the environment has grown, the Department of Defense (DOD) has initiated various programs to investigate and remediate conditions related to suspected past releases of hazardous materials at their facilities. Two of these programs are the Installation Restoration (IR) program and the Base Realignment and Closure (BRAC) program.

The IR program complies with the Base Closure and Realignment Act of 1988 (Public Law 100-526, 102 Statute 2623) and the Defense Base Closure and Realignment Act of 1990 (Public Law 101-510, 104 Statute [1808]), which require the DOD to observe pertinent environmental legal provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Executive Order 12580, and the statutory provisions of Defense Environmental Restoration Program, the National Environmental Policy Act, and any other applicable statutes that protect natural and cultural resources.

The goal of the BRAC program is to expedite and improve environmental response actions to facilitate the disposal and reuse of a BRAC installation while protecting human health and the environment.

The Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), the U.S. Environmental Protection Agency (USEPA), and the Florida Department of Environmental Protection (FDEP) collectively coordinate the cleanup activities through the BRAC cleanup team, called the Orlando Partnering Team (OPT). This team approach is intended to foster partnering, accelerate the environmental cleanup process, and expedite timely, cost-effective, and environmentally responsible disposal and reuse decisions.

Questions regarding the BRAC program at Naval Training Center (NTC), Orlando should be addressed to the SOUTHNAVFACENGCOM BRAC Environmental Coordinator, Mr. Wayne Hansel, at (407) 895-6714, or the SOUTHNAVFACENGCOM Engineer-in-Charge, Ms. Barbara Nwokike, at (843) 820-5566.

EXECUTIVE SUMMARY

Harding Lawson Associates (HLA), under contract to Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), has prepared this Remedial Investigation (RI) report for Operable Unit (OU) 4, which consists of Study Area (SA) 12 (Defense Reutilization and Marketing Office [DRMO] Warehouses and Salvage Yard), SA 13 (former base laundry and dry-cleaning facility), and SA 14 (DRMO Storage Area) at the Naval Training Center (NTC) in Orlando, Florida. The RI was conducted under Contract Number N62467-89-D-0317-135.

OU 4 was initially investigated during a Base Realignment and Closure (BRAC) Environmental Baseline Survey (EBS) conducted in 1994 (ABB Environmental Services, Inc. [ABB-ES], 1994). This survey, the first phase of the Installation Restoration (IR) program, included a records search and site walkovers. Based on the findings of the EBS, further investigation under the site screening program was recommended. HLA (formerly ABB-ES) began a site screening investigation at SAs 12, 13, and 14 in January 1995 (ABB-ES, 1996a).

During the 1995 site screening investigation of SA 12, tetrachloroethene (PCE) and trichloroethene (TCE) were detected in groundwater. At SA 13, PCE and TCE were measured in soil gas north of Building 1100 (the former laundry). Chlorinated solvents above Florida Department of Environmental Protection (FDEP) maximum contaminant levels (MCLs) were detected in all four shallow monitoring wells at SA 13. Groundwater samples collected from shallow TerraProbeSM borings installed between Building 1100 and Lake Druid contained PCE, *cis*-1,2-dichloroethene (*cis*-DCE), and TCE. Surface water samples collected along the lake shoreline contained several chlorinated solvents, including PCE, TCE, *cis*-DCE, 1,1-dichloroethene (1,1-DCE), and vinyl chloride (VC). Sediment samples also contained PCE and TCE. The highest surface water and sediment volatile organic compound (VOC) concentrations were detected where a small ditch formed by the surface expression of groundwater enters the lake, along the eastern shoreline.

At SA 14, a soil gas survey indicated PCE at only one location near the northwest corner of Building 1102. No other VOCs were detected in soil gas. No compounds were detected above screening criteria in surface soil. PCE and TCE were detected above their respective FDEP MCLs in one groundwater sample, and antimony was detected above its FDEP MCL in three groundwater samples.

Based on these findings, the Site Screening Report (ABB-ES, 1996a) recommended further investigation of the groundwater beneath SAs 12, 13, and 14, including delineation of the PCE and TCE in groundwater at SA 13, and investigation of the antimony in groundwater at SA 14. The report also recommended further investigation of soil at SAs 13 and 14.

A Focused Field Investigation (FFI) was conducted in May 1996 to delineate the VOC contamination in groundwater along the lake shore, and in surface water and sediment. Chlorinated solvents were detected in groundwater, surface water, and sediment samples. As in the 1995 site screening, the highest detected VOCs were concentrated in the area where the ditch formed by the surface expression of groundwater enters the lake. Data from drive point well samples indicated that groundwater containing chlorinated VOCs is present just below the lake bottom. At these locations, water elevations of the lake and within the drive points

indicated an upwelling of groundwater into the lake. The results of this FFI indicated that contaminated groundwater appeared to be the source of VOCs detected in Lake Druid.

In March and April 1997, a focused source confirmation investigation was conducted to confirm whether or not the area around a surge tank at the northwest corner of Building 1100 was a primary source of groundwater contamination. The investigation concentrated on the area upgradient of the surge tank, under the former laundry facility itself. The TerraProbeSM was used to collect groundwater and subsurface soil samples. In general, soil VOC concentrations decreased with depth. The highest groundwater VOC concentrations were detected under the former laundry facility, between the laundry and the surge tank, and northeast (upgradient) of the laundry at one location. PCE and TCE were found at concentrations in the 1 to 3 milligrams per liter range at several locations. These results suggested a strong possibility that a source area of residual nonaqueous-phase liquid (NAPL) is present beneath the former laundry facility, possibly at more than one location. The residual PCE below the former laundry facility is thought to occur as relatively immobile ganglia (or stringers), which dissolve into passing groundwater. As groundwater flows toward Lake Druid, PCE degrades to TCE and *cis*-1,2-DCE. A site conceptual model (SCM) was developed, and identified a plume of chlorinated solvent-contaminated groundwater originating from the area around Building 1100 and migrating through the surficial aquifer into Lake Druid, near the shoreline west of the building.

An Interim Remedial Action (IRA) for groundwater consisting of two *in situ* stripping recirculation wells installed within the VOC plume was implemented to intercept and treat most of the contaminated groundwater before it reaches Lake Druid. The objective of the IRA is to contain and control groundwater containing VOCs upgradient of the lake, through the use of recirculating well stripping technology. Groundwater is pumped into each recirculating well, aerated within the well chamber (volatilizing the VOCs and thereby reducing VOC concentrations), and then discharged. Due to overwhelming operation and maintenance (O&M) problems, the recirculating wells have been replaced by extraction wells to maintain the IRA objective.

This RI was conducted in order to characterize areas of OU 4 that were represented as data gaps in the site conceptual model (SCM). These data gaps were addressed through further characterization of groundwater contamination located upgradient and cross-gradient of the main source area(s), determination of the potential for off-site migration north of OU 4, and characterization of contaminated soils. These results were to be used to define the nature and distribution of contaminants at OU 4, identify potential threats to public health or the environment, and, ultimately, evaluate potential remedial alternatives. A work plan for the RI and subsequent feasibility study (FS) was written and finalized by HLA in October 1997. The work plan was developed in conjunction with and approved by the Orlando Partnering Team (OPT).

The RI field investigation included the following components: installation and sampling of 11 monitoring wells and 5 microwells, sampling of 24 existing monitoring wells and 5 drive points, collection of 11 surface soil samples and 20 subsurface soil samples, collection of 11 surface water and sediment samples, aquifer characterization, an ecological survey, and a location and elevation survey. The field investigation was conducted between September 1997 and March 1998.

Results of RI sampling and analyses indicated that analytes detected at three surface soil sample locations were at concentrations above FDEP Residential Soil Cleanup Target Levels (SCTLs; FDEP, 1999): sample locations U4S011 (arsenic), U4S006 (polynuclear aromatic hydrocarbons [PAHs] and polychlorinated biphenyls [PCBs]), and U4S015 (PAHs). In May 1999, the Environmental Detachment, Charleston (DET) of the Supervisor of Shipbuilding, Conversion and Repair, USN (SUPSHIP) Portsmouth, Virginia, conducted a surface soil IRA at OU 4 that involved the excavation of three areas associated with the surface soil sample locations. This IRA was undertaken to mitigate potential risks associated with exposure to analytes in surface soil. Each excavation measured 10 feet by 10 feet, and extended to a depth of 2 feet below land surface (bls). Confirmatory samples collected from the four sidewalls of each excavation indicated that elevated concentrations of arsenic, PAHs, and PCBs had been significantly reduced or completely eliminated. Each excavation area was backfilled with clean fill.

The contaminants of concern (COCs) at OU 4 are primarily PCE and its degradation products (TCE, *cis*-DCE, and VC) in groundwater, and in the surface water and sediment of Lake Druid. The highest concentrations of chlorinated solvents within the plume are believed to have already entered the lake.

Antimony was also detected in groundwater at SA 14. The affected area is limited, and the antimony does not appear to have migrated substantially during the last three years. Antimony concentrations in groundwater from several OU 4 monitoring wells have been measured twice: groundwater samples were collected in April 1995 and in February 1998. The antimony concentrations detected in samples from both sampling events were comparable.

Results of the human health risk assessment (HHRA) indicate that the cumulative risk associated with potential future residential exposure to surface soil, groundwater, surface water, and sediment at OU 4 is above the U.S. Environmental Protection Agency (USEPA) acceptable cancer risk range and the FDEP target level of concern. This risk is primarily due to chlorinated VOCs in groundwater. The estimated lifetime cancer risk at OU 4 associated with potential exposures to soil, groundwater, and surface water did exceed Florida's target cancer risk level of concern of 1×10^{-6} .

Risks to terrestrial, aquatic, and semi-aquatic receptors based on exposure to contaminants in surface soil, groundwater, surface water, and sediment at OU 4 were evaluated in the ecological risk assessment (ERA). Potential sublethal risks were identified for terrestrial plants and wildlife exposed to surface soil at OU 4, primarily due to aluminum, lead, silver, vanadium, and zinc. Potential sublethal risks were also identified for certain aquatic and semi-aquatic organisms exposed to surface water and sediment at OU 4. Pelagic aquatic organisms are not at risk from exposure to chlorinated VOCs in groundwater.

Because the results of the RI indicate that risks to human health and the environment are present at OU 4, a feasibility study will be prepared for the OU. The FS will evaluate potential remedial alternatives based on engineering factors, implementability, environmental and public health concerns, and costs. The results of the FS will be presented in the FS report.

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GLOSSARY

ABB-ES	ABB Environmental Services, Inc.
ACOE	Army Corps of Engineers
AQUIRE	Aquatic Information Retrieval
AST	aboveground storage tank
atm-m ³ /mol	atmosphere - cubic meters per mole
AWQC	ambient water quality criteria
BAF	bioaccumulation factor
BCF	bioconcentration factor
BEI	Bechtel Environmental, Inc.
BHC	benzene hexachloride
bls	below land surface
BRAC	Base Realignment and Closure (Act)
°C	degrees Celsius
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
cm/sec	centimeters per second
CNS	central nervous system
COC	contaminant of concern
COPC	chemical of potential concern
cPAH	carcinogenic polynuclear aromatic hydrocarbons
CRQL	contract-required quantitation limit
CSF	cancer slope factor
CT	central tendency
DCE	dichloroethene
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethene
DDT	dichlorodiphenyltrichloroethane
DOD	Department of Defense
DPT	direct-push technology
DQO	data quality objective
DRMO	Defense Reutilization and Marketing Office
EBS	environmental baseline survey
ECPC	ecological chemical of potential concern
ELCR	excess lifetime cancer risk
EPC	exposure point concentration
ERA	ecological risk assessment
ER-L	effects range-low
ER-M	effects range-medium
ERED	Environmental Residue-Effects Database
°F	degrees Fahrenheit
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FFI	Focused Field Investigation
FID	flame ionization detector

GLOSSARY (Continued)

FNAI	Florida Natural Areas Inventory
FS	feasibility study
ft/day	feet per day
ft ² /day	square feet per day
ft/ft	feet per foot
ft/yr	feet per year
GC	gas chromatograph
GCTL	groundwater cleanup target level
GPR	ground-penetrating radar
GPS	global positioning system
HEAST	Health Effects Assessment Summary Tables (published document)
HHRA	human health risk assessment
HI	hazard index
HLA	Harding Lawson Associates
HQ	hazard quotient
HSA	hollow-stem auger
IAS	initial assessment study
IR	Installation Restoration
IRA	Interim Remedial Action
IRIS	Integrated Risk Information System
LEL	lowest effect level
LOAEL	lowest observed adverse effects level
LOEC	Lowest Observed Effect Concentrations
MDL	method detection limit
MCL	maximum contaminant level
msl	mean sea level
mg/kg	milligrams per kilogram
mg/kg-day	milligrams per kilogram per day
ml/g	milliliters per gram
μg/kg	micrograms per kilogram
μg/l	micrograms per liter
NACIP	Navy Assessment and Control of Installation Pollutants
NAPL	nonaqueous-phase liquid
NFESC	Naval Facilities Engineering Service Center
NOAA	National Oceanic and Atmospheric Administration
NOAEL	no observable adverse effect level
NOEC	no observed effect concentration
NTC	Naval Training Center
OAFB	Orlando Air Force Base
OME	Ontario Ministry of the Environment
OPT	Orlando Partnering Team
OU	operable unit
PA	preliminary assessment

GLOSSARY (Continued)

PAH	polynuclear aromatic hydrocarbons
PARCC	precision, accuracy, representativeness, completeness, and comparability
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PDE	potential dietary exposure
PEF	particulate emission factor
POP	project operations plan
ppb	parts per billion
PRE	preliminary risk evaluation
PVC	polyvinyl chloride
QC	quality control
RBC	risk-based concentrations
RfC	reference concentration
RfD	reference dose
RGO	remedial goal option
RI	remedial investigation
RI/FS	remedial investigation and feasibility study
RME	reasonable maximum exposure
RPD	relative percent difference
RTECS	Registry of Toxic Effects of Chemical Substances
RTV	reference toxicity value
SA	study area
SBP	SBP Technologies, Inc.
SCM	site conceptual model
SCTL	soil cleanup target level
SFF	site foraging frequency
SI	site inspection
SOUTHNAV- FACENCOM	Southern Division, Naval Facilities Engineering Command
SQG	sediment quality guideline
SQL	sample quantitation limit
SVOC	semivolatile organic compound
SWCTL	surface water cleanup target level
TAL	target analyte list
TCE	trichloroethene
TCL	target compound list
TEF	toxicity equivalence factor
TOC	total organic carbon
TPH	total petroleum hydrocarbons
UCL	upper confidence limit
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VC	vinyl chloride
VOC	volatile organic compound

CHAPTER 1.0

1.0 INTRODUCTION

Harding Lawson Associates (HLA), under contract to Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), has prepared this Remedial Investigation (RI) Report for Operable Unit (OU) 4 at the Naval Training Center (NTC) in Orlando, Florida (shown on Figure 1-1). OU 4 is located within Area C of the NTC, and includes Study Area (SA) 12 (Defense Reutilization and Marketing Office [DRMO] Warehouses and Salvage Yard), SA 13 (former base laundry and drycleaning facility), and SA 14 (DRMO Storage Area). The RI was conducted under Contract Number N62467-89-D-0317-135. This RI report incorporates responses to comments received from the Florida Department of Environmental Protection (FDEP) and the U.S. Environmental Protection Agency (USEPA) (Appendix R).

The approach to the RI at OU 4 was developed with guidance from the Orlando Partnering Team (OPT), which includes representatives from FDEP, USEPA Region IV, and SOUTHNAVFACENGCOM and their consultants.

The following sections describe the regulatory and facility background for NTC, Orlando, and outline the organization of the report.

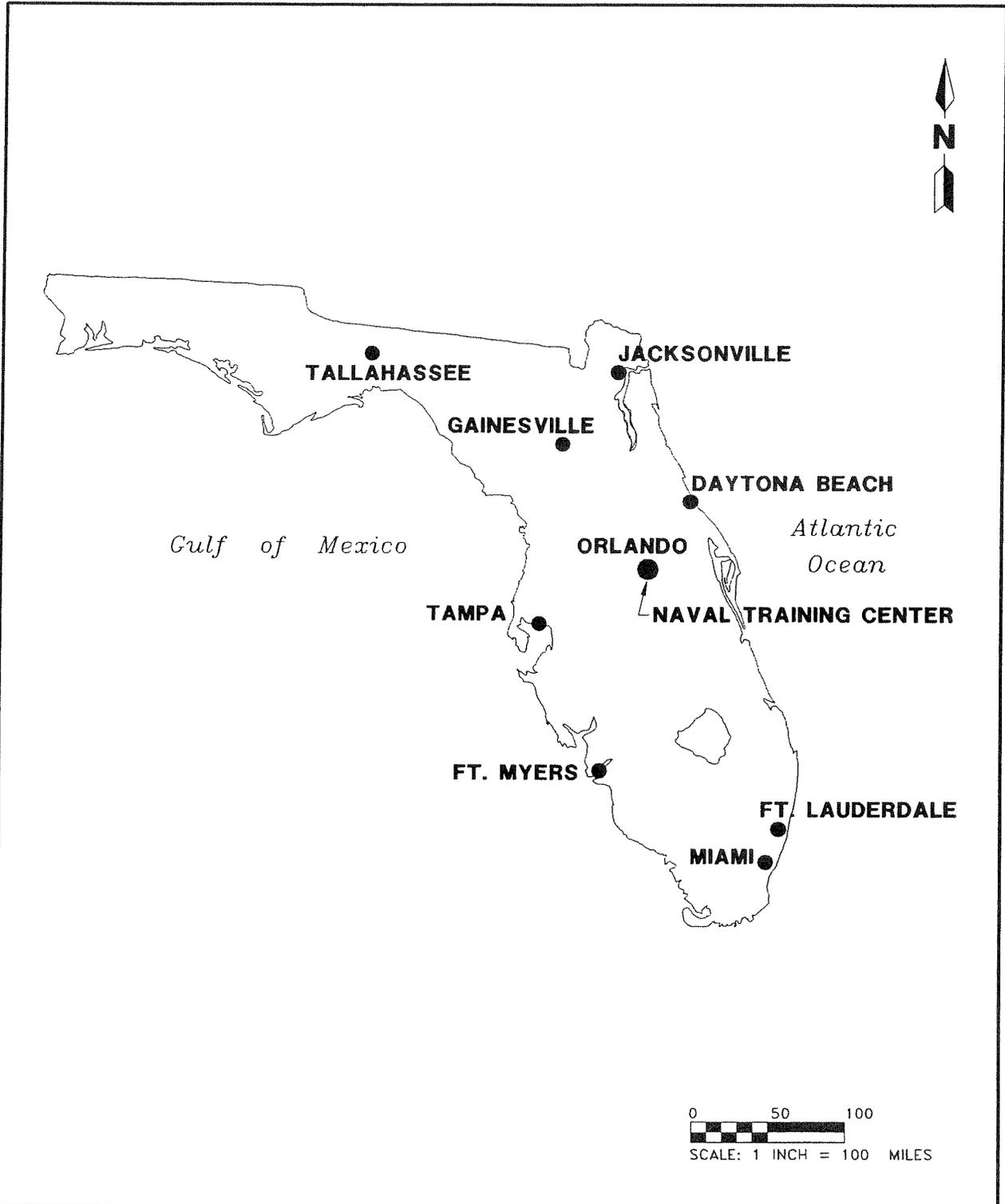
1.1 REGULATORY BACKGROUND. To meet its mission objectives, the U.S. Navy performs a variety of operations, some of which require the use, handling, storage, or disposal of hazardous materials. Because of accidental spills and leaks and past conventional methods of disposal, hazardous materials may have entered the environment in ways unacceptable by today's standards. As knowledge of the long-term effects of hazardous materials on the environment has grown, the Department of Defense (DOD) has initiated various programs to investigate and remediate conditions related to suspected past releases of hazardous materials at DOD facilities. Two of these programs are the Installation Restoration (IR) program and the Base Realignment and Closure (BRAC) program.

The IR program complies with the Base Closure and Realignment Act of 1988 (Public Law 100-526, 102 Statute 2623) and the Defense Base Closure and Realignment Act of 1990 (Public Law 101-510, 104 Statute [1808]), which require the DOD to observe pertinent environmental legal provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Executive Order 12580, as well as the statutory provisions of the Defense Environmental Restoration Program, the National Environmental Policy Act, and any other applicable statutes that protect natural and cultural resources.

Originally, the Navy's part of the IR program was called the Navy Assessment and Control of Installation Pollutants (NACIP) program. Early reports reflect the NACIP process and terminology. The Navy eventually adopted the program structure and terminology of the standard IR program.

The IR program is conducted in several stages, as listed below.

- Preliminary Assessment (PA)
- Site inspection (SI) (under the NACIP program, the PA and SI steps were together called the Initial Assessment Study [IAS])



**FIGURE 1-1
VICINITY MAP**



**REMEDIAL INVESTIGATION
OPERABLE UNIT 4**

**NAVAL TRAINING CENTER
ORLANDO, FLORIDA**

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- Remedial Investigation and Feasibility Study (RI/FS)
- Record of Decision
- Remedial Design and Remedial Action.

The goal of the BRAC program is to expedite and improve environmental response actions to facilitate the disposal and reuse of a BRAC installation, while protecting human health and the environment.

Several investigations have been performed at the NTC, Orlando, to assess and characterize potential contamination at the facility. These include an IAS (C.C. Johnson, 1985) and a subsequent Verification Study (Geraghty & Miller, 1986). Under BRAC, the following investigations have been completed: an Environmental Baseline Survey (EBS) (ABB Environmental Services, Inc. [ABB-ES], 1994a), a Site Screening Report (ABB-ES, 1996a), Lake Druid surface water and sediment sampling (ABB-ES, 1997f), SA 13 groundwater delineation (ABB-ES, 1997f), a Focused Field Investigation (FFI) (ABB-ES, 1997f), a pumping test (ABB-ES, 1996d), a Focused Source Investigation (ABB-ES, 1997a), an Interim Remedial Action (IRA) to address contaminants in surface soil, and an ongoing groundwater IRA Performance Monitoring program.

To facilitate their assessment, sites identified as part of the IR program at NTC, Orlando have been combined into groups known as OUs. An OU is composed of sites that are in close proximity to each other, have similar contaminant exposure histories, and/or will likely require similar remedial measures.

The OU 4 RI was conducted in accordance with the methods described in USEPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988a), with the following objectives:

- determine the nature and distribution of contaminants at the site;
- identify potential threats to public health or the environment posed by the potential release of contaminants from the site; and
- as part of the feasibility study (FS), evaluate potential remedial alternatives based on engineering factors, ability to be implemented, environmental and public health concerns, and costs.

Through rapid data acquisition and analysis, the RI program was designed to be as efficient and streamlined as possible. Because it is not possible to completely characterize a site using even a very large number of explorations and chemical analyses, the approach taken was to sufficiently characterize the site using a limited number of explorations and analyses that permitted the development and refinement of a conceptual model. Reasonable conclusions were drawn from the data and were used to formulate a working hypothesis, which will evolve and grow along with increased knowledge.

To support decisions made as a result of this investigation, data have been acquired that will support a human health risk assessment (HHRA), an ecological risk assessment (ERA), and an FS. This RI report presents the results of these investigations.

1.2 FACILITY BACKGROUND. NTC, Orlando is situated in central Florida, in the Orlando, Orange County, area (Figure 1-2). The NTC, Orlando encompasses 2,072 acres and consists of four discrete facilities: Main Base, Area C, Herndon Annex, and McCoy Annex (Figure 1-2). The Main Base occupies 1,095 acres, and is located north of State Road 50, approximately 3 miles east of Interstate 4. Area C occupies 45.8 acres, and is located approximately 1 mile west of the Main Base off Maguire Boulevard. Herndon Annex (approximately 54 acres) is located 1.5 miles south of the Main Base, adjacent to the city of Orlando's Herndon Executive Airport. McCoy Annex (826 acres) is approximately 12 miles south of the Main Base, adjacent to the city of Orlando's International Airport.

OU 4, the subject of this report, is located within Area C. The following background information focuses on this part of NTC, Orlando. Further discussions of Area C, Herndon Annex, and McCoy Annex may be found in the Project Operations Plan (POP) (ABB-ES, 1997b).

1.2.1 Facility History The history of NTC, Orlando begins with the construction of the original Orlando Municipal Airport prior to 1940. In August 1940, the U.S. Army Air Corps (predecessor of the U.S. Air Force) took over the municipal airport and began construction of its Orlando Air Base, which officially opened on December 1, 1940. During the following two years, the Army Air Corps acquired additional property and built auxiliary landing fields in the surrounding area.

The U.S. Army Air Corps conducted operations at the Main Base and Area C from 1940 until 1947, at which time the U.S. Air Force assumed command of the facilities as the Orlando Air Force Base (OAFB). The base was deactivated on October 28, 1949, and remained on standby status until January 1, 1951, when it was reactivated as an Aviation Engineers' training site. Other Air Force units arrived, and the Military Airlift Command assumed full jurisdiction of the base in 1953.

The Navy began moving its Training Device Center from Port Washington, New York, to OAFB on September 15, 1965, and finished the move in June 1967. In 1968, the Air Force ceased operations at OAFB, Area C, and Herndon Annex. The property was commissioned as NTC, Orlando on July 1, 1968.

1.2.2 Facility Description and Conditions The following paragraphs address operations and surrounding land use for Area C. These operations frequently change, as various portions of NTC, Orlando gradually phase out activities.

1.2.2.1 Facility Operations The stated mission of NTC, Orlando was to exercise command over, and coordinate the efforts of, the assigned subordinate activities in recruit training of enlisted personnel; provide initial skill, advanced, and/or specialized training for officer and enlisted personnel of the regular Navy and Naval Reserve; and to support other activities as directed by a higher authority (ABB-ES, 1996c).

Area C (shown on Figure 1-3) served as a supply center for NTC, Orlando and includes a former laundry and dry-cleaning facility, and the DRMO. The laundry and drycleaning facility closed in the fall of 1994.

1.2.2.2 Adjacent Land Use Area C is surrounded by urban development, including single- and multifamily residential developments to the north and south, Lake Druid to the west, and an office park to the east. Lake Druid is approximately

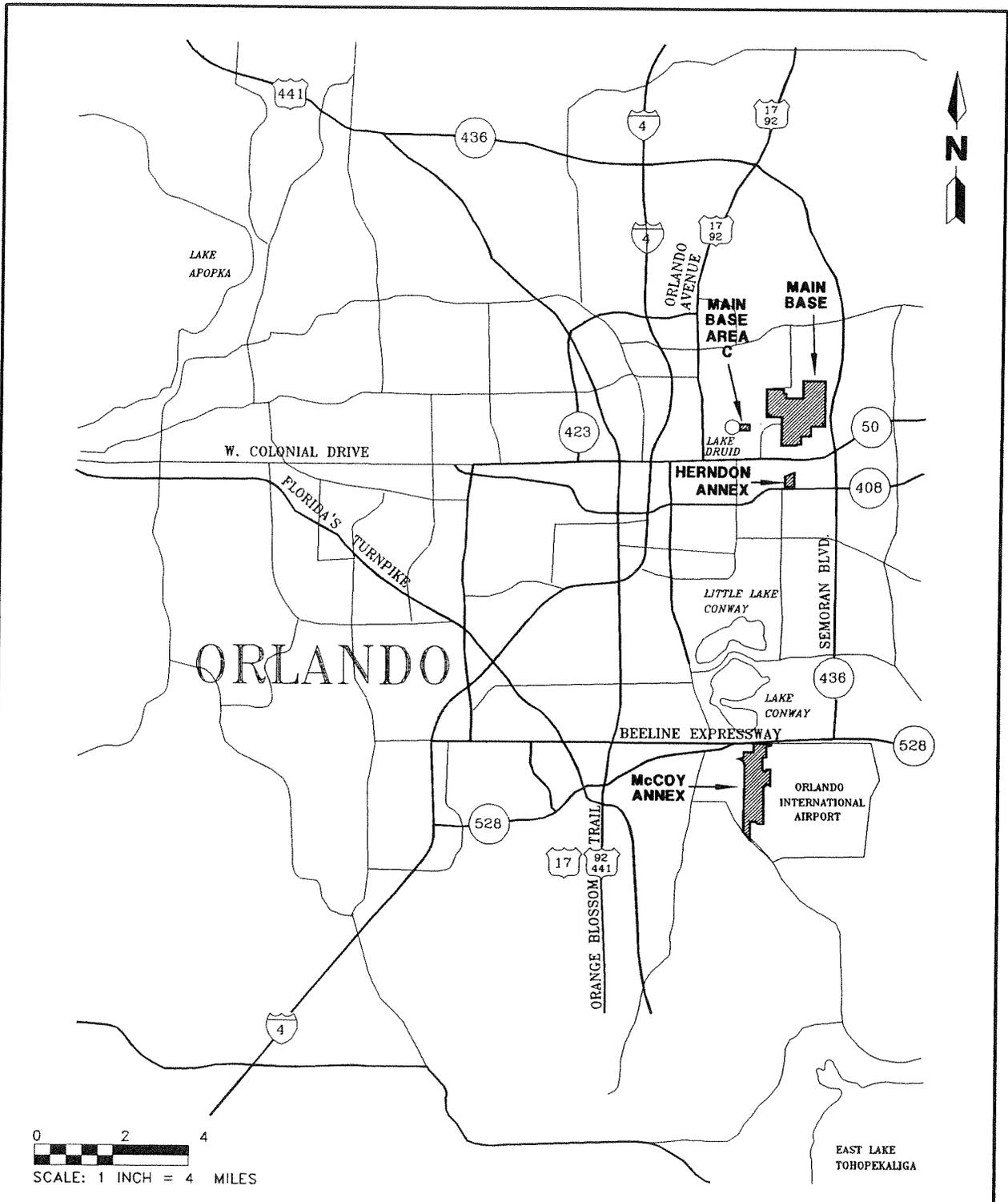
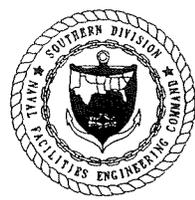


FIGURE 1-2
NAVAL TRAINING CENTER, ORLANDO
SITE LOCATION MAP



REMEDIAL INVESTIGATION
OPERABLE UNIT 4

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

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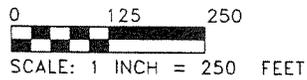
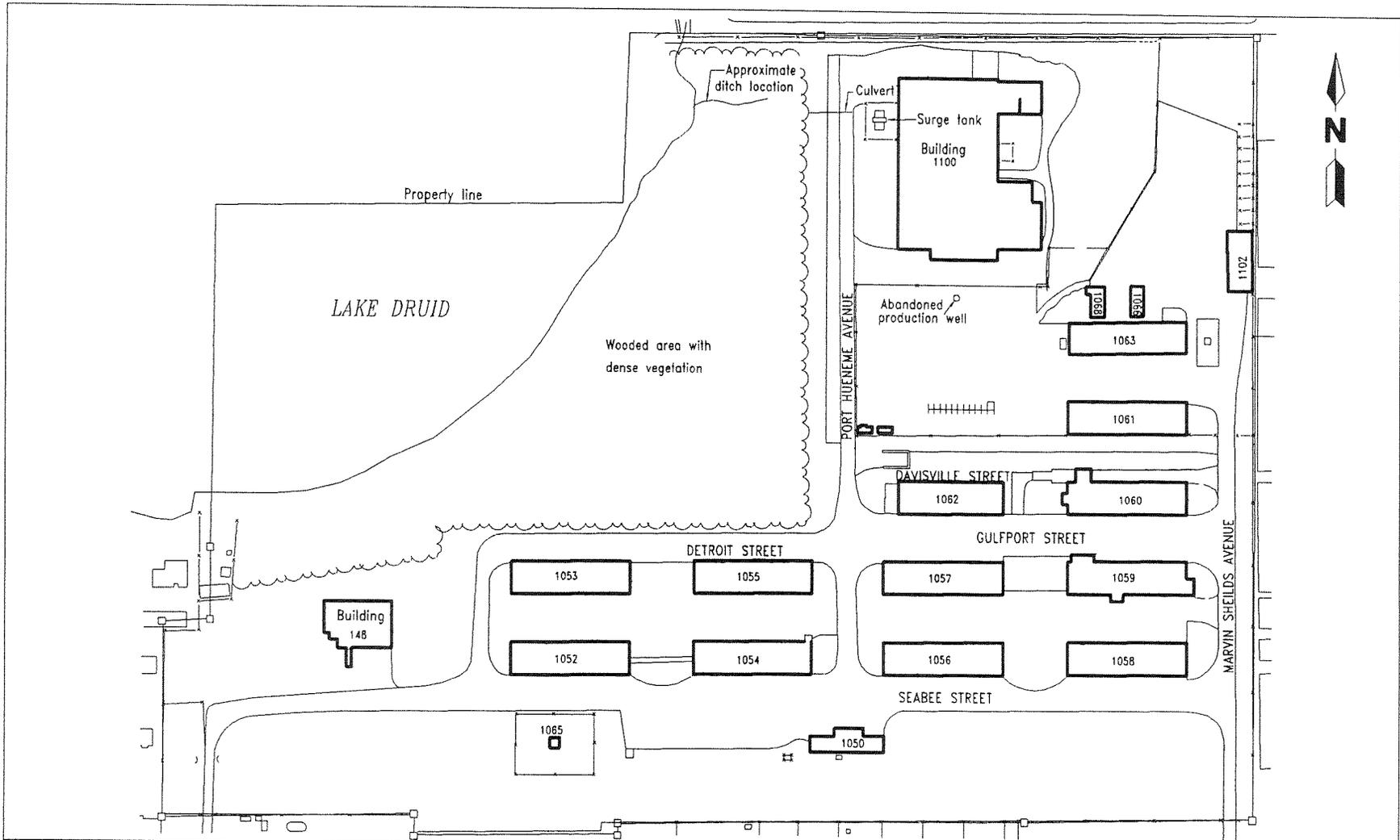


FIGURE 1-3
MAP OF AREA C



REMEDIAL INVESTIGATION
OPERABLE UNIT 4

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

300 feet west of Port Hueneme Avenue. It is semicircular in shape, with a maximum length of approximately 1,260 feet and a width of 860 feet. Approximately one-third of the lake is surrounded by undeveloped land to the east, owned by NTC, Orlando. It is mostly forested, and the shoreline is thick with floating emergent plants. The remainder of the lake is surrounded by approximately 3/4-acre residential properties.

There are no industrial facilities adjacent to Area C. According to City of Orlando records, no permitted irrigation or domestic wells are present within the vicinity of OU 4. Similarly, there are no production wells within 1/2 mile of OU 4.

1.3 REPORT SCOPE AND ORGANIZATION. The format and content of this RI report are summarized below.

- Chapter 1.0 has provided an introduction to the RI process, with a summary of the site history and regulatory background, and this description of the components of the report.
- Chapter 2.0 gives an overview of the site conceptual model (SCM), and summarizes previous investigations at SAs 12, 13, and 14.
- Chapter 3.0 describes the physical setting of the site, including its physiography, climate, geology, hydrogeology, demography, and ecological setting.
- Chapter 4.0 describes the procedures used in data management.
- Chapter 5.0 summarizes the nature and extent of contamination in surface and subsurface soil, groundwater, surface water, and sediment at OU 4.
- Chapter 6.0 presents the revised SCM, based on results of the RI field investigation.
- Chapter 7.0 evaluates the fate and transport of contaminants.
- Chapter 8.0 describes the HHRA.
- Chapter 9.0 describes the ERA.
- Chapter 10.0 summarizes the results and findings developed during this RI.

Appendices are also included to support these chapters. These are

- Appendix A, Summary of Analytical Detections, OU 4 Previous Investigations;
- Appendix B, Previous Investigation Figures;
- Appendix C, Laboratory Positive Detection Tables;
- Appendix D, Complete Laboratory Analytical Results;
- Appendix E, Human Health Risk Assessment;
- Appendix F, Ecological Risk Assessment;

- Appendix G, Soil Boring Logs;
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- Appendix L, Groundwater Plume Contouring;
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- Appendix N, PARCC Report;
- Appendix O, Geostatistics Summary;
- Appendix P, Memoranda re: Lake Druid PAHs; and
- Appendix Q, Fate and Transport Modeling
- Appendix R, Responses to Project Review Comments.

CHAPTER 2.0

2.0 SITE BACKGROUND AND SETTING

As stated in Chapter 1.0, OU 4 is located within Area C and includes SA 12 (DRMO Warehouses and Salvage Yard), SA 13 (Former Base Laundry and Dry-cleaning Facility), and SA 14 (DRMO Storage Area). This chapter presents the site background and physical setting, and includes the results of IR program investigations conducted to date at OU 4.

2.1 HYDROGEOLOGIC SETTING. This section discusses the hydrogeologic framework for the area of NTC, Orlando, providing a general characterization of the major lithologic units and aquifers at NTC, Orlando along with a summary of available documented information for OU 4, Area C. Chapter 3.0 contains a detailed discussion of the regional and local physical characteristics (topography, geology, hydrogeology, soil, and surface water hydrology) of NTC, Orlando. A conceptual framework of the hydrogeologic setting, as it applies to the evaluation of contaminant migration in groundwater, is summarized below. Additional geologic and hydrogeologic information is provided in Chapter 3.0.

Three major lithologic units underlie NTC, Orlando: (1) the surficial sands and clays of Holocene and Pleistocene age; (2) the clays, sands, and carbonates of the Hawthorn Group (Miocene); and (3) the underlying Eocene carbonates of the Ocala, Avon Park, and Lake City Limestones. Three principal aquifers correspond to these lithologic units: (1) the surficial aquifer, (2) an intermediate aquifer and confining zone within the Hawthorn Group (formerly referred to as the secondary artesian aquifer), and (3) the Floridan aquifer system.

The sediments of the Hawthorn Group contain the intermediate aquifer (which may have more than one water-producing zone), and act as a confining unit for the Floridan aquifer system. The Hawthorn Group acts as a lower aquitard for the surficial aquifer by impeding the downward migration of groundwater, and as an upper aquitard for the Floridan aquifer system (causing it to be confined or semiconfined). The Hawthorn Group is 80 to 100 feet thick on the eastern side of Orlando, as shown in geologic cross sections by Lichtler and others (1968).

The net hydrogeological effect of the Hawthorn Group in the NTC, Orlando area is to restrict the vertical flow of groundwater in the surficial aquifer, causing the primary direction of groundwater flow to be horizontal. This is important in the consideration of the potential transport of contaminants in groundwater. Horizontal flow in the surficial aquifer is prevalent in the northern and central parts of Florida where the Hawthorn Group is present. The potential does exist in the NTC, Orlando area for groundwater to migrate vertically into the intermediate aquifer and eventually into the Floridan aquifer system, depending on the elevation of the potentiometric surface for these two lower aquifers relative to the elevation of the water table. However, the low vertical permeability of the clayey Hawthorn Group sediments would result in extremely slow vertical flow rates (i.e., long travel times) relative to horizontal flow rates in the surficial aquifer.

For these reasons, the primary unit of hydrogeologic interest to the investigation of potential groundwater contamination at OU 4 is the surficial aquifer. The Holocene and Pleistocene unit that contains the surficial aquifer is primarily composed of sand with varying amounts of silt and clay. On the eastern

side of Orlando, this unit ranges in thickness from approximately 60 to 90 feet, based on the geologic cross sections presented by Lichtler and others (1968). As discussed above, groundwater flow in the surficial aquifer is generally horizontal, and follows the topography to the nearest surface water body or drainage ditch that intersects the water table.

In the vicinity of OU 4, groundwater flow (following topography) travels westerly from the study areas toward Lake Druid. Potentiometric data collected in January 1997 and subsequent water-level measurement events confirm this westerly flow direction (see Paragraph 3.6.3.1). The aquifer matrix is relatively homogeneous, composed of fine sand interbedded with silty and/or clayey fine sand.

The soil density of the surficial aquifer typically ranges from medium dense to dense, with the exception of a very dense, hard layer approximately 15 feet below land surface (bls), with varying thickness averaging about 5 feet. No stratum has been identified that would act as a hydraulic or chemical confining layer or barrier. For these reasons, the conceptual understanding of groundwater flow at OU 4 assumes that the entire thickness of the surficial sand unit is available for the potential transport of contaminants in the surficial aquifer.

This conceptual understanding formed the basis on which the RI groundwater investigation was planned.

- The aquifer of primary interest to the groundwater investigation at OU 4 is the surficial aquifer.
- Groundwater flow in the surficial aquifer is primarily horizontal and flows westerly toward Lake Druid.
- The entire thickness of the surficial sand (from the water table to the top of the Hawthorn Group) is available for the potential transport of contaminants, and was assessed during the investigation.

2.2 SITE BACKGROUND AND CONDITIONS. The first phase of the IR program at NTC, Orlando was an IAS conducted in 1985 by C.C. Johnson. This assessment included an archives search and site walkovers at the four main facilities of NTC, Orlando (Main Base, Area C, Herndon Annex, and McCoy Annex). The study identified nine potentially contaminated sites, including one such site at Area C, an old boiler building used for the laundry facility. The boilers were constructed in the early 1940s and removed in 1972. The building that housed the boilers was partially demolished in 1979, and completely removed in the mid-1980s. The IAS did not include this site as one of the five sites identified basewide for further study.

A Verification Study performed in 1986 by Geraghty & Miller did not include any sites at Area C.

In 1994, HLA (then ABB-ES) prepared an EBS for NTC, Orlando (ABB-ES, 1994). The purpose of the EBS was to determine whether or not each installation property is suitable for lease or transfer. If eligible, properties were issued a Finding of Suitability to Lease or a Finding of Suitability to Transfer. SAs 12, 13, and 14 were evaluated as part of the EBS. Potential areas of environmental concern identified in the EBS are discussed below.

2.2.1 SA 12, Background and Conditions SA 12 includes DRMO warehouses (Buildings 1061 and 1063), the salvage yard, and the truck scales (Facility 1069). These buildings are located on Port Hueneme Avenue, in the north-central portion of Area C (Figure 2-1). The warehouse buildings were originally constructed in the early 1940s. Site use as a salvage, scrap, and disposal yard has reportedly remained consistent throughout its history. Based on a review of aerial photographs, Building 1063 originally occupied approximately one-half the footprint of the current structure. This original warehouse was destroyed by fire in 1962, and was replaced in 1963 by the current building. The newer warehouse is constructed of sheet metal walls and roof (known as a "Butler" building) on a concrete slab, and has 9,600 square feet of floor space and steel racks for storing salvage materials. There is a flammables storage locker on the western side of the building. To the east of the building is the truck scale (Facility 1069), which consists of a concrete slab on a weighing mechanism.

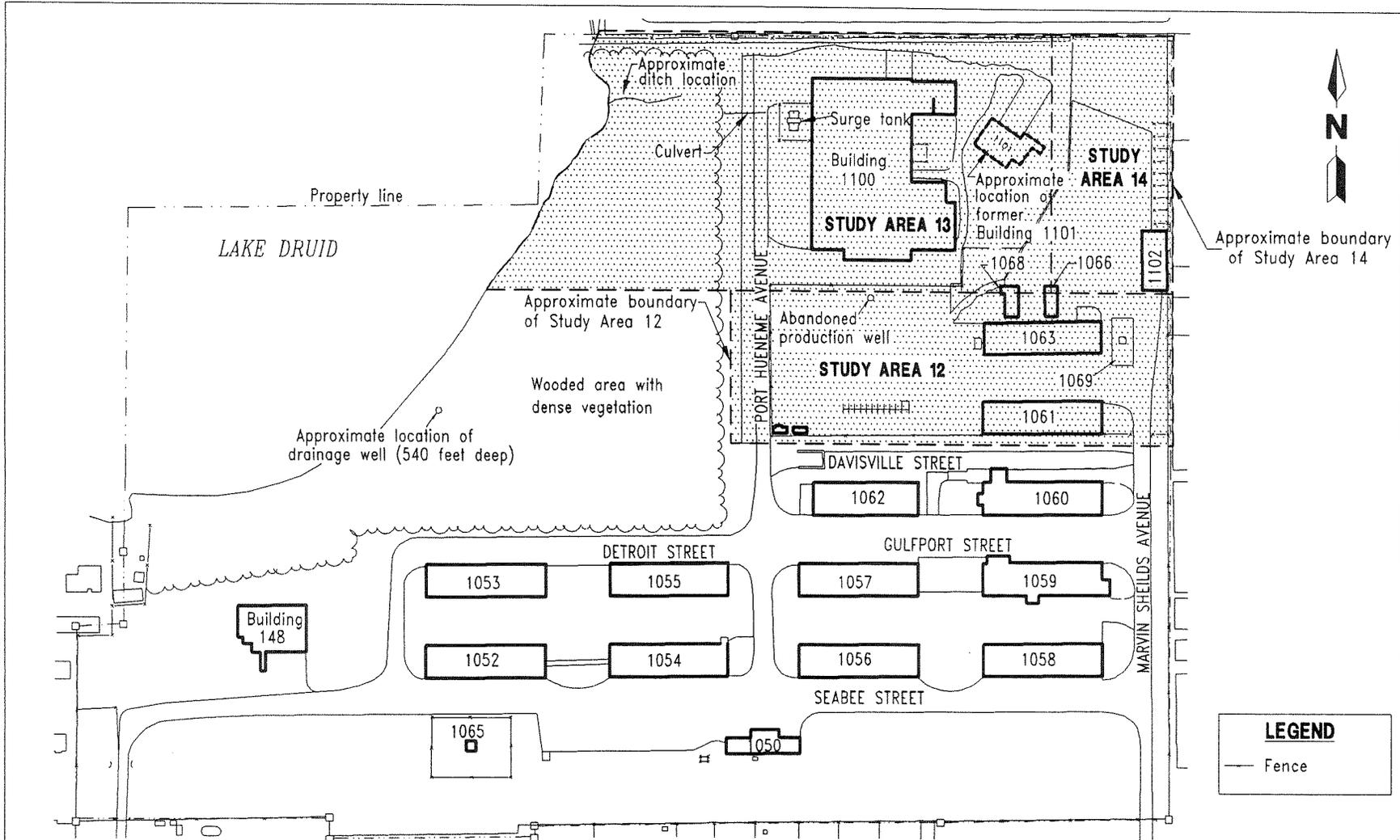
The asphalt-paved salvage yard, located west of the warehouse, is occupied by rows of salvage scrap materials, concrete storage bins, and a drum storage area. There is also a transformer carcass storage area formerly in the southwest corner of the study area. Salvage scrap items are currently stored in this area, including desks, wheels, vehicles, transformers, and fencing. It is not known how long this area has been paved.

Historical records indicate that this area was used to store small quantities (1 to 5 gallons) of hazardous waste between 1959 and 1985. These wastes were stored in the southwest corner of the salvage lot, and included the following: paints, insecticides, asbestos, solvents (including trichloroethene [TCE] and methyl-ethyl ketone), ammonium hydroxide, sodium sulfide, and mercury. A more detailed description of SA 12 can be found in the BRAC Site Screening Report (ABB-ES, 1996a).

2.2.2 SA 13, Background and Conditions Buildings 1100 and 1101 are located in the northern end of Area C at the intersection of Port Hueneme Avenue and Davisville Street (Figure 2-1). Building 1101, located east of Building 1100, was a boiler house that was partly demolished in 1979 and completely removed in the mid-1980s.

Building 1100 (Figure 2-2) is a single-story, wood-framed structure that occupies 54,916 square feet. Since its construction in 1943, it has been used as an industrial laundry and dry-cleaning facility that served the entire military base. The surrounding ground surface is paved with asphalt, except for small areas north, east, and west of the building that are landscaped and grass-covered. The paved areas around the perimeter of the building include roads and parking lots. Prior to construction of the facility, the land was undeveloped.

The IAS provided the following brief description of the former laundry processes. The U.S. Army Air Corps built the laundry facility sometime around 1941 for the purpose of cleaning all base personnel uniforms and clothing. An Orlando Army Air Base sewer drawing from 1946 indicates that a sanitary sewer connection was present at the laundry, presumably for disposal of laundry wastewater. Dry-cleaning machines were operated by the Air Force beginning as early as 1958, and possibly earlier. The Air Force operated the laundry facility until 1968, at which time the U.S. Navy took over operations.

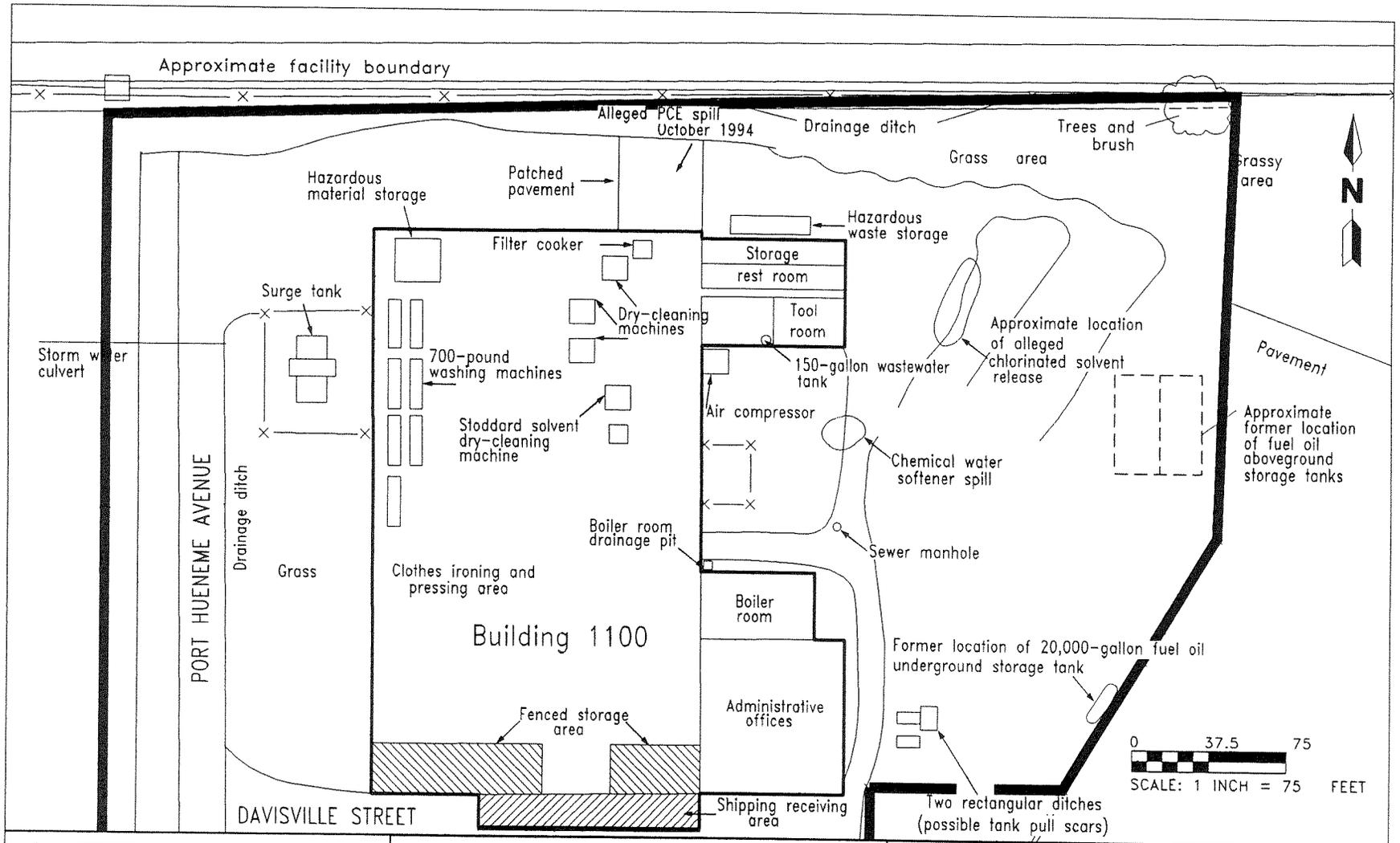


**FIGURE 2-1
LOCATION OF STUDY AREAS 12, 13 AND 14
AREA C**



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LEGEND
PCE Tetrachloroethene

**FIGURE 2-2
BUILDING 1100
FORMER LAUNDRY FACILITY**

Source: Environmental Baseline Survey (ABB-ES, 1994a)

K:\02545\02545-09\RV\02545548.DWG, VC-BB 03/03/00 09:24:37, ACD14



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0 37.5 75
SCALE: 1 INCH = 75 FEET

During Navy operation of the facility, all conventional wash water discharged to the sewer system via a surge tank/equalization basin (C.C. Johnson, 1985).

From 1958 to 1967, the dry-cleaning operations at Building 1100 generated approximately 25 gallons per month of tetrachloroethene (PCE) "still bottoms" for on-base disposal. "Still bottoms" or "stills" were a distillation by-product of solvent recovery common to early dry-cleaning operations. The still bottoms were allegedly disposed of in the North Grinder Landfill (OU 1). Diatomaceous earth filters removed soil from the solvent. The IAS reported that from 1958 to 1967, about 70 pounds of these filters were disposed of each week in the North Grinder Landfill. In the mid-1970s, paper filter cartridges replaced the earth filters. In 1984, cartridge strippers were added to remove PCE by using a steam technology. From 1968 to early 1985, the waste filters and still bottoms were placed in dumpsters and hauled off base by a waste disposal contractor. By 1985, all spent cartridges and still bottoms were handed over to the Defense Property Disposal Office, later referred to as the DRMO (C.C. Johnson, 1985).

The EBS reported several historical spills/releases, including the release of 20 gallons of PCE northeast of Building 1100, and a reported spill of 55 gallons of PCE on pavement along the north side of Building 1100 in October 1994 (ABB-ES, 1994).

A review of engineering drawings indicates that there may have been a production well located north of Area C, in what is now a condominium complex. According to U.S. Geological Survey (USGS) records, this production well was installed in February 1943 to supply water for the laundry facility. The well was completed to a depth of 828 feet, and was cased down to 360 feet. Aerial photographs from 1962 show no evidence of the well or the associated pump house. No well abandonment records have been found. The well location shown on the engineering drawing is currently under the footprint of one of the condominium buildings.

A second production well was also installed in February 1943 to supply the laundry. This well, which was located 75 feet south of the laundry, was 655 feet deep and cased down to 383 feet. In December 1995, representatives of the City of Orlando purged and sampled groundwater from this well. No volatile organic compounds (VOCs) were detected. The well was then properly abandoned by the St. John's Water Management District.

There is also a deep drainage well (over 500 feet deep) near the shore of Lake Druid, approximately 600 feet southwest of Building 1100 (Figure 2-1). This well was also installed in the 1940s, presumably to regulate the Lake Druid water level. Lake overflow is now directed to Lake Rowena via a weir constructed on the western bank of the lake, and the old drainage well is not in use. A trench that once connected the well structure to the lake is now bermed. Presently, the former drainage well is covered by a square, brick enclosure. In 1997 HLA personnel probed the well using a polyvinyl chloride (PVC) pipe, and encountered what appeared to be a concrete plug approximately 6 feet bls. This plug was interpreted as evidence that the drainage well had been abandoned, although no records of the abandonment have been located.

Laundry operations ceased in the fall of 1994, and the facility is currently inactive. All of the laundry and dry-cleaning equipment have been removed from the building.

A more detailed description of SA 13 can be found in the BRAC Site Screening Report (ABB-ES, 1996a).

2.2.3 SA 14, Background and Conditions SA 14 includes Building 1102 and the surrounding paved and grassy areas, and is located off Marvin Shields Avenue in the northeast portion of Area C (Figure 2-1). The area is used for indoor and outdoor storage of salvageable equipment and materials, in support of DRMO operations. The facility includes a rectangular, one-story corrugated steel building (3,840 square feet) constructed on a concrete slab with a gabled roof. The building was originally constructed in 1969. Prior to that time, the area between the base laundry facility (to the northwest) and the current structure was used as a scrap and salvage yard. The surrounding salvage yard is currently asphalt-paved. Equipment and materials reportedly stored at this location during the 1994 EBS include office furniture, mattresses, refrigerators, and dry-cleaning equipment (ABB-ES, 1994).

A documented release of 3 gallons of PCE from scrap dry-cleaning equipment occurred in 1989. Remediation included the removal and disposal of approximately 20 drums of contaminated soil and asphalt. However, the exact location of the release was not indicated (ABB-ES, 1994).

A more detailed description of SA 14 can be found in the BRAC Site Screening Report (ABB-ES, 1996a).

2.3 BRAC INVESTIGATIONS. BRAC investigations at Area C began with site screening. SAs 12, 13, and 14 were each evaluated separately, beginning in early 1995. The purpose of the site screening process was to either confirm that the sites were suitable for immediate transfer, or determine data needs for any additional investigations that may be required. All BRAC investigations conducted to date are summarized in Table 2-1. Figure 2-3 shows all site monitoring well locations. Groundwater contamination was detected in all three SAs, most notably in SA 13. Additional focused investigations were subsequently conducted at SA 13 to evaluate Lake Druid and identify the potential source(s) of VOCs detected in the lake. SAs 12, 13, and 14 were formally designated OU 4 in December 1995.

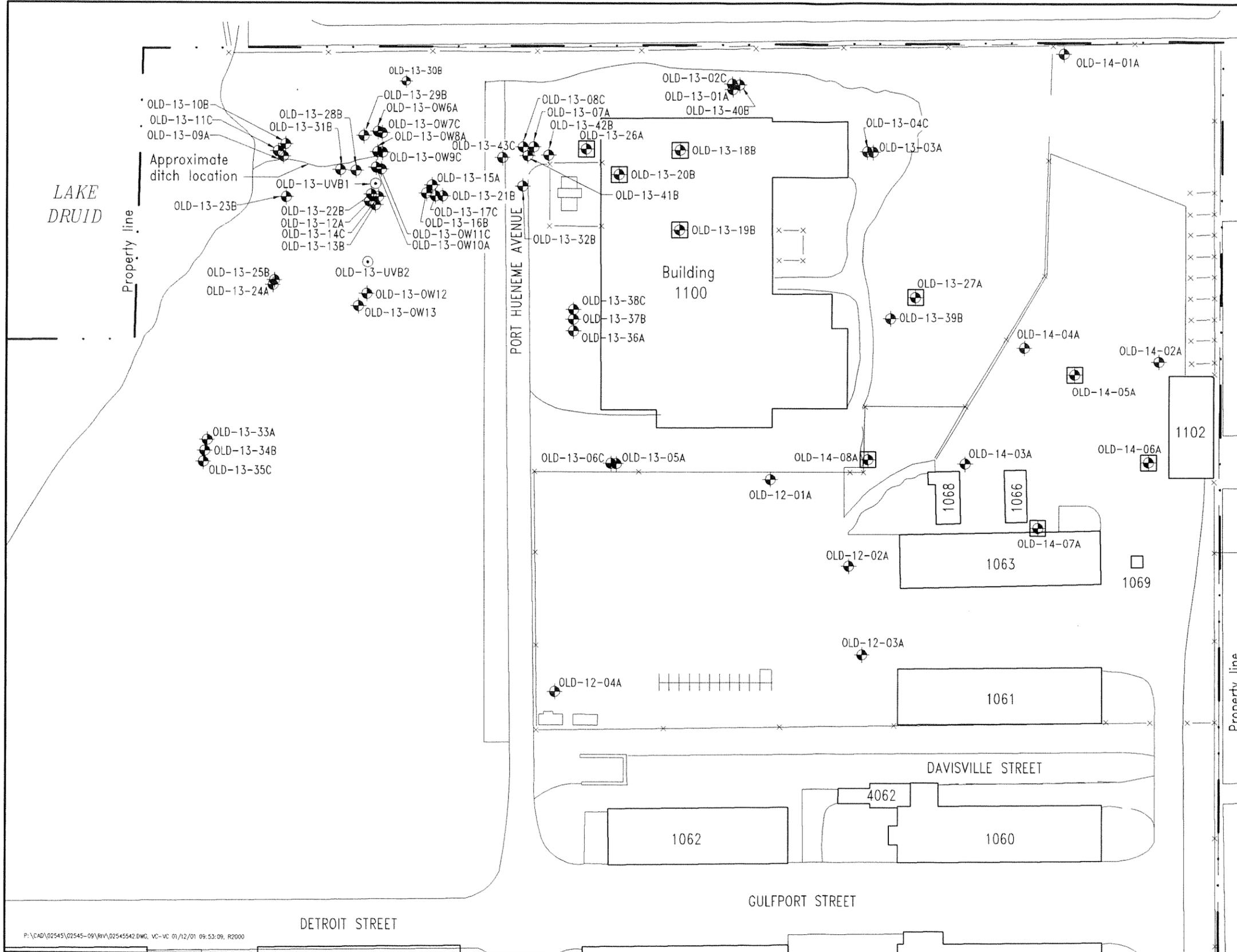
The site screening investigation at SAs 12, 13, and 14 was conducted from January to April 1995, and included a geophysical survey, a soil gas survey, surface and subsurface soil sampling, and the installation of 16 monitoring wells to evaluate groundwater. Twelve of the wells were installed to evaluate the shallow surficial aquifer, and the four remaining wells were installed in the immediate vicinity of the former laundry facility with screens that extend to the base of the surficial aquifer (approximately 60 feet bls). Saturated soil samples were collected approximately every 6 feet during installation of each deep well, and were analyzed for VOCs using a field gas chromatograph (GC). Combined with the shallow and deep groundwater sample data collected from the monitoring wells, the field GC data provided information about the entire thickness of the surficial aquifer. These results are summarized by study area in the following subsections.

2.3.1 SA 12, Investigation Summary and Results The site screening program for SA 12 included the collection and analysis of surface soil, subsurface soil, and groundwater samples at four locations. Four soil borings, 12B001 through 12B004,

**Table 2-1
 BRAC Investigations**

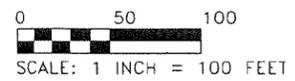
Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center
 Orlando, Florida

Investigation	Date	Techniques Employed	Report Reference
Site Screening at SAs 12, 13, and 14	January 1995 to April 1995	Geophysics, soil gas, surface and subsurface soil sampling. Shallow and deep groundwater sampling.	BRAC Environmental Site-Screening Report, NTC, Orlando, Florida, ABB-ES 1996a.
Lake Druid Sampling	December 1995	Surface water and sediment sampling.	Interim Remedial Action Focused Field Investigation Report OU 4, NTC, Orlando, Florida, ABB-ES 1997f.
SA 13 Groundwater Delineation	December 1995	Groundwater sampling via TerraProbe SM	Interim Remedial Action Focused Field Investigation Report OU 4, NTC, Orlando, Florida, ABB-ES 1997f.
OU 4 Focused Field Investigation	May 1996	Surface water, sediment, and groundwater sampling. TerraProbe SM , cone penetrometer, permanent wells.	Interim Remedial Action Focused Field Investigation Report OU 4, NTC, Orlando, Florida, ABB-ES 1997f.
OU 4 Pumping Test	August 1996	Eighteen-hour constant rate pumping test.	Letter Report, Pumping Test Implementation and Results, NTC, Orlando, Florida, ABB-ES 1996d.
OU 4 Focused Source Investigation	March-April 1997	Subsurface soil and groundwater sampling beneath laundry building using TerraProbe SM .	Technical Memorandum, Interim Remedial Action, Focused Investigation/Source Confirmation, Building 1100 Surge Tank, NTC, Orlando, Florida, ABB-ES 1997a.
OU 4 Interim Remedial Action Performance Monitoring Program	December 1997 - present	Recirculation well influent and effluent sampling, groundwater sampling.	OU 4 IRA, Performance Monitoring and Sampling Plan, Quarterly Reports #1, #2, #3, and #4, NTC, Orlando, Florida, ABB-ES, 1998a, HLA, 1999a, 1999b, 1999c.
Notes: BRAC = Base Realignment and Closure. RI/FS = remedial investigation and feasibility study. SA = study area. OU = operable unit. NTC = Naval Training Center. ABB-ES = ABB Environmental Services, Inc. SM = service mark.			



LEGEND

- OLD-13-10B Monitoring well location and designation
- OLD-13-27A Microwell location and designation
- OLD-13-UVB2 Interim remedial action recirculation well
- Fence



**FIGURE 2-3
WELL LOCATIONS**

**REMEDIAL INVESTIGATION
OPERABLE UNIT 4**

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were each advanced to a depth of 15 feet bls using hollow-stem augers (HSAs). Soil samples were collected at continuous two-foot intervals using a split-spoon sampler, and were field-screened for VOCs using a flame ionization detector (FID). Surface and subsurface soil samples, including one duplicate sample, were collected at each soil boring location. Surface soil samples were collected from immediately below the asphalt to 1 foot bls. Subsurface soil samples were collected from the interval immediately above the water table (at 4 to 6 feet bls). Each of the four soil borings was completed as a shallow monitoring well.

A complete set of soil and groundwater analytical results for SA 12 is presented in the Site Screening Report (ABB-ES, 1996a). Positive detections in soil are shown in Appendix A, Tables A-1 and A-2. Positive detections in groundwater are shown in Appendix A, Table A-3 and in Appendix B, Figure B-2. Groundwater analytical VOC results for all of OU 4 (SAs 12, 13, and 14) are also shown in Appendix B, Figure B-2. No compounds or analytes were detected in surface soil samples above screening criteria. PCE was detected in groundwater from monitoring well OLD-12-01A, at a concentration of 8 micrograms per liter ($\mu\text{g}/\ell$). TCE was also present at a concentration of 2 $\mu\text{g}/\ell$, below the FDEP maximum contaminant level (MCL) of 3 $\mu\text{g}/\ell$. A discussion of the results can be found in the Site Screening Report (ABB-ES, 1996a).

2.3.2 SA 13, Investigation Summary and Results The site screening investigations at SA 13 included a geophysics program, a passive soil gas survey, and the collection and analysis of subsurface soil and groundwater samples.

The geophysical program consisted of an initial vertical gradiometer (magnetometer) survey, followed by a confirmatory ground-penetrating radar (GPR) survey, which focused on anomalies identified by the magnetometer. The geophysical data did not define any areas requiring additional investigation or underground storage tanks.

Results of the soil gas survey indicated that the highest concentration of PCE was north of Building 1100, which is consistent with the documented release of dry-cleaning solvent in October 1994. The PCE detection northwest of Building 1100 corresponds to a location at which VOC concentrations in groundwater are among the highest detected at OU 4. The VOCs detected northeast of Building 1100 are in the vicinity of a reported release of chlorinated solvents.

Four nested pairs of groundwater monitoring wells were installed in the surficial aquifer at locations surrounding Building 1100 (Appendix B, Figure B-2). During well installation, deep and shallow soil borings were advanced using HSAs. Soil borings 13B001 through 13B008 correspond to monitoring well locations OLD-13-01 through OLD-13-08, respectively. Soil samples were collected continuously using a split-spoon sampler and were field-screened with an FID. Soil samples collected from the deep borings at SA 13 were also analyzed using a portable GC, at a rate of one sample per 6 linear feet, or more frequently when FID screening results were elevated. The results of the field GC screening are shown in Appendix A, Table A-4. Soil samples were collected from selected shallow and deep borings. The samples were submitted for total petroleum hydrocarbons (TPH) and full suite Contract Laboratory Program (CLP) target compound list (TCL) and target analyte list (TAL) laboratory analyses, in accordance with USEPA Level IV Data Quality Objectives (DQOs). In general, sampling locations were selected from intervals with the highest VOC concentrations, as determined by FID screening, or at the interval above the water table.

A summary of positive detections in soil and groundwater samples is presented in Appendix A, Tables A-5 through A-7. Arsenic and beryllium were detected in soil at four locations, but at concentrations only slightly above background screening values. The primary contaminants of concern (COCs) were chlorinated solvents. VOCs above FDEP MCLs were detected in all four shallow monitoring wells. Trace concentrations of VOCs were detected in two of four deep monitoring wells (OLD-13-02C and -08C). See Appendix B, Figure B-2, for groundwater VOC results.

After review of the above site screening data, the NTC, Orlando Restoration Advisory Board requested sampling of surface water and sediment along the Lake Druid shoreline, downgradient of SA 13. On November 29, 1995, surface water and sediment samples were collected along the shoreline and were analyzed for VOCs by an off-site laboratory using USEPA Method 8010 (Appendix B, Figure B-2). PCE, TCE, *cis*-1,2-dichloroethene (*cis*-DCE), 1,1-dichloroethene (1,1-DCE), and vinyl chloride (VC) were detected at these locations in concentrations as high as 9.4 $\mu\text{g}/\ell$, 370 $\mu\text{g}/\ell$, 1,100 $\mu\text{g}/\ell$, 1.5 $\mu\text{g}/\ell$, and 15 $\mu\text{g}/\ell$, respectively. At some locations, TCE and *cis*-DCE were detected in surface water at concentrations greater than had been detected in groundwater collected from the monitoring wells during site screening.

Lake Druid is a Class III surface water body, as described in Chapter 62-302, Florida Administrative Code (FAC), Surface Water Quality Standards. Concentrations of PCE and TCE were at concentrations above Florida Freshwater Surface Water Cleanup Target Levels (SWCTLs) (FDEP, 1999). VC concentrations also exceeded minimum criteria (the detection limit), as specified in Chapter 62-302.500, FAC. There is not a published SWCTL for *cis*-DCE, but SWCTLs are available for total 1,2-DCE (7,000 $\mu\text{g}/\ell$) and *tran*-DCE (11,000 $\mu\text{g}/\ell$). However, because SWCTLs were not promulgated until 1999, the Florida MCL (70 $\mu\text{g}/\ell$) was established as the performance standard for *cis*-DCE in groundwater discharging to the lake for the OU 4 IRA (ABB-ES, 1997c). The highest surface water and sediment VOC concentrations were detected where a ditch formed by the surface expression of groundwater enters the lake, along the eastern shoreline (see Figure 2-3).

On December 11, 1995, additional surface water and sediment samples were collected in Lake Druid approximately 50 feet west of the November locations. The water depth at these locations was approximately 4 feet. *Cis*-DCE was detected in surface water collected at each location. TCE was also detected in surface water at sample location 13D/W00801. TCE and PCE were detected in sediment from this location, and from location 13W/D00901. Chlorinated solvent concentrations from the locations farther out in the lake were generally lower than those at the shoreline. None of the constituents detected were above SWCTLs.

During the week of December 18, 1995, groundwater samples were collected from the area between Lake Druid and Building 1100 to further delineate groundwater contamination and to identify the possible source of the elevated VOCs in the lake. Samples were collected from temporary wells installed by hand auger in the heavily vegetated areas, and from TerraProbeSM borings installed in open areas. Sample points were placed along north-south lines adjacent to Building 1100 and along the northern fenceline. Sample locations are shown in Appendix B, Figure B-4.

Groundwater samples were collected at the water table from the temporary wells, screened using a portable GC, and sent off-site for laboratory analysis of VOCs. No VOCs were detected in these shallow monitoring wells.

Groundwater samples were collected from three depth intervals at each TerraProbeSM boring: (1) at the water table, (2) at approximately 18 bls, and (3) at 30 feet bls. Analysis of the TerraProbeSM samples included field GC screening and off-site laboratory analyses. The results of this phase of screening showed that PCE, *cis*-DCE, and TCE were present at total concentrations over 1,000 $\mu\text{g}/\text{l}$ to a depth of at least 30 feet bls. Deeper samples were not collected at that time. Total VOCs concentrations over 7,000 $\mu\text{g}/\text{l}$ were detected 30 feet bls at location 13Q011, northwest of the surge tank. These data are summarized in Appendix A, Table A-8.

Using these data, HLA prepared human health and ecological preliminary risk evaluations (PREs) (ABB-ES, 1997f). The PREs were screening level evaluations of potential risks to human and ecological receptors. The PREs were performed to determine if the environmental contamination at Area C required further action, with particular focus on human health risks posed by the VOC contamination in the lake.

The PREs were reviewed and approved by FDEP and USEPA. They concluded that although potential human health risks existed, an imminent hazard condition was not present.

Additional investigations have been conducted at SA 13, and are considered focused because they were intended to address only specific areas, such as the pathways for VOCs to reach the lake and a source confirmation conducted beneath the laundry building. This work occurred after the designation of OU 4, and is described below in Subsection 2.3.5.

2.3.3 SA 14, Investigation Summary and Results The site screening investigations at SA 14 included a geophysics program, a passive soil gas survey, and the collection and analysis of surface and subsurface soil and groundwater samples.

The magnetometer and GPR surveys did not define any disposal areas that would require additional investigation.

The soil gas survey was conducted concurrently with the adjacent survey at SA 13. Results of the soil gas survey are shown in Appendix B, Figure B-3. PCE was detected at 1.9 $\mu\text{g}/\text{l}$ in the vicinity of monitoring well OLD-14-02, approximately 30 feet northwest of the northwest corner of Building 1102. No other chlorinated solvents or petroleum-related hydrocarbons were detected in the soil gas survey at SA 14.

A summary of positive detections in surface and subsurface soil analytical results is presented in Appendix A, Tables A-9 and A-10. No compounds or analytes were detected above screening criteria in surface soil. PCE was detected at 11 micrograms per kilogram ($\mu\text{g}/\text{kg}$) in surface soil from boring 14B002, corresponding to the soil gas detection in this area. At boring 14B001, arsenic and beryllium were detected in subsurface soil (10 feet bls) above background and residential screening criteria. However, at this depth, residential soil standards would not apply, and the detections likely represent locally elevated background concentrations.

PCE and TCE were detected above their respective FDEP MCLs in groundwater from monitoring well OLD-14-04A. A trace of PCE (1.37 J $\mu\text{g}/\ell$) was also detected in groundwater from monitoring well OLD-14-02A. Antimony was detected in groundwater above its FDEP MCL of 6 $\mu\text{g}/\ell$ in monitoring wells OLD-14-02A (10.1 $\mu\text{g}/\ell$), OLD-14-03A (17.6 $\mu\text{g}/\ell$), and OLD-14-04A (10.5 B $\mu\text{g}/\ell$). See Appendix B, Figure B-2, and Appendix A, Table A-11, for groundwater analytical results.

2.3.4 Former Personnel Interviews During May 1997, HLA personnel interviewed several former employees of the Navy dry-cleaning facility at OU 4. The interviewees provided limited information about the dry-cleaning processes used, chemical storage, and chemical spills at the facility.

According to a former employee who worked as the operations clerk between 1970 and 1994, the facility used two types of dry-cleaning machines: one type that operated using petroleum-based chemicals, and another that used "perc". This is consistent with the fact that petroleum-based solvents and PCE are commonly used as solvents in commercial dry-cleaning. In fact, the laundry facility at OU 4 was permitted to operate two dry-cleaning machines that used Stoddard Solvent (a naphtha-petroleum based solvent), and three machines that used PCE. The washing machines and dryers were located in the northwest part of the building. Wastewater from the washing machines discharged to the surge tank located west of the building. The former operations clerk believed that the dry-cleaning machines did not discharge wastewater, because they were part of a closed-loop system.

All dry-cleaning chemicals were reportedly stored outside the building, in aboveground storage tanks (ASTs) located north of the building. The chemicals were piped from these tanks into the machines. All other chemicals were stored in the indoor hazardous materials storage room. However, it should be noted that no drawings or other evidence for the presence of these ASTs has been discovered. A second former employee, a presser who worked at the laundry facility between 1975 and 1994, indicated that the dry-cleaning chemicals were brought to the facility in 55-gallon drums from a source in Jacksonville.

The former clothing presser recalled occasional chemical spills on the interior floor, some of which resulted in strong odors that prompted workers to leave the facility for the day. Another employee mentioned one spill that occurred in the early 1990's, near the loading dock north of the building. The former operations clerk also recalled an outdoor spill near the ASTs. She indicated that the Navy made arrangements for workers from Patrick Air Force Base to perform the cleanup.

2.3.5 OU 4 Focused FFI In May 1996, a FFI was performed to (1) define the extent of contamination in Lake Druid's surface water and sediment, (2) evaluate the source of VOCs in Lake Druid, (3) delineate the horizontal and vertical extent of VOC contaminants in the groundwater along the lake shore, (4) measure physical characteristics of the lake, and (5) support a focused IRA to mitigate VOCs in Lake Druid. In order to meet these proposed objectives, a field program was initiated that included surface water and sediment sampling, the collection of groundwater samples within the surficial aquifer using direct-push technology (DPT), monitoring and drive point well installation and sampling, and a site hydrogeologic characterization study. Sampling locations are shown in Appendix B, Figures B-5, B-6, and B-7.

The analytical program for this investigation included on-site laboratory analyses for 10 target VOCs using a GC. Results of the DPT groundwater investigation indicated that the width of the groundwater VOC plume extended approximately 500 feet, from just south of the north fence line, down along the shoreline of Lake Druid. VOCs were detected in groundwater at depths ranging from 4 to 68 feet bbls, and included chlorinated solvents (primarily *cis*-1,2-DCE, TCE, and PCE). Analytical results are summarized in Appendix A, Table A-12.

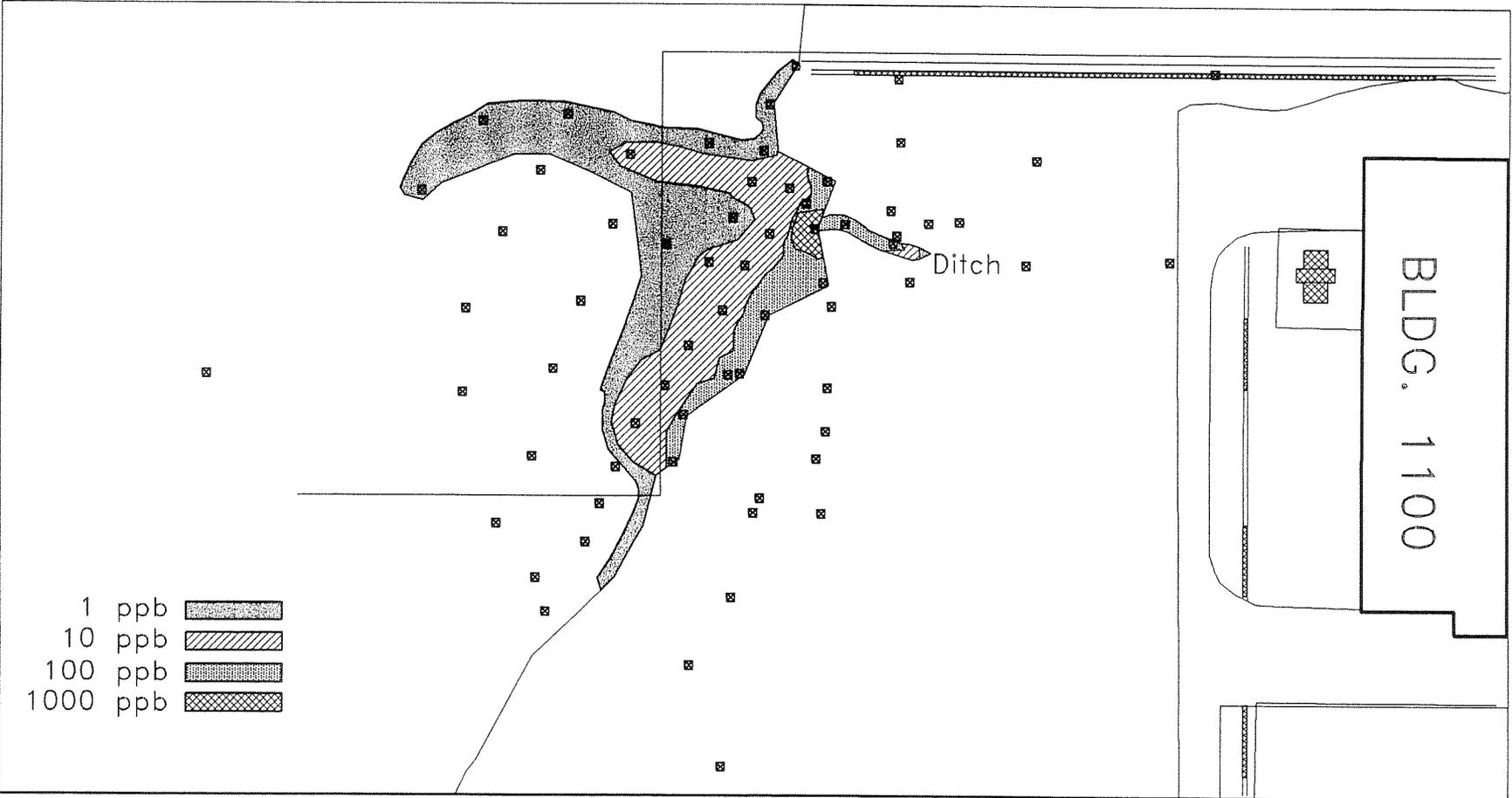
Chlorinated VOCs (VC, DCE, TCE, PCE) were also identified in the drive point well samples, as well as in the surface water and sediment samples. These data were used to delineate the extent of VOCs. Surface water and sediment samples were collected from within the ditch formed by the surface expression of groundwater, along the shoreline, and out into Lake Druid at approximately 25-foot intervals. The highest VOC concentrations were concentrated in the area where the groundwater ditch enters the lake. The three drive point wells, installed near the shoreline, in the groundwater ditch, and out in the lake, were screened into the subsurface just below the sediment bottom of the lake. Data from the drive point wells indicated that groundwater contaminated with the target chlorinated compounds is present just below the lake's sediment bottom. Water elevations of the lake and within the drive points indicated an upwelling of groundwater into the lake at these locations. Analytical data from Lake Druid are summarized in Appendix A, Table A-12.

Figures 2-4 and 2-5 show the extent of total chlorinated VOCs in Lake Druid surface water and sediment, based on the onsite laboratory analytical results from the Focused FFI. A plan view of the total VOC concentrations in groundwater between the laundry and Lake Druid (based on the Focused FFI data only) is shown on Figure 2-6. Appendix B, Figure B-8, shows the locations of cross-section lines parallel to the lakeshore and east-west between the laundry and the lake. Appendix B, Figure B-9, is the cross section showing the distribution and concentration of total VOCs in groundwater along the shoreline of Lake Druid. Appendix B, Figure B-10, is the cross section showing the distribution and concentration of total VOCs in groundwater running east-west between Lake Druid and the laundry. All of the Lake Druid and groundwater plume figures are based on onsite laboratory GC data.

The results of the FFI along the lake shore indicated that contaminated groundwater appears to be the source of VOCs detected in Lake Druid. It was estimated that approximately 25 pounds per year of total VOCs entered Lake Druid via groundwater. Approximately 1 to 5 pounds of VOCs were present in Lake Druid sediments (ABB-ES, 1997e).

2.3.6 OU 4 Pumping Test A constant-rate pumping test was performed at SA 13 in August 1996. A 5-inch-diameter extraction well was installed in the wooded area in the vicinity of DPT location U4Q010 (Appendix B, Figure B-8). The aquifer was pumped for 18 consecutive hours, at a rate of approximately 40 gallons per minute. Water-levels in the extraction well and in eleven nearby monitoring wells were periodically monitored.

The purpose of this test was to support future remedial actions by providing characteristic aquifer parameters and to refine the SCM. Initial analysis of the



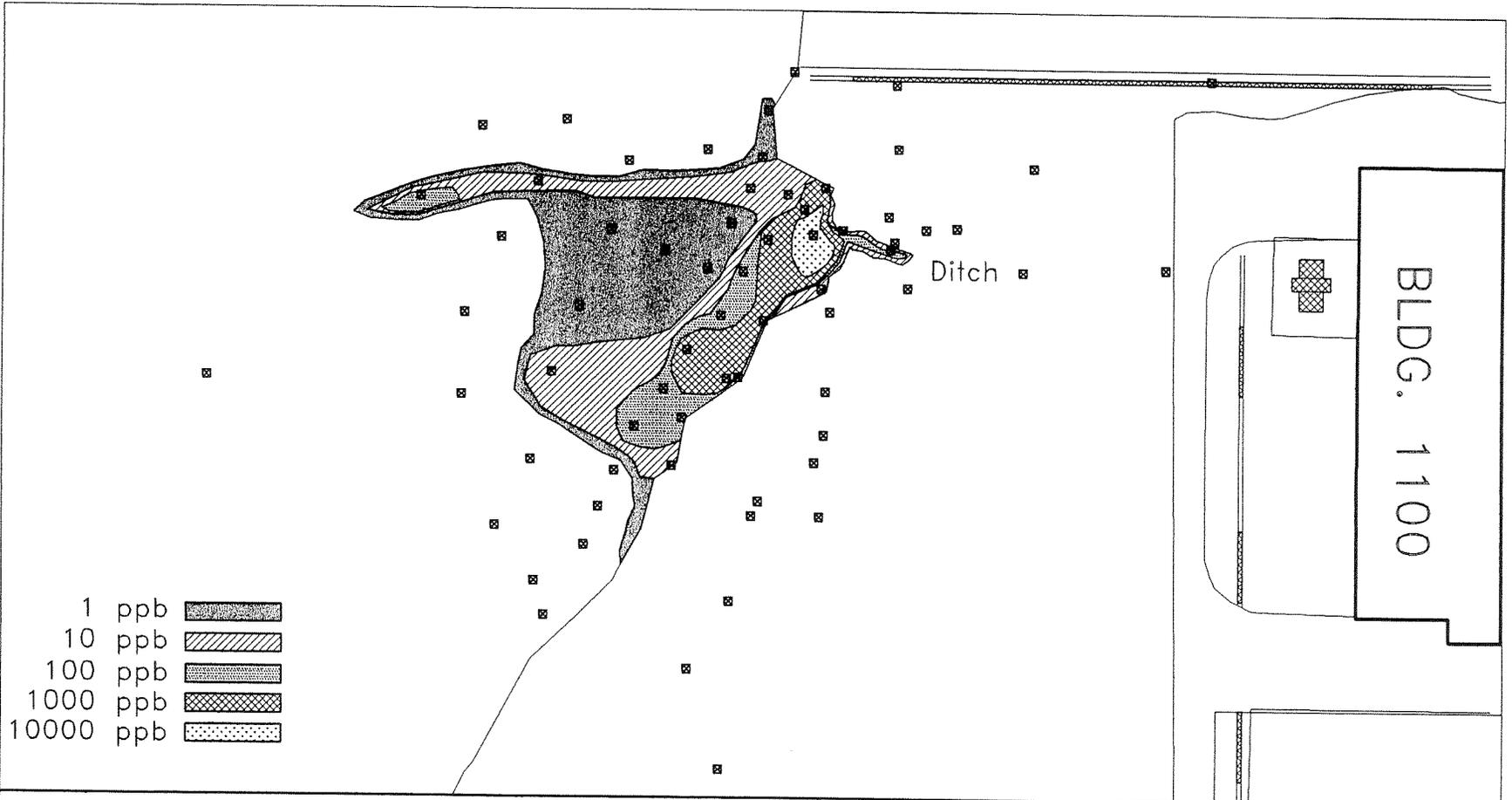
NOTE:
VOC = volatile organic compound

**FIGURE 2-4
PLAN VIEW, VOC CONCENTRATIONS
IN SURFACE WATER**



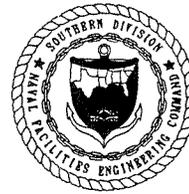
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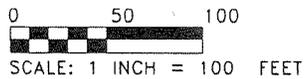
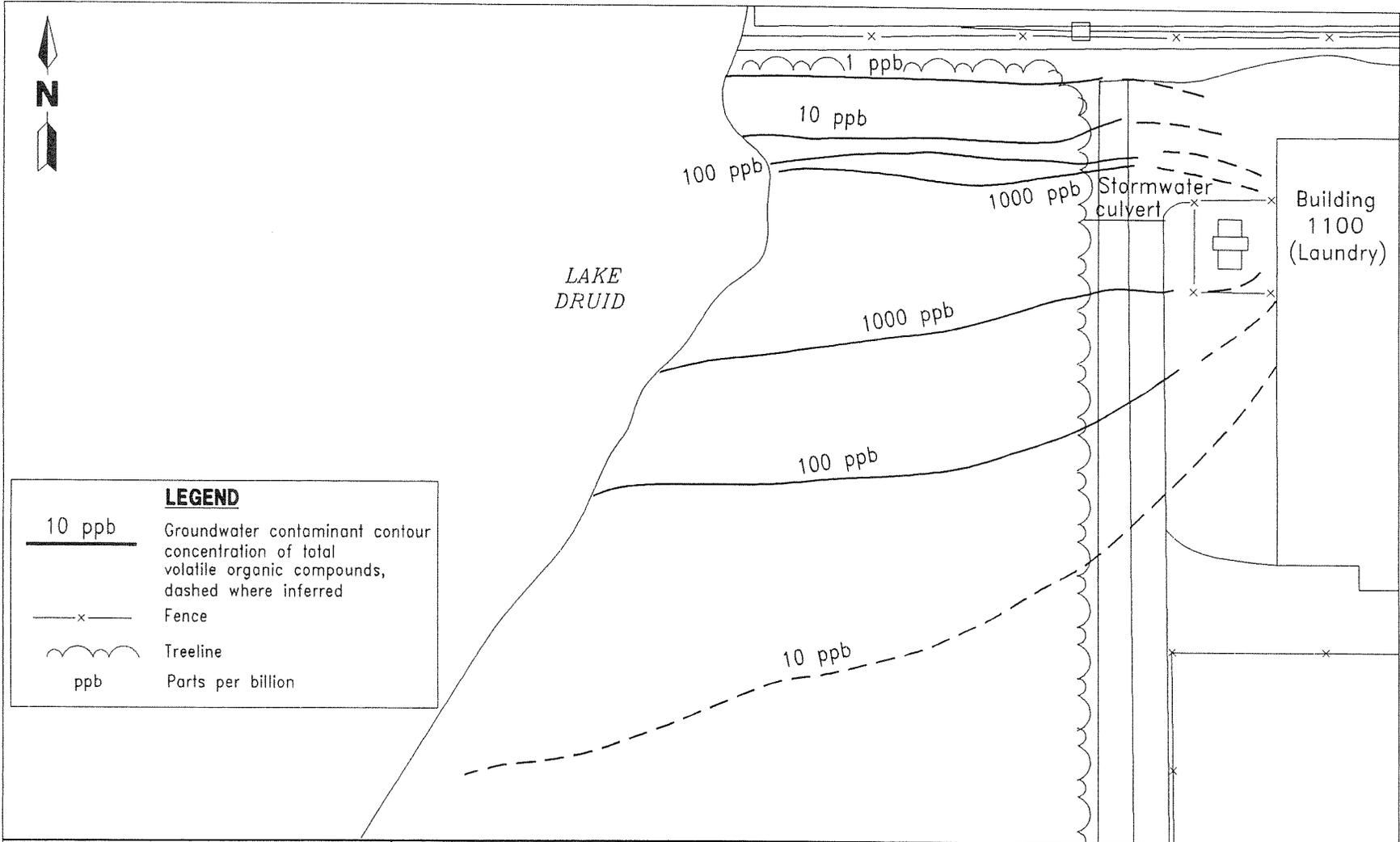
NOTE:
VOC = volatile organic compound

**FIGURE 2-5
PLAN VIEW, VOC CONCENTRATIONS
IN SEDIMENT**



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**FIGURE 2-6
SITE PLAN VIEW
DEPICTING TOTAL VOLATILE
ORGANIC COMPOUNDS IN
GROUNDWATER**



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pumping test data produced the following aquifer parameter values:

- coefficient of transmissivity (T) was estimated to be 1,960 square feet per day (ft²/day),
- hydraulic conductivity (K) was estimated to be 32.7 feet per day (ft/day), and
- storage coefficient (S) was estimated to be 0.13.

Previous subsurface investigations encountered a distinct, very dense sand horizon approximately 15 feet bls throughout most of the site. The effect of this unit on the site hydrogeology was considered during analysis of the pumping test data. Aquifer response during the pumping test suggests that although the dense layer may delay groundwater migration from the upper few feet of the surficial aquifer, it does not act as a hydraulic barrier.

Data generated from the pumping test were reevaluated as part of a groundwater flow model effort conducted by the USGS. Refined estimates of hydraulic conductivity that accounted for both horizontal and vertical hydraulic conductivity for the upper layer (above the dense sand horizon) and lower layer (below the dense sand horizon) of the surficial aquifer were calculated. The modeling effort is summarized in Section 2.5.

2.3.7 OU 4 Focused Source Confirmation The OU 4 investigations described above suggested that the area around the surge tank at the northwest corner of Building 1100 could be a source of groundwater contamination between the former laundry facility and Lake Druid.

This source confirmation investigation was conducted to determine if the area around the surge tank was a primary source of groundwater contamination. If confirmed as a source, the IRA may have been expanded to include the vicinity of the surge tank.

The focused investigation/source confirmation concentrated on the area upgradient of the surge tank, primarily under the former laundry facility itself. This was the most likely location for additional sources associated with the storage and use of PCE in the dry-cleaning process. If VOC concentrations in soil and groundwater under the laundry facility were comparable to the concentrations immediately downgradient of the surge tank, then other source(s) besides the surge tank were likely contributing to the plume. However, if VOC concentrations under the laundry facility were much less than those near the surge tank, then the surge tank would likely be the primary source of VOCs. The TerraProbeSM and an on-site laboratory were used to collect and analyze subsurface soil and groundwater samples from beneath the former laundry facility.

2.3.7.1 Subsurface Soil Characterization The TerraProbeSM was used to collect soil samples from both vadose and phreatic (saturated) zones at 12 locations in and around the laundry facility, as shown in Appendix B, Figure B-11. Vadose zone soil samples were collected from each sampling location at continuous 4-foot intervals, from the ground surface down to the water table. Phreatic zone soil samples were also collected from each sampling location at continuous 4-foot intervals, from the water table down to 28 feet bls, or refusal. All subsurface soil sampling results are provided in Appendix A, Tables A-13 and A-14.

The highest VOC concentration in soil measured by the laboratory was 430 parts per billion (ppb) of PCE at U4P015. In general, soil VOC concentrations decreased with depth. The lower concentrations detected may be present from the volatilization of a release some distance away, and do not suggest the presence of residual nonaqueous-phase liquid (NAPL) at these sample locations. However, residual concentrations of NAPL are notoriously difficult to locate. These soil data do not necessarily provide conclusive evidence that NAPL is not present.

2.3.7.2 Groundwater Characterization The TerraProbeSM was used to collect groundwater samples at 14 locations beneath the floor and around Building 1100, as shown in Appendix B, Figure B-11. Groundwater samples were also collected from monitoring wells OLD-13-01A through OLD-13-08C and microwells OLD-13-18B through OLD-13-20B (Appendix B, Figure B-12).

Groundwater Collected Via TerraProbeSM. Groundwater samples were collected using the TerraProbeSM, and were sent to either on-site and/or off-site laboratories for VOC analysis. Complete results are summarized in Appendix A, Tables A-15 and A-16.

The highest groundwater VOC concentrations were detected under the laundry facility, between the laundry facility and the surge tank, and northeast (upgradient) of the laundry facility. At several locations, PCE and TCE were found at concentrations in the 1000 to 3000 $\mu\text{g}/\ell$ range.

Typically, VOC concentrations in groundwater greater than one percent of the aqueous solubility limit are suggestive of NAPL presence (Cohen, et. al., 1992). The highest VOCs detected in groundwater collected using the TerraProbeSM approached 20 percent of the theoretical solubility for PCE, suggesting a strong possibility that a source area of residual NAPL is present beneath the laundry facility, possibly at more than one location, as approximated on Figure 2-6.

Due to the depth limitations of the TerraProbeSM (which typically reached refusal at approximately 30 feet bls), delineation of the vertical extent of contamination was not possible at many locations. The highest VOC concentrations measured at many locations were at the deepest interval sampled before refusal. Further details concerning this investigation were reported in the FFI report (ABB-ES, 1997f).

Groundwater Collected from Monitoring Wells and Microwells. Groundwater samples collected from monitoring wells and microwells were sent to the off-site laboratory. Analytical results are included in Appendix A, Table A-17. Results of monitoring well and microwell sampling generally indicate lower groundwater VOC concentrations than those collected from TerraProbeSM sampling. This may be attributed to the monitoring wells having longer screen lengths, causing dilution of the sample. Also, the microwells were set in the same locations as the TerraProbeSM groundwater samples. These wells are approximately 4 to 5 feet deeper than the last TerraProbeSM collection interval, and may be near the lower depth limit of contamination.

Prior to initiation of the RI, the highest VOC concentration detected in groundwater from a monitoring well was 28,000 $\mu\text{g}/\ell$. This monitoring well is located off the northwest corner of Building 1100. The 28,000 $\mu\text{g}/\ell$ PCE concentration approaches 20 percent of the solubility for that compound, indicating a very strong argument for NAPL presence.

2.4 SITE CONCEPTUAL MODEL. The SCM is a framework within which the source/release mechanism and environmental pathways of potential concern are identified schematically. The SCM was previously identified and refined as part of a comprehensive IRA conducted at OU 4 (see Section 2.5), and has been further refined throughout this RI. Therefore, one of the objectives of the RI was to identify data needs remaining from the IRA SCM in order to complete the definition of the SCM.

An SCM addresses the following key components:

- contaminant source,
- release mechanism,
- transport mechanism,
- migration pathway,
- affected media,
- primary exposure pathways, and
- potential receptors

The migration pathway that the contamination appeared to be following at OU 4 began with the contaminants seeping into the groundwater, then ultimately being partitioned into dissolved-phase constituents that migrate through groundwater into Lake Druid. Supporting data can be found in the FFI report (ABB-ES, 1997f). Drive points installed in Lake Druid have also demonstrated an upward potential, suggesting that groundwater is upwelling into the lake. In addition to seepage and groundwater migration, surface runoff had been considered as a transport mechanism. However, surface soil samples collected at runoff locations showed little or no evidence of chlorinated solvents, suggesting that surface runoff was not a major contributor to the spread of the contamination.

One of the goals of the RI was to fill in any gaps in our conceptual understanding of the key components outlined in the SCM, through the following activities:

- delineation of the southern extent of the groundwater plume, and determination of its origin or source to clarify the transport mechanism(s) associated with COCs and their migration pathways;
- investigation along the northern and eastern boundaries of the OU for possible off-base contaminant migration to more fully understand transport and migration of COCs;
- additional assessment of groundwater in SAs 12 and 14, due to VOC and antimony (SA 14 only) detections in groundwater samples collected during the site screening investigation; and
- assessment of exposure pathway(s) and potential receptors.

The suspected source area for VOC contamination in groundwater is shown in Figure 2-7. The SCM, as illustrated before the RI, is shown on Figure 2-8. Chapter 6.0 presents the refined SCM, which incorporates data generated during the RI field investigation.

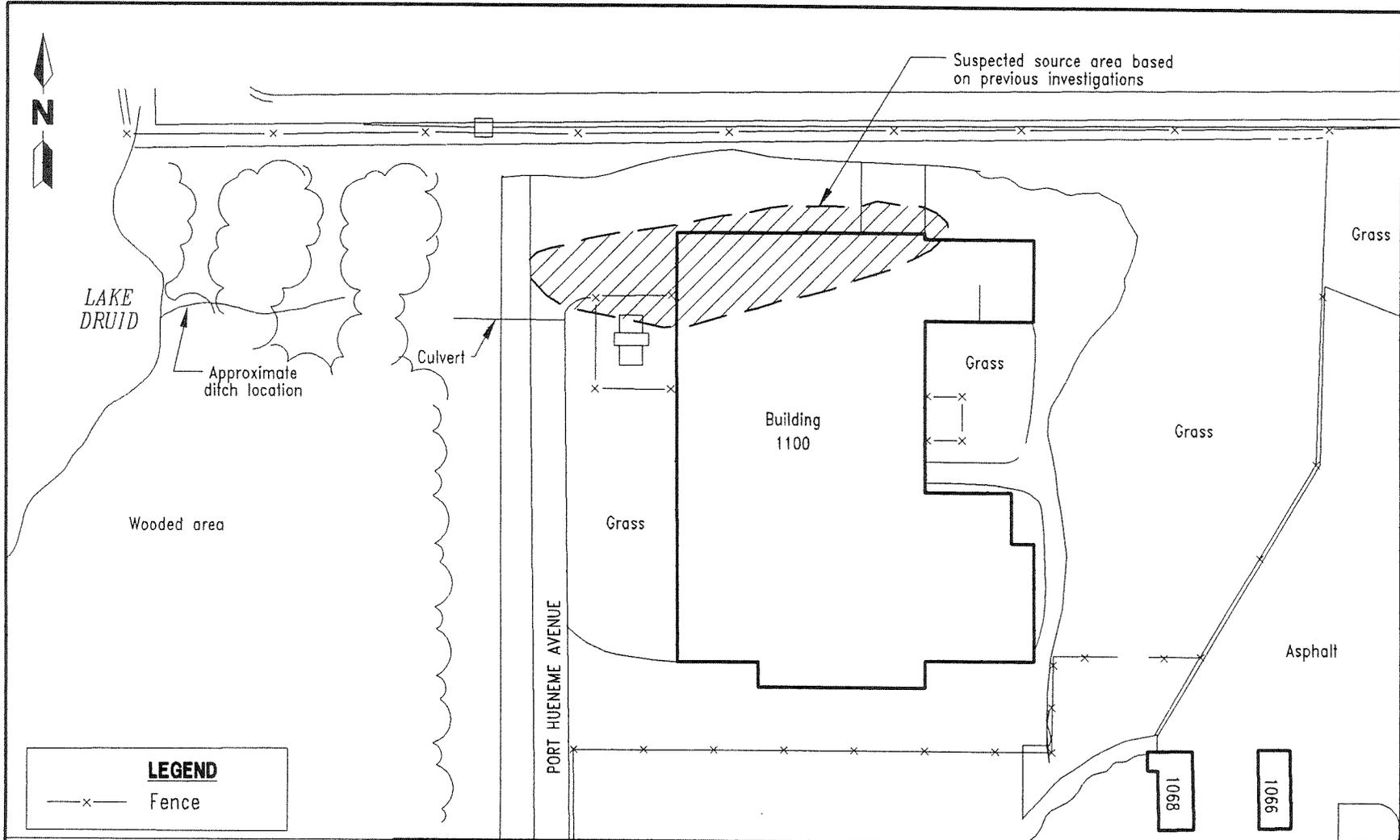
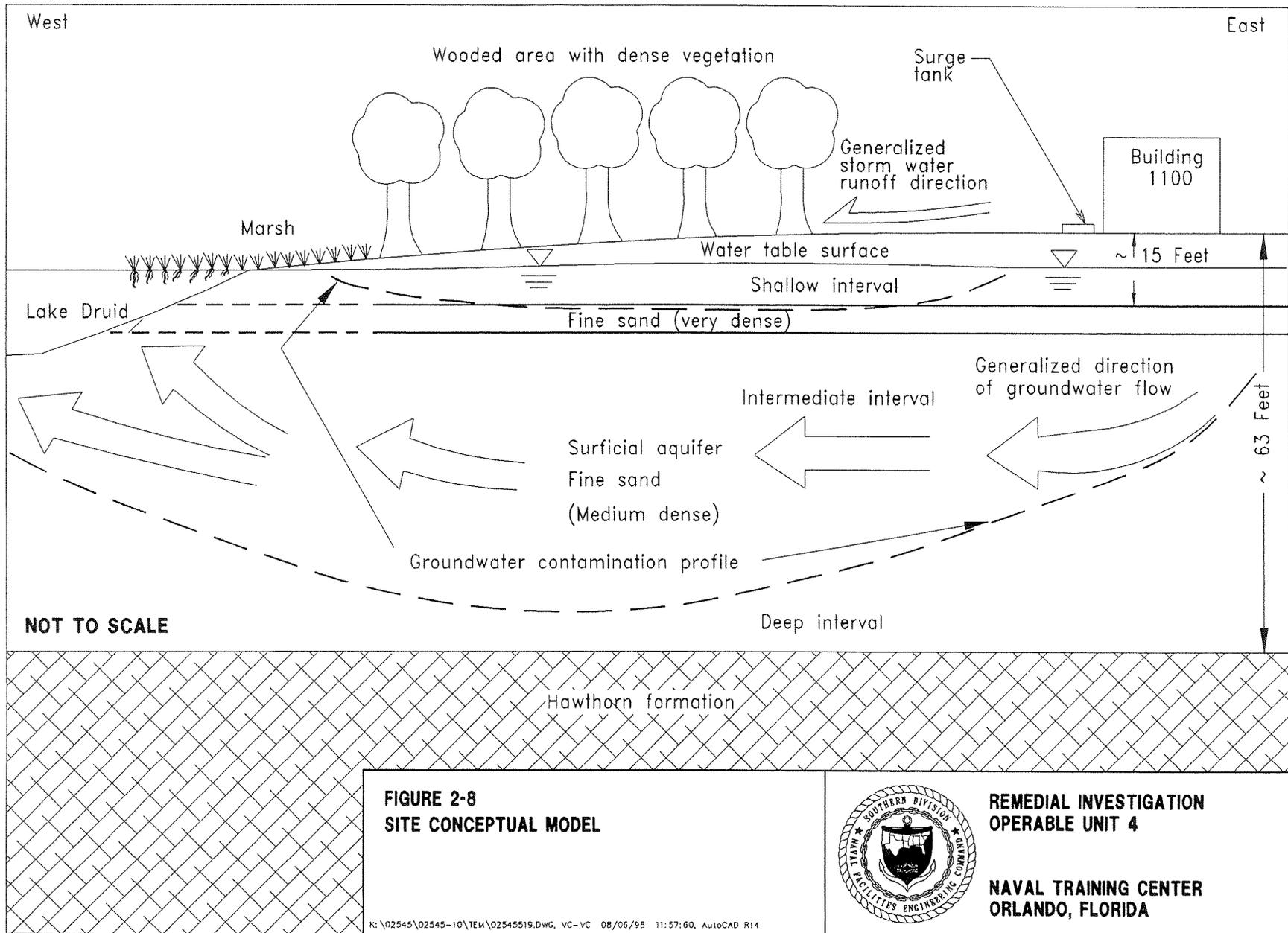


FIGURE 2-7
SUSPECTED SOURCE AREA(S)



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2.5 INTERIM REMEDIAL ACTION AND PERFORMANCE MONITORING PROGRAM. The SCM summarized above identified a plume of chlorinated solvent-contaminated groundwater originating from the area around Building 1100 and migrating through the surficial aquifer into Lake Druid, near the shoreline west of the building. Source areas appear to be multiple, and are likely located adjacent to and beneath the building. An IRA, consisting of two *in situ* stripping recirculation wells, has been implemented to intercept and treat the majority of the contaminated groundwater before it reaches Lake Druid.

2.5.1 Objective of the IRA The objective of the IRA is to contain and control groundwater containing VOCs through the use of *in situ* stripping recirculation well technology. This technology is designed to intercept and treat the VOC plume upgradient of Lake Druid.

2.5.2 In-Situ Stripping Recirculation Wells The recirculation well system is designed to intercept, both horizontally and vertically, the part of the plume defined by the 100 ppb or greater total VOC contaminant contour, and to prevent these VOCs from reaching Lake Druid. The approximate dimensions of the capture zone are 200 feet wide and 45 feet deep. Detailed performance requirements and system design criteria were provided in the IRA Conceptual Design and Performance Specification, OU 4 (ABB-ES, 1997c), and are summarized below.

Recirculation well technology creates a spherical capture zone within the targeted part of the aquifer. Groundwater is pumped into the upper screen of each recirculating well, and is aerated as it travels through the well. The aeration process volatilizes the VOCs in the water, thereby reducing concentrations. The treated groundwater exits through a second well screen near the bottom of the well, discharging back to the surficial aquifer.

The volatilized VOCs are transported out of the well by means of negative pressure created by a vacuum blower. An exclusion from off-gas treatment was granted by the FDEP, which allows the off-gases to be vented from the well casing to the atmosphere without treatment. Because the contaminated groundwater is treated and discharged without leaving the wells, no consumptive use permit or underground injection permit is required.

SOUTHNAVFACENGCOM contracted Bechtel Environmental, Inc. (BEI), to design the recirculation well system. BEI subcontracted SBP Technologies, Inc. (SBP) to construct the system, which became operational in December 1997. Two recirculating wells (UVB-1 and UVB-2) were installed within the VOCs plume, between Building 1100 and Lake Druid. Several monitoring wells and piezometers were installed in the vicinity of the recirculating wells to evaluate system performance. Some of the wells and piezometers were equipped with pressure transducers and dataloggers, which periodically monitor water-levels during system operation.

Four reports have been prepared summarizing the results of the groundwater IRA performance monitoring program (ABB-ES, 1998a, and HLA, 1999a, 1999b, and 1999c). By January 1999, SWCTLs had been achieved in several monitoring points downgradient of the recirculation wells along the lakeshore. However, the recirculation wells have proven difficult to maintain, and have frequently been inoperable. Consequently, after evaluating the overall performance of the recirculation wells, the Navy and the OPT have recommended converting the recirculation well system to a standard groundwater recovery and treatment system. This conversion was done in mid-2000.

2.5.3 USGS Flow Model A USGS hydrogeologist used data generated during the August 1996 pumping test at SA 13 to simulate the flow pathlines that would develop during recirculation well operation. A simulation of the IRA FFI pumping test was also conducted to calibrate the model and to refine the understanding of the layered surficial aquifer. Details of the 18-hour pumping test were summarized in Subsection 2.3.6.

The USGS began by simulating the pumping test using MODFLOW (Harbaugh and MacDonald, 1988) and 3D discretization.

The USGS determined that the surficial aquifer can be separated into two layers with different hydraulic conductivities: an upper layer from 0 to 20 feet bls, and a lower layer from 20 to 60 feet bls.

Using the measured drawdown data from the pumping test, the following horizontal (K_h) and vertical (K_v) hydraulic conductivity values were calculated for the two layers:

Upper Layer (0 to 20 feet bls): $K_h = 10$ ft/day
 $K_v = 3.8$ ft/day

Lower Layer (20 to 60 feet bls): $K_h = 40$ ft/day
 $K_v = 17$ ft/day

These values were used by SBP to refine the design of the recirculation well system.

2.6 RI ACTIVITIES AND RATIONALE. The following subsections describe field activities that were conducted in support of the OU 4 RI. Each of the investigative tasks was designed to support the SCM (outlined in Section 2.4). The field investigation was conducted in accordance with the guidelines set forth in the POP for NTC, Orlando (ABB-ES, 1997b) and the OU 4 RI/FS Workplan (ABB-ES, 1997d). Well installation, development, and sampling activities were performed in accordance with SOUTHNAVFACENCOM guidelines for groundwater monitoring well installation and as specified in the *Region IV Environmental Compliance Branch Standard Operating Procedures and Quality Assurance Manual* (USEPA, 1996a).

Components of the RI field investigation included the following:

- groundwater sampling using DPT,
- surface and subsurface soil sampling,
- surface water and sediment sampling,
- monitoring well and microwell installation and sampling,
- aquifer characterization, and
- an ecological survey.

These tasks are summarized in detail below. Results of the RI field investigation are discussed in Chapter 5.0.

2.6.1 DPT Sampling Program A 20-ton DPT rig was used during the RI in order to collect groundwater samples quickly and with minimal impact to the site. The system used constant hydraulic pressure to force stainless-steel rods into the subsurface. The rig was equipped with a hydrocone, which allowed for the

collection of groundwater samples. A more detailed description of DPT methodologies is presented in Section 4.4 of the NTC, Orlando POP (ABB-ES, 1997b).

The DPT rig was used to obtain groundwater samples at discrete depth intervals, in order to determine the vertical and horizontal distribution of contaminants at selected locations. The rig was capable of exploring the entire thickness of the surficial aquifer (approximately 65 feet). At each DPT location, groundwater samples were collected at 3-foot intervals beginning at the water table and continuing to the bottom of the surficial aquifer, which is defined at the top of the Hawthorn Group.

Twenty-one DPT borings (U4Q029 through U4Q049) were installed and sampled using the DPT rig. These locations were selected to further characterize source areas and to delineate the area of affected groundwater. Nine of the sampling points were positioned along the north and east fence lines to assess the potential for off-base contamination. The remaining 12 sampling locations were positioned in various locations throughout the OU to fill any remaining data gaps. DPT exploration locations were surveyed using a global positioning system (GPS) rover and base station system capable of submeter accuracy.

Groundwater samples from DPT probes were screened for selected VOCs using an on-site GC purge-and-trap concentrations for trace level detection (modified USEPA SW-846 Method 8010/8020). The data obtained during these activities are considered Level II, and were used to select optimal locations and screen depths for the new monitoring wells at OU 4 (see Subsection 2.6.4). DPT groundwater samples were also submitted to an off-site laboratory for confirmatory VOC analyses, at a rate of 1 in 10. On-site GC screening results and off-site VOC results are summarized in Paragraph 5.2.3.1.

2.6.2 Soil Sampling Program During the RI field investigation, surface and subsurface soil samples were collected at OU 4 in support of the risk, fate and transport, and treatability evaluations.

2.6.2.1 Surface Soil Sampling Eleven surface soil samples (U4S005 through U4S015) were collected primarily within SA 13, after an evaluation of existing surface soil data collected in previous investigations. Sample locations selected for the RI were approved by the OPT. Of the eleven surface soil locations, three (U4S006, U4S011, and U4S015) were later excavated as part of an surface soil IRA (see Section 2.7). The human health and ERAs (discussed in Chapters 8.0 and 9.0, respectively) used a combination of the RI data, existing surface soil data, and post-excavation confirmatory sample data.

Samples were collected from a depth interval of 0 to 1 foot bls. Within paved areas, the samples were collected below the paving subgrade. Surface soil sample locations were surveyed using a GPS rover and base station system capable of submeter accuracy.

The surface soil samples were collected using stainless-steel hand augers. Samples collected prior to and during the RI were analyzed for CLP TCL VOCs, semivolatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), and CLP TAL inorganics in accordance with USEPA Level IV DQOs. As described in Section 2.7, surface soil IRA confirmatory samples were analyzed for polynuclear aromatic hydrocarbons (PAHs), arsenic, and/or PCBs. Soil collected

for VOC analysis was obtained directly from the auger bucket. Soil collected for the remaining nonvolatile parameters was homogenized in a decontaminated glass bowl prior to placement into sample containers.

2.6.2.2 Subsurface Soil Sampling Eleven soil borings (OLD-13-33 through OLD-13-43) were installed using Rotasonic™ drilling techniques. The Rotasonic™ sampler uses vibrational and rotational forces to advance into unconsolidated and consolidated materials.

Advancement of the 6-inch casing by Rotasonic™ drilling produced 4-inch-diameter continuous cores, from which samples were collected for lithologic description, headspace screening using an FID, and chemical analyses. Four samples were collected from each location at various depths, for the following analyses: CLP TCL VOCs, TAL inorganics, and total organic carbon (TOC). Boring logs are included in Appendix G.

Subsurface soil to be collected for VOC analyses was obtained directly from the continuous cores. Soil to be collected for the remaining nonvolatile parameters (TAL inorganics and TOC) was homogenized in a decontaminated glass bowl prior to placement into sample containers.

Upon completion of the Rotasonic™ borings, monitoring wells were installed within the boreholes (see Paragraph 2.6.4.2).

2.6.3 Surface Water and Sediment Sampling Program Surface water and sediment samples were collected from six locations within Lake Druid. Because previous investigations had established that the primary COCs were chlorinated VOCs and delineated extent (ABB-ES, 1997f), the RI analytical program focused on further characterizing VOCs and providing additional data for risk assessment. Samples from four of the six locations were submitted for VOC analysis only, and samples from the remaining two locations were submitted for the full suite of analyses. One of the surface water and sediment pairs to be collected for full suite analyses (U4D/W010) was collected from within an area of the lake known to contain chlorinated VOCs. The second full suite pair, U4D/W050, was collected from a Navy-owned portion of the lake that is near (but beyond) the area of known VOC contamination. This second sample location served as a control, aiding in the evaluation and interpretation of the results of sampling within the VOC-contaminated area. Exact sample locations were surveyed using a GPS rover and base station system capable of submeter accuracy.

At locations in which the water depth was greater than 1 foot, one surface water sample was collected from just beneath the lake surface, and a second was collected directly above the sediment. At locations at which the water depth was less than 1 foot, a single sample was collected just above the sediment. Surface water samples were collected using a direct sampling device. Sediment samples were collected using a sleeved, drive-type device similar to a split spoon in order to minimize sediment disturbance. Additional details of surface water and sediment sampling techniques are available in the NTC, Orlando POP (ABB-ES, 1997b).

Surface water samples were also analyzed for TOC, pH, hardness, total dissolved solids, total suspended solids, and total alkalinity to support treatability evaluations. TOC and pH of the sediment samples were also measured in support of risk and treatability evaluations.

2.6.4 Monitoring Well and Microwell Program Monitoring wells and microwells were installed during the OU 4 RI in order to further characterize the vertical and horizontal extent of groundwater contamination, and to develop sufficient information in order to complete the risk assessments and the FS.

2.6.4.1 Microwell Installation Five shallow microwells (OLD-14-05A through OLD-14-08A and OLD-13-27A) were installed at or near SA 14 in order to characterize the extent of antimony detected during previous site screening activities.

Each of the microwells was constructed of a 0.5-inch-diameter, Schedule 80 PVC screen that was prepacked with 20/40 silica sand. Screens were 9 feet long, with a slot size of 0.010 inch. Each microwell was installed using the TerraProbeSM to a depth of 15 feet bls, through a 2-inch-diameter, stainless-steel casing fitted with an expendable point. Once the casing was advanced to the desired depth, the prepacked screened was lowered down the inside of casing along with the required length of PVC riser. The casing was then retracted, and the microwell was completed in the same manner as a conventional monitoring well. Microwell construction diagrams are provided in Appendix H.

2.6.4.2 Monitoring Well Installation Results of the DPT program were used to select the exact locations and depths for new monitoring wells. Eleven wells (OLD-13-33 through OLD-13-43) were installed using RotasonicTM drilling techniques, which were described above in Paragraph 2.6.2.2. Well installation using this method is similar to well installation using HSA techniques. The monitoring well is typically constructed within the 6-inch casing, which is extracted as well materials are placed in the annular space.

The eleven monitoring wells were constructed using 2-inch inside diameter, 0.020-inch machine-slotted, Schedule 40 PVC screens. The screen length varied between 5 and 10 feet. Total depths ranged from 13 to 65 feet bls. Upon installation of each well screen, 20/30 filter pack sand was tremied into the annular space around the screen from the bottom of the borehole to at least 2 feet above the top of the screen. A 2- to 3-foot-thick bentonite seal was installed directly above the filter pack, followed by a 2-foot-thick, fine sand cap (30/65 standard sand). Above this cap, a grout mixture of neat cement and 2 to 4 percent bentonite powder was tremied into the annular space. Additional monitoring well construction details can be found in the NTC, Orlando POP (ABB-ES, 1997b). Well construction diagrams are provided in Appendix H.

Each monitoring well was subsequently developed in order to remove fines from in and around the well screen. Well development records are provided in Appendix I. The location and elevation of each well was surveyed using traditional civil surveying techniques, as described in the NTC, Orlando POP (ABB-ES, 1997b).

2.6.4.3 Monitoring Well and Microwell Sampling The 11 new and 23 existing monitoring wells, along with the 5 microwells, were purged and sampled using low-flow techniques as described in the OU 4 RI/FS Workplan (ABB-ES, 1997d). The low-flow method was used in order to ensure that the sample was collected from the targeted aquifer zone.

Prior to sampling, each well was purged of stagnant water using new 1/4-inch outside diameter TeflonTM tubing connected to a peristaltic pump. Temperature, pH, conductivity, dissolved oxygen, and turbidity were measured regularly during

purging. Upon stabilization of these parameters, the well was sampled. Additional details of the sampling methodology are provided in the RI/FS Workplan (ABB-ES, 1997d) and the NTC, Orlando POP (ABB-ES, 1997b). Groundwater sampling logs are included in Appendix J.

Groundwater samples from each well were submitted for analysis of CLP TCL VOCs and TAL inorganics. Filtered groundwater samples were also collected at SA 14 (where antimony had previously been detected), and were analyzed for CLP TAL inorganics. To support the risk assessments, 10 of the 34 new and existing monitoring wells were submitted for full suite CLP TCL and CLP TAL analyses.

2.6.5 Aquifer Characterization Survey An aquifer characterization program was undertaken in order to evaluate site-specific aquifer properties. This program included a groundwater elevation survey, a vertical head potential survey, and aquifer tests in the recently installed monitoring wells.

2.6.5.1 Groundwater Elevation Survey Groundwater elevations were measured in each of the new and existing monitoring wells in order to better evaluate the direction of groundwater flow across the site. In January 1998 and April 1998, two rounds of water-level measurements were taken from all wells within the OU using a water-level indicator. The horizontal and vertical coordinates of the wells were subsequently surveyed by a Florida-licensed surveyor, and were used to calculate groundwater elevations across the site. The data that were used to generate two potentiometric surface maps are discussed in Chapter 3.0.

A vertical head potential survey was also conducted in order to analyze the head potential associated with different areas of the surficial aquifer, as well as its relationship to the surface water.

Vertical head potential in drive point wells situated along the shoreline of Lake Druid, within the lake, and within the groundwater ditch were analyzed by measuring the difference in the water-level between the groundwater inside the drive point and the surface water outside the well casing. A higher water-level inside the well indicates an upward potential from the surficial aquifer; i.e., water is likely flowing from the surficial aquifer into the lake (assuming a hydraulic connection exists). A lower water-level inside the well indicates a downward potential from the lake into the surficial aquifer.

Vertical head potential within the surficial aquifer was measured from monitoring well clusters that have both shallow and deep wells. The head potential was evaluated by measuring the water-elevation difference between two wells within a cluster. A higher water elevation in the deep well indicates that portion of the aquifer has an upward potential; i.e., the groundwater velocity would have a component toward the surface. A higher water elevation in a shallow well indicates that portion of the aquifer has a downward potential; i.e., the groundwater velocity would have a component toward the lower layer of the surficial aquifer. Results of the vertical head potential survey are interpreted in Subsection 3.6.3.

2.6.5.2 Aquifer Testing *In situ* hydraulic conductivity tests were performed on nine of the monitoring wells installed during the RI. Rising-head slug tests were conducted on all of these wells, and falling head tests were conducted on those wells with fully saturated screened intervals.

Before each test, the monitoring well was opened and allowed to equilibrate with ambient air conditions. A static water-level measurement was recorded once the well had equilibrated. A pressure transducer was then lowered into the well and connected to a Hermit 1000C datalogger. Once sufficient time had passed for the water-level to equilibrate again, a slug was submerged and the datalogger started. When the water-level had fallen to at least 90 percent of its original level, the falling head test was stopped. The slug was then swiftly removed from the well, and the rising head test was begun. The rising head test continued until the water-level had risen to at least 90 percent of its original level.

Data from the slug tests were downloaded to a computer and were analyzed using the Aqtesolv™ software program, which utilizes the Bouwer and Rice method (Bouwer and Rice, 1976) to calculate hydraulic conductivity. For wells within which the top of the screen is above the water table, the plot was analyzed using the double straight line method (Bouwer and Rice, 1989) to account for filter pack drainage. Appendix K provides data from the slug tests. Test results are discussed in Paragraph 3.6.3.2.

2.6.6 Ecological Survey An ecological survey of OU 4 was conducted by HLA ecologists in October 1997. The purposes of the survey were to characterize the existing ecological habitats and identify potential ecological receptors and exposure pathways. The guidance used to complete the ecological survey is described below, and the results of the survey are summarized in Section 9.1, Site Characterization.

During the OU 4 ecological survey, upland, wetland, and aquatic habitats were identified. In addition, a list of all vegetative species observed at each of the study areas was recorded.

Upland habitats, which are referred to as "land not considered to be a jurisdictional wetland", were described based on the Florida Natural Areas Inventory (FNAI) classification system (FNAI, 1990). It is important to note that the FNAI classification system describes undisturbed areas. Because the habitats at OU 4 have been altered or disturbed by human activities, the FNAI classifications were slightly modified to more appropriately describe the vegetative cover types occurring at each of the study areas.

Wetland areas were also described according to the U.S. Fish and Wildlife Services (USFWS) classification (Cowardin and others, 1979).

2.7 SURFACE SOIL INTERIM REMEDIAL ACTION - SELECTED SURFACE SOIL SAMPLE LOCATIONS. Results of the RI surface soil sampling program indicated that three sample locations contained analytes at concentrations above FDEP Residential Soil Cleanup Target Levels (SCTLs): sample location U4S011, which contained arsenic; sample U4S006, which contained PAHs and PCBs; and sample U4S015, which contained PAHs. Surface soil sample locations are shown on Figure 5-1, and a more detailed summary of RI surface soil analytical results is presented in Subsection 5.2.1.

To mitigate potential risks associated with exposure to analytes in surface soil, a surface soil IRA was initiated at OU 4. SOUTHNAVFACENGCOCM contracted the Environmental Detachment Charleston (DET) of the Supervisor of Shipbuilding, Conversion and Repair, USN (SUPSHIP) Portsmouth, Virginia, to implement the IRA, which involved the excavation and disposal of contaminated soil in the area

directly surrounding the three surface soil sample locations (U4S006, U4S011, and U4S015). The IRA Completion Report is provided in Appendix M.

The surface soil IRA was conducted on May 11, 1999. The excavations were centered around the former surface soil sample locations. Each excavation measured 10 feet by 10 feet, and extended to a depth of 2 feet bls. Confirmatory samples were collected from the four sidewalls of each excavation. Samples obtained from the excavation centered around U4S011 were analyzed for arsenic using Method 6010B. Samples collected from the excavation at U4S015 were analyzed for PAHs using Method 8270, and samples collected around U4S006 were analyzed for PAHs (Method 8270) and PCBs (Method 8082).

Following excavation, confirmatory sampling results indicated that elevated concentrations of arsenic, PAHs, and PCBs had been significantly reduced or completely removed. The excavated soil (a total of 31 tons) was disposed of at a permitted treatment, storage and disposal facility. Each excavation area was backfilled with Florida-certified clean fill, and was graded and re-seeded.

CHAPTER 3.0

3.0 REGIONAL AND SITE-SPECIFIC SETTING

The following section describes the regional and site-specific physical characteristics of the region and the OU 4 area, including the physiography, climate, surface water hydrology, surface soil, hydrogeology, demography, and local ecology. The presented information was gathered from surface and subsurface exploration, field observations, sample collection, and review of available published and unpublished data.

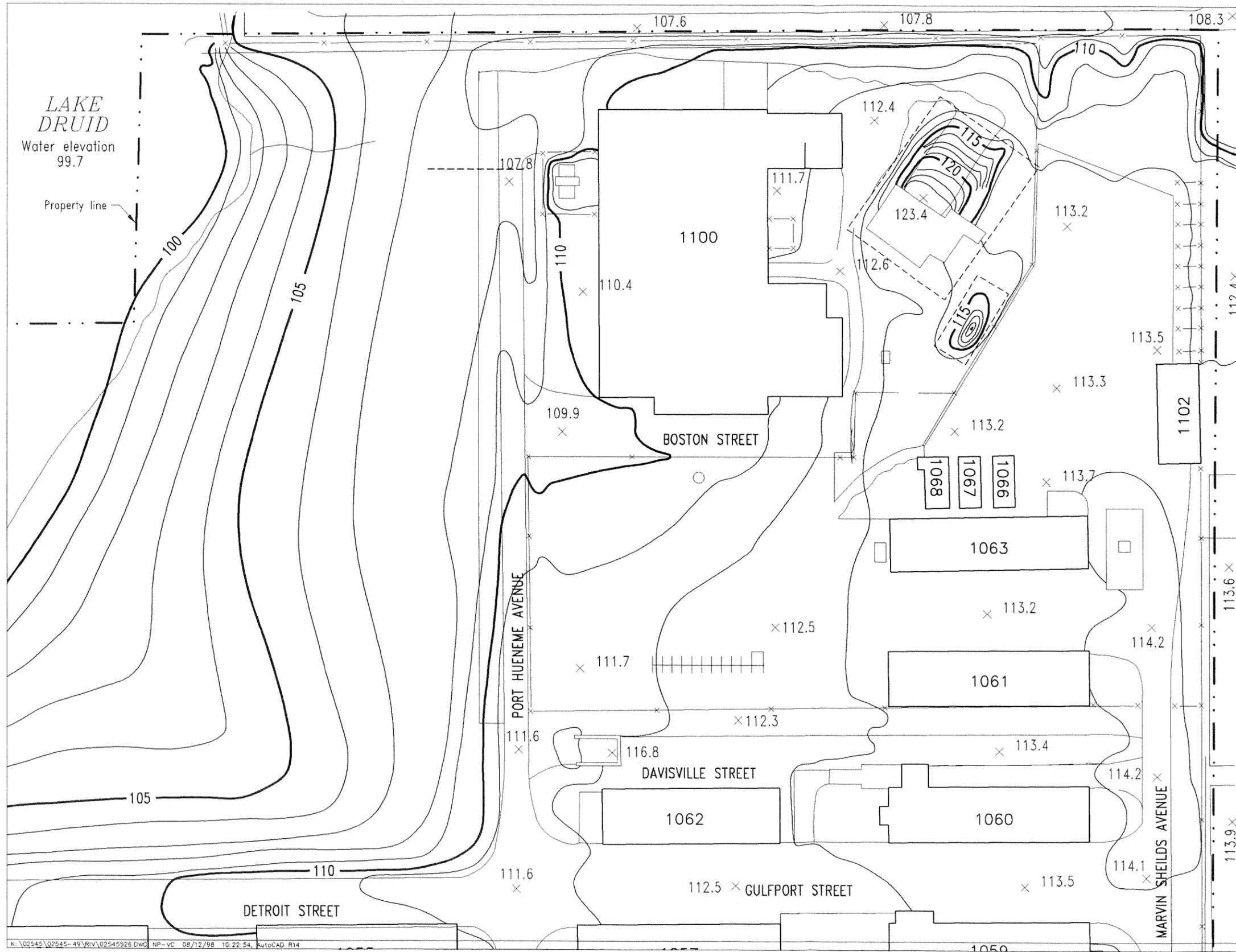
3.1 PHYSIOGRAPHY. Central Florida is situated within the Atlantic Coastal Plain physiographic province as defined by Brooks (1971). Most of the city of Orlando, and all of the NTC, Orlando property, is contained within the Highland topographic region, where elevations are generally greater than 105 feet above mean sea level (msl). The land surface across most of the area is generally flat; the higher ground elevations exist in the west side of the county and decrease gradually eastward. The elevation ranges from near 175 feet above msl in the western part of the county to approximately 100 feet msl in the east.

The physiographic foundation of central Florida is the Florida Structural Platform, upon which Cretaceous-, Tertiary-, and Quaternary-aged carbonates have been deposited. The carbonates are overlain by unconsolidated clastic sediments composed primarily of clay- to sand-size grains and organic material. Dissolution along the upper surface of the underlying carbonates has resulted in the present landform which is characterized by closed surface depressions and, if the water table is of sufficient elevation, shallow sinkhole lakes.

At Area C the surface elevation ranges from 110 to 115 feet msl throughout most of the eastern and southern parts of the property (Figure 3-1). In the northwest corner of the property the land surface slopes gently westerly down toward Lake Druid. Near the lake the land surface elevation measures approximately 100 feet msl.

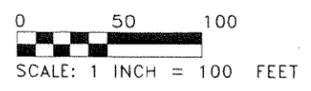
3.2 CLIMATE. The climate of the Orlando area is characterized as humid and semitropical. According to the U.S. Department of Commerce (1994), the average annual temperature is approximately 71.5 degrees Fahrenheit (°F). The range in daily average temperatures varies from approximately 50°F in January to 80°F in July. The prevailing winds blow from the west and south. The average annual rainfall in Orange County is 51.4 inches. Most of the rainfall occurs during afternoon thundershowers during the period from June through September. During the summer months, thunderstorms occur at a frequency of every other day, and may yield several inches of rainfall. Rainfall amounts from thunderstorms vary widely. Winters typically are mild and dry. Potential evaporation for the area is estimated at a maximum value of 46 inches per year based on meteorological factors such as solar radiation, wind movement, air temperature, and humidity.

The Orlando area is subject to tropical storms and, on a lesser scale, tornadoes. Tropical storms are likely to occur between June through November. Tornadoic activity occurs infrequently and is associated with both thunderstorms and tropical storms. Inland, the greatest impact from tropical storms is from prolonged rains that may cause flooding. Tropical storms that produce such flooding are considered equivalent to storm events of 100-year frequency.



LEGEND

- Structure removed; topography no longer accurate.
- Elevation contour (1-foot interval)
- Ground elevation



SOURCE: Naval Training Center Public Works Department, Storm Sewer Map, 1978

**FIGURE 3-1
TOPOGRAPHIC MAP OF
OPERABLE UNIT 4**



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3.3 SURFACE WATER HYDROLOGY. Surface drainage is poor across most of the undeveloped areas of central Florida, but generally flows toward the south and east. The largest local drainage feature is the Little Econlockhatchee River, located approximately 4 miles to the east. The Little Econlockhatchee River flows northeastward and eventually drains into the St. Johns River. All surface waters in the vicinity of NTC, Orlando are classified by the State of Florida as Class III waters suitable for fish and wildlife propagation and water contact sports (Department of Navy [DON], 1992).

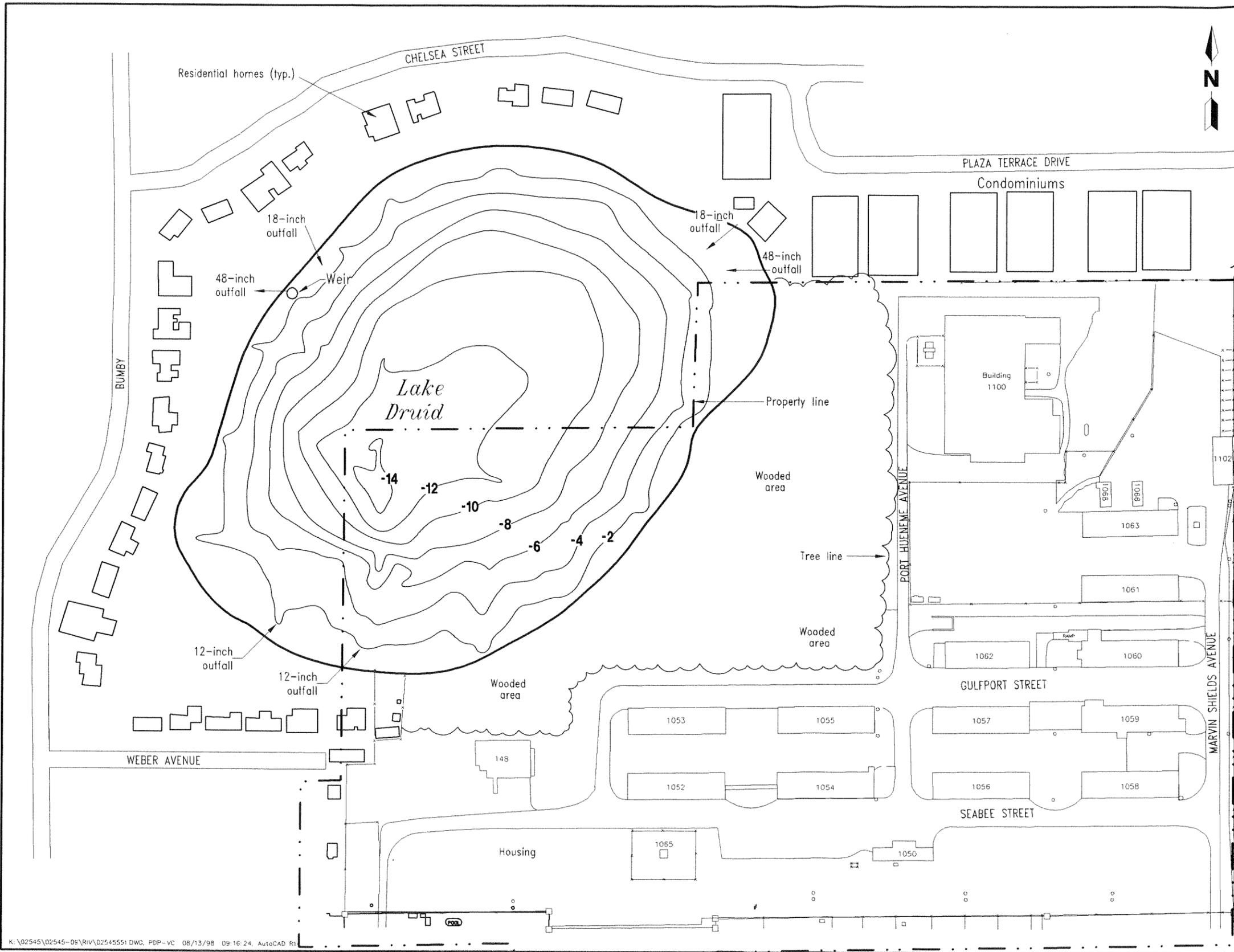
The major surface water feature at Area C is Lake Druid, which straddles the western boundary of the property. The lake captures storm runoff through the storm drainage system of the surrounding neighborhoods and small, intermittent streams. The Lake Druid basin area is approximately 150 acres. Storm water outfalls include an 18 inch and a 48 inch outfall at the northeast corner of the lake, two 12 inch outfalls at the southwest end, and an 18 inch outfall on the northwest shoreline (Figure 3-2). The 48 inch outfall collects stormwater from up to 1000 feet away, including the Koger Center office park located east of Area C. Lake level is maintained by a weir at a 48 inch discharge on the northwest shoreline. Lake Druid overflow water is piped from this location to Lake Rowena, located approximately 0.75 mile to the northwest.

Bathymetry data on file with the city of Orlando's Stormwater Utility Bureau indicate that the lake covers over 800,000 square feet (approximately 18 acres) (Figure 3-2). The lake reaches a maximum depth of approximately 15 feet in the south-central part, and has a mean depth of approximately seven feet. In 1996, the average elevation of the lake was 101.1 feet, National Geodetic Vertical Datum.

No stormwater runoff from Area C is discharged directly to Lake Druid. No catch basins are present on the property. The primary means of stormwater control is by infiltration. Stormwater does collect in a drainage swale east of Port Hueneme Avenue, and from there is directed through a culvert into the wooded area to the west. Stormwater infiltrates through the wooded area, and during particularly heavy rains flows overland toward Lake Druid, located approximately 200 feet further west.

3.4 SURFACE SOIL. According to the U.S. Soil Conservation Service (U.S. Department of Agriculture, 1989), the native soil at the NTC, Orlando property is composed predominantly of sand-size particles that were deposited as marine terraces. All of the surficial soil beneath Area C is classified into a unit called the Basinger Sand. The Basinger Sand is typically found along the edges of freshwater marshes and swamps. The soil generally drains poorly and typically has a layer of organic-rich material in the upper foot.

3.5 GEOLOGY. Information presented in the following sections was compiled from a review of regional literature (Lichtler, et al., 1968), and from direct observations in the field during the RI investigation.



Lake Druid Bathymetric Parameters

Maximum length	1,260 feet
Maximum width	860 feet
Mean width	660 feet
Water surface area	833,000 square feet
Lake bottom surface area	834,000 square feet
Volume	208,000 cubic yard
Maximum depth	14.6 feet
Mean depth	6.7 feet
Relative depth	1.4 percent
Shoreline	3,400 feet

LEGEND

-2 Lake depth in feet

0 100 200
SCALE: 1 INCH = 200 FEET

**FIGURE 3-2
LAKE DRUID
BATHYMETRIC DETAIL WITH
ASSOCIATED SURFACE WATER FEATURES**

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3.5.1 Regional The upper 2,000 feet or so of the subsurface in central Florida is divided into three separate lithologic units (Figure 3-3).

- The surficial deposits are a thin (generally less than 100 feet) sequence of undifferentiated clastic terrace deposits of Recent and Pleistocene age.
- The underlying Hawthorn Group is a thin (generally less than 100 feet) sequence of mixed unconsolidated clastic material and carbonates of Miocene age.
- The Hawthorn Group overlies a thick (more than 1,200 feet) sequence of Eocene-age marine carbonates. The carbonate sequence is divided into three units: the Ocala Group, the Avon Park Limestone, and the Lake City Limestone. The major regional characteristics of these units is addressed in detail below.

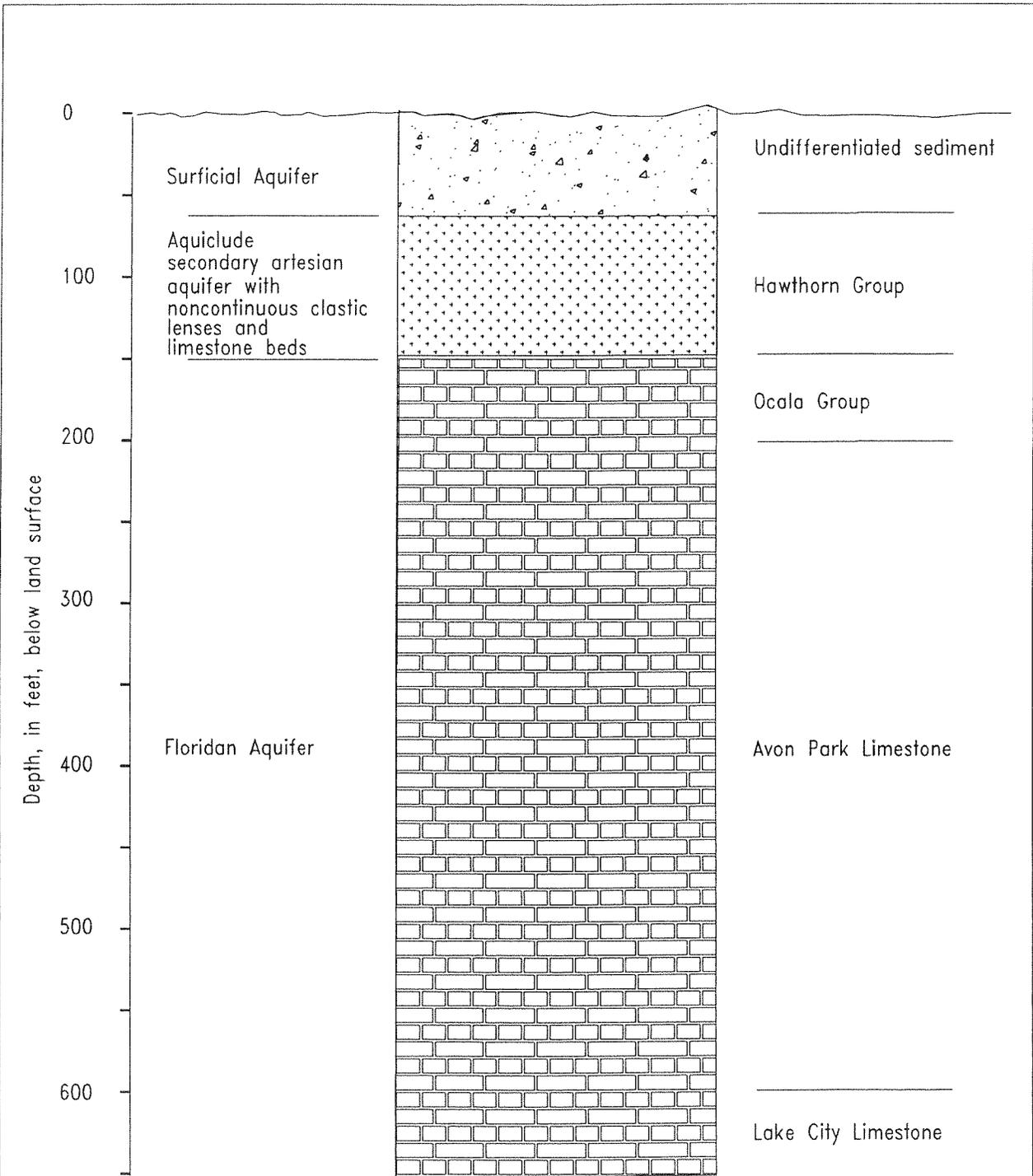
3.5.1.1 Surficial Deposits The surficial deposits consist predominantly of quartz sand with varying amounts of silt- and clay-sized grains, and shell fragments. The lithology of these deposits varies laterally and vertically in most areas. Red iron oxide-cemented fine sand sediment, referred to locally as "hardpan", is common in the upper reaches of the surficial deposits. The sediment ranges from 50 to 100 feet thick over most of the region. The thickest accumulation of sediment exists along the ridge of the Florida peninsula and thins toward the coast.

3.5.1.2 Hawthorn Group The Hawthorn Group is typically described as a gray-green calcareous, phosphatic sandy clay, and clayey sand interbedded with thin discontinuous lenses of phosphatic sand, phosphatic sandy limestone, limestone, and dolostones. The limestone and dolostone lenses are thicker and more prevalent near the base of the Hawthorn section. Phosphate is present throughout the sediment of the Hawthorn Group. The most common carbonate components of the Hawthorn Group are dolomite and dolosilt. Clay minerals associated with the Hawthorn Group sediment include smectite, illite, palygorskite, and kaolinite (Scott, 1988).

The Hawthorn Group averages approximately 100 feet in thickness over most of central Florida. The unit thickens progressively southward and measures over 600 feet in thickness in south Florida. Conversely, the Hawthorn thins appreciably to the north and, in some areas of northeast and northwest Florida, the unit is absent.

3.5.1.3 Marine Carbonate Sequence The marine carbonate sequence consists of three units: the Ocala Group, the Avon Park Limestone, and the Lake City Limestone.

The Ocala Group consists of cream- to tan-colored, fine- to medium-grained limestone of variable hardness, which is locally dolomitic. This unit varies in thickness from 0 feet (not present) to 125 feet. The Ocala Group is further divided into the Crystal River Formation, the Williston Formation, and the Inglis Formation. The Crystal River Formation is a white to cream, chalky, massive fossiliferous limestone and is the shallowest Eocene formation underlying the area. The Williston Formation, which lies conformably between the overlying Crystal River Formation and the underlying Inglis Formation, is a tan to buff,



Source: Lichtler, et al., 1968

FIGURE 3-3
GENERALIZED HYDROSTRATIGRAPHIC COLUMN



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granular limestone. The Inglis Formation, of early late Eocene age, is lithologically a tan to buff, calcitic limestone that is very similar to the Williston Formation.

The Avon Park Limestone, of late middle Eocene age, unconformably underlies the Ocala Group, and is composed of an upper section of cream to tan, granular limestone with abundant cone-shaped foraminifera and a lower section of mostly dense, hard, brown, crystalline dolomite. In total, this unit ranges from 400 to 600 feet in thickness.

The Lake City Limestone unconformably underlies the Avon Park Limestone and is early middle Eocene in age. It consists of alternating layers of dark brown crystalline dolomite and chalky, fossiliferous limestone. The total thickness of this unit exceeds 700 feet.

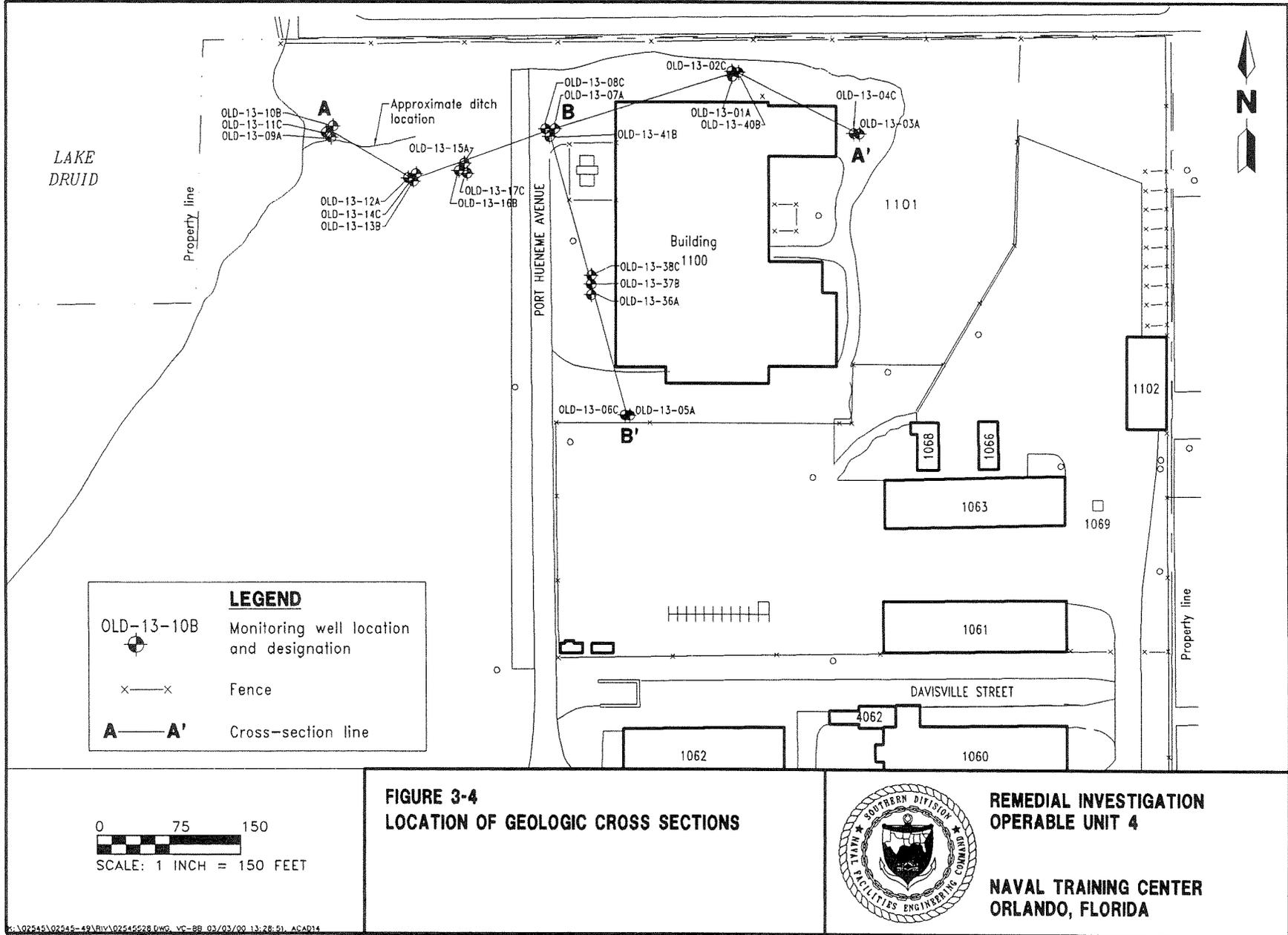
Below the Lake City Limestone is the Oldsmar Limestone of early Eocene age. It consists of a cream to brown, soft, granular limestone and cherty, glauconitic, massive to finely crystalline dolomite.

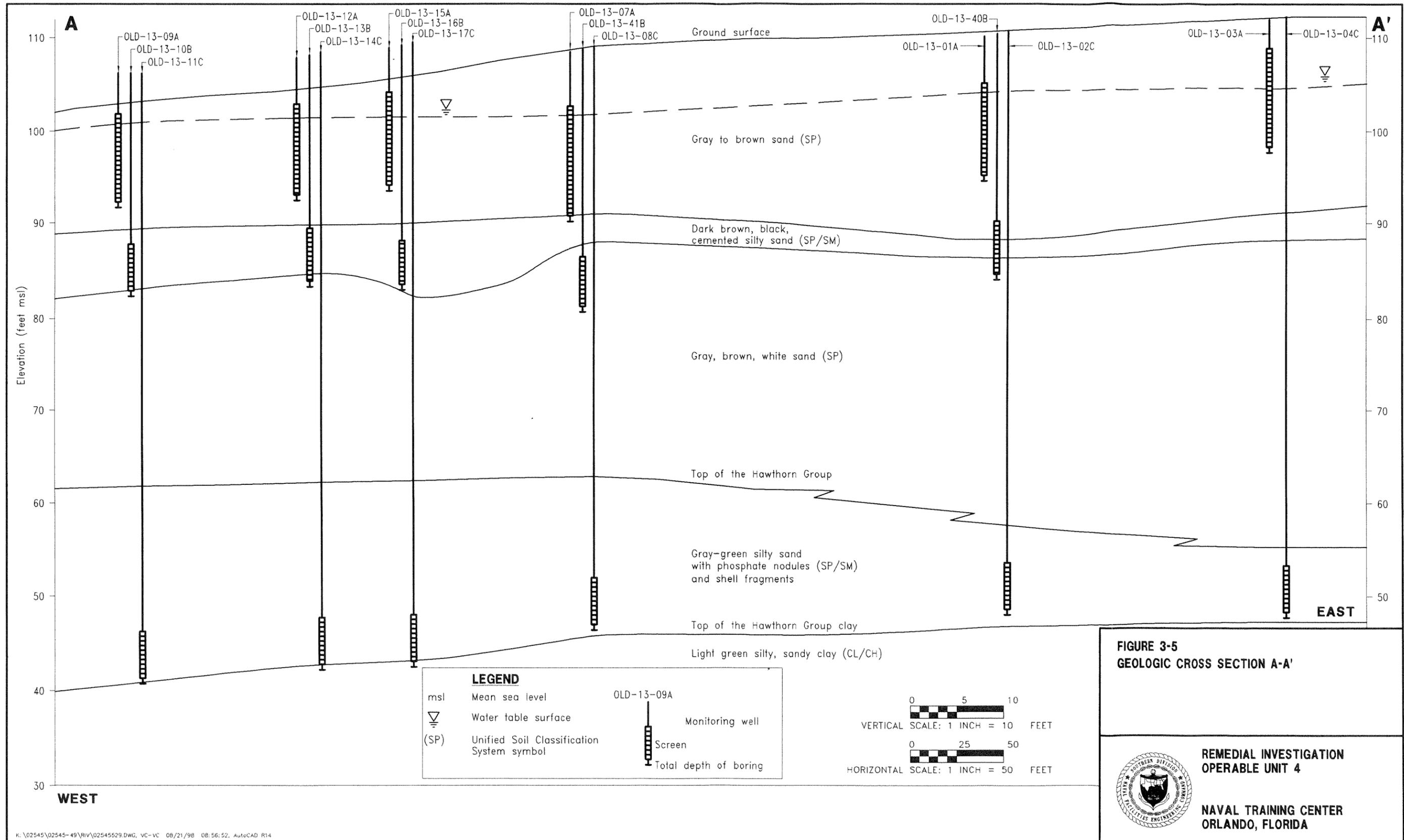
3.5.2 Local The subsurface exploration activities during the investigation at Area C included the undifferentiated surficial deposits and the upper 30 feet or so of the Hawthorn Group sediment. The surficial deposits can generally be divided into three separate units based on differing color and textural characteristics. The shallowest unit is composed of light gray to light brown silty, fine-grained sand. The second unit is a dark brown to black, silty, fine-grained sand, which is cemented to varying degrees. This unit ranges anywhere from two to 10 feet in thickness. The third unit is a gray, yellow, and white to tan silty, fine-grained sand with intermingled layers of gray clayey silt. All three units are continuous across the site.

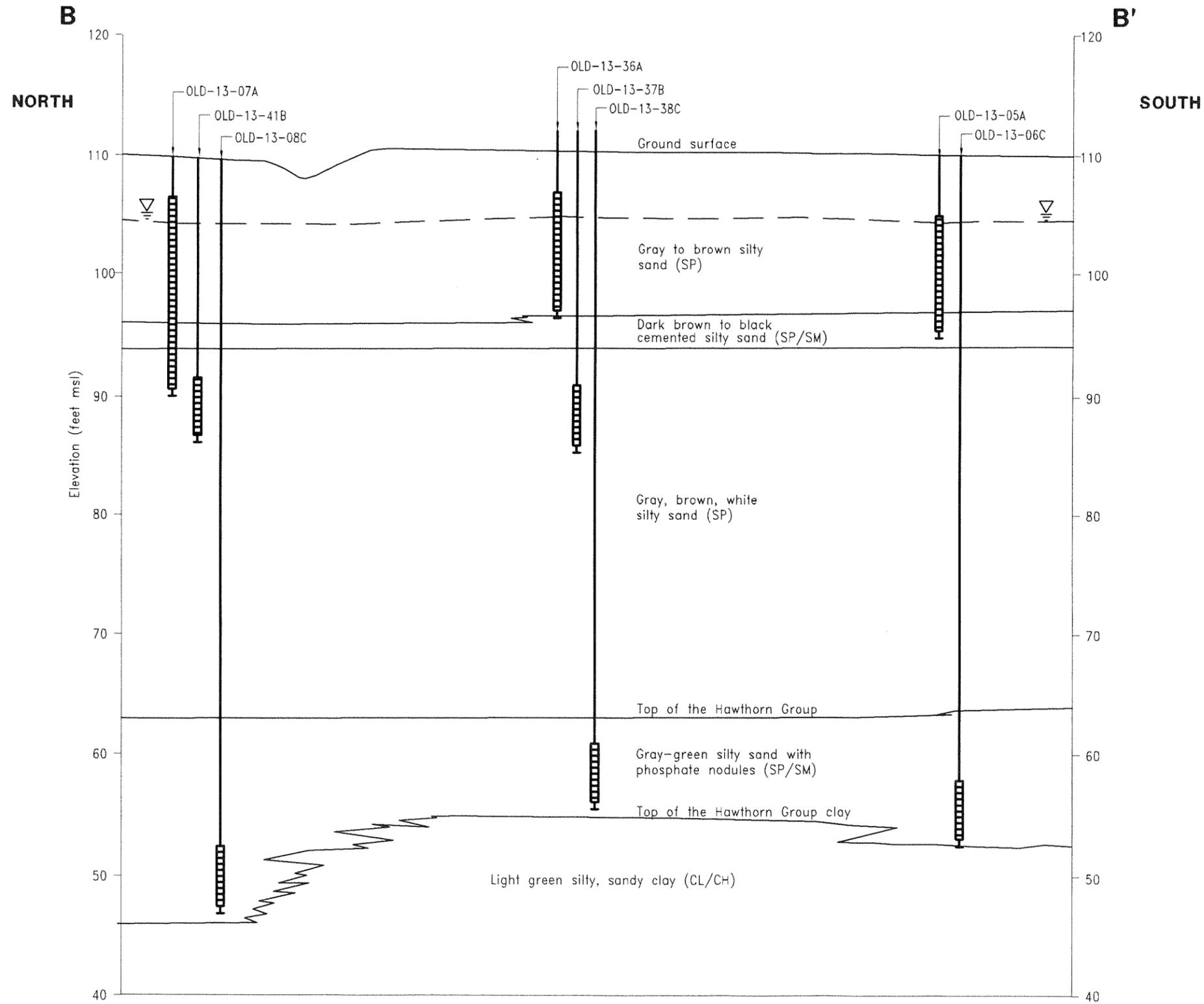
The Hawthorn Group sediments can be divided into two units within the study area. One is a greenish-gray silty fine to coarse sand with phosphate nodules and shell fragments. This unit comprises the upper 10 to 20 feet of the Hawthorn Group throughout the study area. The second unit is a greenish-gray, silty clayey sand with intermingled layers of clay, of varying degrees of plasticity. This unit was also observed at every subsurface exploration where the Hawthorn Group sediment was penetrated.

The upper surface of the Hawthorn Group is irregularly shaped and dips generally westward across the study area. The surface was encountered at a depths ranging from 50 to 60 feet bls in the higher elevated parts of the site, and from 40 to 50 feet bls on the west side. The upper 10 to 15 feet of the Hawthorn Group in the study area is composed primarily of coarse-grained sand with varying percentages of silt, shell, and phosphate nodules. The second unit is a greenish-gray silty, sandy clay, with intermingled layers of clayey silty and sand. The clay is variable in plasticity.

The lithologic data collected at selected soil boring locations were used to construct two geologic cross sections (designated A-A' and B-B', located on Figure 3-4). Cross section A-A' provides a west-to-east profile from the eastern edge of Lake Druid to just east of Building 1100 (Figure 3-5). Cross section B-B' provides a north-to-south profile from the northwest corner side of Building 1100 to the south-central boundary of OU 4 (Figure 3-6).







LEGEND

msl Mean sea level

▽ Water table surface

(SP) Unified Soil Classification System symbol

OLD-13-07A

Monitoring well

Screen

Total depth of boring

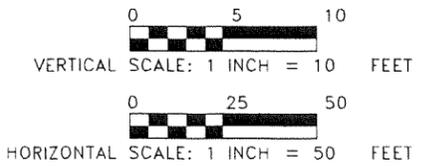


FIGURE 3-6
GEOLOGIC CROSS SECTION B-B'



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The cross sections demonstrate that the surficial deposits at OU 4 range in thickness from 40 to 50 feet. The deposits are thickest near Building 1100 and thin gradually westward in the direction of Lake Druid. The surficial deposits may be further subdivided into three units. The shallowest unit is approximately 20 feet in thickness on the east side of the area, and decreases to 12 feet in some areas near the lake. The cemented sand unit retains a consistent thickness of 5 to 8 feet throughout most of the study area. Approximately midway between Building 1100 and the lake, the unit measures over 12 feet in thickness. The lowest unit measures approximately 20 feet in thickness on the west side of the area and approximately thirty feet on the east side.

The upper sand unit of the Hawthorn Group measures a maximum thickness of approximately 20 feet on the far west side of the study area. The unit decreases in thickness to approximately 10 feet on the east and south sides of the site. The sand unit is underlain everywhere by the clay unit. The thickness of the clay layer could not be determined because no subsurface exploration completely penetrated the unit.

3.6 HYDROGEOLOGY. A description of the regional and site-specific hydrogeology of the area is provided below. The information was compiled from regional literature and from direct observations and measurements made in the field during the RI investigation.

3.6.1 Regional According to regional literature (Lichtler, et al., 1968), three distinct aquifer systems corresponding to the three major stratigraphic divisions are found in this area of central Florida: the surficial aquifer, an intermediate aquifer, and the Floridan aquifer system. The surficial or, shallow, aquifer is an unconfined porous flow system within the unconsolidated surficial deposits. The intermediate aquifer occurs where the clastic deposits of the Hawthorn Group are sufficiently permeable to allow groundwater flow. The solution openings associated with bedding planes, cracks, and fissures within the Eocene carbonate sequence provides space for the groundwater of the Floridan aquifer system (Figure 3-3). A description of each of the aquifer systems is presented below.

3.6.1.1 Surficial Aquifer The surficial aquifer is present throughout central Florida. With the exception of isolated areas where impermeable units may impede flow, the surficial aquifer is an unconfined groundwater system. The aquifer boundaries generally correspond to those of the undifferentiated surficial deposits. In some areas, such as at OU 4, The surficial aquifer extends into the upper part of the Hawthorn Group sediment. This occurs where a section of coarser-grained sediment is present above a confining clay layer.

The potentiometric surface of the surficial aquifer corresponds generally to the water table surface, and typically ranges in depth from 5 to 15 feet bls. The water table surface is at its deepest point (greater than 20 feet, on average) along the central Florida ridge and is shallowest near the coast. The potentiometric surface of the surficial aquifer (i.e., the water table) fluctuates with seasonal variation in rainfall and proximity to recharge and discharge areas. Seasonal fluctuations range from a few feet in eastern Orange County, where the topography is predominantly flat, to approximately 15 feet in the highland areas on the west side of the county.

Topography is the predominant factor controlling the configuration of water table surface, hence, the direction and velocity of the groundwater movement within the surficial aquifer. The general flow pattern in central Florida is eastward from the western highlands to the lower areas in the St. Johns River valley. The surficial aquifer is recharged primarily by local precipitation, with a limited exchange with the underlying intermediate and Floridan aquifers. Discharge of the surficial aquifer occurs by evapotranspiration, seepage into surface water bodies, and downward leakage into the underlying Hawthorn aquifer. Groundwater from the surficial aquifer is of marginal quality and is used primarily for irrigation purposes, not as a potable supply.

3.6.1.2 Intermediate Hawthorn Aquifer Groundwater within the intermediate Hawthorn aquifer is contained within the clastic lenses and limestones of the Hawthorn Group. Limestone layers in the upper part of the Hawthorn are typically the most productive. The coarser-grained horizons are not continuous over the extent of the aquifer and are not extensively utilized as a water supply source. This aquifer is recharged from both the overlying surficial aquifer and underlying Floridan aquifer. The Hawthorn Group generally acts as a confining bed to the underlying Floridan aquifer.

3.6.2 Floridan Aquifer System The Floridan aquifer system is the principal source of freshwater in central Florida. The groundwater is contained within the sequence of Eocene carbonates (the Ocala Group, the Avon Park Limestone, and the Lake City Limestone) and is capable of storing large amounts of groundwater. Transmissivities greater than 150,000 gallons per day per foot have been reported (Lichtler, et al., 1968). The two major water producing zones in the Floridan aquifer in this region lie within the Avon Park Limestone and Lake City Limestone. The Avon Park zone lies anywhere from 150 feet to 600 feet bls, and the Lake City zone lies approximately 1,100 to 1,500 feet bls. The lower zone is the primary water supply source for the city of Orlando.

The Eocene carbonate sequence is folded on a megascopic scale. The units dip in a southerly direction throughout central and southern Florida. Lateral groundwater flow within the Floridan aquifer generally conforms to the configuration of the producing zones and moves in the down-dip direction. Lateral flow is locally altered in areas where large amounts of water are pumped. The potentiometric surface of the Floridan aquifer exists at elevations ranging from 40 to 60 feet above msl in the Orlando area, resulting in a net downward hydraulic gradient between the Floridan and surficial aquifers and a net upward gradient between the Floridan and Intermediate aquifers. Recharge to the Floridan aquifer is by direct rainfall in those areas of north Florida where the limestones of the aquifer outcrop at the land surface. Discharge occurs by pumping from supply wells and leakage to the overlying Hawthorn aquifer.

3.6.3 Site-Specific Hydrogeology The investigation into the hydrogeology of the study area was limited to the surficial aquifer. In order to determine the direction of groundwater flow within the surficial aquifer, a map of the potentiometric surface was generated by measuring the water-level elevation at all of the monitoring wells in the study area. Water elevation measurements were also made at staff gauges and piezometers installed in Lake Druid to determine the hydraulic relationship between the surficial aquifer and the surface water. Slug tests were performed at selected wells to determine the hydraulic conductivity and, in turn, to support the evaluations of groundwater flow characteristics within the aquifer.

3.6.3.1 **Potentiometric Surface Mapping** Water-level measurements were made twice during the RI investigation on January 14, 1998 and April 23, 1998. The survey results are presented in Table 3-1. The water-level data were used to generate the potentiometric surface maps presented on Figures 3-7 and 3-8.

The potentiometric surface of the surficial aquifer mimics the topographic surface within the study area. In the higher, flat areas to the east and south, the water table is generally flat, and lies between six to eight feet bls. On the northwest side of the area, where the land surface slopes toward Lake Druid, the water table surface also dips westward, but at a more shallow angle than that of the land surface. As a result, the water table is progressively shallower toward the lake, and eventually intersects with the lake's surface. In the higher elevated parts of the study area, the water table surface dips at an average horizontal gradient of 0.003 feet per foot (ft/ft). The horizontal gradient increases to approximately 0.013 ft/ft on the west side of the study area. The overall average for the site is 0.008 ft/ft.

The water-level elevation data were also used to evaluate the hydraulic potential within the surficial aquifer at OU 4. Vertical gradients were calculated based on the relationship between water-level elevations (potentiometric head) and screen depths (elevation head). These vertical gradients, along with the corresponding potentiometric head measurements from the shallow, intermediate, and deep units of the surficial aquifer, are presented in Table 3-2. The data indicate that vertical gradients do exist within the surficial aquifer at OU 4; ranging from calculated gradients of 0.008 ft/ft (downward) to 0.0 ft/ft (vertical equilibrium) to 0.025 ft/ft (upward). Generally, downward gradients represent recharge areas within an aquifer and upward gradients represent a discharge relationship.

Vertical gradients calculated from April 1998 data were plotted and contoured on OU 4 site maps and provided as Figures 3-9 and 3-10. In the area of Building 1100 and several of the suspected sources of contamination, a slight downward potential exists. Contaminants released or seeping into the subsurface soil are likely to have migrated downward under these recharge conditions. West of Building 1100 and Port Hueneme Avenue, head potential reverses and vertical gradients progressively increase toward Lake Druid.

Groundwater, along with any dissolved contaminants, within the surficial aquifer discharges into Lake Druid from these three (shallow, intermediate, and deep) aquifer units. Groundwater discharge to Lake Druid was confirmed by potentiometric head measurements made in drive points installed into the lake bottom as well as by the contaminant distribution pattern found in the lake sediments. More details regarding contaminant distribution are discussed in Chapter 5.0. Specifics regarding the fate and transport of COCs are presented in Chapter 7.0.

The effects of the IRA recirculation wells can be seen on Figure 3-10. In the central wooded area west of Port Hueneme Avenue, the upward gradient is relatively strongest in the vicinity of OLD-13-15A. Here, the upward gradient has been hydraulically increased by the system's injection of treated groundwater into the intermediate/deep surficial aquifer units through the lower screens of the recirculation wells (UVB-1 and UVB-2).

3.6.3.2 **Hydraulic Conductivity Test Results** Falling head (slug-in) and rising head (slug-out) hydraulic conductivity tests were performed at a total of nine

**Table 3-1
Water-Level Elevation Survey**

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Well Identifier	Well Depth (feet bls)	Screened Interval Elevation (ft msl) ¹	Top-of-Casing Elevation (ft msl) ¹	Depth to Water (ft btoc)		Water-Level Elevation (ft msl) ¹	
				1/14/98	4/23/98	1/14/98	4/23/98
OLD-12-01A	15	96.5 to 106.5	110.97	5.16	5.74	105.81	105.23
OLD-12-02A	15	98.1 to 108.1	112.90	6.76	7.30	106.14	105.60
OLD-12-03A	15	98.5 to 108.5	113.34	7.15	7.06	106.19	106.28
OLD-12-04A	15	97.7 to 107.7	112.47	7.30	8.06	105.17	104.41
OLD-13-01A	15	95.4 to 105.4	110.22	4.68	5.32	105.54	104.90
OLD-13-02C	62	48.3 to 53.3	109.90	4.36	5.02	105.54	104.88
OLD-13-03A	14	98.1 to 108.1	111.88	6.81	-	105.07	-
OLD-13-04C	64	48 to 53	111.83	5.95	6.56	105.88	105.27
OLD-13-05A	15	95.5 to 105.5	110.20	4.95	5.66	105.25	104.54
OLD-13-06C	57	53.5 to 58.5	109.98	4.99	5.60	104.99	104.38
OLD-13-07A	18.5	90.5 to 105.5	108.71	4.02	4.71	104.69	104.00
OLD-13-08C	62	46.9 to 51.9	108.67	4.14	4.75	104.53	103.92
OLD-13-09A	11	92.5 to 102.5	105.99	3.71	4.06	102.28	101.93
OLD-13-10B	21	82.5 to 87.5	105.87	3.51	3.78	102.36	102.09
OLD-13-11C	62	41.1 to 46.1	105.98	3.31	3.65	102.67	102.33
OLD-13-12A	11.5	93.4 to 103.4	107.17	4.06	4.28	103.11	102.89
OLD-13-13B	21	83.9 to 88.9	107.69	4.34	4.68	103.35	103.01
OLD-13-14C	62	42.7 to 47.7	107.93	4.38	4.88	103.55	103.05
OLD-13-15A	12.5	93.7 to 103.7	108.74	4.60	5.34	104.14	103.40

See notes at end of table.

Table 3-1 (Continued)
Water-Level Elevation Survey

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center
 Orlando, Florida

Well Identifier	Well Depth (feet bls)	Screened Interval Elevation ¹ (ft msl)	Top-of-Casing Elevation ¹ (ft msl)	Depth to Water (ft btoc)		Water-Level Elevation (ft msl) ¹	
				1/14/98	4/23/98	1/14/98	4/23/98
OLD-13-16B	23	83.0 to 88.0	108.95	4.91	5.58	104.04	103.37
OLD-13-17C	63	42.9 to 47.9	109.08	4.97	5.61	104.11	103.47
OLD-13-18B	31.5	81.1 to 87.1	112.72	7.29	7.94	105.43	104.78
OLD-13-19B	20.5	92.1 to 98.1	112.74	7.30	7.95	105.44	104.79
OLD-13-20B	20	91.1 to 97.1	111.45	6.34	7.01	105.11	104.44
OLD-13-21B	32	74.4 to 79.4	108.67	4.65	5.23	104.02	103.44
OLD-13-22B	32	72.8 to 77.8	107.05	4.05	4.08	103.00	102.97
OLD-13-23B	31	73.2 to 78.2	106.37	3.63	4.02	102.74	102.35
OLD-13-24A	12.7	92.2 to 102.2	106.85	4.09	4.67	102.76	102.18
OLD-13-25B	23.5	81.3 to 86.3	107.00	4.13	4.64	102.87	102.36
OLD-13-26A	13	96.7 to 102.7	109.53	4.40	5.07	105.13	104.46
OLD-13-27A	15.5	97.6 to 106.6	112.91	6.50	7.08	106.41	105.83
OLD-13-OW1 (OLD-13-28B)	35	69.9 to 74.9	107.69	4.37	4.85	103.32	102.84
OLD-13-OW2 (OLD-13-29B)	35	70.5 to 75.5	108.14	4.81	5.29	103.33	102.85
OLD-13-OW3 (OLD-13-30B)	34	74.1 to 79.1	110.57	6.81	7.30	103.76	103.27
OLD-13-OW4 (OLD-13-31B)	35	69.9 to 74.9	107.37	4.20	4.65	103.17	102.72

See notes at end of table.

**Table 3-1 (Continued)
Water-Level Elevation Survey**

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Well Identifier	Well Depth (feet bls)	Screened Interval Elevation ¹ (ft msl)	Top-of-Casing Elevation ¹ (ft msl)	Depth to Water (ft btoc)		Water-Level Elevation (ft msl) ¹	
				1/14/98	4/23/98	1/14/98	4/23/98
				OLD-13-OW5 (OLD-13-32B)	35	73.6 to 78.6	111.38
OLD-13-OW6A	11.3	94.2 to 99.2	108.07	--	5.09	--	102.98
OLD-13-OW7C	45	60.5 to 65.5	107.83	--	4.77	--	103.06
OLD-13-OW8A	11.2	93.9 to 98.9	107.54	--	4.58	--	102.96
OLD-13-OW9C	44.4	60.9 to 65.9	107.72	--	4.66	--	103.06
OLD-13-OW10A	11.2	94 to 99	107.70	--	4.75	--	102.95
OLD-13-OW11C	45	60.3 to 65.3	107.71	--	4.65	--	103.06
OLD-13-33A	12.5	92.6 to 102.6	108.35	5.51	6.13	102.84	102.22
OLD-13-34B	25	80.1 to 85.1	108.27	5.42	5.94	102.85	102.33
OLD-13-35C	56	49.2 to 54.2	108.34	5.46	5.98	102.88	102.36
OLD-13-36A	14	96.6 to 106.6	113.45	8.65	9.34	104.80	104.11
OLD-13-37B	25	85.7 to 90.7	113.49	8.73	9.38	104.76	104.11
OLD-13-38C	55	55.6 to 60.6	113.45	8.68	9.34	104.77	104.11
OLD-13-39B	25	87.9 to 92.9	115.68	9.59	10.17	106.09	105.51
OLD-13-40B	25	85.4 to 90.4	110.30	4.75	5.40	105.55	104.90
OLD-13-41B	28	80.9 to 85.9	108.61	4.10	4.71	104.51	103.90
OLD-13-42B	28	81.1 to 86.1	108.82	4.20	4.81	104.62	104.01
OLD-13-43C	50	58.8 to 63.8	108.00	3.59	4.18	104.41	103.82

See notes at end of table.

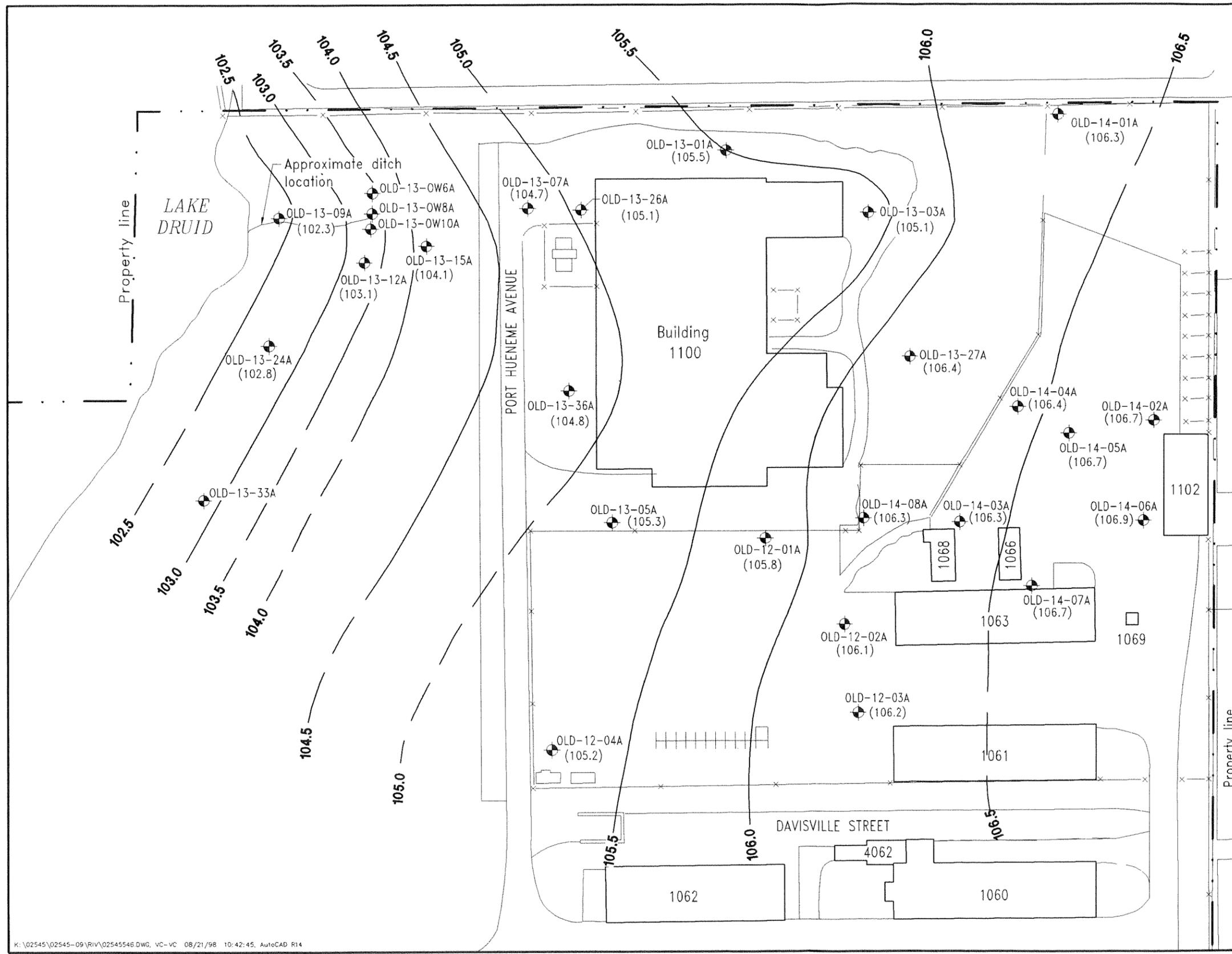
Table 3-1 (Continued)
Water-Level Elevation Survey

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Well Identifier	Well Depth (feet bls)	Screened Interval Elevation ¹ (ft msl)	Top-of-Casing Elevation ¹ (ft msl)	Depth to Water (ft btoc)		Water-Level Elevation (ft msl) ¹	
				1/14/98	4/23/98	1/14/98	4/23/98
OLD-14-01A	13	96.2 to 106.2	109.00	2.67	3.21	106.33	105.79
OLD-14-02A	15	98.8 to 108.8	113.66	6.96	7.39	106.70	106.27
OLD-14-03A	15	98.6 to 108.6	113.29	6.97	7.48	106.32	105.81
OLD-14-04A	15	98.5 to 108.5	113.33	6.92	7.42	106.41	105.91
OLD-14-05A	15	98.9 to 107.9	113.60	6.92	7.39	106.68	106.21
OLD-14-06A	15	98.9 to 107.9	113.72	6.85	7.25	106.87	106.47
OLD-14-07A	15	99.2 to 108.2	114.06	7.40	7.87	106.66	106.19
OLD-14-08A	15	98.2 to 107.2	113.03	6.73	7.26	106.30	105.77
OLD-13-DP1	NA	98.0 to 99.0	104.01	1.81	2.06	102.20	101.95
OLD-13-DP2	NA	98.8 to 99.8	104.78	3.36	3.52	101.42	101.26
OLD-13-DP3	NA	99.2 to 100.2	105.15	3.66	3.86	101.49	101.29
OLD-13-DP5	NA	98.7 to 99.7	104.68	2.40	3.45	102.28	101.23
OLD-13-DP11	NA	--	--	1.95	2.00	-	-

¹ U.S. Geological Survey, North American Datum, 1929.

Notes: ft = feet.
bls = below land surface.
msl = mean sea level.
btoc = below top of casing.
-- = not measured.
NA = not applicable.



LEGEND

- OLD-13-27A
 (106.4)

Monitoring well location and designation

Water-level elevation (in feet above mean sea level)
- 102.5

Groundwater elevation contour (in feet above mean sea level; dashed where inferred)
- Fence

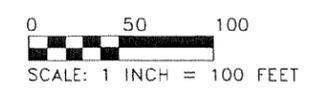
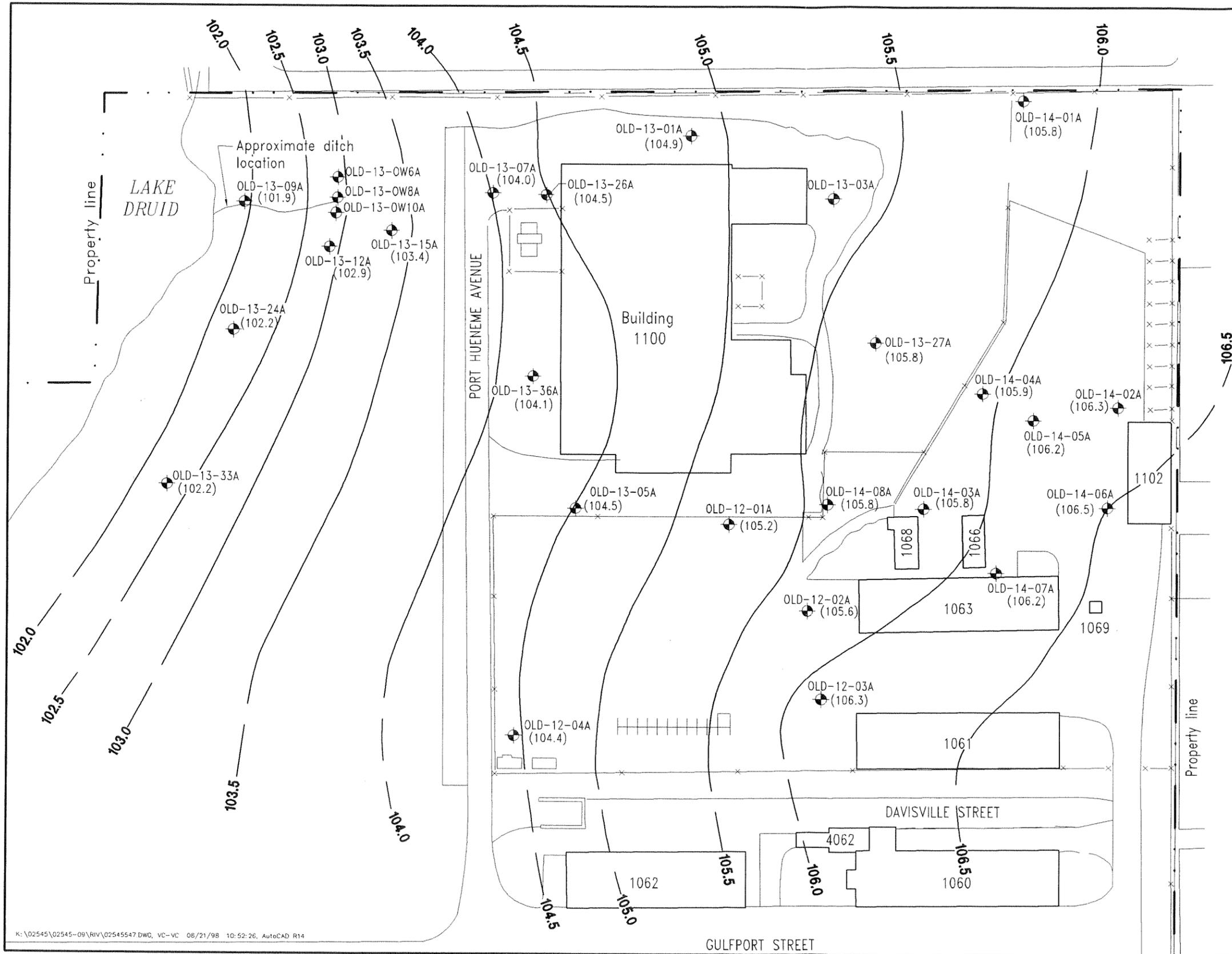


FIGURE 3-7
POTENTIOMETRIC SURFACE MAP
JANUARY 1998

REMEDIAL INVESTIGATION
OPERABLE UNIT 4

NAVAL TRAINING CENTER
ORLANDO, FLORIDA



LEGEND

- OLD-13-27A
 (106.4)
 Monitoring well location and designation
Water-level elevation (in feet above mean sea level)
- 102.5
 Groundwater elevation contour (in feet above mean sea level; dashed where inferred)
- Fence

SCALE: 1 INCH = 100 FEET

FIGURE 3-8
POTENTIOMETRIC SURFACE MAP
APRIL 1998

REMEDIAL INVESTIGATION
OPERABLE UNIT 4

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

**Table 3-2
Hydraulic Potential Survey Results**

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Well Identifier	Water-Level Elevation (feet msl)		Elevation of Midpoint of Well Screen (feet msl)	Head Potential Measurements (feet)			
	January 14, 1998	April 23, 1998		January 14, 1998		April 23, 1998	
				Vertical Gradient (ft/ft) ¹	Direction of Hydraulic Potential	Vertical Gradient (ft/ft) ¹	Direction of Hydraulic Potential
OLD-13-01A	105.54	104.90					
OLD-13-40B	105.55	104.90	87.90	0.0005	Upward	0	At equilibrium
OLD-13-02C	105.54	104.88	48.80	0.0005	Downward	0.0005	Downward
OLD-13-07A	104.69	104.00					
OLD-13-41B	104.51	103.90	83.40	0.008	Downward	0.005	Downward
OLD-13-08C	104.53	103.92	47.40	0.0005	Upward	0.0005	Upward
OLD-13-09A	102.28	101.93					
OLD-13-10B	102.36	102.09	85.30	0.005	Upward	0.01	Upward
OLD-13-11C	102.67	102.33	44.60	0.008	Upward	0.014	Upward
OLD-13-12A	103.11	102.89					
OLD-13-13B	103.35	103.01	86.40	0.014	Upward	0.007	Upward
OLD-13-14C	103.55	103.05	45.20	0.005	Upward	0.0009	Upward
OLD-13-15A	104.14	103.40					
OID-13-16B	104.04	103.37	85.50	0.005	Downward	0.002	Downward
OLD-13-17C	104.11	103.47	45.40	0.004	Upward	0.025	Upward
OLD-13-33A	102.84	102.22					

See notes at end of table.

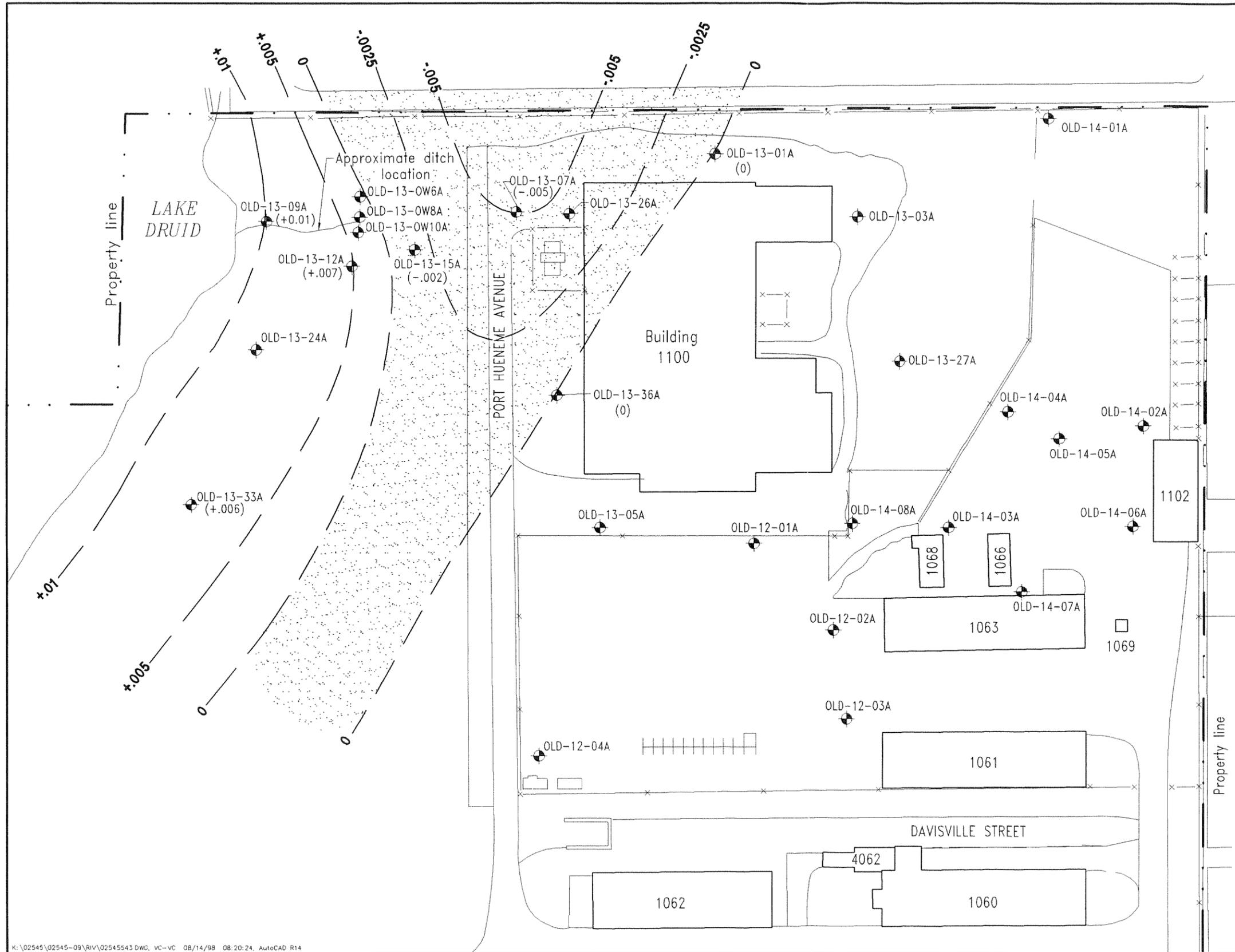
Table 3-2 (Continued)
Hydraulic Potential Survey Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Well Identifier	Water-Level Elevation (feet msl)		Elevation of Midpoint of Well Screen (feet msl)	Head Potential Measurements (feet)			
	January 14, 1998	April 23, 1998		January 14, 1998		April 23, 1998	
				Vertical Gradient (ft/ft) ¹	Direction of Hydraulic Potential	Vertical Gradient (ft/ft) ¹	Direction of Hydraulic Potential
OLD-13-34B	102.85	102.33	83.60	0.0005	Upward	0.006	Upward
OLD-13-35C	102.88	102.36	51.90	0.0009	Upward	0.0009	Upward
OLD-13-36A	104.80	104.11					
OLD-13-37B	104.76	104.11	88.20	0.003	Downward	0	At equilibrium
OLD-13-38C	104.77	104.11	58.10	.0003	Upward	0	At equilibrium

¹ Calculated by dividing the difference between the elevation of the water-level in each monitoring well by the elevation of the midpoint of the respective well screens.

Notes: ft = feet.
msl = mean sea level.
ft/ft = feet per foot.



LEGEND

- OLD-13-27A Monitoring well location and designation
- (+.005) Vertical gradient reading (positive for upward, negative for downward)
- 0 Vertical gradient contour (dashed where inferred)
- x—x Fence

- NOTES:**
1. Contours are interpreted from data at well/piezometer cluster and overlays of the data.
 2. Shaded areas indicate areas with a downward gradient.

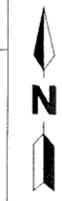
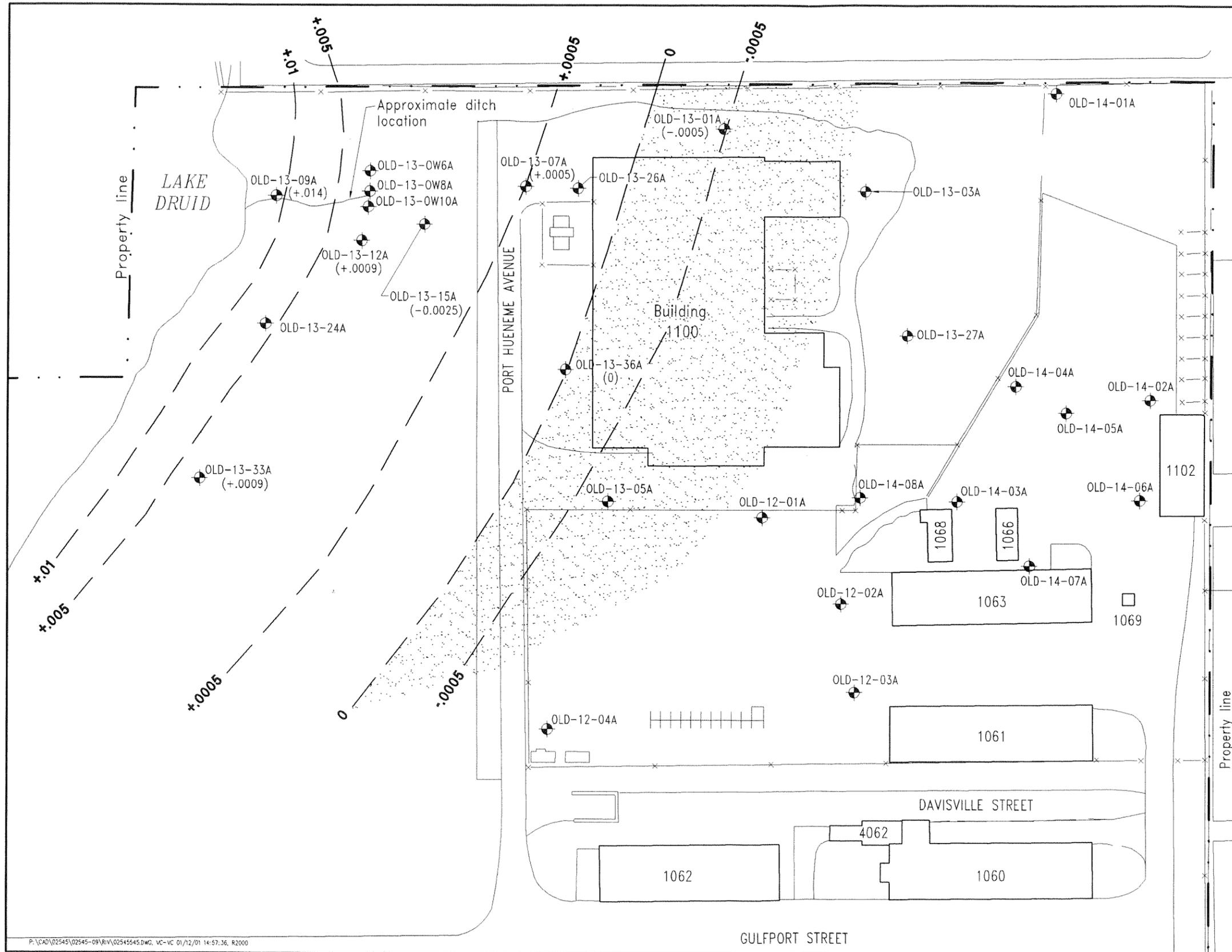


FIGURE 3-9
CONTOUR MAP OF VERTICAL GRADIENT
SHALLOW TO INTERMEDIATE UNITS
APRIL 1998



REMEDIAL INVESTIGATION
OPERABLE UNIT 4

NAVAL TRAINING CENTER
ORLANDO, FLORIDA



LEGEND

OLD-13-09A Monitoring well location and designation
 (+.014) Vertical gradient reading (positive for upward, negative for downward)
 0 Vertical gradient contour (dashed where inferred)
 x—x Fence

- NOTES:**
1. Contours are interpreted from data at well/piezometer cluster and overlays of the data.
 2. Shaded areas indicate areas with a downward gradient.

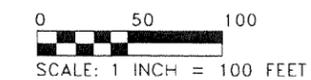


FIGURE 3-10
CONTOUR MAP OF VERTICAL GRADIENT
INTERMEDIATE TO DEEP UNITS
APRIL 1998

REMEDIAL INVESTIGATION
OPERABLE UNIT 4

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

monitoring wells during the investigation. A representative sample of the shallow (rising head test only), intermediate, and deep wells were targeted to provide hydraulic conductivity values throughout the surficial aquifer. The test results are presented in Table 3-3. Slug test data were plotted and analyzed using computer software (Aqtesolv™). The slug test plots are provided in Appendix K.

Two shallow monitoring wells were selected for permeability testing. The geometric mean hydraulic conductivity value for the two wells was 1.1×10^{-3} centimeters per second (cm/sec). The mean conductivity value for the five intermediate wells tested was 1.5×10^{-3} cm/sec, and the mean for the two deep wells tested was 4.2×10^{-3} cm/sec. These values converted to 3.0, 7.4, and 11.8 ft/day, respectively, for the three intervals.

Although the hydraulic conductivity values were somewhat higher in the intermediate and deep intervals, all of the values fall within a relatively narrow range, suggesting that the surficial aquifer in the study area is relatively homogeneous. These results differ somewhat from those of the USGS (see subsection 2.5.3).

To provide a more conservative estimate of linear groundwater travel times, the hydraulic conductivity values determined by the USGS were evaluated in lieu of the lower conductivity values calculated using the slug test data. Calculations based on the USGS flow model yielded horizontal hydraulic conductivity (K_h) values of 10 ft/day (3.5×10^{-3} cm/sec) (upper layer, 0 to 20 feet bls) and 40 ft/day (1.4×10^{-2} cm/sec) (lower layer, 20 to 60 feet bls). These K_h values were combined with the average horizontal gradient measured for each depth interval of the aquifer to determine linear groundwater flow velocities. The flow rate calculations are based on the following equation for Darcy's Law (Bouwer and Rice, 1976):

$$V = Ki/p$$

where: V = groundwater flow velocity (ft/day),
 K = hydraulic conductivity (ft/day),
 i = hydraulic gradient (ft/ft), and
 p = porosity (unitless), assuming .30 for sand aquifers (Fetter, 1980).

An average horizontal gradient of 0.008 ft/ft was calculated for each depth interval.

Using this formula, the average linear groundwater flow rates for the upper and lower units of the surficial aquifer in the study area were calculated to be:

<u>Depth (feet bls)</u>	<u>K_h (ft/day)</u>	<u>V (ft/day)</u>	<u>V (ft/year)</u>
0 to 20	10	0.27	97
20 to 60	40	1.1	390

The horizontal hydraulic conductivity values were also used to calculate the transmissivity of the aquifer, using the formula $T = bK$ (where T = transmissivity [ft²/day], b = the saturated thickness of the aquifer [ft], and K = the hydraulic conductivity [ft/day]):

**Table 3-3
Hydraulic Conductivity Testing Results**

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Monitoring Well Identifier	Geologic Unit	Calculated Hydraulic Conductivity ¹		
		ft/min	ft/day	cm/sec
Shallow Well:				
OLD-13-33A	Fine sand	1.8×10 ³	2.6	9.0×10 ⁴
OLD-13-36A	Fine sand	2.5×10 ³	3.6	1.3×10 ³
<u>Geometric Mean:</u>		2.2×10 ³	3.1	1.1×10 ³
Intermediate Well:				
OLD-13-34B	Fine to medium sand	2.8×10 ²	40.3	1.4×10 ²
OLD-13-37B	Fine to medium sand	3.1×10 ³	4.5	1.6×10 ³
OLD-13-39B	Silty fine sand	1.02×10 ³	1.5	5.1×10 ⁴
OLD-13-40B	Silty fine sand	6.2×10 ⁴	0.9	3.1×10 ⁴
OLD-13-41B	Fine to medium sand	5.2×10 ³	7.3	2.6×10 ³
<u>Geometric Mean:</u>		1.4×10 ²	20.2	7.0×10 ³
Deep Well:				
OLD-13-35C	Fine to medium sand	4.8×10 ³	6.9	2.4×10 ³
OLD-13-38C	Fine sand	1.4×10 ²	20.2	7.0×10 ³
<u>Geometric Mean:</u>		9.4×10 ³	13.3	4.7×10 ³

¹ Both falling head (slug-in) and rising head (slug-out) tests were performed at each intermediate and deep monitoring well. Hydraulic conductivity shown above was calculated by averaging the two test values. Only rising head tests were performed at the shallow wells.

Notes: ft/min = feet per minute.
ft/day = feet per day.
cm/sec = centimeters per second.

	<u>b (ft)</u>	<u>K_p (ft/day)</u>	<u>T (ft²/day)</u>
Upper Layer (0 to 20 feet bls)	25	10	250
Lower Layer (20 to 60 feet bls)	40	40	1,600

Thus, the total transmissivity of the aquifer is 1,850 ft²/day.

3.7 DEMOGRAPHY AND LAND USE. Area C occupies 46 acres and is located approximately 1 mile west of the Main Base off Maguire Boulevard. Area C is surrounded by urban development with multifamily residential development to the north, an office park to the east, single family residences to the west and south, and a single family residential development to the west, across Lake Druid. No industrial facilities exist adjacent to Area C. According to City of Orlando records, no permitted irrigation or domestic wells are present within the vicinity of OU 4. Similarly, there are no production wells within 1/2 mile of OU 4.

3.8 ECOLOGICAL SETTING. The ecological setting of OU 4 was characterized based on information gathered from historical information summarized in the OU 4 RI/FS Workplan (ABB-ES, 1997d) and an ecological survey conducted by HLA ecologists in October 1997. The guidance used to conduct the ecological survey is described in Subsection 2.6.6. Results are summarized in Section 9.1.

4.0 DATA MANAGEMENT

4.1 DATA COLLECTION AND TRANSFER. Sampling methodologies are described in detail in the POP (ABB-ES, 1997b) and the OU 4 RI/FS Workplan (ABB-ES, 1997d). Observations and field parameter measurements, such as groundwater temperature and turbidity, were recorded in the field logbook and/or on the appropriate field data records.

The majority of soil, groundwater, surface water, and sediment samples collected during the RI effort at OU 4 were submitted to a fixed-base (off-site) laboratory for analysis. CompuChem Laboratory of North Carolina performed the analyses. During the DPT program (which is summarized in Subsection 2.6.1), groundwater samples were screened on site for 10 target VOCs using a GC. Confirmatory samples were submitted to the fixed-base laboratory at a rate of approximately 1 in 10. The results of the DPT program were used to direct the placement of additional permanent monitoring wells. DPT data were not used in the OU 4 risk assessment.

As described in Chapter 2.0, OU 4 has been the subject of several investigative programs. Some of these results have been used to supplement the data collected during the RI. These instances are described in greater detail in Section 4.4.

Samples submitted to the fixed-base laboratory were preserved on site prior to shipment. These samples were transported under chain-of-custody to the laboratory, on ice in coolers, via Federal Express.

4.2 DATA VALIDATION. Analytical results for the various media sampled at OU 4 during the RI were combined into a unified analytical database, following a review of data quality. The analytical data were independently validated by Environmental Data Services of Concord, New Hampshire. Analytical data not subjected to independent data validation (primarily data collected during previous investigations at OU 4) were informally reviewed in-house by a senior chemist.

Data quality indicators include the precision, accuracy, representativeness, completeness, and comparability (PARCC) of the analytical data on a per-medium basis. In general, the combined data set complied with PARCC criteria, and is considered acceptable for use in this RI and to support an FS. The analytical data, including Positive Detection Tables and complete Laboratory Analytical Data, are presented as Appendices C and D, respectively.

Details of the PARCC Criteria Evaluation Report can be found in Appendix N. The PARCC Report summarizes the results of the data quality assessment according to the PARCC parameters relative to the project-specific DQOs. The analytical data packages from CompuChem Laboratory (North Carolina) conform to Naval Facilities Engineering Service Center (NFESC) Level C method requirements, and were validated at NFESC Level C requirements by Environmental Data Services (New Hampshire).

Quality control (QC) samples included trip blanks, equipment rinsate blanks, field source blanks, method blanks, laboratory control samples, surrogate spikes,

matrix spike/matrix spike duplicate samples, laboratory duplicates, and field duplicates.

Prior to the PARCC evaluation, the data were validated according to the functional guidelines for organic and inorganic data (USEPA, 1994b and 1994c). Samples that did not meet functional guideline acceptance criteria were qualified with a data quality flag (see Appendix N, page 2). Upon completion of the review and qualification of the data according to the functional guidelines, the data were then evaluated using PARCC criteria to provide an evaluation of overall data useability.

Precision, completeness, and comparability requirements were acceptable for all sample delivery groups according to NFESC requirements. Accuracy and representativeness for all sample data groups were also acceptable within certain qualifications made in some cases, as detailed in the PARCC report. Many of these qualifications were made on the basis of low-level contamination found in laboratory method blanks and field blanks. Additional details regarding data useability are provided in Appendix N.

4.3 DATA EVALUATION. The combined data set was also subjected to data evaluation. Data evaluation differs from data validation in that the latter deals only with the adherence of the analytical process to protocol specifications, whereas data evaluation considers the environment from which the analyzed sample was collected, the means of collection, as well as the characteristics of data considered to be within the same data set and knowledge of the compound's behavior in the area of the investigation. Data evaluation is discussed below.

- Evaluation for the presence of chemicals that may not be true detections and may have been introduced during decontamination, field sampling, or laboratory analysis (analytical and sampling artifacts). These chemicals include acetone, methylene chloride, toluene, 2-butanone, five phthalate esters (butylbenzylphthalate, di-*n*-butylphthalate, di-*n*-octylbutylphthalate, diethylphthalate, and bis (2-ethylhexyl)phthalate (USEPA, 1991d; 1988c). These contaminants, when analytical artifacts, are either introduced during analysis or during decontamination of sampling equipment. The lack of a discernable pattern of contamination, the lack of a potential source, or the presence of low levels (below practical quantitation limits) of these chemicals in some locations (especially without any other detection of a related compound, e.g., other ketones for acetone or other aromatics for toluene) may indicate that these chemicals are artifacts.
- An evaluation of OU 4 data against facility background data as published in the *Background Sampling Report* (ABB-ES, 1995).

Data interpretation was aided by the use of several graphics as tools. These included geologic cross sections (Figures 3-5 and 3-6), site maps, and other figures.

4.4 DATA SET DEVELOPMENT. The data set used in the RI included background data, site screening data, IRA performance monitoring data, and data collected as part of the RI field investigation.

4.4.1 Background Data As part of the overall NTC, Orlando environmental investigation activities, a basewide background sampling program was conducted to establish background concentrations of inorganics in surface soil, subsurface soil, and groundwater matrices. The background comparison provides a method of establishing the range of concentrations over which inorganic compounds naturally fluctuate. Detected concentrations can be compared to this range of concentrations. The *Background Sampling Report* (ABB-ES, 1995) summarizes the native concentrations of inorganics occurring in surface soil, subsurface soil, and groundwater.

4.4.2 Site Screening Data Site screening data for surface and subsurface soil were used to supplement data collected during the RI. The combination of these two data sets provided a thorough and comprehensive evaluation of soil at OU 4. The site screening data are summarized in Appendix C, and can be identified by sampling dates that occurred in 1995. These data are presented in detail in the *Site Screening Report* (ABB-ES, 1996a). All site screening samples were analyzed in accordance with USEPA CLP protocol.

Site screening data for two other NTC, Orlando lakes (Lakes Baldwin and Susannah) were also used to augment the single control sample collected from Lake Druid. The use of the lake control data is discussed in detail in Chapter 9.0.

4.4.3 IRA Performance Monitoring Program The IRA Performance Monitoring Program included a baseline sampling phase for VOCs prior to system startup, followed by periodic monitoring of groundwater downgradient of the recirculation wells. Analyses were performed using SW846 Method 8021. In general, VOC in groundwater data collected within four months of the RI sampling effort were included in the OU 4 RI data set. When several samples were collected from the same location during a 3- to 4-month period (as occurred during performance monitoring), the laboratory results were averaged to provide a single value (see Section 4.5). These results are summarized in Appendix C for each medium. Performance monitoring data are evaluated in detail in the *OU 4 Interim Remedial Action, Performance Monitoring and Sampling Plan, Quarterly Report #1* (ABB-ES, 1998a).

4.5 STATISTICAL CALCULATIONS. At many sample locations, multiple samples were collected. For example, up to six rounds of groundwater sampling were conducted at certain OU 4 monitoring wells. For purposes of the risk assessments, multiple sample results were averaged to produce a single value for each location. Where an analyte was not detected above its method detection limit (MDL), a value equal to one half of its MDL was used to calculate the average.

4.6 ON-SITE LABORATORY CONFIRMATORY SAMPLING PROGRAM. The overall precision and variability of the field screening program were assessed through the use of split samples analyzed by both the HLA field laboratory and a certified off-site laboratory. Approximately 10 percent of the environmental samples collected were sent to the off-site laboratory. A total of 19 groundwater samples (including two field duplicates) was included in the confirmatory sampling program. These data are summarized in Appendix C.

Presented below is an evaluation of the analytical results for these samples. On-site samples were analyzed for purgeable VOCs using the field screening methodology described in the *OU 4 RI Workplan* (ABB-ES, 1997d). Groundwater

samples were analyzed off-site for low level VOCs, using the *Superfund Analytical Method for Low Concentration Organics Analysis* (October, 1992). Off-site laboratory results conform to Level D (USEPA Level IV) requirements and were independently reviewed and validated by a subcontractor against Level C requirements using (NEESA) guidance document 20.2-047B, entitled *Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Program* (NEESA, 1988).

4.6.1 Off-Site Data Comparison Methodology Because there are no specific review criteria for split samples in both the NEESA and USEPA CLP documents, the laboratory duplicate precision criteria are utilized in this evaluation. It should be noted; however, that the use of this evaluation procedure may be overly conservative. Split samples measure comparability of field and laboratory results; therefore, the results may have more variability than laboratory duplicates, which measure only laboratory performance. Another source of variability is the different methods used in the analysis, i.e., GC (on-site) versus gas chromatography/mass spectroscopy (off-site).

The duplicate precision criteria have been routinely used in the NEESA and USEPA CLP to evaluate comparability of laboratory duplicate samples. The same approach can be applied to field duplicates and split samples. Precision is a measure of the agreement or repeatability of a set of replicate results obtained from duplicate laboratory analyses of samples collected from the same location or depth interval. Precision is a quantitative measure that is expressed as the relative percent difference (RPD) between analytical values for two samples from the same source divided by the average of their analytical values. RPD is calculated using the equation

$$RPD = \frac{D_1 - D_2}{\frac{1}{2} (D_1 + D_2)} \times 100 \quad (1)$$

where D_1 and D_2 are the reported values for the duplicate samples.

Laboratory duplicate precision criteria specify that RPDs be no greater than ± 20 percent for water samples when both sample results are greater than five times the contract-required quantitation limit (CRQL). It should be noted that primarily because of the greater variability expected in field duplicates, some USEPA regional offices (e.g., Region II) specify that field duplicates be qualified as estimated if RPD is greater than 100 for paired data where sample and duplicate are both greater than five times the CRQL.

If the sample and/or duplicate is less than five times the CRQL, the absolute difference criteria ($|D|$), $|D_1 - D_2|$, where D_1 and D_2 are the reported values for the duplicate samples, are used. Field duplicates are qualified as estimated if the absolute difference between the analytical values is greater than the CRQL for water samples. No calculations are made if both sample and duplicate are below quantitation limits; i.e., the nondetected parameter pairs are considered to be within control limits.

For this evaluation, the acceptance criteria for evaluating precision of field duplicates is an RPD of 20 for water matrices. For sample results where one or both samples are below five times CRQL, the absolute difference criteria of less than the CRQL for water samples is used. A CRQL value of 10 $\mu\text{g}/\ell$ is used as the

proxy concentration for nondetected parameters in the calculation of absolute difference.

4.6.2 Statistical Comparison of On-Site and Off-Site Laboratory Results A comparison of the field screening results and the off-site laboratory results for VOCs is presented in Table 4-1. Only those compounds with at least one detection in at least one sample (field lab or off-site laboratory) are shown and evaluated. If all nondetected compounds analyzed in both the on-site and off-site laboratories are included in the calculations, the percentage of parameter pairs that are out of control for either the RPD or absolute difference criteria is significantly reduced.

Samples for off-site analysis were often chosen before field GC results were available. The RI DPT program was used to complete characterization of OU 4, which had already undergone several investigative programs. No VOCs were detected in many of the groundwater samples collected via DPT. For these reasons, VOCs were not detected in several of the 19 groundwater pairs submitted for both on-site and off-site analysis. This limited the confirmatory sampling comparison to only the seven pairs shown in Table 4-1.

Five out of the seven samples have at least one parameter pair outside of control limits. Only 5 out of 13 parameter pairs evaluated (39 percent of the total) failed the RPD or |D| criteria. However, the sample size was a small fraction of the total samples collected. Most of the pairs that failed the criteria did so because the VOC concentrations in the on-site samples were higher than the off-site laboratory. Although all VOC samples were preserved, these differences could be due to the longer hold time experienced by the samples shipped off-site. In no case did the off-site laboratory detect VOCs that had not been detected on-site, with the exception of acetone. Acetone was not analyzed with the on-site GC, and is believed to be an artifact of the off-site laboratory. Acetone has never been detected in groundwater collected from OU 4 monitoring wells, and is not believed to be present in OU 4 groundwater.

Table 4-1
Comparison of Analytical Results Between On-Site and Off-Site Laboratory
DPT Rig Groundwater Samples

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Identifier: Sample Date: Depth (feet bls):	U4Q03101 28-OCT-97 7 to 10	U4Q03101F 28-OCT-97 7 to 10		U4Q03101D 28-OCT-97 7 to 10	U4Q03101F 28-OCT-97 7 to 10		U4Q03303 29-OCT-97 17 to 20	U4Q03- 303F 29-OCT- 97 17 to 20		U4Q03305 30-OCT-97 27 to 30	U4Q03- 305F 30-OCT- 97 27 to 30	
	RPD or D			RPD or D			RPD or D			RPD or D		
Acetone	160	NA	--	280	NA	--	400 J	NA	--	4,900 J	NA	--
1,2-Dichloroethene (total)	5 J	2.4	2.6	3 J	2.4	0.6	160	200	22.2*	120 J	79	41.2*
Tetrachloroethene	--	--	--	--	--	--	42 J	50	8	42 J	10	32*
Trichloroethene	6 J	2.7	3.3	3 J	2.7	0.3	16 J	17	1	16 J	440	424*
See notes at end of table.												

Table 4-1 (Continued)
Comparison of Analytical Results Between On-Site and Off-Site Laboratory
DPT Rig Groundwater Samples

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center
 Orlando, Florida

Identifier: Sample Date: Depth (feet bls):	U4Q03307 30-OCT-97 37 to 40	U4Q03307F 30-OCT-97 37 to 40		U4Q03311 30-OCT-97 57 to 60	U4Q03311F 30-OCT-97 57 to 60		U4Q03802 31-OCT-97 12 to 15	U4Q03802F 31-OCT-97 12 to 15	
	RPD or D			RPD or D			RPD or D		
Acetone	340	NA	--	880	NA	--	220	NA	--
1,2-Dichloroethene (total)	--	--	--	--	--	--	--	--	--
Tetrachloroethene	32	31	1	--	1.3	8.7	53	78	38.2*
Trichloroethene	--	--	--	--	--	--	--	--	--

Sample identifiers ending in F (e.g., U4Q03101F) are split samples analyzed in the on-site laboratory, while sample identifiers without an F (e.g., U4Q03008) are split samples that were analyzed in an off-site laboratory.
 Analytical results are expressed in micrograms per liter ($\mu\text{g}/\ell$).

Notes: bls = feet below land surface.
 RPD = relative percent difference.
 |D| = absolute difference. Paired results evaluated using the RPD criteria include results where one or both detected results are below 5 times contract required quantitation limits (CRQL). The CRQL of 10 $\mu\text{g}/\ell$ is used as the proxy for nondetected parameters.
 -- = not detected.
 NA = not analyzed.
 J = reported concentration is estimated quantity.
 * = either the RPD or |D| criteria is exceeded for the particular pair.

5.0 NATURE AND EXTENT OF CONTAMINANTS

This chapter focuses on the nature and location of contaminants in the existing soil and groundwater at OU 4, and assesses the extent contamination is migrating into Lake Druid. This discussion uses the information discussed in the earlier chapters on regional and site-specific conditions (Chapter 3.0) and the physical and chemical data collected during the RI and previous investigations (Chapter 2.0).

A discussion of contaminant sources is presented in Section 5.1. In Section 5.2, contaminant assessment of the different media at OU 4 is presented. The nature and extent of contamination in the surface soil is discussed first, followed by contamination in subsurface soil, groundwater, and finally, Lake Druid. In this report, Lake Druid will be broken down into sediment assessment, surface water assessment, and groundwater assessment. Within each of these media, analytical fractions are discussed in the following order: VOCs, SVOCs, pesticides and PCBs, and inorganic analytes. Following the evaluation of each analytical fraction for a particular medium, a summary of relevant results and findings is presented.

5.1 SOURCES OF CONTAMINATION. A full account of the known history of the facility and the land use of the area comprising OU 4 is presented in the Facility Background section (Section 1.2), but the potential sources of contamination are discussed in more detail below.

The source of VOC contamination has been identified during the IRA process and confirmed during the RI as dry-cleaning solvents (i.e., PCE) associated with the industrial laundry and dry-cleaning facility during its operation from 1943 to 1994.

The probable contaminant source/release mechanisms at OU 4 are

- operational spills on the ground surface outside the building during the loading and unloading of containers of PCE (ranging from 5- to 55-gallon containers);
- leaks associated with the collection and conveyance of wastewater from laundry and dry-cleaning machines; and
- spills inside the building transferring to the environment via leaks in floor drains, drainpipes, and/or sanitary sewer pipe, and seeping into the subsurface.

Antimony is also present in groundwater. Potential sources of antimony include lead-acid batteries, munitions, and flame retardants for clothing. There is no evidence that munitions were ever present at OU 4. Batteries are an unlikely source, as no lead was detected in groundwater. It is likely, however, that the Navy laundry treated recruit clothing to make it flame retardant. Although a review of the final chemical inventory of the laundry and nearby buildings did not identify any such chemical, nor are there records of a release, this hypothesis remains the most probable.

5.2 CONTAMINATION ASSESSMENT. Analytical results of the RI field investigation are presented below, by medium.

5.2.1 Surface Soil Assessment To assess the quality of the surface soil, 32 surface soil samples (plus 3 duplicates) were collected from 0 to 2 feet bls for laboratory analysis. Nine of these 32 surface soil samples were collected during the initial site screening of SAs 12, 13, and 14 (ABB-ES, 1996a). Eleven additional surface soil samples were collected during the RI where voids in the data set existed, primarily in SA 13. Of these sample locations, three areas surrounding the samples (U4S006, U4S011, and U4S015) have been subsequently excavated as part of the surface soil IRA (see Section 2.7). The twelve remaining samples are confirmatory samples collected following the surface soil IRA excavation.

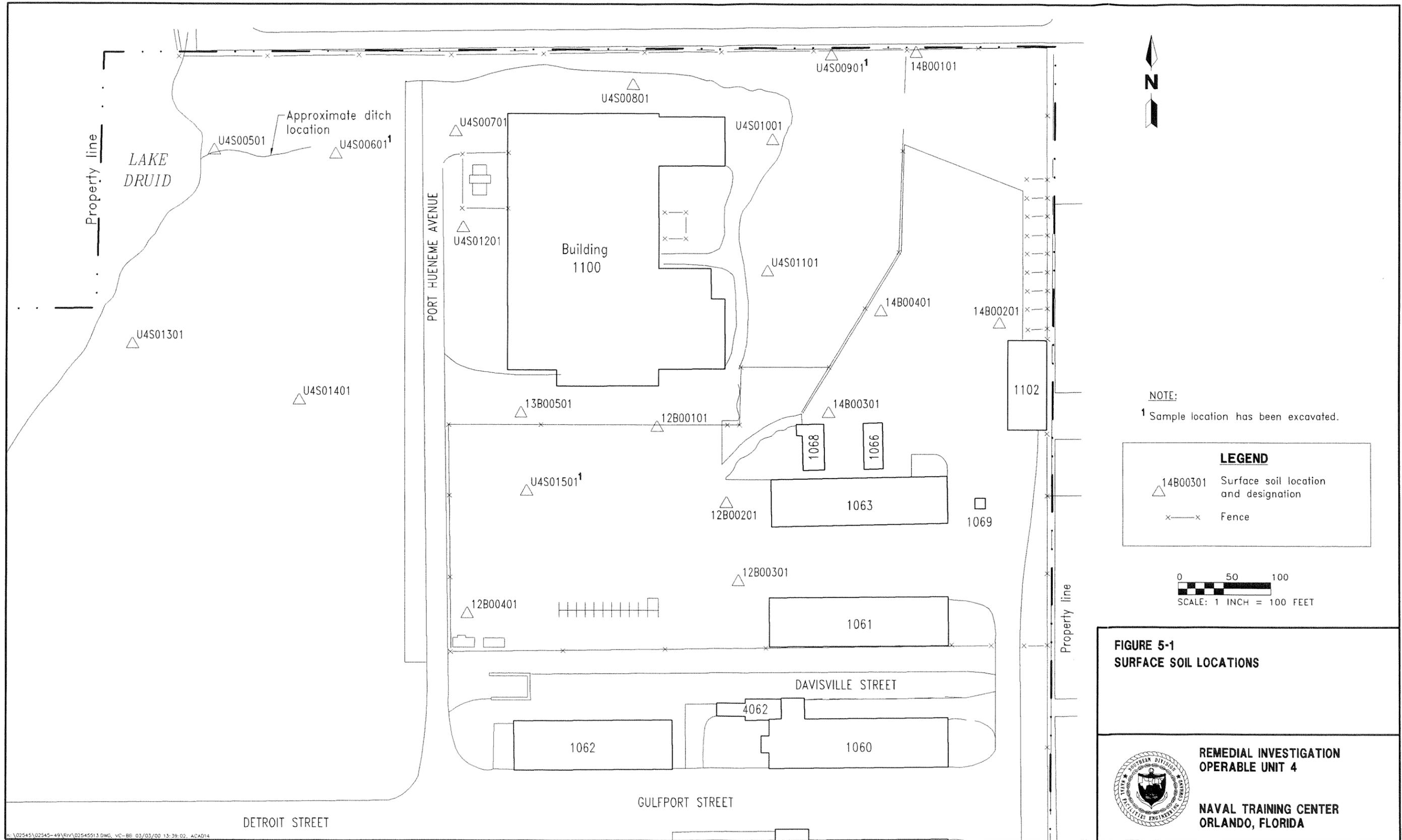
Twenty of the 32 samples were collected under the asphalt, while twelve were collected in grass or unpaved areas. The locations of the surface soil samples are shown on Figure 5-1. Analytes detected in surface soil are shown on Figure 5-2, and are discussed in Paragraphs 5.2.1.1 through 5.2.1.4. Positive detection tables are provided in Appendix C, and complete laboratory analytical results are provided in Appendix D. Data corresponding to excavated sample locations U4S006, U4S011, and U4S015 have been superseded by surface soil IRA confirmatory sample results. However, because the confirmatory samples were analyzed for only selected parameters, original (pre-excavation) results have been retained for parameters that were not re-analyzed.

Interpretation of the analytical data in terms of possible sources and the extent of compounds exceeding background are discussed in Paragraph 5.2.1.5. In order to focus the discussion on detected analytes or compounds which are site-related, a preliminary comparison to FDEP Residential SCTLs was made. In cases where particular compounds were detected in both soil and groundwater, FDEP leachability SCTLs based on groundwater criteria were also included in this preliminary comparison.

5.2.1.1 VOCs Twenty of the 32 surface soil samples and three duplicate samples were analyzed for VOCs. Table C-1 (Appendix C) lists the VOCs present in surface soil at OU 4 with corresponding residential SCTLs and, where applicable, leachability SCTLs. PCE was detected in 7 out of 20 surface soil samples at concentrations ranging from 1 to 110 $\mu\text{g}/\text{kg}$. Three locations, U4S00701 (61 $\mu\text{g}/\text{kg}$), U4S00801 (110 $\mu\text{g}/\text{kg}$), and U4S01001 (58 $\mu\text{g}/\text{kg}$) had exceedances of the leachability SCTL of 30 $\mu\text{g}/\text{kg}$ (Table C-1, Appendix C).

Toluene was detected 5 out of 20 surface soil samples at concentrations ranging from 1 to 2 $\mu\text{g}/\text{kg}$ (Table C-1, Appendix C). Total xylene was detected in 1 surface soil sample at 1 $\mu\text{g}/\text{kg}$. No detections of toluene or xylene exceeded SCTLs.

2-Hexanone was detected in one surface soil sample at 8 $\mu\text{g}/\text{kg}$ (Table C-1, Appendix C). Acetone was detected in 4 out of 20 surface soil samples at concentrations ranging from 10 to 42 $\mu\text{g}/\text{kg}$ (Table C-1, Appendix C). Methylene chloride was detected in two surface soil samples at 44 and 68 $\mu\text{g}/\text{kg}$ (Table C-1, Appendix C). These compounds, however, appear to be analytical or field decontamination artifacts, because it is highly unlikely that these compounds are present in surface soil due to their high volatility. None of these detections exceeded SCTLs.



NOTE:
¹ Sample location has been excavated.

LEGEND

△ 14B00301 Surface soil location and designation

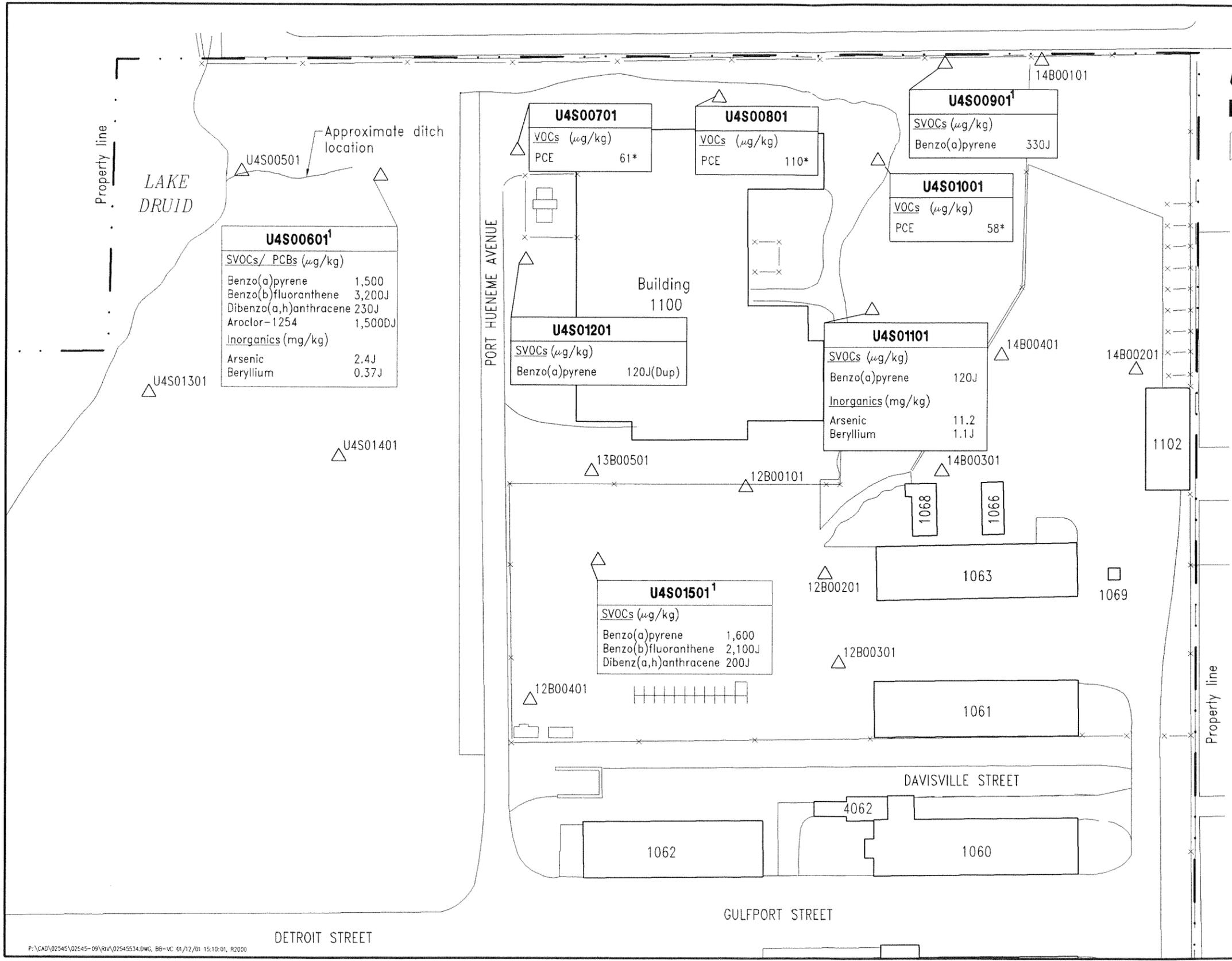
—x—x— Fence

0 50 100
 SCALE: 1 INCH = 100 FEET

FIGURE 5-1
SURFACE SOIL LOCATIONS

 **REMEDIAL INVESTIGATION**
OPERABLE UNIT 4

NAVAL TRAINING CENTER
ORLANDO, FLORIDA



U4S00601¹

SVOCs/ PCBs (µg/kg)	
Benzo(a)pyrene	1,500
Benzo(b)fluoranthene	3,200J
Dibenzo(a,h)anthracene	230J
Aroclor-1254	1,500DJ
Inorganics (mg/kg)	
Arsenic	2.4J
Beryllium	0.37J

U4S00701

VOCs (µg/kg)	
PCE	61*

U4S00801

VOCs (µg/kg)	
PCE	110*

U4S00901¹

SVOCs (µg/kg)	
Benzo(a)pyrene	330J

U4S01001

VOCs (µg/kg)	
PCE	58*

U4S01201

SVOCs (µg/kg)	
Benzo(a)pyrene	120J(Dup)

U4S01101

SVOCs (µg/kg)	
Benzo(a)pyrene	120J
Inorganics (mg/kg)	
Arsenic	11.2
Beryllium	1.1J

U4S01501¹

SVOCs (µg/kg)	
Benzo(a)pyrene	1,600
Benzo(b)fluoranthene	2,100J
Dibenz(a,h)anthracene	200J

LEGEND

- △ 14B00301 Surface soil location and designation
- SCTL Soil Cleanup Target Level
- PCE Tetrachloroethene
- D Diluted
- J Estimated value
- µg/kg Micrograms per kilogram
- mg/kg Milligrams per kilogram
- x—x Fence
- Dup Duplicate sample
- FDEP Florida Department of Environmental Protection
- * Indicates exceedance of FDEP Leaching SCTL of 30 µg/kg

NOTES:

Figure shows analytes detected at concentrations greater than Orlando background concentrations and FDEP SCTLs.

¹ Sample location has been excavated.

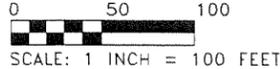


FIGURE 5-2
ANALYTES DETECTED IN SURFACE SOIL



REMEDIAL INVESTIGATION
OPERABLE UNIT 4

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

1,1,2,2-Tetrachloroethane was detected in 1 surface soil sample at 1 $\mu\text{g}/\text{kg}$ (Table C-1, Appendix C), below the SCTL of 700 $\mu\text{g}/\text{kg}$. In addition, 1,1,2,2-tetrachloroethane has not been detected in any other media at OU 4 to this point.

5.2.1.2 SVOCs Twenty-eight of the surface soil samples and three duplicates were analyzed for SVOCs. Table C-1 (Appendix C) lists the SVOCs detected in surface soil at OU 4 with corresponding residential SCTLs. Fifteen PAHs were detected in surface soil. Of those 15 PAHs, only benzo(a)pyrene, benzo(b)fluoranthene, and dibenz(a,h)anthracene exceeded SCTLs in any surface soil. Surface soil locations U4S00601 (1,500 $\mu\text{g}/\text{kg}$ benzo(a) pyrene, 3,200 $\mu\text{g}/\text{kg}$ benzo(b)fluoranthene, and 230 $\mu\text{g}/\text{kg}$ dibenz(a,h)anthracene) and U4S01501 (1,600 $\mu\text{g}/\text{kg}$ benzo(a) pyrene, 2,100 $\mu\text{g}/\text{kg}$ benzo(b)fluoranthene, and 200 $\mu\text{g}/\text{kg}$ dibenz(a,h)anthracene) exceeded residential SCTLs of 100 $\mu\text{g}/\text{kg}$ for benzo(a)pyrene, 1,400 $\mu\text{g}/\text{kg}$ for benzo(b)fluoranthene, and 100 $\mu\text{g}/\text{kg}$ for dibenz(a,h)anthracene. These two sample locations, however, were among those removed during the surface soil IRA excavations. Of the eight confirmatory samples collected at these locations following excavation, only one sample contained one PAH (benzo[a]pyrene) at a concentration (203 $\mu\text{g}/\text{kg}$) above its SCTL: a sample collected from the north sidewall of the U4S006 excavation. Benzo(a)pyrene also exceeded residential SCTLs at locations U4S00901 (330 $\mu\text{g}/\text{kg}$), U4S01101 (120 $\mu\text{g}/\text{kg}$, later excavated), and U4S01201D (120 $\mu\text{g}/\text{kg}$). U4S01201 (78 $\mu\text{g}/\text{kg}$) did not exceed the SCTL for benzo(a)pyrene (Table C-1, Appendix C).

Three other SVOCs, butylbenzylphthalate, carbazole, and bis(2-ethylhexyl)-phthalate were detected in surface soils, but did not exceed SCTLs (Table C-1, Appendix C).

5.2.1.3 Pesticides and PCBs Twenty surface soil samples and 3 duplicate samples were analyzed for pesticides, and 24 samples and 3 duplicates were analyzed for PCBs. Several pesticide compounds were detected at low levels in 13 out of 20 samples, including 2 duplicate samples (Table C-1, Appendix C). They include 4,4-dichlorodiphenyltrichloroethane (DDT) and its degradation products, 4,4-dichlorodiphenyldichloroethane (DDD) and 4,4-dichlorodiphenyldichloroethene (DDE), as well as aldrin, dieldrin, endosulfan I, endosulfan II, endosulfan sulfate, endrin, endrin aldehyde, endrin ketone, heptachlor, heptachlor epoxide, methoxychlor, alpha-benzene hexachloride (BHC), beta-BHC, delta-BHC, gamma-BHC (Lindane), alpha-chlordane, and gamma-chlordane. None of the detected pesticide concentrations, however, exceeded its respective SCTL.

A PCB compound, Aroclor-1254, was detected at three locations: U4S00501D (130 J $\mu\text{g}/\text{kg}$), U4S00601 (1,500 DJ $\mu\text{g}/\text{kg}$), and U4S00901 (210 $\mu\text{g}/\text{kg}$). Of these detections, the 1,500 $\mu\text{g}/\text{kg}$ concentration exceeded the residential SCTL for PCBs (500 $\mu\text{g}/\text{kg}$). However, this location (U4S006) has been excavated, and confirmatory samples collected in this area following excavation did not contain any PCBs. Another PCB compound, Aroclor-1260, was detected in U4S01201 at 33 $\mu\text{g}/\text{kg}$.

5.2.1.4 Inorganics Twenty surface soil samples and three duplicate samples were analyzed for inorganics, and 4 additional surface soil IRA confirmatory samples were analyzed for arsenic only. One or more inorganics were detected above background screening concentrations in 10 out of 24 surface soil samples, including 1 duplicate sample, all of which are expected to be present naturally in the soil (Table C-1, Appendix C). Of the detected inorganics, aluminum, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, silver, vanadium, and zinc are higher

in OU 4 than the background screening concentrations. Calcium does not have an SCTL.

Surface soil samples U4S00601 and U4S01101, both now excavated, contained arsenic (2.4 milligrams per kilogram [mg/kg] and 11.2 mg/kg, respectively) above the SCTL of 0.8 mg/kg for arsenic. Of the 4 confirmatory samples collected in the area of U4S011 following excavation, two contained arsenic at concentrations of 0.74 and 0.521 mg/kg, both below the SCTL of 0.8 mg/kg. Sample U4S00601 also contained chromium (45.2 mg/kg) and mercury (2.2 mg/kg) above their leachability SCTLs of 38 mg/kg and 2.1 mg/kg, respectively. Similarly, sample U4S01101 contained barium (167 mg/kg) and vanadium (17.7 mg/kg) above residential SCTLs of 110 mg/kg and 15 mg/kg, respectively.

5.2.1.5 Interpretation of Surface Soil Data Contaminants detected in surface soil samples collected at OU 4 included VOCs, SVOCs, pesticides, PCBs, and inorganics; however, many of these compounds were present at concentrations below their SCTLs.

PCE was the only VOC detected at concentrations above its SCTL. The three sample locations at which PCE was present above its SCTL, U4S007, U4S008, and U4S010, are adjacent to the northern part of Building 1100. Dry-cleaning machines were housed inside the northern portion of the building, and former employees of the laundry facility recalled a chemical spill near the loading dock north of the building (see Subsection 2.3.4). Such a spill, as well as other small-scale spills that may have occurred periodically during dry-cleaning operations, would contribute to surface soil PCE contamination.

Three SVOCs were detected at concentrations greater than their respective SCTLs: benzo(a)pyrene, benzo(b)fluoranthene, and dibenz(a,h)anthracene. Sample U4S00901, which contained benzo(a)pyrene at 330 $\mu\text{g}/\text{kg}$, was collected adjacent to a drainage swale at the northern boundary of OU 4. The presence of this single PAH above its SCTL may be the result of contaminated runoff within the swale, originating from an upgradient source. The above-listed PAHs were also detected at various locations throughout SAs 12 and 13, and are not believed to be site-related. Such compounds are commonly detected in the surface soils of urban, improved lots, and are the result of commonplace, anthropogenic activities. Detectable levels of PAHs in urban surface soils mainly originate from high-temperature combustion sources such as automobile exhausts, urban fires, and boilers.

Two of the surface soil samples locations at which elevated SVOC concentrations were detected have since been removed, through the completion of the surface soil IRA.

Leaching of the asphalt pavement above sample locations was considered another potential source of PAHs in surface soil. However, the many surface soil samples collected throughout SA 14 (much of which is paved) did not contain PAHs above SCTLs.

None of the pesticides detected in surface soil was at concentrations above its respective SCTL. One PCB, Aroclor-1254, was detected in one sample (U4S00601) at a concentration (1,500D $\mu\text{g}/\text{kg}$) greater than its SCTL of 500 $\mu\text{g}/\text{kg}$. However, Aroclor-1254 was not detected in confirmatory samples collected following excavation of surface soil at this location.

Arsenic was detected in samples U4S00601 and U4S01101 at concentrations greater than its SCTL of 0.8 mg/kg. The presence of arsenic in surface soil is often attributed to the use of pesticides. However, arsenic was not detected ubiquitously along the boundaries of OU 4. The small number of occurrences does not support pesticide application as a source. The presence of this inorganic analyte more likely results from statistical variation in concentrations. Nonetheless, surface soil at locations U4S00601 and U4S01101 has been excavated.

Calcium was detected above background concentrations. There is no SCTL for calcium, nor is there a USEPA Region III residential risk-based concentration (RBC) for calcium. However, calcium is considered an essential nutrient, and is a common, naturally-occurring component of most soils in this region. Chapter 8.0 addresses the detections of these nutrients in soil.

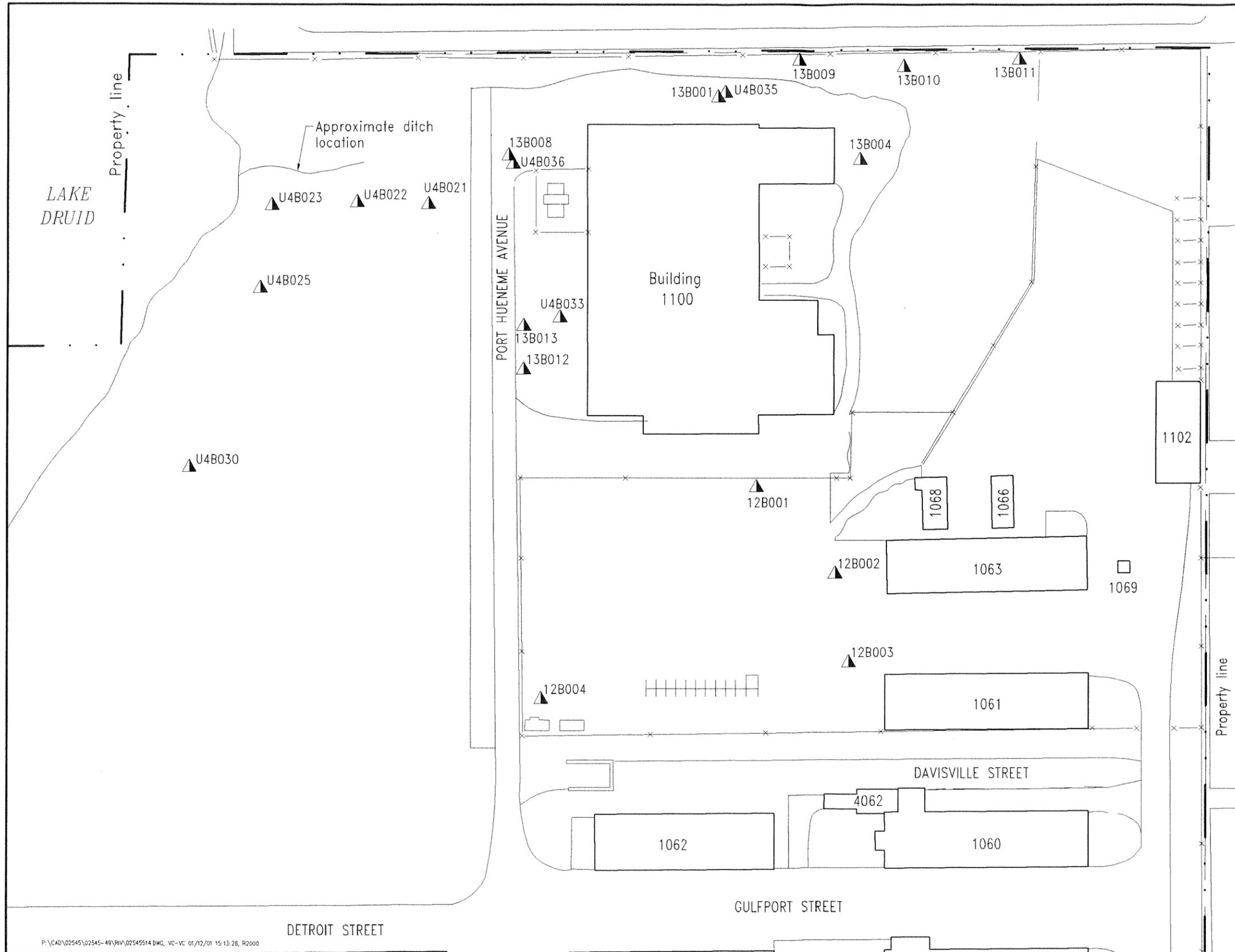
5.2.2 Subsurface Soil Assessment To assess the quality of subsurface soil, 24 subsurface soil samples (plus 2 duplicates) were collected at depths ranging from 8 to 58 feet bls for laboratory analysis. Initially, 12 of these 24 subsurface soil samples were collected during the initial site screening of SAs 12, 13, and 14 (ABB-ES, 1996a). The additional 12 subsurface samples were collected during the RI where further delineation was required. Subsurface soil sample locations are shown on Figure 5-3.

Analytes detected in subsurface soil are shown on Figure 5-4, and are discussed in Paragraphs 5.2.2.1 through 5.2.1.4. Positive detection tables are provided in Appendix C, and complete laboratory analytical results are provided in Appendix D. Interpretation of the analytical data in terms of possible sources and extent of compounds exceeding background is discussed in Paragraph 5.2.2.5. In order to focus the discussion on detected analytes or compounds that are site-related, a preliminary comparison to FDEP residential SCTLs was made. Where compounds were detected in both soil and groundwater, FDEP leachability SCTLs based on groundwater criteria were also included in the preliminary comparison.

5.2.2.1 VOCs Table C-2 (Appendix C) lists the VOCs present in subsurface soil at OU 4 with corresponding SCTLs. PCE was detected in 5 out of 24 subsurface soil samples at concentrations ranging from 2 to 49 $\mu\text{g}/\text{kg}$. Two locations, 13B00101 (31 $\mu\text{g}/\text{kg}$) and U4B03601 (49 $\mu\text{g}/\text{kg}$) had exceedances of the leachability SCTL of 30 $\mu\text{g}/\text{kg}$ (Table C-2, Appendix C). TCE was detected in 2 samples, 13B00101 and U4B03602 at concentrations of 2 $\mu\text{g}/\text{kg}$ and 1 $\mu\text{g}/\text{kg}$, respectively (Table C-2, Appendix C). Both detections were below the leachability SCTL for TCE of 30 $\mu\text{g}/\text{kg}$. In addition, 13B00101 had a detection of 6 $\mu\text{g}/\text{kg}$ 1,2-DCE (total), which did not exceed the leachability SCTL of 400 $\mu\text{g}/\text{kg}$ for *cis*-1,2-DCE or 700 $\mu\text{g}/\text{kg}$ for *trans*-1,2-DCE (Table C-2, Appendix C). No other subsurface soil samples collected had detections of DCE.

Acetone was detected in six subsurface soil samples at concentrations ranging from 8 to 130 $\mu\text{g}/\text{kg}$. 2-Butanone was also detected in one subsurface soil sample at a concentration of 4 $\mu\text{g}/\text{kg}$. Neither compound exceeded its respective SCTL (Table C-2, Appendix C).

5.2.2.2 SVOCs Table C-2 (Appendix C) lists the SVOCs detected in subsurface soil at OU 4 with corresponding SCTLs and collection depths. Only the original 12 samples collected during the original site screening (ABB-ES, 1996a) were analyzed for SVOCs. Of those 12 subsurface samples, only 12B00102 and 12B00302 had SVOCs detected. None of the detected SVOCs exceeded its respective SCTL.



LEGEND

▲ 12B003 Subsurface soil location and designation

x—x Fence

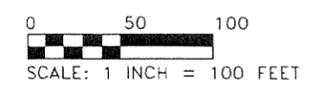
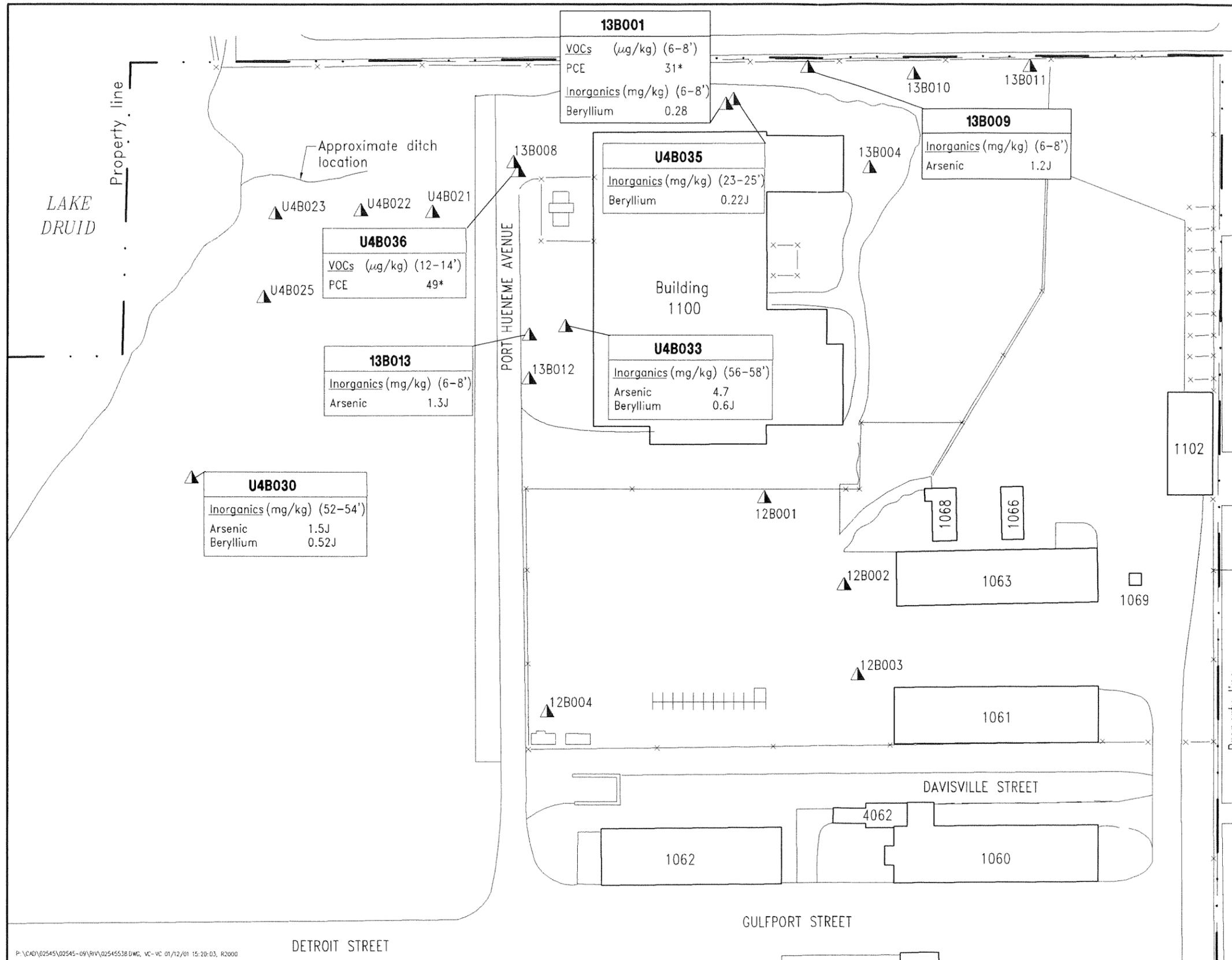


FIGURE 5-3
SUBSURFACE SOIL LOCATIONS



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LEGEND

- ▲ 12B003 Subsurface soil location and designation
- SCTL Soil Cleanup Target Level
- J Estimated value
- μg/kg Micrograms per kilogram
- mg/kg Milligrams per kilogram
- FDEP Florida Department of Environmental Protection
- PCE Tetrachloroethene
- * Indicates exceedance of FDEP Leaching SCTL of 30 μg/kg
- ×—× Fence

NOTE:
 1. Figure shows analytes detected at concentrations greater than Orlando background concentrations and FDEP SCTLs.

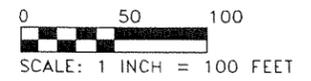


FIGURE 5-4
ANALYTES DETECTED IN SUBSURFACE SOIL



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5.2.2.3 Pesticides and PCBs Table C-2 (Appendix C) lists the pesticides and PCBs detected in subsurface soil at OU 4 with corresponding SCTLs and collection depths. Only the original 12 samples collected during the original site screening (ABB-ES, 1996a) were analyzed for pesticides and PCBs. Of those 12 subsurface samples, low concentrations of 4,4'-DDE, 4,4'-DDT, and Aroclor-1260 were detected in 12B00102 and low concentrations of 4,4'-DDD and 4,4'-DDE were detected in 13B01101. No compounds exceeded FDEP SCTLs.

5.2.2.4 Inorganics One or more inorganic analytes were detected above background screening concentrations in 22 out of 24 subsurface soil samples, including both duplicate samples, all of which are expected to be present naturally in the soil (Table C-2, Appendix C). Of the detected inorganic analytes, aluminum, arsenic, barium, beryllium, cadmium, calcium, chromium, copper, iron, lead, magnesium, manganese, mercury, nickel, sodium, vanadium, and zinc are higher in OU 4 subsurface soil than the background screening concentrations. Of these seventeen inorganics, calcium, magnesium, and sodium do not have SCTLs.

Arsenic was detected in excess of its residential SCTL of 0.8 mg/kg in 13B00901 (1.2 mg/kg), 13B01301 (1.3 mg/kg), U4B03001 (0.97 mg/kg), U4B03004 (1.5 mg/kg), and U4B03304 (4.7 mg/kg). Barium was detected above its residential SCTL of 110 mg/kg in one sample: U4B03001 (135 mg/kg).

5.2.2.5 Interpretation of Subsurface Soil Data Contaminants detected in subsurface soil samples collected at OU 4 included VOCs, SVOCs, pesticides, PCBs, and inorganics. However, none of the detected SVOCs, pesticides, or PCBs were found at concentrations greater than their respective SCTLs.

PCE was the only VOC detected at concentrations above its leachability SCTL of 30 $\mu\text{g}/\text{kg}$. The two soil boring locations at which PCE was detected above 30 $\mu\text{g}/\text{kg}$, U4B036 and 13B001, correspond to two of the three surface soil locations that had elevated PCE detections (U4S007 and U4S008, respectively). Sample U4B03601 (which contained PCE at 49 $\mu\text{g}/\text{kg}$) was collected at a depth of 12 to 14 feet bls, and sample 13B00101 (which contained PCE at 31 $\mu\text{g}/\text{kg}$) was collected at 6 to 8 feet bls. Both of these samples were collected in the phreatic (saturated) zone; therefore, PCE in groundwater was considered as a possible source of the PCE in subsurface soil (through adsorption onto the organic carbon fraction of the aquifer matrix). To evaluate this possibility, the measured concentration of PCE in groundwater was used to calculate the theoretical resulting concentration of PCE in soil. Using K_{oc} (PCE) = 364 milliliters per gram (mL/g), a fraction of organic carbon (f_{oc}) of 5.53×10^{-4} , and a PCE concentration in groundwater of 340 $\mu\text{g}/\ell$, the calculated resulting PCE concentration in soil would be 0.068 mg/kg. This estimate is in the same order of magnitude as the actual soil concentration detected at that location, 0.049 mg/kg.

Arsenic and barium were detected in subsurface soil at concentrations above their respective SCTLs, but were not detected in groundwater above their FDEP groundwater cleanup target levels (GCTLs). There is no known site-related source of these inorganic analytes. The detected concentrations may be the result of natural variation in concentrations.

5.2.3 Groundwater Assessment Prior to monitoring well installation and sampling, groundwater samples were collected from 21 DPT probes (U4Q029 through

U4Q049) to further characterize source areas and to delineate the area of affected groundwater. DPT sampling locations are shown on Figure 5-5.

Groundwater samples from DPT probes were screened on site for selected VOCs using a portable GC (modified USEPA SW-846 Method 8010/8020). DPT groundwater samples were also submitted to an off-site laboratory for confirmatory VOC analyses, at a rate of 1 in 10. On-site GC screening results and off-site VOC results are summarized below in Paragraph 5.2.3.1 and on Figure 5-6.

The locations and depths of monitoring wells installed during the RI were based on an evaluation of data provided by the DPT groundwater sampling program. The analytical results from the DPT groundwater sampling program are found in Appendices C and D. Ten monitoring wells were installed during the RI. Five shallow microwells were also installed to analyze the extent of antimony found during previous site screening investigations at SA 14.

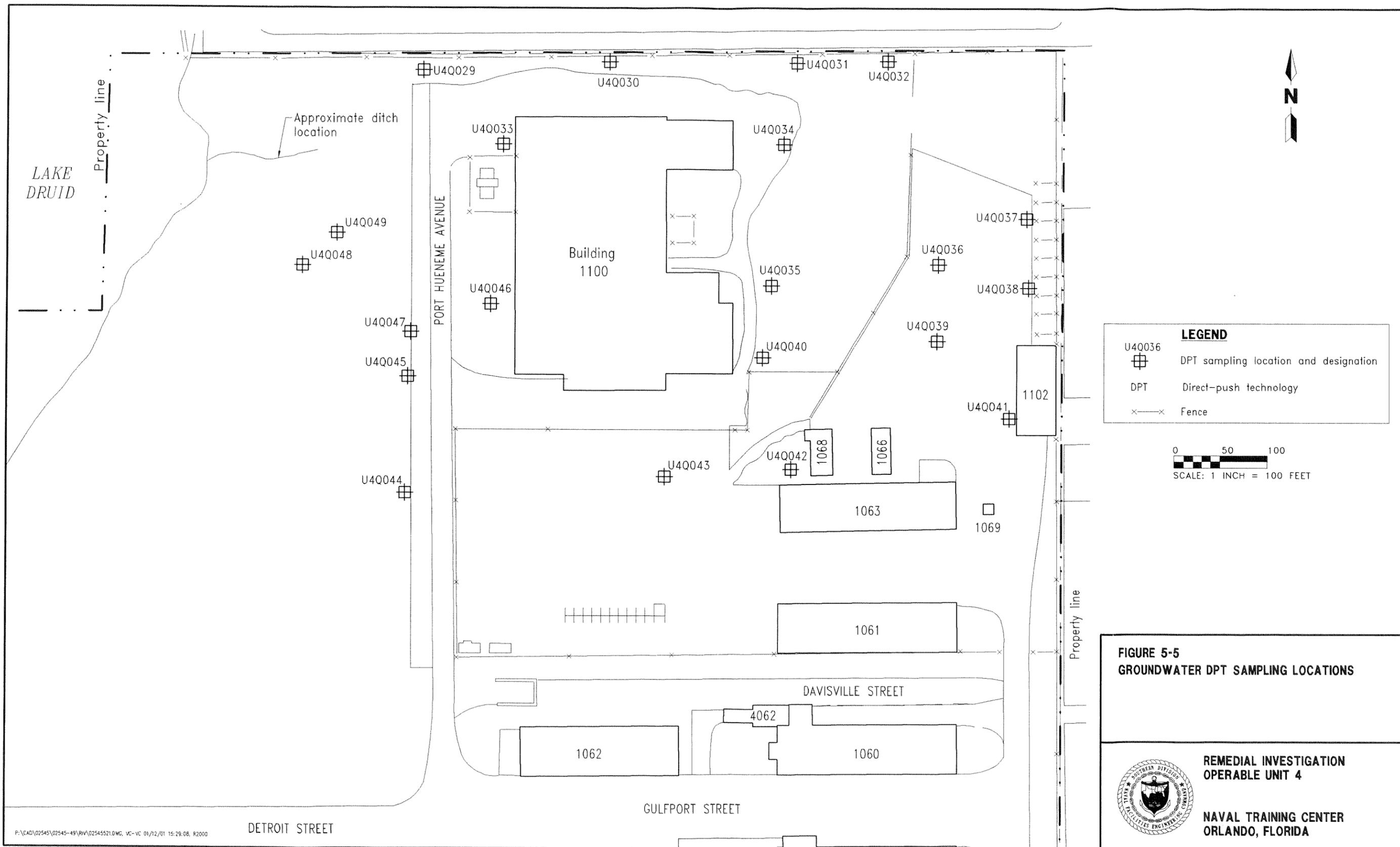
A total of 39 sampling locations was evaluated during the RI, with some locations sampled more than once. Wells that were sampled several times are part of the IRA Performance Monitoring Program, and data from the multiple sampling events have been included in this RI. Figure 5-7 shows the locations of the sampling points. Of those 39 locations, 10 were sampled for VOCs, SVOCs, pesticides, PCBs, and inorganics, 25 were sampled for VOCs and inorganics, and 4 were sampled for VOCs only. Sample depths ranged from approximately 5 to 53 feet bls.

Analytes detected in the 75 unfiltered and 7 filtered groundwater samples (including 4 duplicates) are shown on Figure 5-8, and are discussed in Paragraphs 5.2.3.1 through 5.2.3.4. Paragraph 5.2.3.1 also summarizes on-site and off-site VOC results of DPT groundwater sampling. Positive detection tables are provided in Appendix C, and complete laboratory analytical results are provided in Appendix D. Interpretation of the groundwater analytical data in terms of possible sources and extent of compounds exceeding background and/or MCLs is discussed in Paragraph 5.2.3.5.

5.2.3.1 VOCs VOCs detected in DPT groundwater screening samples are listed in Table C-3 (Appendix C) and shown on Figure 5-6. PCE was detected in 29 of the 206 DPT screening samples, including 3 duplicate samples. Where detected, PCE concentrations ranged from 1.3 $\mu\text{g}/\text{l}$ to 6,300 $\mu\text{g}/\text{l}$. TCE was detected in 21 of the 206 samples (including 2 duplicate samples), at concentrations ranging from 2.7 $\mu\text{g}/\text{l}$ to 440 $\mu\text{g}/\text{l}$. *Cis*-1,2-DCE was detected in 14 samples (including 1 duplicate), at concentrations ranging from 2.4 $\mu\text{g}/\text{l}$ to 340 $\mu\text{g}/\text{l}$. 1,1-DCE was detected in one sample, at a concentration of 3.5 $\mu\text{g}/\text{l}$. Other VOCs detected in one or more DPT groundwater screening samples include benzene in 3 samples, including 1 duplicate (maximum concentration 1.7 $\mu\text{g}/\text{l}$), toluene in 8 samples (maximum concentration 106 $\mu\text{g}/\text{l}$), *m*-/*p*-xylenes in 3 samples (maximum concentration 1.7 $\mu\text{g}/\text{l}$), and *o*-xylene in 4 samples (maximum concentration 4.6 $\mu\text{g}/\text{l}$).

VOCs detected in confirmatory DPT groundwater samples that were submitted to an off-site laboratory are listed in Table C-4 (Appendix C-4). PCE was detected in 3 of the 21 confirmatory samples, at concentrations ranging from 32 $\mu\text{g}/\text{l}$ to 53 $\mu\text{g}/\text{l}$. TCE was detected in 4 of the 21 samples, including 1 duplicate sample.

Where detected, TCE concentrations ranged from 3 $\mu\text{g}/\text{l}$ to 380 $\mu\text{g}/\text{l}$. 1,2-DCE (total) was detected in 4 samples (including 1 duplicate), at concentrations ranging from 3 $\mu\text{g}/\text{l}$ to 160 $\mu\text{g}/\text{l}$. Acetone was detected in 18 samples (including



LEGEND

U4Q036 DPT sampling location and designation

DPT Direct-push technology

x-x Fence

0 50 100
SCALE: 1 INCH = 100 FEET

FIGURE 5-5
GROUNDWATER DPT SAMPLING LOCATIONS

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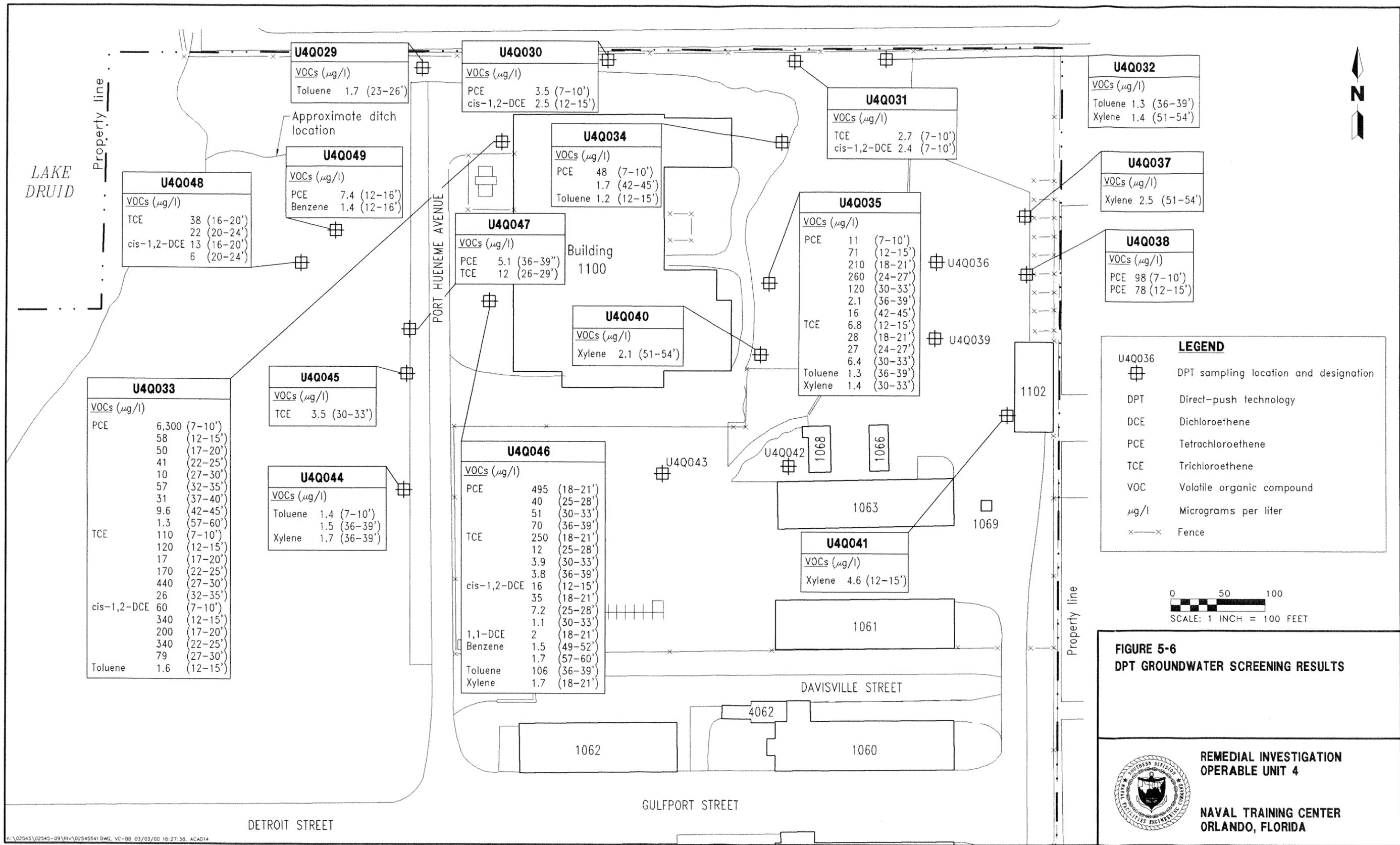
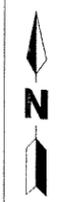
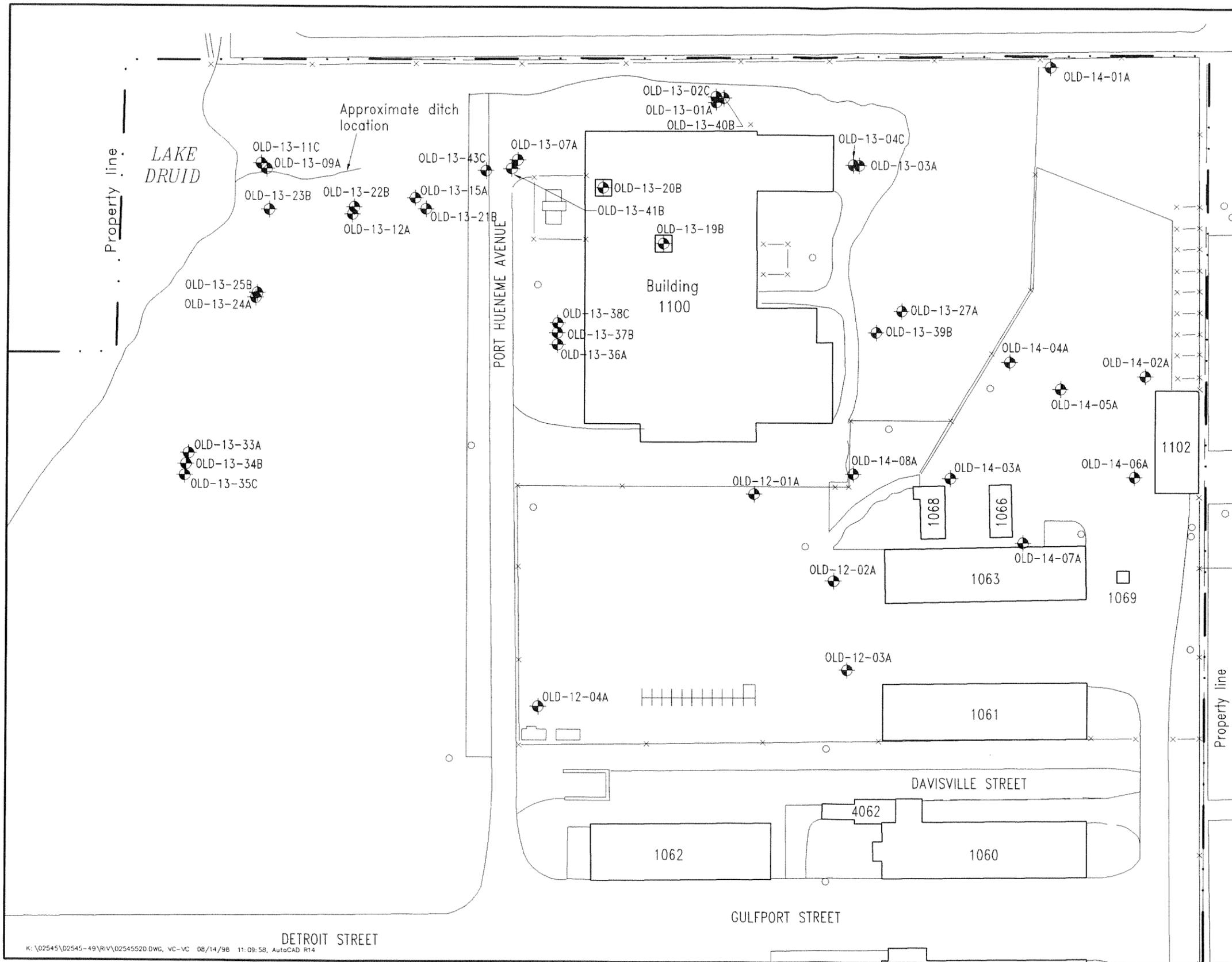


FIGURE 5-6
DPT GROUNDWATER SCREENING RESULTS

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- 
 OLD-13-11C Monitoring well location and designation
- 
 OLD-13-19B Microwell location and designation
- 
 Fence

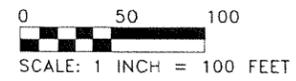
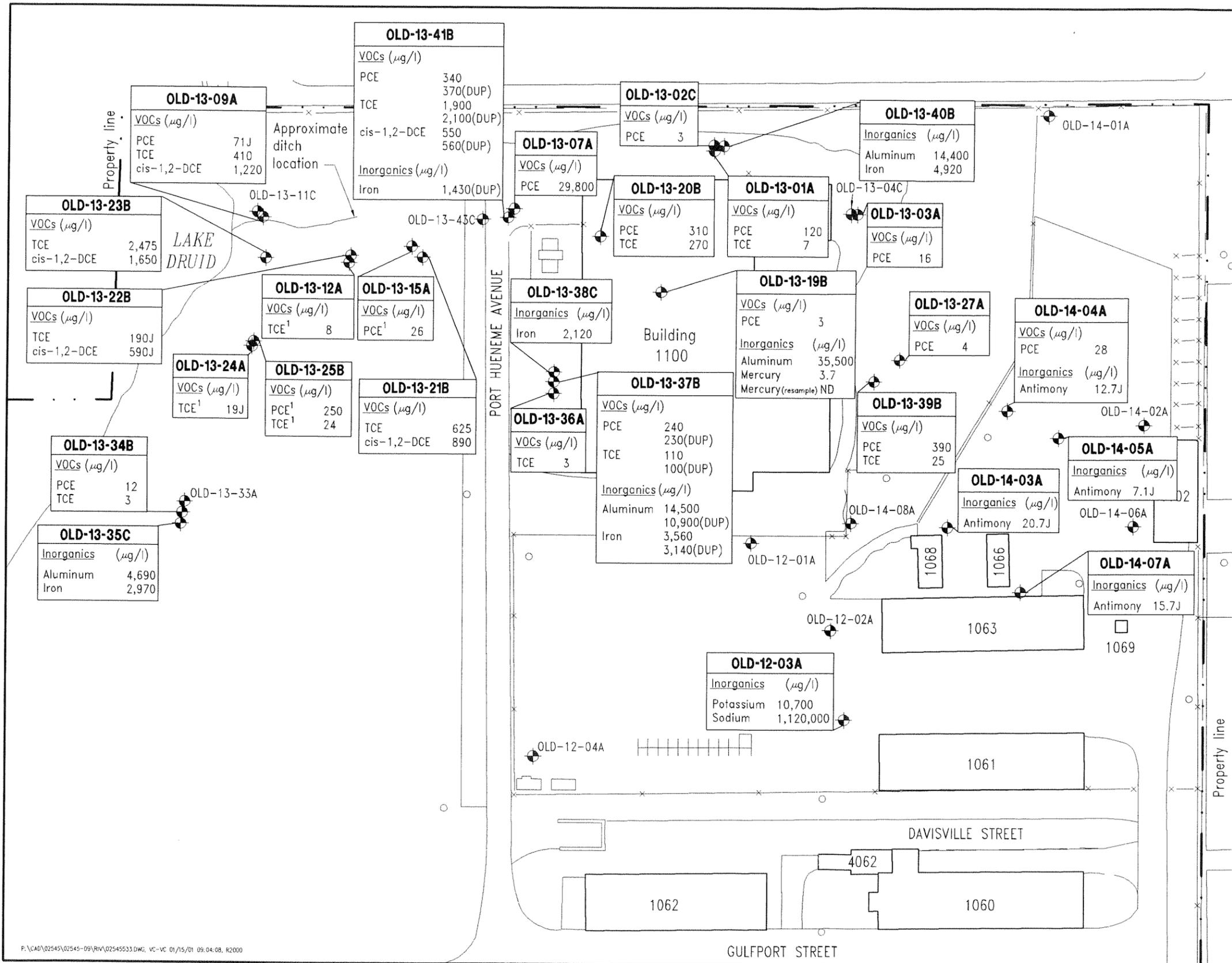


FIGURE 5-7
MONITORING WELLS SAMPLED DURING
THE REMEDIAL INVESTIGATION



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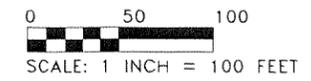
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LEGEND

OLD-13-11C Monitoring well location and designation
 1 Indicates that multiple sample results were averaged.
 A Suffix indicates a shallow (1 to 18.5 feet below land surface [bls] well)
 B Suffix indicates an intermediate depth (14 to 35 feet bls) well
 C Suffix indicates a deep (39 to 64 feet bls) well
 PCE Tetrachloroethene
 TCE Trichloroethene
 cis-1,2-DCE cis-1,2-dichloroethene
 Dup Duplicate sample
 J Estimated value
 ND Not detected
 μg/l Micrograms per liter
 x—x Fence

- NOTES:**
- Figure shows analytes detected at concentrations greater than Florida Department of Environmental Protection groundwater guidance concentrations and/or Orlando background concentrations.
 - Inorganic data shown are unfiltered.



**FIGURE 5-8
ANALYTES DETECTED IN GROUNDWATER**

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2 duplicates), at concentrations ranging from 10 µg/l to 7,200 µg/l. The presence of acetone is most likely attributable to laboratory contamination, because it is a common laboratory artifact and there is no known source of acetone at OU 4.

Table C-5 (Appendix C) lists the analytes detected in groundwater samples collected from monitoring wells at OU 4, along with corresponding FDEP GCTLs. PCE was detected in 30 out of 71 groundwater samples, including 3 duplicates, at concentrations ranging from 1 to 34,000 µg/l. Of the 30 samples in which PCE was detected, 22 samples were collected from 13 locations and detected PCE at concentrations above the GCTL of 3 µg/l. Five samples, 13G00706 through 13G00710, (all collected from monitoring well OLD-13-07A), had detections of PCE ranging from 18,000 to 34,000 µg/l. The two most recent samples of the five collected from well OLD-13-09A during the RI had PCE exceedances of 270 µg/l in U400906 and 12 µg/l in U4G00907. The first two of four samples collected at OLD-13-15A during the RI had PCE exceedances of 65 and 35 µg/l in U4G01502 and U4G01503, respectively. All four samples collected at OLD-13-25B during the RI had PCE exceedances of 240, 180, 270, and 320 µg/l. The remaining monitoring wells with PCE exceedances were OLD-13-01A (120 µg/l), OLD-13-03A (16 µg/l), OLD-14-04A (28 µg/l), OLD-13-20B (310 µg/l), OLD-13-27A (4 µg/l), OLD-13-34B (12 µg/l), OLD-13-37B (240 µg/l and 230 µg/l in the duplicate sample), OLD-13-39B (390 µg/l), and OLD-13-41B (340 µg/l and 370 µg/l in the duplicate sample).

TCE was detected in 42 out of 71 groundwater samples, including 2 duplicates, at concentrations ranging from 0.7 to 3,000 µg/l. Of the 42 samples in which TCE was detected, 35 samples were collected from 12 locations and TCE was detected at concentrations exceeding the GCTL of 3 µg/l for TCE. All samples collected from OLD-13-09A (detections of 370, 550, 530, 590, and 20 µg/l), OLD-13-21B (detections of 690, 530, 680, and 600 µg/l), OLD-13-22B (detections of 690, 11, 21, 20, 24, and 360 µg/l), OLD-13-23B (detections of 3,000, 2,400, 2,500, and 2,000 µg/l), OLD-13-24A (detections of 22, 35, 14, 11, and 14 µg/l), and OLD-13-25B (detections of 15, 21, 28, and 32) during the RI had TCE exceedances. The last two of four samples collected from OLD-13-12A during the RI had TCE exceedances of 5.1 µg/l in U4G01205 and 26 µg/l in U4G01206. The remaining monitoring wells with TCE exceedances were OLD-13-01A (7 µg/l), OLD-13-20B (270 µg/l), OLD-13-37B (110 µg/l and 100 µg/l in the duplicate sample), OLD-13-39B (25 µg/l), and OLD-13-41B (1,900 µg/l and 2,100 µg/l in the duplicate sample).

Cis-1,2-DCE was detected in 37 out of 71 groundwater samples, including 2 duplicates, at concentrations ranging from 1 to 2000 µg/l. Of those 37 samples with detections of *cis*-1,2-DCE, 20 samples were collected from 7 locations and *cis*-1,2-DCE was detected at concentrations exceeding the GCTL of 70 µg/l for *cis*-1,2-DCE. The first four of the five samples collected from OLD-13-09A during the RI had concentrations of 1600, 1500, 1700, and 1300 µg/l of *cis*-1,2-DCE. The last sample of four collected from OLD-13-12A during the RI had a detection of *cis*-1,2-DCE of 90 µg/l, exceeding the GCTL. All samples collected from OLD-13-21B during the RI (detections of 990, 790, 1,000, and 770 µg/l) and OLD-13-23B (detections of 1,300, 1,900, 1,700, and 1,700 µg/l) exceeded the GCTL for *cis*-1,2-DCE. Monitoring well OLD-13-22B had five out six samples collected during the RI with detections of 2,000, 90, 92, 94, and 1,200 µg/l of *cis*-1,2-DCE. One out of five samples collected at OLD-13-24A during the RI exceeded the GCTL for *cis*-1,2-DCE with a detection of 96 µg/l. OLD-13-41B had a detection of *cis*-1,2-DCE at 550 µg/l and 560 µg/l in the duplicate sample, which also exceeded the GCTL for *cis*-1,2-DCE.

Trans-1,2-DCE was detected in one groundwater sample collected during the RI, but the detection did not exceed the GCTL of 100 µg/l for *trans*-1,2-DCE. In addition, only one groundwater sample had a detection of chloroform, which did not exceed the GCTL of 5.7 µg/l for chloroform.

5.2.3.2 SVOCs No SVOCs were detected in groundwater samples collected from OU 4 monitoring wells (Table C-5, Appendix C).

5.2.3.3 Pesticides and PCBs No pesticides or PCBs were detected in groundwater samples collected from OU 4 monitoring wells (Table C-5, Appendix C).

5.2.3.4 Inorganics Between December 9, 1997, and March 17, 1998, 7 filtered and 75 unfiltered groundwater samples (including 4 duplicate samples) were collected from 39 monitoring wells and were submitted for inorganics analyses. Inorganic analytes detected in groundwater samples collected from OU 4 monitoring wells are listed in Table C-5 (Appendix C).

Unfiltered Samples. In 37 of the 75 unfiltered groundwater samples (including 3 of the 4 duplicate samples), one or more inorganic analytes were detected at concentrations above GCTLs (Table C-5, Appendix C). These inorganic analytes included aluminum, antimony, iron, mercury, and sodium.

Aluminum was present at concentrations above its GCTL of 200 µg/l in 27 unfiltered samples, including 3 duplicate samples, although only five of these detections (including one duplicate result) were above the background screening concentration of 4,067 µg/l. Background screening concentrations were calculated using basewide background samples that were collected in 1995 in order to establish the range of concentrations over which inorganic compounds naturally fluctuate. Where detected at OU 4, aluminum concentrations ranged from 117 J µg/l (at well OLD-13-09A) to 35,500 µg/l (at OLD-13-19B). No relationship between screen depth and aluminum concentration is apparent; elevated concentrations are present in several A-, B-, and C-interval wells.

Antimony was detected at concentrations above its GCTL of 6 µg/l in unfiltered samples from four locations: OLD-14-03A (20.7 J µg/l), OLD-14-04A (12.7 µg/l), OLD-14-05A (7.1 J µg/l), and OLD-14-07A (15.7 J µg/l). These concentrations also exceeded the local background concentration of 4.1 µg/l for antimony. Each of the four wells is a shallow (A-interval) well. The wells are adjacent to each other, within the paved area of SA 14 (Figure 5-7). The affected area is limited, and the antimony does not appear to have migrated substantially during the last three years. Antimony concentrations in groundwater from several OU 4 monitoring wells have been measured twice: groundwater samples were collected in April 1995 and in February 1998. The antimony concentrations detected following both sampling events were comparable, as shown in Table 5-1. These data demonstrate that the detected concentrations of antimony have not varied significantly between 1995 and 1998.

Results of the 1998 sampling event provided no indication that the antimony plume has migrated westward since 1995. Antimony was not detected in groundwater samples collected from several monitoring wells located between 100 feet and 600 feet downgradient of SA 14, including OLD-12-02A, OLD-12-03A, OLD-12-04A, OLD-13-27A, OLD-13-33A, and OLD-13-36A.

**Table 5-1
Historic Unfiltered Antimony Data**

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Well ID	Antimony Concentration ($\mu\text{g}/\ell$)	
	April 1995	February 1998
OLD-14-01A	2.5 U	2.5 U
OLD-14-02A	10.1 B	4.7 J
OLD-14-03A	17.6	20.7 J
OLD-14-04A	10.6 B	12.7 J
OLD-12-01A ¹	2.5 U	3.6 J

¹ OLD-12-01A is located approximately 200 feet downgradient of OLD-14-03A.

Notes: $\mu\text{g}/\ell$ = micrograms per liter.

U = Analyte not detected at the reporting limit.

B = Reported concentration is between the instrument detection limit and the contract required detection limit.

J = Reported concentration is an estimated quantity.

Iron concentrations were above the GCTL of 300 $\mu\text{g}/\ell$ for iron in 23 unfiltered samples, including 3 duplicates, although only six of the detections (including two duplicates) were at concentrations exceeding the calculated local background concentration of 1,227 $\mu\text{g}/\ell$. Detected concentrations ranged from 16.7 J $\mu\text{g}/\ell$ (OLD-13-07A) to 4,920 $\mu\text{g}/\ell$ (OLD-13-40B). Most of the iron detections come from B- and C-interval wells.

Mercury was detected at a concentration above its GCTL of 2 $\mu\text{g}/\ell$ in one unfiltered sample, U4G01902 (at OLD-13-19B), at 3.7 $\mu\text{g}/\ell$. This concentration is also above the background mercury concentration of 0.12 $\mu\text{g}/\ell$. This was an unexpected result, because mercury had never been detected above background in OU 4 groundwater. Examination of the sampling logs for this well indicated a highly turbid sample. The well was resampled and groundwater was analyzed for filtered and unfiltered inorganics. Mercury was not detected in the unfiltered sample, and was detected above the background screening concentration in the filtered analysis, but below the GCTL of 2 $\mu\text{g}/\ell$ (Appendix C). The resampling results were not used in the OU 4 risk assessment.

One unfiltered sample (12G00302, at OLD-12-03A) contained sodium at a concentration of 1,120,000 $\mu\text{g}/\ell$, which is above the GCTL of 160,000 $\mu\text{g}/\ell$ and the background concentration of 18,222 $\mu\text{g}/\ell$ for sodium.

Calcium, potassium, and/or magnesium, inorganics for which no GCTLs exist, exceeded local background concentrations in unfiltered samples from two locations: OLD-12-03A and OLD-13-09A. Both wells are A-interval wells, although they are not proximal to each other. The maximum calcium and magnesium concentrations were 3,350 J $\mu\text{g}/\ell$ and 1,340 J $\mu\text{g}/\ell$, respectively, both at OLD-13-09A. The maximum potassium concentration was 10,700 $\mu\text{g}/\ell$, at OLD-12-03A.

Filtered Samples. Eight inorganic analytes (aluminum, antimony, barium, copper, iron, nickel, selenium, and vanadium) were detected in one or more of the seven filtered groundwater samples. Of these eight inorganics, only antimony (in four of the seven filtered samples) was detected at concentrations that exceed GCTLs.

There is a strong correlation between filtered sample data and unfiltered data with respect to antimony, as the following results demonstrate: at location OLD-14-03A, antimony was detected in the unfiltered sample at 20.7 $\mu\text{g}/\ell$, and was detected in the filtered sample at 21 J $\mu\text{g}/\ell$. At OLD-14-04A, antimony was present in the unfiltered sample at 12.7 $\mu\text{g}/\ell$ and in the filtered sample at 12.4 J $\mu\text{g}/\ell$. Similarly, antimony was detected at location OLD-14-05A at concentrations of 7.1 $\mu\text{g}/\ell$ (unfiltered) and 8 J $\mu\text{g}/\ell$ (filtered). Antimony was also detected at OLD-14-07A at 15.7 $\mu\text{g}/\ell$ (unfiltered) and 13.7 J $\mu\text{g}/\ell$ (filtered). The GCTL for antimony is 6 $\mu\text{g}/\ell$.

5.2.3.5 Interpretation of Groundwater Data Interpretation of the data summarized above was aided through the use of such tools as geostatistical analysis and groundwater plume contouring.

Geostatistical Analysis. Several of the chemical analytes were examined using geostatistics to determine the smoothness of their distribution. Geostatistics is a branch of statistics that exploits a feature of most environmental data called "spatial correlation". Spatial correlation means that two samples taken "close together" should have similar values, while two taken "far apart" may vary drastically.

Spatial correlation is an intuitive concept. Land surface elevations in most areas vary only slightly within a five-foot distance (mountainous areas excepted), but may change dramatically in five miles. Chemical concentrations in groundwater, both natural and man-induced, also usually have some spatial correlation. What varies with concentrations is the critical distance, which separates "near" and "far". In geostatistics, this critical distance is called the "range" of spatial correlation. For two samples separated by less than the range, one would expect some similarity of values. For two samples separated by more than the range, no such similarity should be expected.

Sometimes, the direction between points is as important as the distance between these same points. Elevations along a roadway have a longer range of spatial correlation than points across a roadway at a roadcut. This is an example of directional spatial correlation. When looking at a contaminant plume, one direction usually has a longer spatial correlation than the others, usually the direction along the length of the plume.

One tool used in geostatistics is the semivariogram. In effect, the semivariogram is a graph of variability with distance between points; i.e., a plot of spatial correlation. From a semivariogram, one can estimate range and examine two other aspects of spatial correlation: how much variability there is at the same point ("nugget effect") and how quickly variability changes with distance (shape of semivariogram).

The nugget effect occurs because there may be some variability from duplicate samples. This may be due to fairly large-scale inhomogeneities (a nugget of gold in a handful of sand), sampling variations, analytical problems, or any of a number of causes that cause duplicate samples to have different analytical results. Due to diligence in sampling and analysis, much environmental data has a negligible nugget effect.

The shape of the semivariogram indicates how quickly spatial correlation is lost. Experience shows that many data sets follow the "spherical" model. In the spherical model, much of the correlation is lost quickly, but some correlation is conserved out to the range of spatial correlation. A linear loss (linear model) is also occasionally seen. In this, correlation is lost steadily with distance.

Moving to the data from OU 4, three VOCs (PCE, TCE, and *cis*-1,2-DCE) and antimony were geostatistically examined. Only three VOCs were included since these were the only VOCs that had a significant number of detections. A full three dimensional, directional semivariogram modelling exercise (see Appendix O for details) showed a range of spatial correlation between 100 and 120 feet for the VOCs and 220 feet for antimony. Sill values (maximum variability) were high for the VOCs and relatively low for antimony. All four analytes followed the spherical model of semivariograms fairly well.

The short range and high variability for the VOCs are indicative of a plume of constituents in a background free from them. The scale of the range is related to the size of the plume. Antimony is apparently present as a stable, relatively immobile plume in groundwater.

Groundwater Plume Contouring. Contaminant concentrations in groundwater were plotted and contoured to aid in data evaluation. Appendix L includes individual

plots of PCE, TCE, DCE, and antimony based solely on data collected from OU 4 monitoring wells (Figure 5-8). Groundwater concentrations above and below an elevation of 85 feet (approximately 20 feet bls) were plotted separately. This helps illustrate the downward migration and biodegradation of contaminants away from the former laundry building, followed by the upward movement of the plume as it discharges to Lake Druid.

5.2.4 Lake Druid Assessment The nature and extent of chlorinated VOC contamination in Lake Druid was established in previous investigations (ABB-ES, 1997f). During the RI, HLA collected additional surface water, sediment, and drive point groundwater samples at the lake to provide additional data for risk assessment. The following paragraphs describe the sampling events and summarize contaminants detected in each medium.

5.2.4.1 Surface Water Assessment On October 29, 1997, and March 17, 1998, a total of 10 surface water samples (including 2 duplicate samples) were collected in Lake Druid. The samples were collected from six locations along the eastern shoreline (Figure 5-9). Five of the six locations are within the area where chlorinated VOCs are known to be present. The sixth sample location, U4W050, is on a Navy-owned portion of the lake that is near (but beyond) the area of known VOC contamination. Samples from this location served as controls, and were not included as part of the risk assessment data set. Instead, data from this location were qualitatively compared to data from the locations within the VOC-contaminated area.

Samples from the control location (U4W050) and from location U4W010 were submitted for the full suite of analyses (VOCs, SVOCs, pesticides, PCBs, and inorganics). Samples from the four remaining locations were analyzed for VOCs only. Details of the surface water sampling methodology are provided in the RI/FS Workplan (ABB-ES, 1997d) and the NTC, Orlando POP (ABB-ES, 1997b). Analytes detected in surface water are summarized in Tables C-6 and C-7, Appendix C, and are shown on Figure 5-10. Complete laboratory analytical results are provided in Appendix D.

No chlorinated VOCs were detected in surface water at location U4W007. PCE was detected at concentrations above its MDL in one sample, U4W01902, at 19 J $\mu\text{g}/\text{l}$. PCE was also present in one of the two control samples, at 2 J $\mu\text{g}/\text{l}$. The Florida Freshwater Surface Water Cleanup Target Level (SWCTL) for PCE is below 8.85 $\mu\text{g}/\text{l}$ (annual average). TCE was detected above its MDL in four samples (including one duplicate sample) from three locations. Detected TCE concentrations ranged from 3 J $\mu\text{g}/\text{l}$ (U4W01003 and its duplicate) to 57 $\mu\text{g}/\text{l}$ (U4W01304). TCE was also present in one control sample at 18 $\mu\text{g}/\text{l}$. The Florida Freshwater SWCTL for TCE is below 80.7 $\mu\text{g}/\text{l}$ (annual average). *Cis*-1,2-DCE was detected in five samples (including one duplicate) from four locations at concentrations that ranged from 40 $\mu\text{g}/\text{l}$ (U4W01103D [duplicate]) to 760 $\mu\text{g}/\text{l}$ (U4W01004). The compound was also present in both control samples at concentrations of 0.5 J $\mu\text{g}/\text{l}$ and 14 $\mu\text{g}/\text{l}$. There is no Florida SWCTL for *cis*-1,2-DCE. VC was detected in three samples (including one duplicate) from one location, U4W010, at concentrations ranging from 20 $\mu\text{g}/\text{l}$ to 46 J $\mu\text{g}/\text{l}$. VC was not detected in the control samples. Based on Florida's Minimum Criteria for Surface Waters (Chapter 62-302.500, FAC), VC must not be present above the MDL.

Other detected VOCs include 1,2-DCE (total) in a sample and its duplicate at 110 $\mu\text{g}/\text{l}$ and 130 $\mu\text{g}/\text{l}$, respectively (U4W01003 and U4W01003D), and toluene,

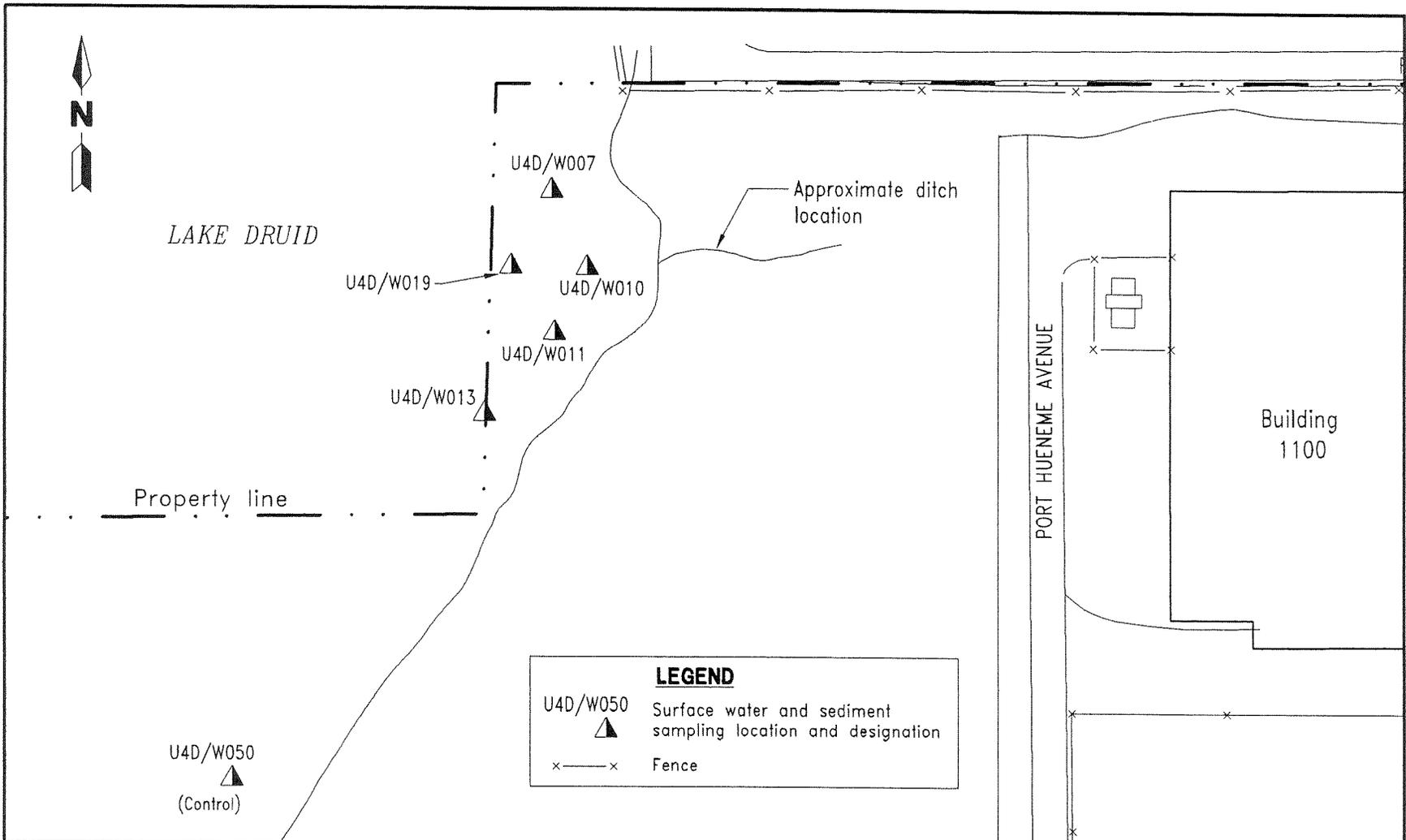
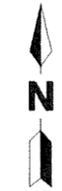
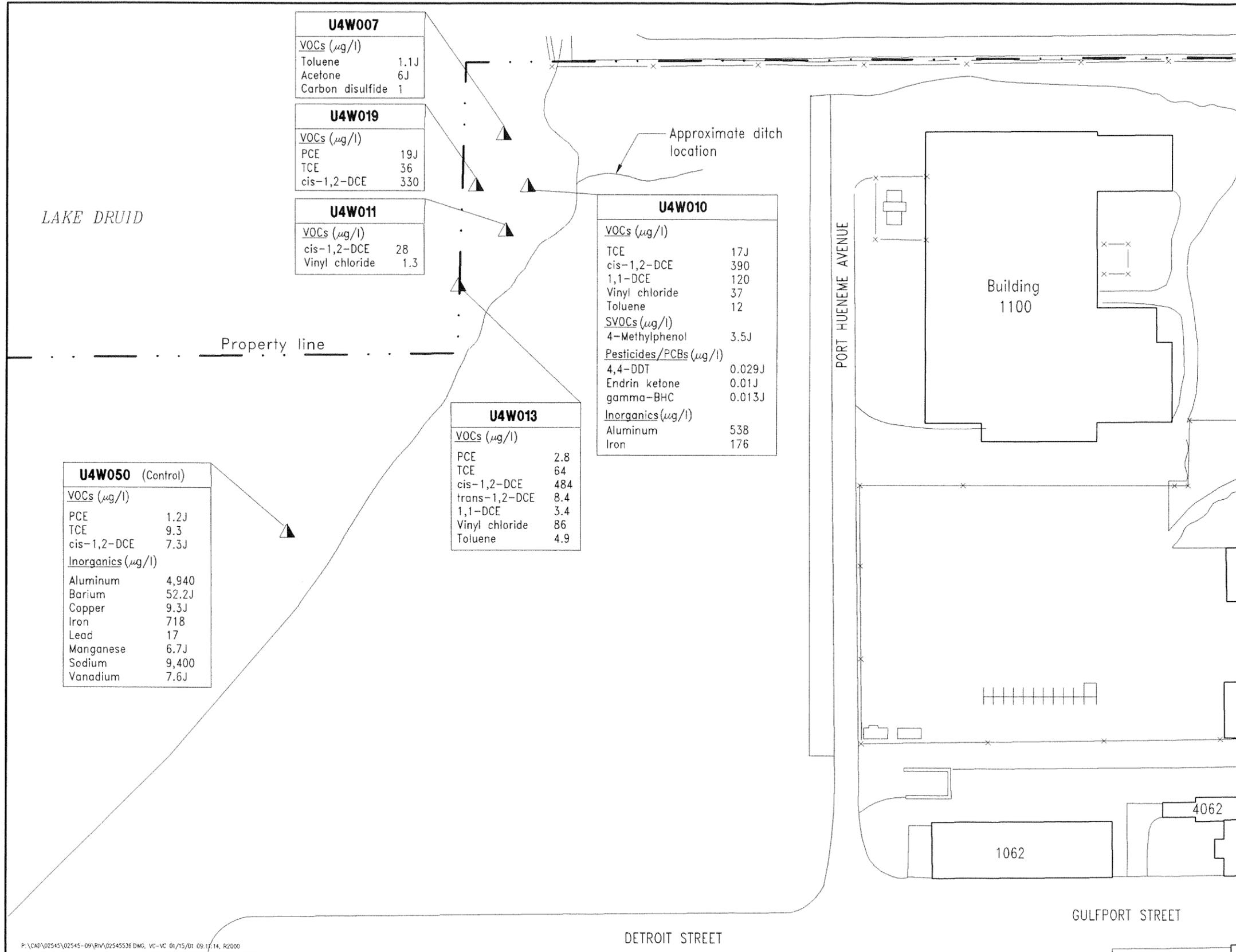


FIGURE 5-9
SURFACE WATER AND SEDIMENT
SAMPLING LOCATIONS



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LEGEND

U4W050	Surface water sample location and designation
▲	
VOC	Volatile organic compound
PCE	Tetrachloroethene
TCE	Trichloroethene
DCE	Dichloroethene
DDT	Dichlorodiphenyltrichloroethane
BHC	Benzene hexachloride
µg/l	Micrograms per liter
J	Estimated value
SVOC	Semivolatile organic compound
x—x	Fence

- NOTES:**
- Multiple sample results were averaged.
 - Figure shows organic analytes and inorganic analytes detected above Naval Training Center, Orlando control sample concentrations.

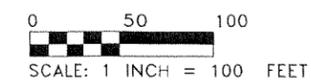


FIGURE 5-10
ANALYTES DETECTED IN SURFACE WATER

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acetone, and carbon disulfide in one sample (U4W00703) at 0.7 J $\mu\text{g}/\ell$, 6 J $\mu\text{g}/\ell$, and 1 $\mu\text{g}/\ell$, respectively. Each detection was below the applicable SWCTLs of 1,692 $\mu\text{g}/\ell$ (acetone), 105 $\mu\text{g}/\ell$ (carbon disulfide), 7,000 $\mu\text{g}/\ell$ (1,2-DCE), and 475 $\mu\text{g}/\ell$ (toluene). None of these additional VOCs was detected in the two control samples.

Only one SVOC, 4-methylphenol, was detected in one of the four samples submitted for the full suite of analyses. The compound was present in duplicate sample U4W01003D at a concentration of 2 J $\mu\text{g}/\ell$, but was not detected in its associated sample (U4W01003). The Florida Freshwater SWCTL for 4-methylphenol is 70 $\mu\text{g}/\ell$. No SVOCs were detected in the two control samples.

The pesticides 4,4'-DDT, endrin ketone, and gamma-BHC (Lindane) were detected at low concentrations in sample U4W01003 and/or its duplicate sample (U4W01003D).

No pesticides or PCBs were detected in the control samples. Applicable Florida Freshwater SWCTLs include below 0.00059 $\mu\text{g}/\ell$ (annual average) for 4,4'-DDT, below 0.0023 $\mu\text{g}/\ell$ (annual average) for endrin, and below 0.063 $\mu\text{g}/\ell$ (annual average) for Lindane.

Three samples (U4W01003, duplicate sample U4W01003D, and control sample U4W05001) were analyzed for inorganic analytes. The control sample contained the maximum concentrations of each analyte. Detected compounds included the following: aluminum (maximum concentration 4,940 $\mu\text{g}/\ell$, in the control sample), barium (detected in the control sample only, at 52.2 J $\mu\text{g}/\ell$), calcium (maximum concentration 12,400 $\mu\text{g}/\ell$, in the control sample), cobalt (detected in the control sample only, at 1.7 J $\mu\text{g}/\ell$), copper (detected in the control sample only, at 9.3 J $\mu\text{g}/\ell$), iron (maximum concentration 718 $\mu\text{g}/\ell$, in the control sample), lead (maximum concentration 17 $\mu\text{g}/\ell$, in the control sample), manganese (maximum concentration 6.7 J $\mu\text{g}/\ell$, in the control sample), sodium (detected in the control sample only, at 9,400 $\mu\text{g}/\ell$), and vanadium (maximum concentration 7.6 J $\mu\text{g}/\ell$, in the control sample). Applicable Florida surface water standards are discussed in the risk assessments, and include the following: for aluminum, less than 13 $\mu\text{g}/\ell$; for barium, not greater than 10% above background; for copper, a value calculated using the formula $e^{(0.8545[\ln(\text{hardness})]-1.465)}$ $\mu\text{g}/\ell$; for iron, less than 1,000 $\mu\text{g}/\ell$; for lead, a value calculated using the formula $e^{(1.273[\ln(\text{hardness})]-4.705)}$ $\mu\text{g}/\ell$; and for sodium, not greater than 50% above background, or 1,275 $\mu\text{g}/\ell$, whichever is greater. Analytes for which no Florida SWCTLs exist include calcium, cobalt, manganese, and vanadium.

5.2.4.2 Sediment Assessment On October 29, 1997, and March 17, 1998, a total of 10 sediment samples (including 2 duplicate samples) were collected from Lake Druid. The sediment sample locations are collocated with the six surface water sample locations described above (see Paragraph 5.2.4.1 and Figure 5-9). Five of the sample locations are within the area of known VOC contamination, and the sixth location served as a control.

The focus of the sediment sampling program was on delineating the extent of chlorinated VOCs in Lake Druid. As such, only samples from the control location (U4D050) and from location U4D010 were submitted for the full suite of analyses (VOCs, SVOCs, pesticides, PCBs, and inorganics). Samples from the four remaining locations were analyzed for VOCs only. Details of the sediment sampling methodology are provided in the RI/FS Workplan (ABB-ES, 1997d) and the NTC, Orlando POP (ABB-ES, 1997b).

Analytes detected in sediment are summarized in Tables C-8 and C-9, Appendix C, and are shown on Figure 5-11. Complete laboratory analytical results are provided in Appendix D. Values shown on Figure 5-11 are averages where duplicates or multiple samples were collected, and therefore may not correspond to the individual sample results discussed in the following paragraphs.

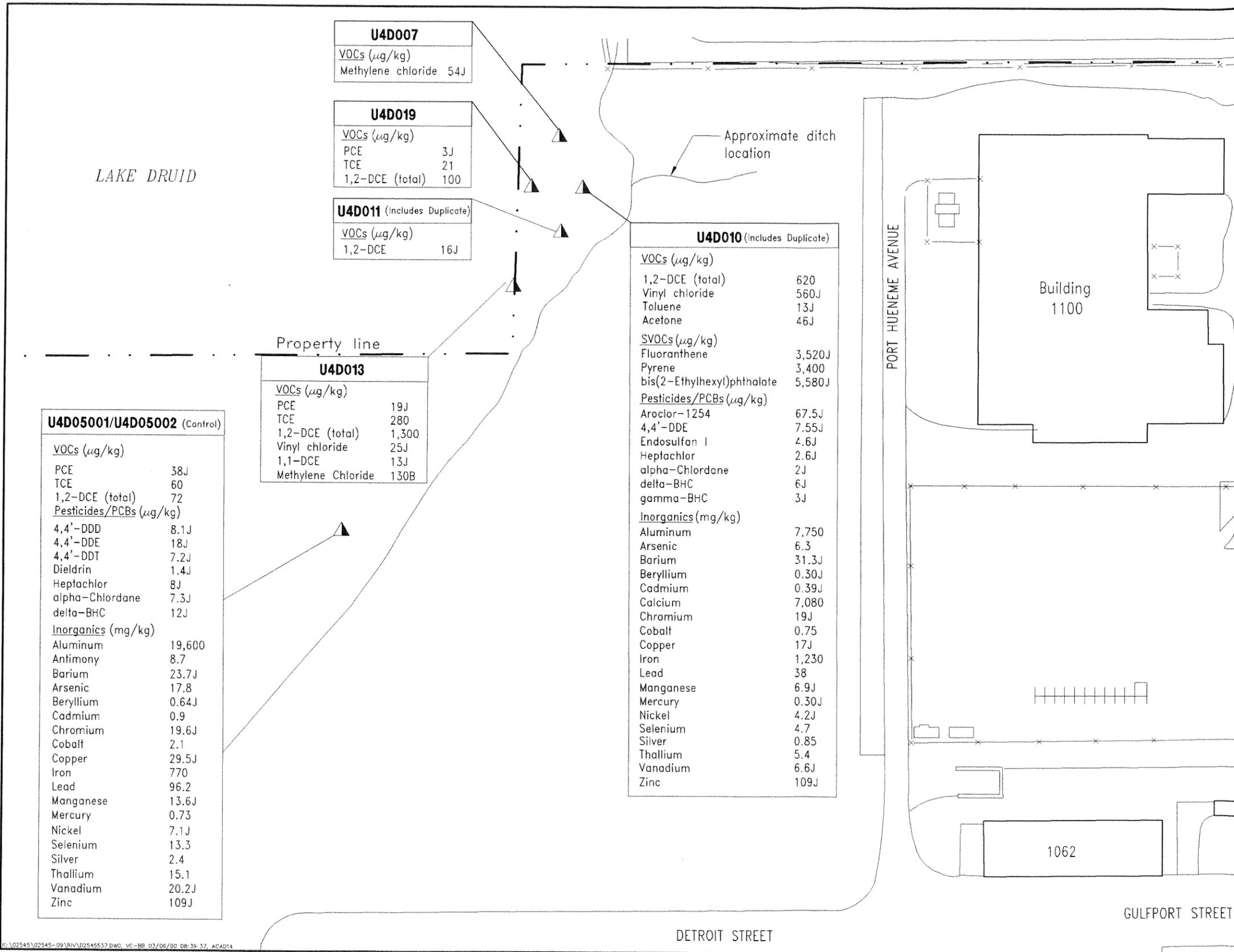
No chlorinated VOCs were detected in sediment at location U4D007. PCE and TCE were both detected at concentrations above their respective MDLs in two samples from two locations. Sample U4D01305 contained PCE at 19 J $\mu\text{g}/\text{kg}$ and TCE at 280 $\mu\text{g}/\text{kg}$, and sample U4D01902 contained PCE at 3 J $\mu\text{g}/\text{kg}$ and TCE at 21 $\mu\text{g}/\text{kg}$. PCE and TCE were also present in one of the two control samples at concentrations of 6 J $\mu\text{g}/\text{kg}$ and 51 $\mu\text{g}/\text{kg}$, respectively. VC was detected in three samples from 2 locations at concentrations that ranged from 25 J $\mu\text{g}/\text{kg}$ (U4D01305) to 564 J $\mu\text{g}/\text{kg}$ (U4D01004). VC was not detected in the control samples. 1,2-DCE (total) was detected in seven samples (including two duplicates) from four locations at concentrations that ranged from 26 $\mu\text{g}/\text{kg}$ (U4D01104) to 1,300 $\mu\text{g}/\text{kg}$ (U4D01305). The compound was also detected in one control sample at 74 $\mu\text{g}/\text{kg}$.

Other detected VOCs include toluene (13 J $\mu\text{g}/\text{kg}$ at U4D010), acetone (46 J $\mu\text{g}/\text{kg}$ at U4D010), and methylene chloride from three locations (maximum concentration 130B $\mu\text{g}/\text{kg}$ at U4D01305). None of these additional VOCs were detected in the control sample.

Two locations, including the control location, were submitted for the full suite of analyses. No SVOCs were detected in the control samples, although detection limits were high due to matrix interferences. The SVOCs fluoranthene, pyrene, and bis(2-ethylhexyl)phthalate were detected in one or both of the noncontrol samples, at a location that is approximately 80 feet south of a 48-inch outfall. Fluoranthene was detected in duplicate sample U4D01003D at 6,200 J $\mu\text{g}/\text{kg}$, but was not detected in its associated sample (U4D01003). Pyrene was detected at concentrations of 200 J $\mu\text{g}/\text{kg}$ (U4D01003) and 6,600 J $\mu\text{g}/\text{kg}$ (U4D01003D). Bis(2-ethylhexyl)phthalate was also detected at 170 J $\mu\text{g}/\text{kg}$ (U4D01003) and 11,000 J $\mu\text{g}/\text{kg}$ (U4D01003D). Given that several stormwater outfalls discharge to Lake Druid, the presence of PAHs and phthalates in sediment is most likely due to the large volume of stormwater that enters the lake from the surrounding urban environment.

Two regular samples (U4D01003 and its duplicate) and one control sample (U4D05001) were submitted for pesticide and PCB analyses. The pesticides 4,4'-DDD and 4,4'-DDT were detected in the control sample, at concentrations of 8.1 J $\mu\text{g}/\text{kg}$ and 7.2 J $\mu\text{g}/\text{kg}$, respectively. 4,4'-DDE was detected in two of the three samples, at a maximum concentration of 18 J $\mu\text{g}/\text{kg}$ in the control sample. Other detected pesticides include dieldrin (detected at 1.4 J $\mu\text{g}/\text{kg}$ in the control sample), endosulfan I (at 4.2 J $\mu\text{g}/\text{kg}$ in U4D01003), heptachlor (maximum concentration 8 J $\mu\text{g}/\text{kg}$, in the control sample), alpha-chlordane (maximum concentration 7.3 J $\mu\text{g}/\text{kg}$, in the control), delta-BHC (maximum of 12 J $\mu\text{g}/\text{kg}$, in the control), and gamma-BHC (Lindane) (detected at 0.54 J $\mu\text{g}/\text{kg}$, in U4D01003). The PCB Aroclor-1254 was also detected, at a maximum concentration of 70 J $\mu\text{g}/\text{kg}$. As is the case with PAHs and phthalates, pesticides and PCBs in Lake Druid sediment are probably derived from stormwater runoff that discharges to the lake via outfalls at several locations around the lake.

Several inorganic analytes were present in the three samples, including aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper,



U4D007

VOCs (µg/kg)	
Methylene chloride	54J

U4D019

VOCs (µg/kg)	
PCE	3J
TCE	21
1,2-DCE (total)	100

U4D011 (Includes Duplicate)

VOCs (µg/kg)	
1,2-DCE	16J

U4D010 (Includes Duplicate)

VOCs (µg/kg)	
1,2-DCE (total)	620
Vinyl chloride	560J
Toluene	13J
Acetone	46J
SVOCs (µg/kg)	
Fluoranthene	3,520J
Pyrene	3,400
bis(2-Ethylhexyl)phthalate	5,580J
Pesticides/PCBs (µg/kg)	
Aroclor-1254	67.5J
4,4'-DDE	7.55J
Endosulfan I	4.6J
Heptachlor	2.6J
alpha-Chlordane	2J
delta-BHC	6J
gamma-BHC	3J
Inorganics (mg/kg)	
Aluminum	7,750
Arsenic	6.3
Barium	31.3J
Beryllium	0.30J
Cadmium	0.39J
Calcium	7,080
Chromium	19J
Cobalt	0.75
Copper	17J
Iron	1,230
Lead	38
Manganese	6.9J
Mercury	0.30J
Nickel	4.2J
Selenium	4.7
Silver	0.85
Thallium	5.4
Vanadium	6.6J
Zinc	109J

U4D013

VOCs (µg/kg)	
PCE	19J
TCE	280
1,2-DCE (total)	1,300
Vinyl chloride	25J
1,1-DCE	13J
Methylene Chloride	130B

U4D05001/U4D05002 (Control)

VOCs (µg/kg)	
PCE	38J
TCE	60
1,2-DCE (total)	72
Pesticides/PCBs (µg/kg)	
4,4'-DDD	8.1J
4,4'-DDE	18J
4,4'-DDT	7.2J
Dieldrin	1.4J
Heptachlor	8J
alpha-Chlordane	7.3J
delta-BHC	12J
Inorganics (mg/kg)	
Aluminum	19,600
Antimony	8.7
Barium	23.7J
Arsenic	17.8
Beryllium	0.64J
Cadmium	0.9
Chromium	19.6J
Cobalt	2.1
Copper	29.5J
Iron	770
Lead	96.2
Manganese	13.6J
Mercury	0.73
Nickel	7.1J
Selenium	13.3
Silver	2.4
Thallium	15.1
Vanadium	20.2J
Zinc	109J



LEGEND

U4D050 Sediment sample location and designation

PCE Tetrachloroethene

TCE Trichloroethene

DCE Dichloroethene

PCB Polychlorinated biphenyl

BHC Benzene hexachloride

DDD Dichlorodiphenyldichloroethene

DDE Dichlorodiphenyldichloroethene

DDT Dichlorodiphenyltrichloroethene

µg/kg Micrograms per kilogram

mg/kg Milligrams per kilogram

J Estimated value

VOC Volatile organic compound

Fence

- NOTES:**
1. Values are averages when duplicate or multiple samples were collected.
 2. Figure shows all organic analytes and inorganic analytes detected.

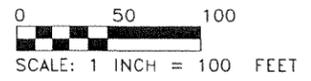


FIGURE 5-11
ANALYTES DETECTED IN SEDIMENT



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iron, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, and zinc. The higher concentrations were generally in the control sample.

5.2.4.3 Drive Point Groundwater Assessment Between September 10, 1997, and March 12, 1998, a total of 15 groundwater samples was collected from three drive points along the shore of Lake Druid (Figure 5-12). The drive points were installed during the FFI, within the area of known VOC contamination.

Groundwater samples are periodically collected from the drive points as part of the ongoing IRA performance monitoring effort, and are analyzed for VOCs only. Details of the sampling methodology are provided in the NTC, Orlando POP (ABB-ES, 1997b).

Analytes detected in drive point groundwater are summarized within the table of analytes detected in other groundwater samples (Table C-5, Appendix C). Complete laboratory analytical results are provided in Appendix D.

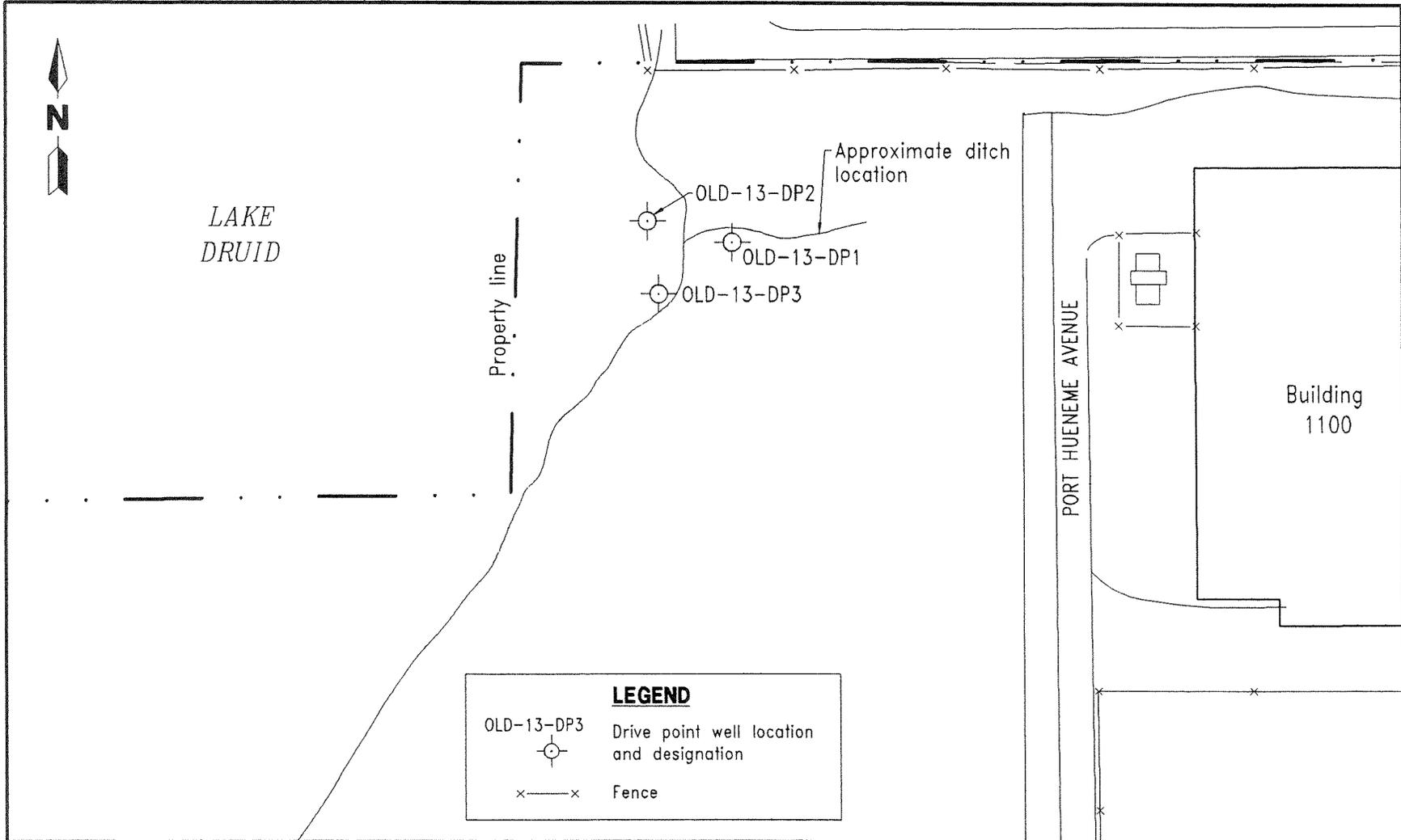
PCE was detected in only one drive point sample, at a concentration of 10 $\mu\text{g}/\ell$ (U4G00205). TCE was detected in 14 samples from all 3 locations, at concentrations ranging from 69.6 $\mu\text{g}/\ell$ (U4G00103) to 2,400 $\mu\text{g}/\ell$ (U4G00205). *Cis*-1,2-DCE was also present in 14 samples from the three locations, at concentrations ranging from 776 $\mu\text{g}/\ell$ (U4G00103) to 5,600 $\mu\text{g}/\ell$ (U4G00208). *Trans*-1,2-DCE was detected in one sample from each of the three locations, at concentrations ranging from 9.4 $\mu\text{g}/\ell$ (U4G00103) to 75 $\mu\text{g}/\ell$ (U4G00205). VC was present in two samples from two locations, at 1.3 $\mu\text{g}/\ell$ (U4G00302) and 7.8 $\mu\text{g}/\ell$ (U4G00103). Finally, 1,1-DCE was detected in two samples from two locations, at 0.7 $\mu\text{g}/\ell$ (U4G00103) and 1.5 $\mu\text{g}/\ell$ (U4G00302).

5.2.4.4 Interpretation of Lake Druid Data The primary source of contamination in Lake Druid originates from contaminated groundwater near or under the former laundry building. The groundwater contaminants degrade naturally as they move towards Lake Druid and enter through the lake bottom. To determine which contaminants were entering Lake Druid, selected drive points were sampled and compounds were compared to GCTLs.

PCE and VC exceeded their GCTLs in two samples, while TCE and *cis*-1,2-DCE exceeded their GCTLs in 16 and 15 samples, respectively. These compounds then migrated into the sediment of Lake Druid. The contaminants found in the sediment were compared to the background or control samples collected and indicated approximate concentrations migrating into the surface water.

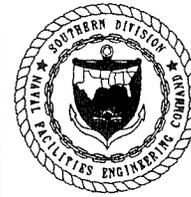
PCE and TCE were found in sediment samples at concentrations as high as 89 $\mu\text{g}/\text{kg}$ and 1400 $\mu\text{g}/\text{kg}$, respectively. PCE and TCE were also detected in one control sample, at respective concentrations of 6 $\mu\text{g}/\text{kg}$ and 51 $\mu\text{g}/\text{kg}$. Total 1,2-DCE was detected with concentrations as high as 3500 $\mu\text{g}/\text{kg}$, exceeding the control sample detection of 74 $\mu\text{g}/\text{kg}$ of total 1,2-DCE. VC was detected with concentrations as high as 1,100 $\mu\text{g}/\text{kg}$, but it was not detected above MDLs in control samples.

VOCs detected in surface water were compared to SWCTLs and control samples. PCE was detected in one sample (19 $\mu\text{g}/\ell$) above its respective SWCTL of 8.85 $\mu\text{g}/\ell$ and the control sample detection of 2 $\mu\text{g}/\ell$. TCE was detected at concentrations as high as 71 $\mu\text{g}/\ell$, but it did not exceed the SWCTL of 80.7 $\mu\text{g}/\ell$. *Cis*-1,2-DCE was present in samples at a maximum concentration of 787 $\mu\text{g}/\ell$, exceeding both control sample detections of 0.5 $\mu\text{g}/\ell$ and 14 $\mu\text{g}/\ell$. *Trans*-1,2-DCE (maximum concentration



0 50 100
SCALE: 1 INCH = 100 FEET

FIGURE 5-12
DRIVE POINT WELL LOCATIONS



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of 8.4 $\mu\text{g}/\ell$) and VC (maximum concentration of 167 $\mu\text{g}/\ell$) were not detected in control samples.

SVOCs, pesticides, and inorganics were also detected in surface water and sediment samples collected in Lake Druid. However, many of these analytes were also detected in the control samples, and they are not believed to be site related. Such compounds commonly enter the environment as a result of commonplace, anthropogenic activities (e.g., combustion, motor vehicles, landscaping activities). Pyrene and fluoranthene are pyrogenic PAHs, produced primarily by the combustion organic matter. These compounds would be expected to be present in urban runoff. Lake Druid receives substantial volumes of stormwater during rain events, and outfalls are present at several locations around the lake.

The distribution of PAHs in Lake Druid sediment was compared to the distribution measured in similar urban stormwater settings in the region, as reported in available literature. The USGS (USGS, 1983 and 1989), the St. John's Water Management District (Battelle, 1998), and FDEP (FDEP, 1998) have published reports evaluating the water quality of stormwater runoff.

FDEP's *"Final Report, Characterization of Stormwater Contaminated Sediment and Debris for Determining Proper Disposal Methods"* (FDEP, 1998) evaluated sediment quality associated with stormwater management devices such as detention and retention basins, canals, and lakes. A comparison of Lake Druid PAH data to PAH data from the FDEP report clearly shows that PAH concentrations detected in Lake Druid are generally much lower than concentrations found in stormwater sediments in Florida. Similarly, pesticide results of Lake Druid sampling and analysis are comparable to pesticide levels encountered in samples collected from stormwater management devices. Phthalates were also frequently detected by FDEP's stormwater sediment sampling program. Appendix P includes a graphical comparison of the PAH data, including total PAHs, pyrene, and fluoranthene. Also presented in Appendix P is a letter report issued to SOUTHNAVFACENGCOCM on October 18, 1999 which summarizes this PAH data comparison.

Many stormwater outfalls are located around the perimeter of Lake Druid, discharging stormwater collected from the surrounding residential neighborhood and the nearby Koger Center office park. The concentrations of PAHs and pesticides detected in Lake Druid are consistent with what has been shown to be present in urban stormwater sediments in Florida, and are therefore unrelated to waste handling and/or disposal activities conducted by the Navy at Area C and OU 4. On October 27, 1999, FDEP issued a letter to SOUTHNAVFACENGCOCM expressing FDEP's concurrence that PAHs, PCBs, and pesticides may be screened off the COPC list in the OU 4 ecological risk assessment (see Appendix P). USEPA has also agreed to abide by FDEP's decision on this matter.

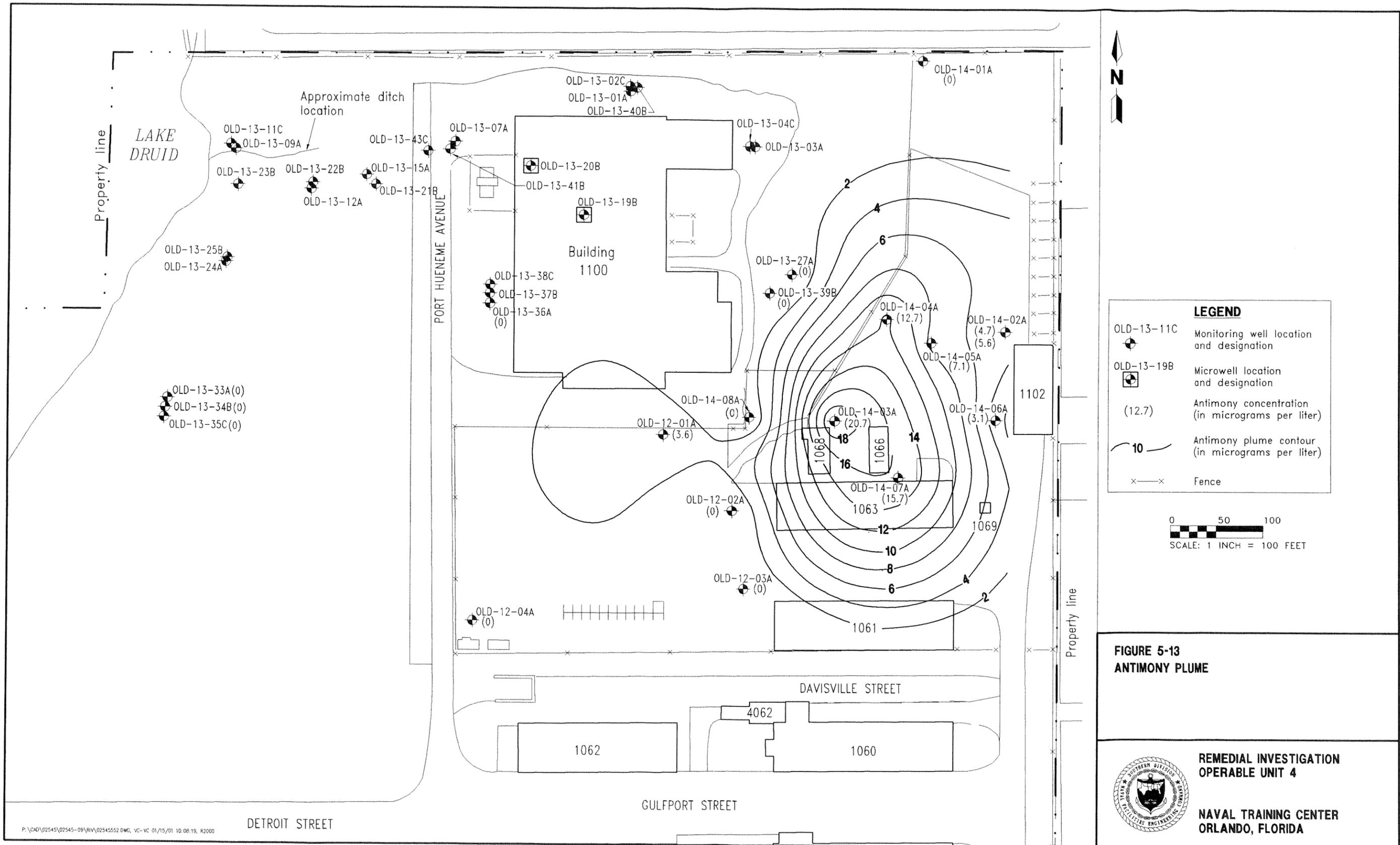
5.3 INTERPRETATION OF CONTAMINANT RELEASE AND AFFECTED AREA. VOC and antimony contour maps are shown in Appendix L. Figures L-1 and L-2 illustrate the variation of PCE concentrations in groundwater with depth. The highest concentrations are in the shallow portion of the aquifer (less than 20 feet bls) near the source area(s) at the northern end of Building 1100. As the PCE plume moves down (due to the downward groundwater potential; see paragraph 3.6.3.1) and west, the PCE degrades to TCE (Figures L-3 and L-4). The downgradient extent of the PCE plume is generally limited by this degradation.

As the plume continues to migrate towards the lake, the TCE biologically degrades to *cis*-1,2-DCE (Figures L-5 and L-6). The highest DCE concentrations are generally in the lower portion of the aquifer, downgradient or collocated with the highest TCE concentrations. The shallow plots for TCE and DCE also illustrate the high concentrations of each compound as the plume completes its migration west and discharges upward into Lake Druid. Note that relatively little PCE is present in this portion of the plume.

The antimony plume (Figure 5-13) is limited to the southeast corner of OU 4. Concentrations above the GCTL of 6 $\mu\text{g}/\ell$ are limited to an area approximately 300 feet in diameter. Antimony data is only available for the shallow (less than 20 feet bls) portion of the surficial aquifer. As discussed in Section 5.1, potential sources of antimony include lead-acid batteries, munitions, and flame retardants for clothing. There is no evidence that munitions were ever present at OU 4. Batteries are an unlikely source, as no lead was detected in groundwater. It is likely, however, that the Navy laundry treated recruit clothing to make it flame retardant. Although a review of the final chemical inventory of the laundry and nearby buildings did not identify any such chemical, nor are there reports of a release, this hypothesis remains the most probable.

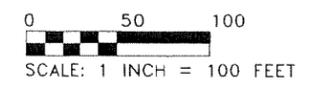
Figure 5-14 represents the extent of total VOC concentrations in OU 4 groundwater. Data used to create this figure include those reported in this RI report, along with DPT and monitoring well data collected from previous investigations. This figure shows that the primary (northern) chlorinated solvent plume originates at the suspected source area(s) at the northern and northwestern end of Building 1100. Monitoring well and DPT data have shown that it is likely that this plume is confined to Area C along the northern property line, and does not extend into the condominium property located north of OU 4.

A second, much lower concentration chlorinated solvent plume exists at the southern end of Building 1100. This southern plume appears to originate near the southeast corner of Building 1100 or the southern end of Study Area 14. Approximately 3 gallons of PCE were reportedly released from scrap dry-cleaning equipment in 1989, but the exact location was not recorded. It is likely that the release would have occurred in Study Area 14 while it was operated as a DRMO storage yard. A number of drums of contaminated soil were reportedly removed from the spill location (ABB-ES, 1994). This effort appears to have been successful in removing the source area. No source was discovered during the soil gas program conducted during site screening (ABB-ES, 1996a), and the relatively low VOC concentrations in groundwater suggest a source area is not present.



LEGEND

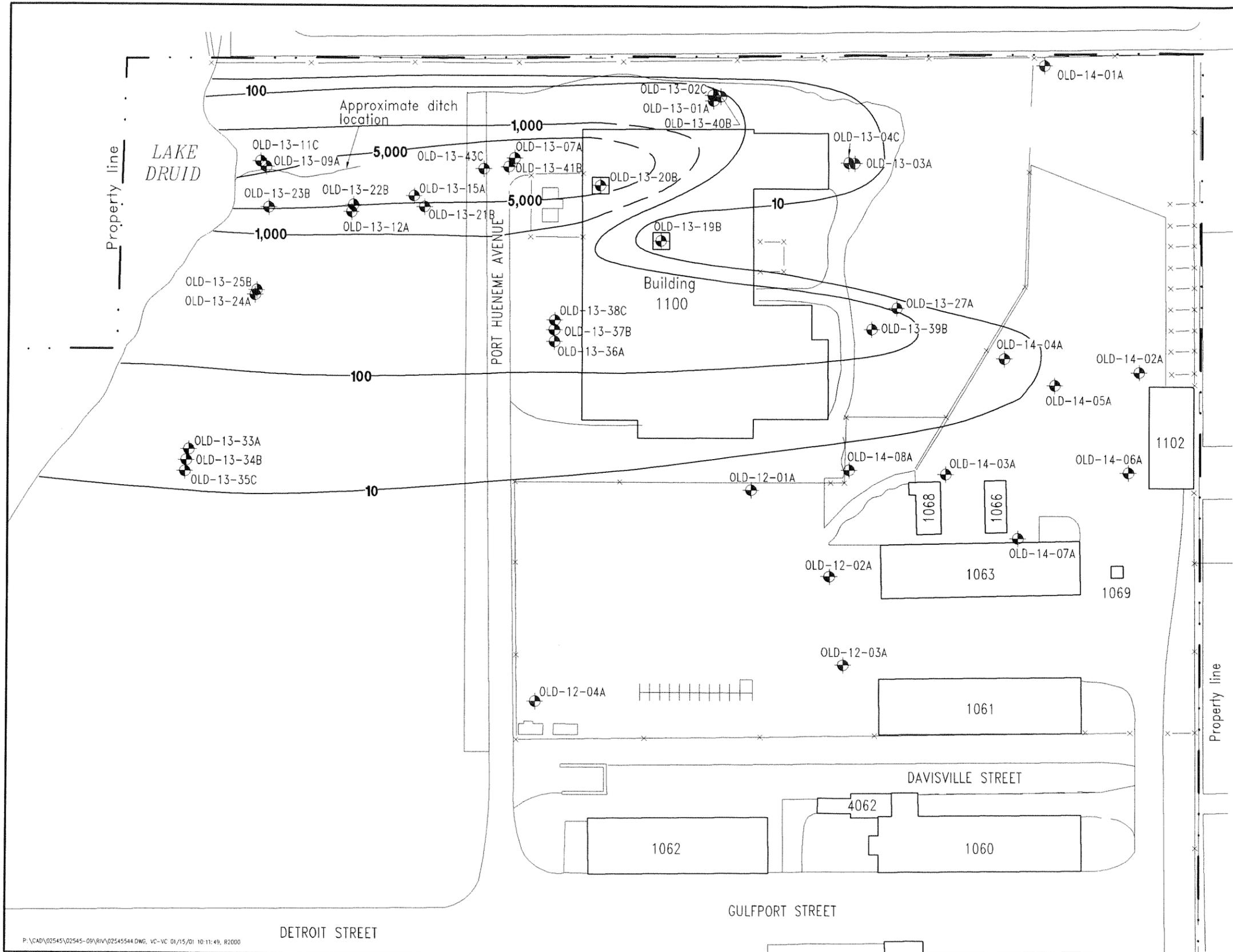
- Monitoring well location and designation
- Microwell location and designation
- (12.7) Antimony concentration (in micrograms per liter)
- Antimony plume contour (in micrograms per liter)
- ×—× Fence



**FIGURE 5-13
ANTIMONY PLUME**

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LEGEND

- 
 OLD-13-11C Monitoring well location and designation
- 
 OLD-13-19B Microwell location and designation
- 
 10 VOC contour (in micrograms per liter, dashed where inferred)
- 
 VOC Volatile organic compound
- 
 Fence

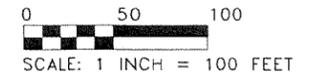


FIGURE 5-14
MAXIMUM TOTAL VOC CONCENTRATIONS



**REMEDIAL INVESTIGATION
 OPERABLE UNIT 4**

**NAVAL TRAINING CENTER
 ORLANDO, FLORIDA**

6.0 REVISED SITE CONCEPTUAL MODEL

The SCM provides a framework within which the source/release mechanism, transport of contaminants, and environmental pathways of concern are identified schematically (Figure 6-1). The SCM has been previously defined and refined throughout the execution of two comprehensive IRAs and the RI at OU 4. One of the objectives of the RI was to identify data needs left from the FFI for the IRA SCM and evaluate those needs to complete the definition of the SCM.

The current version of the SCM is best represented by the Project Logic Diagram (Figure 6-2). This diagram identifies the critical or likely path for contaminant release and exposure pathways. The contaminant sources for this SCM are the fluids associated with the dry-cleaning processes at Building 1100. Source areas and release mechanisms are identified as those areas where releases of chlorinated solvents are documented or believed to have occurred and have migrated into the immediate environment. Once in the environment, contaminants were transferred between media and transported away from the source and/or the site. These contaminants may affect multiple receptors through one or more exposure pathways. The following discussions elaborate on the key headings within the SCM.

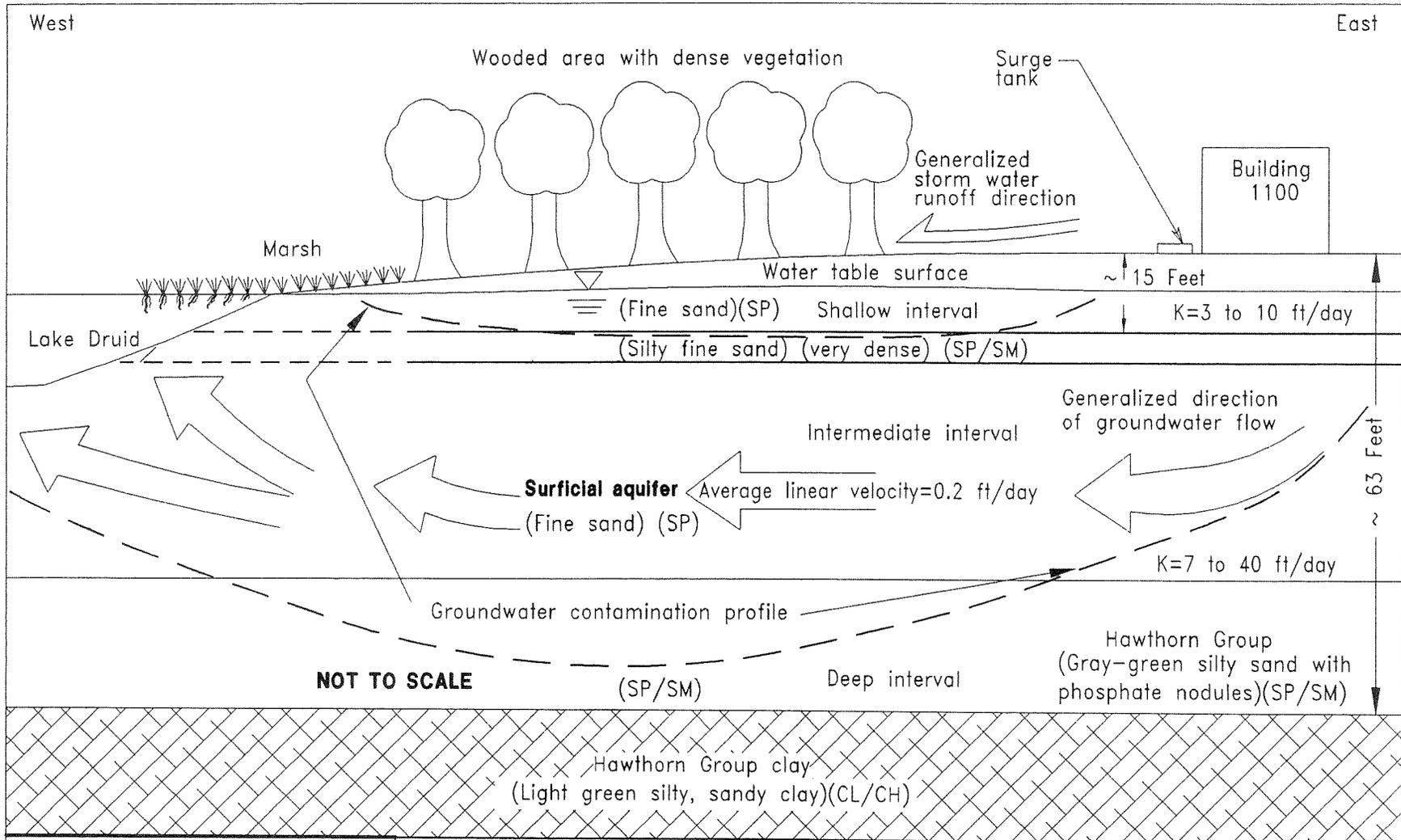
6.1 CONTAMINANT SOURCE/RELEASE MECHANISM. The source of contamination has been identified during the IRA process and confirmed during the RI as PCE associated with the industrial laundry and dry-cleaning facility during its operation from 1943 to 1994.

The probable contaminant source/release mechanisms at OU 4 are

- operational spills on the ground surface outside the building during the loading and unloading of containers of PCE (ranging from 5- to 55-gallon containers);
- leaks associated with the collection and transport of wastewater from laundry and dry-cleaning machines; and
- spills inside the building transferring via leaks in floor drains, drainpipes, the surge tank, and/or sanitary sewer pipe and migrating to the subsurface.

The specific information below has been gained from previous investigations regarding the contaminant source/release mechanism.

- During the source investigation, the highest VOC concentration in soil measured by the laboratory was 430 ppb of PCE at U4P015.
- During the source investigation, groundwater was collected via TerraProbeSM, which resulted in 8,600 $\mu\text{g}/\ell$ PCE and 15,000 $\mu\text{g}/\ell$ TCE. Considering 15,000 $\mu\text{g}/\ell$ TCE is the byproduct of the degradation of 19,000 $\mu\text{g}/\ell$ PCE, the equivalent PCE concentration in this sample is approaching 20 percent of the theoretical solubility for PCE. Similar PCE concentrations were also detected at location U4Q020, based on a comparison of "E" qualified field GC data. These results suggest a



LEGEND	
K	Hydraulic conductivity
ft/day	Feet per day
SP/SM	Unified Soil Classification System symbol

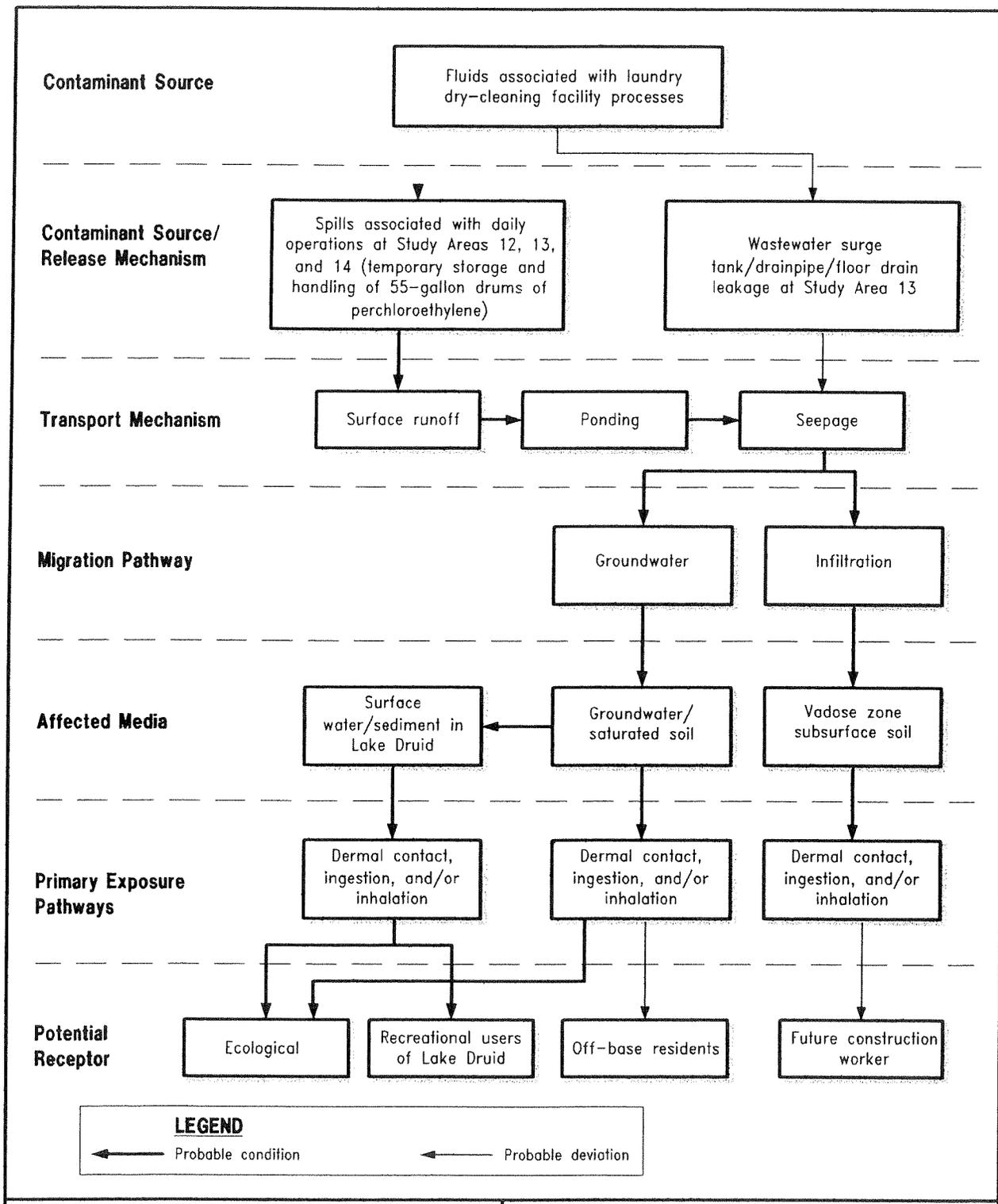
FIGURE 6-1
SITE CONCEPTUAL MODEL

K:\02545\02545-09\RV\02545548.DWG, VC-VC 08/21/98 14:01:16, AutoCAD R14



REMEDIAL INVESTIGATION
OPERABLE UNIT 4

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**FIGURE 6-2
 SITE CONCEPTUAL MODEL:
 PROJECT LOGIC DIAGRAM**



**REMEDIAL INVESTIGATION
 OPERABLE UNIT 4**

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strong possibility that a source area of residual NAPL is present beneath the former laundry building, possibly at more than one location.

- Contaminated groundwater appears to be the source of VOCs detected in Lake Druid. It has been estimated that approximately 25 pounds per year of total VOCs enter Lake Druid via groundwater. Approximately 1 to 5 pounds of VOCs are present in Lake Druid sediment (ABB-ES, 1997e).

6.2 TRANSPORT MECHANISM. The mechanism that provides transportation for the contaminants is through ponding and seepage of the chlorinated solvent releases into the subsurface prior to the chlorinated solvents volatilizing into the atmosphere.

6.3 MIGRATION PATHWAY. The migration pathways listed below show the route by which the chlorinated solvents enter the immediate environment.

- Chlorinated solvents infiltrate through the vadose zone into the groundwater.
- Groundwater in the vicinity of Building 1100 flows in a westerly direction toward Lake Druid, thereby "carrying" dissolved-phase VOCs to the lake.

The specific information below has been gained from previous investigations regarding the migration pathway.

- Stratigraphic information obtained within the surficial aquifer indicates the subsurface is relatively homogeneous, composed of fine sand.
- The soil density of the surficial aquifer typically ranges from medium dense to dense, with the exception of a hard layer (very dense) approximately 15 feet bls, with varying thickness averaging about 5 feet. No stratum has been identified that would act as a hydraulic or chemical confining layer or barrier.
- Results of the DPT groundwater investigation indicated that the width of the groundwater VOC plume extends approximately 500 feet from just south of the north fence line down the shoreline of Lake Druid. VOCs were detected in groundwater at depths ranging from 4 to 68 feet bls and include chlorinated solvents, primarily *cis*-1,2-DCE, TCE, and PCE.
- Aquifer modeling results indicated that hydraulic conductivity varied in two zones of the surficial aquifer. From the groundwater surface to approximately 20 to 25 feet bls, the hydraulic conductivity is about 10 ft/day. Below that point to approximately 55 feet bls, the hydraulic conductivity is about 40 ft/day.

6.4 AFFECTED MEDIA. Contaminated media include:

- surface water and sediment in Lake Druid,
- surface soil and subsurface soil in the vicinity of Building 1100 (source area), and
- groundwater.

The specific information below has been gained from previous investigations regarding the affected media.

- Lake Druid is a Class III surface water, as described in Chapter 62-302, FAC, SWQSS. In comparing SWCTLs for a freshwater body, concentrations of PCE and TCE were above the numeric standards. VC concentrations also exceeded minimum criteria (the detection limit), as specified in Chapter 62-302.500, FAC. There are no specific published standards for *cis*-DCE. However, *cis*-DCE was present in surface water at concentrations exceeding the Florida MCL (70 $\mu\text{g}/\ell$). This concentration has been established as the performance standard for *cis*-DCE in groundwater discharging to the lake for the OU 4 IRA (ABB-ES, 1997c). The highest surface water and sediment VOC concentrations were detected where the ditch formed by the surface expression of groundwater enters the lake.
- Three surface soil samples taken during the RI had exceedances of the leachability SCTL of 30 $\mu\text{g}/\text{kg}$ for PCE. Those samples were collected in areas suspected to have had PCE spills in the north, northeast, and northwest vicinity of Building 1100. PCE was also detected at 11 $\mu\text{g}/\text{kg}$ in surface soil from boring 14B002, corresponding to the soil gas detection in this area. Three PAHs (benzo(a)pyrene, benzo(b)fluoranthene, and dibenz(a,h)anthracene) exceeded residential SCTLs in samples collected in surface drainage swales at SA 13 and under the asphalt in one location in SA 12. However, surface soil excavation completed as part of the surface soil IRA substantially reduced PAH concentrations in surface soil. Several inorganics were detected in surface soil above background screening criteria at OU 4, but only arsenic in two locations and barium and vanadium in one location exceeded residential SCTLs, and only chromium and mercury in one location exceeded leachability SCTLs.
- PCE was detected in subsurface soil above leachability SCTLs near monitoring wells OLD-13-01A and OLD-13-07A and beneath the laundry building itself. Arsenic and barium were detected in subsurface soil (10 feet bls), at concentrations exceeding residential SCTLs.
- In general, during the source investigation, soil VOC concentrations decreased with depth. The low concentrations detected may be present from the volatilization of a release some distance away and do not suggest the presence of residual NAPL at these sample locations.
- The highest VOC concentrations in groundwater were detected in the vicinity of the surge tank and beneath the laundry building. Antimony was detected above the FDEP MCL only in monitoring wells at SA 14.

6.5 PRIMARY EXPOSURE PATHWAYS. Organisms in the vicinity of OU 4 may be exposed to the COCs by the pathways listed below.

- Dermal contact may occur any time biota comes in contact with the surface water, lake sediment, groundwater, and/or soil.
- The ingestion of surface water, sediment, groundwater, and/or soil may occur at OU 4.
- Inhalation of VOCs may occur in and around Lake Druid from surface water and on occasions when the groundwater is used for irrigation purposes by the residents near the lake. Disturbing the soil may cause the volatilization of the compounds into the atmosphere. Volatilization could also occur into structures built over contaminated soil or shallow groundwater.

6.6 POTENTIAL RECEPTORS. Listed below are all the possible receptors that may be exposed to the chlorinated solvents.

- Ecological receptors have the potential to be exposed via all three exposure pathways.
- Recreational users of Lake Druid are in direct contact with surface water and potentially sediment.
- Off-base residents have the potential to be exposed to the contaminated groundwater from OU 4 through irrigation wells, which they may have on their property, and via inhalation of vapors migrating into buildings from groundwater.
- Future construction workers could be exposed to the soil at OU 4, either during demolition of Building 1100 or during the construction of new structures at the site.
- Future residents could be exposed via groundwater ingestion and inhalation of released VOCs.

CHAPTR 7.0

7.0 FATE AND TRANSPORT OF CONTAMINANTS

The environmental fate and transport of contaminants is determined by a variety of complex and interacting processes that ultimately control the concentration and distribution of contaminants in the environment. Fate and transport processes are governed by the physical and chemical properties of the contaminants and the properties of the environmental media (i.e., soil, groundwater, surface water, sediment, biota, and air) in which the contaminants reside. These processes include transport within and among media; physical, chemical, and biological transformation; and bioaccumulation. This chapter qualitatively discusses the probable fate and transport of the site-related contaminants identified at NTC, Orlando OU 4.

7.1 APPARENT SITE-RELATED CONTAMINANTS. The nature and extent of all contaminants detected at OU 4 is discussed in Chapter 5.0. These contaminants are evaluated in the ERA (Chapter 8.0) and the HHRA (Chapter 9.0), and, based on this evaluation, a list of apparent site-related contaminants has been compiled (Table 7-1).

Of these site-related contaminants, the VOCs warrant the focus of discussion throughout this chapter because they are the predominant contaminants, they have identifiable source areas and traceable transport pathways, and contributed significantly to risk.

Inorganics occur naturally and are randomly distributed in the soil and groundwater throughout OU 4. As a result, source areas (if any) and migration pathways are not evident. Chapter 5.0 discusses the comparison between the inorganic data set concentrations and the corresponding background data set concentrations. Arsenic and beryllium detections in soil are limited in extent and appear to be isolated occurrences. Discussion of these inorganics is limited to a brief mention of their persistence characteristics.

7.2 POTENTIAL ROUTES OF MIGRATION. Routes of migration are determined by the physical characteristics of the specific COCs and distribution of chemicals. Media in which contaminants at OU 4 may potentially migrate include air, soil, surface water, sediment, and groundwater. A migration pathway is identified only if the distribution of contaminants indicates migration through the potentially affected medium. Descriptions of the potential pathways are presented in the following subsections.

7.2.1 Air Migration through the air occurs by volatilization of the contaminant or by adsorption of the contaminant onto airborne particulates. Volatilization is not considered to be a significant natural migration route at OU 4 because of the limited concentrations of VOCs detected in the surface soil, sediment, and surface water. VOCs in groundwater discharging to surface water will result in most of the VOCs volatilizing into ambient air, but flow rates and resultant concentrations are low. Metals and other contaminants with high adsorption coefficients in the surface soil may enter the pathway if prevailing winds cause soil particles to become airborne. However, the risk assessment (Chapter 8.0) has indicated that air is not a migration pathway of concern.

Table 7-1
Probable Fate and Transport for Volatile Organic Compounds in Groundwater
(Values given at 25°C unless noted otherwise)

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center
 Orlando, Florida

Compound	MW (g/mol)	Water Solubility (mg/l)	Sorption Potential K_{oc} (ml/g)	Vapor Pressure (mm Hg)	Henry's Law Constant (atm-m ³ /mol)	Biodegradation Potential	Probable Fate and Potential Transport Pathways
cis-1,2-Dichloroethene	96.94	3,500	49	208	0.00758	RN	The plume migrates from Building 1100, extending to and discharging into Lake Druid. The variation in concentration (Figure 5-8 and Appendix L) along the migration pathway is caused by several processes. First, there is apparent natural biological degradation of the PCE, as PCE concentrations decrease markedly and its degradation products, TCE and DCE, appear. Further natural degradation in groundwater to VC does not appear to occur to any significant degree, as only occasional and relatively low concentrations of VC have been detected in the migrating plume. Other processes, such as retardation and dilution through recharge and dispersion, also occur, which cause decreases in concentrations along the migration pathway.
Tetrachloroethene	165.83	150	364	17.8	0.0259	RM	
Trichloroethene	131.39	1,100	126	57.9	0.0091	RM	
Vinyl chloride	62.5	2,670	57	2,660	0.0819	RN	

Notes: M = moderate months.
 O = aerobic.
 S = slow years.
 mg/l = milligrams per liter.
 °C = degrees Celsius.
 atm-m³/mol = atmosphere - cubic meters per mole.

N = none/very slow.
 R = anaerobic.
 ml/g = milliliter per gram.
 mm Hg = millimeters of mercury.
 K_{oc} = organic carbon partition coefficient.

g/mol = grams per mole.

7.2.2 Soil Once contaminants have been released into soil they may migrate by one or more mechanisms. The contaminants may become airborne (volatilization or adsorption to airborne particles), they may migrate overland by surface runoff of precipitation, they may migrate within the soil due to leaching by infiltrating precipitation, or they may be bioconcentrated by plants. The primary route of migration at OU 4 is the leaching of contaminants from the soil into the groundwater of the surficial aquifer by the infiltration and downward percolation of precipitation, and by fluctuations of the water table through zones of residual contaminants in soil.

7.2.3 Surface Water and Sediment Contaminants may reach surface water bodies via overland flow and the discharge of groundwater. Contaminants may accumulate in sediment from erosion of surface soil or the partitioning of ground water contaminants from the aqueous to the solid phase. As has been discussed in Chapters 2.0 and 6.0, it appears most of the contamination in Lake Druid is from the discharge of groundwater into the sediment, and finally into the surface water. Once discharged to a surface water body, contaminants dissolved in water or sorbed to sediment can be taken up by aquatic organisms. Alternatively, they may persist in either the sediment or surface water with relatively little degradation.

The nearest significant surface water body within OU 4 is Lake Druid, a surface expression of the groundwater table, but which also appears to be sustained from surface water runoff from adjacent land and drainage, piped in from the neighborhood. The Lake Druid overflow drains to Lake Rowena, to the west of Lake Druid. The contamination found in Lake Druid appears to be confined to the eastern bank of the lake and it is unlikely that any significant amount of contamination leaves Lake Druid via water or sediment. VOCs emerging into the shallow surface water likely volatilize quickly into the air.

7.2.4 Groundwater Generally, contaminants migrate to groundwater vertically from sources in soil above the aquifer through downward percolation of precipitation. At OU 4, the high concentrations of PCE in groundwater suggest historic releases of PCE that have extended down into the aquifer and become immobilized within soil pore spaces. This residual source most likely continues to dissolve into groundwater flowing through this contaminated zone.

Groundwater is generally first encountered at OU 4 around 3 to 5 feet bls. The observed migration of dissolved-phase contaminants within the surficial aquifer is essentially horizontal, from east to west, flowing into Lake Druid. Some downward movement may occur near recharge areas, and there may be some slight induced downward movement created by the higher K in the lower surficial aquifer and leakage into the Hawthorn unit. However, the short distance to the lake, and the strong upward discharge of groundwater to this surface water, most likely limits the further vertical downward spread, and the dissolved-phase contaminants converge along streamlines of flow to the lake (see conceptual model, Figure 6-1).

7.3 CONTAMINANT PERSISTENCE AND MIGRATION. The ability of a contaminant to persist in environmental media subsequent to release and transport is dependent upon processes to which the contaminant is subjected. Compounds may be physically, chemically, or biologically transformed or accumulated. The

susceptibility of the contaminant to these specific processes is a function of the properties of the chemical itself.

Physio-chemical properties presented for organic chemicals detected at OU 4 include specific gravity, solubility in water, volatility, Henry's Law Constant (H), and organic carbon partition coefficient (K_{oc}) (Table 7-1). The migration potentials and fate of inorganic compounds are subject to much more complex interactions. In addition to the species and oxidation state (valence) of the inorganic chemical being considered, site-related factors such as oxidation-reduction potential, pH, common ion effects, type and concentration of anions present, competing reactions, and geochemical interactions all play an important role in determining inorganic chemical fate and transport. In addition, many of the inorganic species are naturally occurring, and may have been mobilized (rather than occur because of a site release) due to changes in the aquifer-soil equilibrium as the site plume migrates. Physio-chemical properties relevant to the organic chemicals are defined in the paragraphs below.

Specific gravity is the ratio of the mass of a given volume of a substance to the mass of an equal volume of water. Liquids with specific gravities greater than one are termed denser, or "heavier", than water. PCE, the principal contaminant released at the former laundry, is a good example of a dense NAPL with a density of about 1.62 grams per milliliter, more than half again that of water.

Solubility and K_{oc} represent measures of the tendency of a material to move from one phase to another. Solubility measures the partitioning between the pure liquid or solid form of a chemical and the aqueous phase, or the tendency of a material to dissolve in water. Substances with low solubilities are more likely to remain in a pure form when in contact with water; substances with high solubilities will dissolve and move with water more easily. K_{oc} measures the extent that an organic chemical partitions between organic carbon and a liquid phase (generally water), and is used to estimate the degree to which a chemical could be adsorbed to soil organic carbon (Ney, 1990). Chemicals with a K_{oc} greater than 10,000 will tend to adsorb strongly to soil organic carbon. Chemicals with a K_{oc} in the range of 1,000 to 10,000 could be moderately adsorbed or retarded during transport with water. Chemicals with a K_{oc} of less than 1,000 adsorb weakly to soil organic carbon and tend to be more mobile. However, even though the VOCs fall into this latter category, variations in their specific K_{oc} values can result in significantly different rates of migration for each of the VOCs, e.g., PCE dissolved in groundwater may move much more slowly than TCE. This is because the K_{oc} for PCE is almost three times that for TCE, and therefore PCE has a much stronger tendency to be slowed by adsorption to the aquifer solids.

Volatilization potential of an organic compound is measured by vapor pressure and Henry's Law constants (H). Volatility increases with increasing vapor pressure (a function of temperature), and generally considers only the vaporization of a pure compound. H indicates the partitioning of a compound between a dissolved phase (generally aqueous) and a gas phase (generally air). While volatility considers only vapor pressure of the compound as a function of temperature, H is determined by the equilibrium established between the competing phenomena of solubility and volatility. For example, acetone, although it has a high vapor pressure, is stripped out of water only poorly because of its high solubility. Compounds with H values less than 1.0×10^{-5} (atmosphere - cubic meters per mole [atm-m³/mol]) volatilize from water very slowly, and those with an H less than

3.0×10^{-7} are considered non-volatile. Compounds with H values between 1.0×10^{-5} and 1.0×10^{-3} volatilize moderately easily, while those with H values above 1.0×10^{-3} volatilize rapidly.

Specific gravities, solubilities, vapor pressures, Henry's Law constants, and K_{oc} , values are not used to estimate total solubility, because elemental analyses measure the total amount of an inorganic constituent in the same rather than the actual chemical form (e.g., a metal hydroxide, metal ligand complex, or metal oxidation state). Instead, the distribution of specific solute species, pH, oxidation state, and other site factors are used to estimate the total solubility and/or relative mobility of inorganic compounds.

Processes that are thought to contribute to the persistence and migration of the apparent site-related contaminants are discussed by study area and media in the subsections below.

7.3.1 Study Area 12 No significant contaminants were identified in any media at SA 12.

7.3.2 Study Area 13 The paragraphs below will discuss the VOC contamination from chlorinated solvents in each of the media of concern at SA 13.

7.3.2.1 Soil PCE was the only significant COC identified in the surface soil and subsurface soil at SA 13. Three surface soil samples and two subsurface soil samples exceeded the leachability SCTL of $30 \mu\text{g}/\text{kg}$ with detections ranging from 31 to $110 \mu\text{g}/\text{kg}$. PCE has a moderately low solubility ($150 \text{ mg}/\ell$), high H ($0.0259 \text{ atm}\cdot\text{m}^3/\text{mol}$ at 25 degrees Celsius [$^{\circ}\text{C}$]) and vapor pressure (17.8 millimeters of mercury [mm Hg] at 25°C), and a moderate K_{oc} ($364 \text{ ml}/\text{g}$) as shown in Table 7-1. This indicates that most PCE would volatilize or travel in aqueous phase to the surficial aquifer. These five samples were located under asphalt, where volatilizing or migrating within the soil from infiltration of precipitation would be difficult. Soil is considered a potential contaminant source, but not a significant migration pathway at SA 13.

7.3.2.2 Groundwater Significant contaminants identified in the groundwater at SA 13 are three VOCs (PCE, TCE, and *cis*-1,2-DCE).

Groundwater flows to the west, from the former laundry building towards Lake Druid, where it discharges. Areas of highest PCE contamination are found near and under the former laundry building, where the suspected source of contamination originated. The highest PCE sample collected here was $34,000 \mu\text{g}/\ell$. This concentration is in excess of 20 percent of PCE solubility in water, and strongly suggests that residual free-product PCE may be present in the aquifer matrix. It is likely that the PCE occurs as relatively immobile ganglia (or stringers), which dissolve into passing groundwater. As groundwater flows toward Lake Druid, PCE degrades to TCE and *cis*-1,2-DCE. This natural biological degradation is indicated by the increasing proportion of the daughter TCE and *cis*-1,2-DCE compounds, and the near disappearance of the PCE. For instance, as shown below, near Building 1100 in groundwater samples from MWs 01D13-07A and OLD 13-20B the contamination is primarily PCE with no DCE; however, further downgradient in groundwater from MWs OLD-13-21B and OLD-13-23B the ethenes have been degraded to consist of TCE and DCE but no PCE.

	<u>PCE</u>	<u>TCE</u>	<u>DCE</u>
OLD-13-07A	29,800	--	--
OLD-13-20B	310	270	--
OLD-13-21B	--	625	890
OLD-13-23B	--	2,475	1,650

However, groundwater is considered a significant migration pathway from the source at the former laundry building to Lake Druid. Upward potential observed in monitoring wells and drive points indicates that groundwater from the surficial aquifer is discharging into the lake. In addition, plume concentrations decrease with depth in the aquifer near the lake. However, migration of the plume beyond the near shore of Lake Druid likely does not occur. As VC is absent in OU 4 groundwater, but was detected in Lake Druid surface water and sediment samples, it appears that VC forms when the groundwater plume discharges through the lake sediment (see Paragraph 7.3.2.3, below).

7.3.2.3 Lake Druid Significant contaminants identified in the surface water and sediment of Lake Druid are four VOCs (PCE, TCE, DCE, and VC). Other organics detected at low concentrations, such as pesticides and SVOCs, are not believed to be site-related (see Paragraph 5.2.4.4). A likely source for those detections is from the five storm water drains that discharge into Lake Druid from beyond the Navy property line.

Areas of highest contamination are found near the eastern shore of Lake Druid. Groundwater enters Lake Druid upward through the sediment layer into the surface water. PCE and TCE were detected at two sediment locations at maximum concentrations of 89 $\mu\text{g}/\text{kg}$ and 1400 $\mu\text{g}/\text{kg}$, respectively. Total DCE was detected at a maximum concentration of 3500 $\mu\text{g}/\text{kg}$ and was detected in four sediment locations. VC was detected in two sediment locations and was detected at a maximum concentration 1100 $\mu\text{g}/\text{kg}$. Much of the VC in these samples is likely due to the presence in the pore water of the sample rather than sorption. With its high solubility and extremely high vapor pressure, VC would much rather be in air than water, and in water than soil.

These VOCs do not normally adsorb or bioconcentrate to soil particles strongly. However, with the high TOC found in the sediment of Lake Druid, adsorption and bioconcentration may be more predominant than under normal soil/sediment matrix conditions. Because these contaminants migrate from the groundwater to the sediment and finally to the surface water, sediment is a migration pathway. Sediment is also considered a potential residual contaminant source.

TCE was detected at three surface water locations at a maximum concentration of 71 $\mu\text{g}/\text{l}$; thus not exceeding the FDEP SWCTL of 80.7 $\mu\text{g}/\text{l}$. The highest PCE detection from two surface water locations was 19 $\mu\text{g}/\text{l}$, exceeding the FDEP SWCTL of 8.85 $\mu\text{g}/\text{l}$. The highest *cis*-1,2-DCE detection from four surface water locations was 787 $\mu\text{g}/\text{l}$. There is no published FDEP SWCTL for *cis*-1,2-DCE. VC was detected at three surface water locations with a maximum concentration of 167 $\mu\text{g}/\text{l}$, exceeding the FDEP surface water minimum criteria (the detection limit) for VC.

Once the VOCs are present in the water column, volatilization into ambient air occurs rapidly from the shallow surface water. It is unlikely that any significant surface water contamination leaves Lake Druid. As discussed in Section 2.5, the objective of the IRA is to intercept the plume of highest VOC

concentrations and reduce the amount of contamination reaching Lake Druid. Surface water (Lake Druid) is considered the principal receptor for contaminated groundwater, but not a significant migration pathway for further migration.

7.3.3 Study Area 14 The only significant contaminant identified at SA 14 was one inorganic (antimony) in the groundwater. Antimony was detected at concentrations above its GCTL of 6 $\mu\text{g}/\ell$ and its background screening concentration of 4.1 $\mu\text{g}/\ell$ at four locations where filtered and unfiltered samples were analyzed at SA 14. The distribution of antimony suggests it is present as a plume in groundwater. The concentrations of antimony detected in filtered samples correspond well to those detected in unfiltered samples, suggesting that much of the antimony present occurs in the dissolved phase.

According to *USEPA's Water-Related Environmental Fate of 129 Priority Pollutants*, the most probable fate of antimony is, ultimately, transport in solution to the oceans. The antimonite and antimonate ions have a relatively high solubility. To some extent, sorption to clays and other mineral surfaces temporarily removes antimony from solution (USEPA, 1979).

Antimony has a low natural occurrence in groundwater and in surface water. According to the *Toxicological Profile for Antimony* (Agency for Toxic Substances and Disease Registry, 1991), antimony is commonly found in some wastewaters, including laundry effluent.

7.4 TRANSPORT AND FATE UNDER THE GROUNDWATER NO ACTION SCENARIO. This section describes probable fate of contaminants in groundwater associated with the OU 4 plume under a condition of no further action taken to prevent migration of the plume. The purpose of the no action scenario is to serve as a baseline against which to measure the effectiveness of potential remedial actions that might be taken to reduce exposure to migrating contaminants. For this scenario, the recirculation well technology currently being applied as an IRA would be curtailed, and the plume would be allowed to migrate to Lake Druid as it has in the past.

This discussion focuses on the principal plume emanating from the northwest corner of Building 1100, and whose source is believed to be residual PCE in the aquifer and soil beneath or near that corner of the building. Maximum concentrations of PCE observed in monitoring wells in this area have been about 30 mg/ℓ , or about 20 percent of the solubility of PCE in groundwater. Concentrations this high are usually indicative of the presence of free product. Given the probable age of the release(s), it is likely that the PCE is trapped in the aquifer pore space and is relatively immobile. The residual PCE contributes to groundwater contamination primarily by dissolution into the groundwater as it flows through the area of residual PCE. The plume map (Figure 5-14) shows an area of relatively high concentrations surrounded by a zone of lower concentrations. The size of the plume near Building 1100 is approximately 35 feet thick and has a width of approximately 100 feet within the 1000 $\mu\text{g}/\ell$ total VOC contour, and approximately 270 feet within the 100 $\mu\text{g}/\ell$ total VOC.

Fate and transport modeling was previously performed for the OU 4 natural attenuation assessment (HLA, 1998). The assumptions, results, and conclusions are included as Appendix Q.

The plume migrates from Building 1100, extending to and discharging into Lake Druid. The variation in concentration (Figure 5-8 and Appendix L) along the migration pathway is caused by several processes. First, there is apparent natural biological degradation of the PCE, as PCE concentrations decrease markedly and its degradation products, TCE and DCE, appear. Further natural degradation in groundwater to VC does not appear to occur to any significant degree, as only occasional and relatively low concentrations of VC have been detected in the migrating plume. Other processes, such as retardation and dilution through recharge and dispersion, also occur, which cause decreases in concentrations along the migration pathway. Biodegradation causes the loss of contaminant mass and a decrease in concentration, while the other processes result in only a decrease in contaminant concentration. Since further degradation to VC does not seem to have occurred in groundwater, the resultant concentrations of DCE and TCE may be used to backcalculate an equivalent original PCE concentration at points along the migration pathway. These results suggest that decreases in concentrations due to nondegradative mechanisms by factors of 3 to 8 times have occurred over the distance from the source area to wells near Lake Druid. While the degradation mechanism appears to have nearly completely degraded the PCE, the degree of transformation to either primarily TCE or further to DCE varies with location. As can be seen on Figure 5-8, either TCE or DCE appears as the predominant VOC at most downgradient locations. However, whether or not TCE or DCE is predominant is not consistent with distance from the source area, suggesting that along some flow paths there is more natural biodegradation than along others.

When the plume arrives at the lake (with some discharge possible to the groundwater ditch), the upward hydraulic gradients cause the plume to rise with the discharging groundwater. Modeling and hydraulic measurements indicate that the groundwater associated with the OU 4 plume likely completely discharges to the near shore locale of Lake Druid. The observed distribution of VOCs in lake sediment and surface water (ABB-ES, 1997f) indicate a main plume width of about 200 feet at the lake, with the plume discharge occurring within a zone of about 100 feet in length (extending into the lake). Judging from the pattern of the distribution, discharge from the groundwater ditch into the lake apparently carries some sediment further out into the lake in a narrow band. The groundwater and the plume pass through the lake bottom sediments which contain higher concentrations of organic carbon, and which are sites of high biological activity. Further degradation of the chlorinated solvents occur when the groundwater plume discharges through the lake sediment, with the formation of significant concentrations of VC. The higher organic carbon encourages greater partitioning of the chlorinated compounds within the sediment layer, but much passes through into the lake water column. Although VOCs have been detected in the water column near the lake shore, volatilization and mixing become important mechanisms for further dilution in water and the dissipation of the VOCs into the air. Mass flux rates are low due to the relatively small flow rate of contaminated groundwater into the lake, and likely do not pose significant risk when transferred into ambient air.

The history of the site and the observed contaminant distribution suggest that the contaminants released at the site had reached a steady-state distribution in the groundwater prior to the groundwater IRA, and that a stable plume discharging to Lake Druid had developed. Hence, with the site no longer used, and future releases no longer possible, the pre-IRA plume distribution is believed to represent a worst-case scenario. In the future, as the residual contaminant

sources continue to dissolve away and degrade, concentrations within the plume and at the point of discharge are expected to decrease. Although the present total mass of residual contaminants is unknown, it is expected to provide a continuing source for the foreseeable future. An estimated range for the total annual mass flux of PCE is wide due to the uncertainty in estimates of the groundwater velocity and the retardation factor, but may lie between 3 and 22 pounds per year. This represents only a volume of from 0.2 to 1.6 gallons per year of PCE; therefore, the prospect for continued dissolution of the residual source at presently observed concentrations is appreciable. Note that the reported PCE releases at the former laundry building amount to less than 80 gallons. It is likely that significantly more PCE was released during the 30-year period of dry-cleaning activities at OU 4.

7.5 SUMMARY OF FATE AND TRANSPORT. Even though antimony has a tendency to be highly soluble, the small isolated plume at SA 14 seems relatively immobile (see Paragraph 5.2.3.4, and Table 5-1). Antimony was first detected in March of 1993 at SA 14. Since then, antimony has not been detected in any downgradient monitoring wells at SA 13. This antimony plume does not appear to be moving towards Lake Druid.

The majority of contamination at OU 4 is apparently the result of industrial laundry and dry-cleaning facility operations from 1943 to 1994. The highest PCE contamination is found near and under the former laundry building. Contaminants migrate to the groundwater from soil due to leaching by infiltrating precipitation and/or periodic flushing of the soils near the phreatic surface due to natural rise and fall of the potentiometric surface. Passing groundwater flows to the west, from the former laundry building towards Lake Druid, where it discharges. As groundwater flows toward Lake Druid, PCE degrades to TCE and *cis*-1,2-DCE. Once discharged into the sediment and then into the surface water, the degradation processes produce VC.

Based on the interpretations of present contaminant distributions and groundwater flow directions and gradient, it is probable that VOCs will continue to discharge into Lake Druid even though actions taken during the groundwater IRA (two recirculation wells) will reduce the amount of VOCs entering the lake. Further action is anticipated at OU 4 targeting the removal of the source(s) of VOC contamination near the former laundry building.

CHAPTER 8.0

8.0 HUMAN HEALTH RISK ASSESSMENT

A HHRA has been conducted as part of the RI completed for OU 4 at NTC, Orlando. The purpose of the HHRA is to characterize the human health risks associated with potential exposures to site-related contaminants in environmental media present at and migrating from OU 4.

This HHRA is conducted in accordance with the USEPA's *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A)* (USEPA, 1989a), *Guidance for Data Useability in Risk Assessment (Part A), Final* (USEPA, 1992a), *Region IV Risk Assessment Guidance* (USEPA, 1995a) and will consider FDEP guidance, particularly, *Contaminant Cleanup Target Levels* (FDEP, 1999), *FDEP drinking water standards* (FDEP, 1994), as well as numerous other USEPA guidance documents and directives (USEPA, 1986a, 1991a, 1992b, 1992c). The HHRA is conducted to determine if contamination at OU 4 poses potential health risks of concern to individuals under current and/or foreseeable future site conditions in the absence of remediation. The HHRA consists of seven components, including data evaluation, identification of chemicals of potential concern (COPCs), exposure assessment, toxicity assessment risk characterization (including uncertainty analysis) (USEPA, 1989b), a risk assessment summary, and discussion of remedial goal options (RGOs). Collectively, these components are used to identify site-related contaminants and estimate the potential magnitude of exposure and the risks resulting from the estimated exposure conditions. An overview of the technical approach used in the NTC, Orlando OU 4 HHRA is presented here.

This risk assessment is organized as follows: Section 8.1, Data Evaluation; Section 8.2, Selection of Human Health COPC; Section 8.3, Exposure Assessment; Section 8.4, Toxicity Assessment; Section 8.5, Risk Characterization; Section 8.6, Uncertainty Analysis; and Section 8.7, RGOs. Appendix E provides documentation of various aspects of this risk assessment.

Site Description. The location, physical description, and history associated with OU 4, the Former Laundry Facility Area, are described in Sections 1.2 and 1.3, respectively.

OU 4 is located within Area C of NTC, Orlando and includes SA 12 (DRMO Warehouses and Salvage Yard), SA 13 (former base laundry and dry-cleaning facility), and SA 14 (DRMO storage area) (Figure 1-3). Area C served as a supply center for NTC, Orlando and includes a laundry facility and dry-cleaning facility, and the DRMO. The laundry and dry-cleaning facility closed in the fall of 1994. Area C is surrounded by urban development, including single and multifamily residential developments to the north and south. There are no industrial facilities adjacent to Area C. Lake Druid is to the west and an office park is located to the east. Lake Druid is located approximately 300 feet west of Port Hueneme Avenue. Approximately one-third of the lake is surrounded by undeveloped land to the east, which is owned by NTC, Orlando. The shoreline is mostly forested, and the shallow water near the shore is thick with floating emergent plants. The remainder of the lake is surrounded by approximately 3/4 acre residential properties. Lake Druid is primarily used for recreational purposes (i.e., swimming, boating, and fishing).

8.1 DATA EVALUATION. The data evaluation involves numerous activities, including sorting data by medium, evaluating analytical methods, evaluating the quantitation limits, evaluate quality of data with respect to qualifiers and codes, evaluating tentatively identified compounds, comparing potential site-related contamination with background, and developing a data set for use in risk assessment. After a brief summary of the sampling and analysis activities conducted to date, a description of each of these activities is provided below.

Available Data. A thorough discussion of all data collection activities and a presentation of the analytical data are provided in the previous sections of this RI report and its appendices. Surface soil, subsurface soil, groundwater, surface water and sediment samples were collected during the RI, during previous OU 4 investigations, and during the surface soil IRAs completed in 1999. After evaluation and management of the environmental data collected at OU 4 (Chapters 4.0 and 5.0), COPCs were selected and the potential human health risks associated with each medium at the former laundry facility were characterized. The available analytical data for OU 4 consist of surface soil, subsurface soil, groundwater, surface water, and sediment analytical results.

8.1.1 Evaluation of the Analytical Methods A detailed discussion of the analytical methods employed in developing analytical environmental data is presented in the RI report. The data used in this risk assessment are the result of analyses conducted under the CLP with documented quality assurance and QC procedures. The analytical data are further evaluated for useability in the quantitative risk assessment by evaluating quantitation limits, evaluating qualified and coded data, comparing concentrations detected in samples to concentrations detected in blanks.

8.1.2 Evaluation of Quantitation Limits Sample quantitation limits (SQLs) for soils are compared to Federal RBCs and Florida SCTLs to determine if detection limits are suitable for identification of COCs. SQLs are also compared to Federal RBCs for tap water, and GCTLs for groundwater. Analyte-specific SQLs that are above RBCs are identified so that uncertainties in risk estimates for those analytes can be discussed.

8.1.3 Evaluation Qualified and Coded Data Both the laboratory and data validators may assign qualifiers to analytical results. The qualifiers assigned by the data validators supersede the laboratory qualifiers. The results of the data validation are discussed in Chapter 4.0, and the validated data, with qualifiers, are presented in Appendices C and D. All positive detections (whether they are unqualified or qualified with a "J") have been considered detected concentrations for the risk assessment. All nondetects (qualified with a "U") will be retained in the risk assessment data set as samples without positive detections. If all sample results for a given analyte in a given medium are nondetects, then that analyte is not retained as a detected analyte for the purposes of the risk assessment. Any sample results with an "R" validation qualifier are eliminated from the risk assessment data set because QC indicates that the result is unusable.

8.1.4 Comparison Concentrations Detected in Samples to Concentrations Detected in Blanks Sample concentrations are compared to the concentrations in associated blanks in order to distinguish artifacts from the actual presence of analytes in environmental samples. The comparisons are conducted as part of the data

validation process, which has been previously discussed in this RI report. Those sample results considered artifacts are identified in the RI report.

8.1.5 Development of a Data Set for Use in Risk Assessment Data management concludes with the summarization of data and statistics generation for each medium-specific data set. Summary tables provide the chemical name, the frequency of detection, the minimum and maximum detected concentrations, the units associated with the results, the minimum and maximum quantitation limits, and the average of the detected concentrations. These tables are produced for each medium at OU 4. The data sets used in the risk assessment are identified in the human health COPC Selection Tables (Subsection 8.2.2).

8.2 SELECTION OF HUMAN HEALTH COPCs. COPCs are defined as chemicals for which data of sufficient quality are available for use in the risk assessment; that are potentially site related; and that have maximum detected concentrations that are above standards or guidelines, above risk-based screening concentrations (where available), and, for inorganic analytes, above background screening concentrations (where available). The methodology used to select COPCs is described here.

Contaminants for which data of sufficient quality are available for use in the risk assessment and that are present at concentrations greater than those measured at background locations (inorganics only) are the starting point for the development of the list of COPCs. The final list of COPCs is generally a subset of all compounds detected in the various media and are selected based on concentration and frequency of detection; physical, chemical, and toxicological characteristics; and comparison of detected values to background, associated blanks, and risk-based values.

8.2.1 COPC Selection Criteria In selecting COPCs, USEPA criteria are used (USEPA, 1989a and USEPA, 1995a). COPCs at OU 4 include chemicals that are positively identified in at least one sample. For each medium at OU 4, the following criteria are employed to exclude detected analytes from the list of COPCs. Each criterion by itself is justification for excluding the analyte.

- A. The maximum reported site concentration is less than the background screening concentration (USEPA, 1995a). In this HHRA, the background screening concentration is equal to two times the reported average of the detected background concentrations (inorganics only) calculated from background sampling location data, as agreed upon by the OPT and detailed in the *Background Sampling Report* (ABB-ES, 1995). Details of this approach are presented in Paragraph 8.2.1.1.
- B. The maximum reported concentration in a given medium is less than the corresponding risk-based screening concentration(s) or other guidance values. Risk-based screening concentrations are obtained from USEPA, USEPA Region IV Water Quality Standards, and the State of Florida regulations and guidance documents. In situations where multiple screening values are available, a chemical is excluded only if its maximum concentration is less than all of the corresponding screening values. Paragraphs 8.2.1.2 and 8.2.1.4 and Appendices E-1 and E-2 provide additional details concerning risk-

based screening and regulatory guidance values that are used in COPC selection.

- C. The average concentration of an essential nutrient (calcium, magnesium, potassium, and sodium) in a medium is below a toxic level and consistent with or only slightly above the background concentration for that essential nutrient. The COPC selection process for essential nutrients is further described in Paragraph 8.2.1.3 and Appendix E-3.
- D. The concentrations are within 5 times or 10 times the concentrations in associated blanks (USEPA, 1989b; 1992d). This evaluation is conducted as part of the data validation process.
- E. Having a frequency of detection (number of samples in which the analyte is detected divided by the number of samples analyzed for that analyte) of less than 5 percent when there is a minimum of 20 samples (USEPA, 1989b) and the analyte is not a COPC in another medium.

The selection of a member of a chemical class as a COPC in a particular medium required that other members of that class of chemicals detected in that medium be retained as COPCs, even if their maximum detected concentrations were less than the available screening values (USEPA, 1989b). Specific COPCs for human health are identified for each medium at OU 4. Chemicals not identified as COPCs are clearly identified and the justification for their exclusion noted. Transformation products or parent compounds of COPCs are not deleted from the COPC list.

8.2.1.1 Background Data The baseline risk assessments being conducted at OU 4 use a background screening concentration as part of the COPC selection per USEPA Region IV guidance (USEPA, 1995a). The Region IV guidance states that COPCs include "inorganics which are detected at concentrations significantly above background samples (the criteria for determining significance should generally be 2 times the background concentrations)." This statement applies to all media. In this HHRA, the background screening concentration has been defined as two times the arithmetic mean of the detected background inorganic concentrations, as agreed upon by the OPT and detailed in the *Background Sampling Report* (ABB-ES, 1995).

The comparison is conducted as follows: maximum detected concentrations are compared to two times the background mean concentration for inorganics. Organic analytes are not considered in the background evaluation. If the maximum detected concentration is below two times the arithmetic mean of the detected background concentrations, the analyte is considered to be consistent with background. This approach is conservative in that it is likely to identify certain analytes as being inconsistent with background (including them as COPCs) even though the distribution of concentrations on-site is very similar to that of the background data set. Background data are available for surface soil, subsurface soil, and groundwater. The documentation of the background data sets, including sample lists and statistics, appears in the *Background Sampling Report* (ABB-ES, 1995). No background data are available for surface water and sediment.

8.2.1.2 Risk-Based Screening Tables of medium-specific RBCs and standards and guidelines are presented in Appendices E-1 and E-2. The USEPA Region III RBC Table (USEPA, 1999) residential and industrial soil RBCs (adjusted for a hazard quotient (HQ) of 0.1) and Florida Soil Cleanup Target Levels (FDEP, 1999) for residential and industrial soil are used to select COPCs in surface soil and subsurface soil, respectively. COPCs are selected for groundwater using the USEPA Region III RBC Table (USEPA, 1999) tap water RBCs (adjusted for a HQ of 0.1), and FDEP GCTLs (FDEP, 1999). COPCs are selected for surface water using the USEPA Region IV Water Quality Standards (USEPA, 1996b), USEPA Region III tapwater RBCs, and Florida SWCTLs for Class III freshwater (FDEP, 1999). The USEPA Region III RBC Table (USEPA, 1999) residential soil RBCs (adjusted for a HQ of 0.1) and Florida residential SCTLs are used to select COPCs in sediment.

For a given medium, the maximum reported concentration is compared to the corresponding screening value. If the maximum reported concentration is greater than the screening value, the analyte is selected as a COPC. However, if the maximum reported concentration is less than the screening value, the analyte is not selected as a COPC unless it is a parent compound or transformation product of another COPC.

No RBC is available for lead in soil. Based on USEPA recommendation, a target level for cleanup at Superfund sites for lead of 400 mg/kg is used as the RBC for lead in soil (USEPA, 1994a). The published Florida SCTL for lead is 400 mg/kg for residential soil and 920 $\mu\text{g}/\text{kg}$ in commercial/industrial soil. The risk-based screening value only addresses potential leaching of analytes from soil to groundwater if the analyte detected in soil was also retained as a COPC in groundwater.

Surrogates were chosen for those chemicals for which no RBCs exist. Surrogates were selected based on structural and toxicological similarities with the chemical. Pyrene was used as a surrogate for acenaphthylene, benzo(g,h,i)-perylene, and phenanthrene. Additionally, for those chemicals with multiple isomers for which some do not have an RBC, an isomer with an RBC was used.

8.2.1.3 Essential Nutrients In the HHRA, analytes that are considered essential nutrients include sodium, potassium, magnesium, and calcium. The *Risk Assessment Guidance for Superfund, Volume I, Part A*, regarding the evaluation of essential nutrients (calcium, iron, magnesium, potassium, and sodium) in a public health or ERA, states that essential nutrients need not be quantitatively evaluated if they are (1) present at low concentrations (only slightly above background) and (2) toxic only at doses much higher than those that might be related to exposure at the site (USEPA, 1989b). In this report, "only slightly above background" is interpreted to mean that the maximum detected concentration is less than two times the arithmetic mean of the detected background concentration. Essential nutrients that are detected at concentrations that are consistent with background or at concentrations considered essentially "nontoxic" are considered to not cause a public health concern; therefore, they are not further evaluated in the risk assessment.

If an essential nutrient is present at a concentration that is below an essential nutrient screening value (as defined in Table 8-1) and consistent with or only slightly above the background concentration (twice the reference mean) the analyte is eliminated as a COPC for the HHRA. The derivation of the essential

Table 8-1
Essential Nutrient Screening Concentrations
for Surface Soil, Subsurface Soil, Groundwater, Surface Water, and Sediment

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center
 Orlando, Florida

Essential Nutrient	Surface Soil Screening Concentration (mg/kg) ²	Groundwater Screening Concentration (µg/l) ³
Calcium	¹ 1,000,000	1,055,398
Magnesium	460,468	118,807
Potassium	¹ 1,000,000	297,016
Sodium	¹ 1,000,000	⁴ 396,022

¹ Actual calculated screening concentration is greater than 1,000,000 mg/kg (Appendix E-3), indicating that this essential nutrient would not be present at toxic levels in surface soil.

² Values were also used for subsurface soil and sediment.

³ Values were also used for surface water.

⁴ FDEP primary standard, not the essential nutrient screening value, was used for COPC selection.

Notes: mg/kg = milligrams per kilogram.

µg/l = micrograms per liter.

nutrient screening values is presented in Appendix E-3. This approach is consistent with general USEPA guidance on essential nutrients (USEPA, 1989b).

8.2.1.4 Regulatory Guidance Regulatory guidance available for the NTC, Orlando OU 4 RI and HHRA includes the Federal drinking water standards which are called MCLs (USEPA, 1995f), and Florida Cleanup Target Levels for groundwater. The Florida cleanup target levels for groundwater are published in Chapter 62-777 of the Florida Administrative Code, and are based on primary and secondary drinking water standards, as well as health risk-based concentrations (FDEP, 1999). Florida Cleanup Target Levels for Freshwater Surface Water, also published in Chapter 62-777 (FDEP, 1999), are used to screen analytes in surface water.

The FDEP Soil Cleanup Target Levels was also used as guidance (FDEP, 1999). This guidance is presented in Chapter 62-777 of the Florida Administrative Code, and contains a listing of selected cleanup levels for residential and industrial exposure scenarios for surface soil as well as a cleanup level based on leachability to groundwater. The published FDEP cleanup levels for leachability are available only for organics. The leachability values are used for screening analytes in soil that are selected as COPCs in groundwater.

8.2.2 Selection of COPCs

8.2.2.1 Surface Soil Twenty surface soil samples and three duplicates were collected at the former laundry facility and submitted for chemical analysis during the RI. Soil samples were analyzed for all analytes (VOCs, SVOCs, pesticides, PCB, inorganics, and TPH [site screening samples only]), and included sample locations (U4S00501 through U4S001501, 12B00101 through 12B00591, and 14B00101 through 14B00401, and duplicates U4S00501D, U4S01201D, 12B00401D). Sample locations are shown on Figure 5-1.

During surface soil IRAs performed in 1999 to address elevated levels of arsenic, PAHs, and PCBs in surface soil, the soil associated with four surface soil sample locations was removed from the site. Confirmatory soil samples were collected from the side-walls of the excavations. The data for the confirmatory samples were used in the risk assessment in place of the data for the soil samples that were removed, as summarized below. Specifically, the arithmetic mean of the confirmatory soil samples collected at each soil removal area was used to represent the concentration of the soil at that area. For example, the average concentration of arsenic among the confirmatory soil samples 99SPORTT0178-1 through 99SPORTT0178-4 was used to "replace" the arsenic concentration of soil sample U4S01101. This approach was used so that the data set would not be biased by a large number of samples representing a relatively small area of the site. The original (pre-excavation) results have been retained for the parameters that were not re-analyzed during the confirmation sampling.

<u>Soil sample removed from data set</u>	<u>Confirmatory soil samples used in place of removed sample</u>	<u>Analytical parameters measured in confirmatory sample</u>
U4S01101	99SPORT0178-1 99SPORT0178-2 99SPORT0178-3 99SPORT0178-4	Arsenic

U4S01501	99SPORT0178-5 99SPORT0178-6 99SPORT0178-7 99SPORT0178-8	PAH
U4S00601	99SPORT0178-9 99SPORT0178-10 99SPORT0178-11 99SPORT0178-12	PAH, Arsenic, Aroclor

Table 8-2 presents the analytes detected in surface soil at OU 4 and the COPCs selected. One VOC (PCE), seven SVOCs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene), two PCBs (Aroclor-1254, Aroclor-1260), and five inorganics (aluminum, barium, chromium, iron, and vanadium) were selected as COPCs.

8.2.2.2 Subsurface Soil Fourteen subsurface soil samples and one duplicate were collected at the former laundry facility and submitted for chemical analysis. Soil samples were analyzed for all parameters (VOCs, SVOCs, pesticides, PCB, inorganics, and TPH [site screening data only]). Subsurface soil sample locations evaluated in the HHRA (12B00102 through 12B00402, 13B00101, 13B00401, 13B00801, 13B00901, 13B01001, 13B01101, 13B01201, 13B01301, U4B03001, and U4B03301, and a duplicate U4B03001D) are shown on Figure 5-3. The following samples were not included in the risk assessment because they were collected from depths greater than 15 feet: U4B02101, U4B02102, U4B02302, U4B02502, U4B03002, U4B03003, U4B03003D, U4B03004, U4B03302, U4B03303, U4B03304, U4B03501, U4B03502, U4B03601, and U4B03602.

Table 8-3 presents the analytes detected in subsurface soil at OU 4 and the COPCs selected. One VOC, (PCE) was selected as a COPC.

8.2.2.3 Groundwater Thirty-nine unfiltered groundwater samples and four duplicates were collected and submitted for chemical analysis during the RI. Ten groundwater samples were submitted for full suite CLP TCL/TAL analysis. Twenty-five samples were analyzed for CLP TCL VOCs and TAL inorganics. The remaining four samples were analyzed for the groundwater IRA Performance Monitoring program, and were only analyzed for VOCs via USEPA SW 846 Method 8021. The monitoring wells chosen for each analysis were discussed and approved by the OPT. Groundwater sample locations evaluated in the HHRA (12G00102 through 12G00402, 13G00103 through 13G00403, U4G007XX [average of 13G00706, 708, 709, 710 and U4G00707], 14G00102, 14G00203, 14G00304, 14G00403, 14G00501 through 14G00801, U4G009XX [average of U4G00903, 904, 905, 906, and 907], U4G01103, U4G012XX [average of U4G01203, 1204, 1205, and 1206] U4G015XX [average of U4G01502, 1503, 1504, 1505], U4G01902, U4G02003, U4G021XX [average of U4G02102, 2202, 2203, 2204, 2205, 2206] U4G023XX [average of U4G02302, 2303, 2304, 2305], U4G024XX [average of U4G02401, 2402, 2403, 2404, 2405] U4G025XX [average of U4G02502, 2503, 2504, 2505], U4G02701, U4G03301, through U4G04101, U4G04301, and four duplicates 14G00203D, U4G03701D, U4G04101D, U4G04301D) are shown on Figure 5-7. Samples were averaged together because a monitoring well was sampled on several different sampling events. For each sampling event not all parameters were analyzed; therefore, samples were averaged together. Figure 4-3 depicts groundwater analytical results exceeding screening criteria.

Table 8-2
Selection of Human Health Chemicals of Potential Concern
Surface Soil

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Frequency of Detection ¹	Range of Reporting Limits	Range of Detected Concentrations ²	Mean of Concentrations ³	Background Screening Concentration ⁴	USEPA Region III Residential RBC ⁵	Florida Soil Cleanup Target Level ⁶	Analyte HHCOPC? (Yes/No)	Reason ⁷
<u>Volatile Organic Compounds (µg/kg)</u>									
1,1,2,2-Tetrachloroethane	1/20	10 to 15.5	1	5.3	NA	3,200	700	No	S, G
2-Hexanone	1/20	10 to 15.5	8	5.7	NA	310,000	5,100	No	S, G
Acetone	4/20	10 to 15.5	10 to 42	8.2	NA	780,000	780,000	No	S, G
Methylene chloride	2/20	10 to 25	38* to 44	8.9	NA	85,000	16,000	No	S, G
Tetrachloroethene	7/20	10 to 15.5	1 to 110	16	NA	12,000	⁸ 30	Yes	
Toluene	5/20	10 to 15.5	1 to 5.3*	4.8	NA	1,600,000	380,000	No	S, G
Xylene (total)	1/20	10 to 15.5	1	5.3	NA	16,000,000	5,900,000	No	S, G
<u>Semivolatile Organic Compounds (µg/kg)</u>									
Benzo(a)anthracene	5/20	340 to 505	67* to 260	163	NA	870	1,400	Yes	C
Benzo(a)pyrene	5/20	340 to 505	57* to 330	160	NA	87	100	Yes	
Benzo(b)fluoranthene	7/20	340 to 505	49 to 630	179	NA	870	1,400	Yes	
Benzo(g,h,i)perylene	5/20	340 to 505	65* to 220	160	NA	⁹ 230,000	2,300,000	No	S, G
Benzo(k)fluoranthene	5/20	340 to 505	72 to 230	164	NA	8,700	15,000	Yes	C
bis(2-Ethylhexyl)phthalate	4/20	340 to 505	38 to 720	192	NA	46,000	76,000	No	S, G
Butylbenzylphthalate	1/20	340 to 505	200	184	NA	1,600,000	15,000,000	No	S, G
Carbazole	2/20	340 to 505	58 to 200	177	NA	32,000	53,000	No	S, G
See notes at end of table.									

Table 8-2 (Continued)
Selection of Human Health Chemicals of Potential Concern
Surface Soil

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Frequency of Detection ¹	Range of Reporting Limits	Range of Detected Concentrations ²	Mean of Concentrations ³	Background Screening Concentration ⁴	USEPA Region III Residential RBC ⁵	Florida Soil Cleanup Target Level ⁶	Analyte HHCOPC? (Yes/No)	Reason ⁷
Semivolatile Organic Compounds (µg/kg) (Continued)									
Chrysene	7/20	340 to 505	48 to 460	167	NA	87,000	140,000	Yes	C
Fluoranthene	6/20	340 to 505	53 to 550	182	NA	310,000	2,900,000	No	S, G
Indeno(1,2,3-cd)pyrene	5/20	340 to 505	57* to 200	155	NA	870	1,500	Yes	C
Phenanthrene	4/20	340 to 505	82* to 240	166	NA	⁹ 230,000	2,000,000	No	S, G
Pyrene	7/20	340 to 505	63 to 580	187	NA	230,000	2,200,000	No	S, G
Pesticides and PCBs (µg/kg)									
alpha-BHC	1/20	1.7 to 8.6	0.32	1.2	NA	100	200	No	S, G
beta-BHC	1/20	1.7 to 8.6	30	2.7	NA	350	600	No	S, G
delta-BHC	2/20	1.7 to 8.6	0.76 to 2.1	1.8	NA	¹⁰ 350	22,000	No	S, G
gamma-BHC (Lindane)	2/20	1.7 to 8.6	0.25 to 0.9	1.2	NA	490	700	No	S, G
4,4'-DDD	6/20	3.4 to 42	0.51* to 15	3.2	NA	2,700	4,600	No	S, G
4,4'-DDE	6/20	1.8 to 17	2.1 to 60	7.3	NA	1,900	3,300	No	S, G
4,4'-DDT	8/20	1.8 to 42	0.14 to 23	4.6	NA	1,900	3,300	No	S, G
alpha-Chlordane	4/20	1.7 to 8.6	1.8* to 56	4.2	NA	¹¹ 1,800	¹¹ 3,100	No	S, G
gamma-Chlordane	5/20	1.7 to 22	0.76 to 2.4	1.2	NA	¹¹ 1,800	¹¹ 3,100	No	S, G
Aldrin	1/20	1.7 to 8.6	11	2.2	NA	²¹ 38	70	No	S, G
Aroclor-1254	2/20	34 to 170	79* to 210	36	NA	160	¹² 500	Yes	
See notes at end of table.									

Table 8-2 (Continued)
Selection of Human Health Chemicals of Potential Concern
Surface Soil

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Frequency of Detection ¹	Range of Reporting Limits	Range of Detected Concentrations ²	Mean of Concentrations ³	Background Screening Concentration ⁴	USEPA Region III Residential RBC ⁵	Florida Soil Cleanup Target Level ⁶	Analyte HHCOPC? (Yes/No)	Reason ⁷
Pesticides and PCBs (µg/kg) (Continued)									
Aroclor-1260	1/20	34 to 170	25*	24	NA	320	¹² 500	Yes	C
Dieldrin	1/20	3.4 to 17	28	4	NA	40	70	No	S, G
Endosulfan I	2/20	1.7 to 8.6	0.99 to 1.4	1.2	NA	¹³ 47,000	¹³ 410,000	No	S, G
Endosulfan II	5/20	3.4 to 17	0.31 to 29	3.7	NA	¹³ 47,000	¹³ 410,000	No	S, G
Endosulfan sulfate	3/20	3.4 to 17	0.96* to 5.8	2.6	NA	¹³ 47,000	¹³ 410,000	No	S, G
Endrin	1/20	3.4 to 17	24	3.8	NA	2,300	21,000	No	S, G
Endrin aldehyde	1/20	3.4 to 17	56	5.8	NA	¹⁴ 2,300	¹⁴ 21,000	No	S, G
Endrin ketone	1/20	3.4 to 17	50	4.8	NA	¹⁴ 2,300	¹⁴ 21,000	No	S, G
Heptachlor	2/20	1.7 to 8.6	3.1 to 23	3.3	NA	140	200	No	S, G
Heptachlor epoxide	4/20	1.7 to 22	0.37* to 11	1.5	NA	70	100	No	S, G
Methoxychlor	2/20	17 to 220	44 to 1,800	110	NA	39,000	370,000	No	S, G
Inorganic Analytes (mg/kg)									
Aluminum	20/20	NA	8.8 to 9,740	1,680	2,088	7,800	72,000	Yes	
Arsenic	6/20	0.38 to 1.75	0.36* to 0.84	0.52	1.0	0.43	0.8	No	B
Barium	18/20	0.18 to 2	0.25 to 167	15.6	8.7	550	110	Yes	
Beryllium	4/20	0.02 to 0.155	0.07 to 1.1	0.1	0.09	16	120	No	S, G
Cadmium	3/20	0.06 to 0.74	0.84 to 1.9	0.37	0.98	¹⁵ 7.8	75	No	S, G
Calcium	18/20	4.8 to 733	215 to 75,100	7,980	25,295	¹⁶ 1,000,000	NSC	No	E
Chromium	19/20	0.5 to 0.6	0.59 to 45.2	5.7	4.6	¹⁷ 23	¹⁷ 210	Yes	

See notes at end of table.

Table 8-2 (Continued)
Selection of Human Health Chemicals of Potential Concern
Surface Soil

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center
 Orlando, Florida

Analyte	Frequency of Detection ¹	Range of Reporting Limits	Range of Detected Concentrations ²	Mean of Concentrations ³	Background Screening Concentration ⁴	USEPA Region III Residential RBC ⁵	Florida Soil Cleanup Target Level ⁶	Analyte HHCOPC? (Yes/No)	Reason ⁷
Inorganic Analytes (mg/kg) (Continued)									
Cobalt	3/20	0.14 to 0.48	0.55 to 3.4	0.36	ND	470	4,700	No	S, G
Copper	13/20	0.43 to 0.75	0.36* to 36.6	6.2	4.1	310	110	No	S
Iron	18/20	1 to 12.1	14.4 to 6,400	640	712	2,300	23,000	Yes	
Lead	18/20	0.3 to 0.36	0.37 to 78	12	14.5	¹⁸ 400	400	No	S, G
Magnesium	9/20	5 to 1,130	8.2 to 175	97	328	¹⁸ 1,000,000	NSC	No	B, E
Manganese	19/20	0.12 to 0.26	0.52 to 45.2	7.4	8.1	¹⁹ 160	1,600	No	S, G
Mercury	4/20	0.02 to 0.07	0.07 to 2.2	0.15	0.07	²⁰ 2.3	3.4	No	S, G
Nickel	14/20	1.9 to 2.3	0.27 to 9.2	2.2	4.4	160	110	No	S, G
Selenium	1/20	0.45 to 1.3	1.3	0.42	0.95	39	390	No	S, G
Silver	3/20	0.16 to 0.65	1.4 to 31.3	1.89	1.8	39	390	No	S, G
Vanadium	16/20	0.41 to 0.5	0.58 to 17.7	2.3	3.1	55	15	Yes	
Zinc	9/20	0.24 to 7.5	0.36 to 225	20	17.2	2,300	23,000	No	S, G
Others (mg/kg)									
Total Petroleum Hydrocarbons	1/1	5	17.6	17.6	NA	NSC	²¹ 340	No	G
See notes at end of table.									

Table 8-2 (Continued)
Selection of Human Health Chemicals of Potential Concern
Surface Soil

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center
 Orlando, Florida

- ¹ Frequency of detection is the number of samples in which the analyte is detected over the total number of samples analyzed (excluding rejected values).
- ² A value indicated by an asterisk is the average of a sample and its duplicate. For duplicate samples having one nondetect, one-half of the reporting limit is used as a surrogate concentration for the nondetect.
- ³ The mean of concentrations is the arithmetic mean of all samples. For samples with "U," or "UJ" validation qualifiers, half of the sample quantitation limit was used in the calculation of the mean.
- ⁴ The background screening concentration is twice the mean of detected concentrations for inorganic analytes. The background concentrations were obtained from the Naval Training Center Orlando *Background Sampling Report* (ABB Environmental Service, Inc., 1995).
- ⁵ For all chemicals except the essential nutrients (calcium, magnesium, potassium, and sodium), USEPA Region III RBCs residential soil values were used (USEPA, 1999). The RBC values are based on a carcinogenic risk of 1×10^{-6} and an adjusted hazard index of 0.1. For the essential nutrients, screening values were derived based on recommended daily allowances (See Appendix E-3).
- ⁶ Values are for residential cleanup goals from Florida Department of Environmental Protection (FDEP) Chapter 62-777 effective August 5, 1999 (FDEP, 1999).
- ⁷ Analyte was included or excluded from the risk assessment for the following reasons:
 B = the maximum detected concentration did not exceed twice the arithmetic mean of detected concentrations at background locations and will not be considered further;
 C = included because one member of chemical class was selected as a chemical of potential concern; classes included carcinogenic PAHs and PCBs;
 S = the maximum detected concentration did not exceed the risk-based screening concentration and will not be considered further;
 G = the maximum detected concentration did not exceed the Florida guidance concentration and will not be considered further; and
 E = the maximum detected concentration did not exceed the essential nutrient screening concentration derived in Appendix E-3.
- ⁸ The Florida Cleanup Goal based on leaching is used because the analyte is selected as an HHCOPC in groundwater.
- ⁹ Value for pyrene is used as a surrogate.
- ¹⁰ Value for technical BHC is used.
- ¹¹ Value for chlordane is used.
- ¹² Value for polychlorinated biphenyls is used.
- ¹³ Value is based on a mixture of endosulfan isomers.
- ¹⁴ Value for endrin is used as a surrogate.
- ¹⁵ Value is based on cadmium-food.
- ¹⁶ Essential nutrient value (see Appendix E-3).
- ¹⁷ Value is based on hexavalent chromium.

See notes at end of table.

Table 8-2 (Continued)
Selection of Human Health Chemicals of Potential Concern
Surface Soil

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Notes: (Continued)

¹⁸ RBC is not available for lead; value is from Revised Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites (Office of Solid Waste and Emergency Response Directive 9355.4-12) (USEPA, 1994a).

¹⁹ Value is based on manganese-nonfood.

²⁰ Value is for mercuric chloride.

²¹ Value is based on a hazard quotient of 0.1.

Notes: USEPA = U.S. Environmental Protection Agency.

HHCOPC = human health chemical of potential concern.

$\mu\text{g}/\text{kg}$ = micrograms per kilogram.

NA = not applicable.

NSC = No screening concentration available.

* = Value is the average of a sample and its duplicate.

PCB = polychlorinated biphenyl.

BHC = benzene hexachloride.

DDD = dichlorodiphenyldichloroethane.

DDE = dichlorodiphenyldichloroethene.

DDT = dichlorodiphenyltrichloroethane.

mg/kg = milligrams per kilogram.

ND = not detected.

PAH = polynuclear aromatic hydrocarbon.

Table 8-3
Selection of Human Health Chemicals of Potential Concern
Subsurface Soil

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Frequency of Detection ¹	Range of Reporting Limits	Range of Detected Concentrations ²	Mean of Detected Concentrations ³	Background Screening Concentration ⁴	USEPA Region III Industrial RBC ⁵	Florida Soil Cleanup Target Level ⁶	Analyte HHCOPC? (Yes/No)	Reason ⁷
<u>Volatile Organic Compounds (µg/kg)</u>									
1,2-Dichloroethene (total)	1/14	11 to 14	6	6	NA	1,800,000	^{8,9} 400	No	S, G
2-Butanone	1/14	11 to 14	4	4	NA	120,000,000	21,000,000	No	S, G
Acetone	6/14	11 to 58	8 to 130	51	NA	20,000,000	5,500,000	No	S, G
Tetrachloroethene	3/14	11 to 14	2 to 31	15	NA	110,000	⁹ 30	Yes	
Trichloroethene	1/14	11 to 14	2	2	NA	520,000	⁹ 30	No	S, G
<u>Semivolatile Organic Compounds (µg/kg)</u>									
Benzo(a)anthracene	1/12	360 to 410	110	110	NA	7,800	5,000	No	S, G
Benzo(b)fluoranthene	1/12	360 to 410	160	160	NA	7,800	4,800	No	S, G
Benzo(g,h,i)fluoranthene	1/12	360 to 410	120	120	NA	¹⁰ 6,100,000	41,000,000	No	S, G
Benzo(k)fluoranthene	1/12	360 to 410	130	130	NA	78,000	52,000	No	S, G
Chrysene	2/12	360 to 410	110 to 160	140	NA	780,000	450,000	No	S, G
Fluoranthene	2/12	360 to 410	110 to 260	190	NA	8,200,000	48,000,000	No	S, G
Pyrene	2/12	360 to 410	110 to 200	160	NA	6,100,000	37,000,000	No	S, G
<u>Pesticides and PCBs (µg/kg)</u>									
4,4'-DDD	1/12	3.5 to 7.4	2.6	2.6	NA	24,000	18,000	No	S, G
4,4'-DDE	2/12	3.5 to 7.4	2.8 to 5.2	4	NA	17,000	13,000	No	S, G
4,4'-DDT	1/12	3.5 to 7.4	23	23	NA	17,000	13,000	No	S, G
Aroclor-1260	1/12	3.5 to 7.4	110	110	NA	2,900	¹¹ 2,100	No	S, G

See notes at end of table.

Table 8-3 (Continued)
Selection of Human Health Chemicals of Potential Concern
Subsurface Soil

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Frequency of Detection ¹	Range of Reporting Limits	Range of Detected Concentrations ²	Mean of Detected Concentrations ³	Background Screening Concentration ⁴	USEPA Region III Industrial RBC ⁵	Florida Soil Cleanup Target Level ⁶	Analyte HHCOPC? (Yes/No)	Reason ⁷
Inorganic Analytes (mg/kg)									
Aluminum	14/14	NA	0.196 to 17,300*	1,400	2,119	200,000	72,000	No	S, G
Arsenic	9/14	0.15 to 3.1	0.48 to 1.3	0.78	1.1	3.8	3.7	No	S, G
Barium	11/14	0.09 to 1.3	0.4 to 110 *	12.2	3.6	14,000	87,000	No	S, G
Beryllium	2/14	0.02 to 0.17	0.11 to 0.28	0.2	ND	410	800	No	S, G
Cadmium	1/14	0.12 to 0.77	0.72	0.72	ND	¹² 200	1,300	No	S, G
Calcium	12/14	5 to 440	72.4 to 46,700	6,400	115	¹³ 1,000,000	NSC	No	E
Chromium	14/14	0.46 to 2.3	0.62 to 19.7*	3	3.7	¹⁴ 610	420	No	S, G
Cobalt	1/14	0.12 to 1.3	0.39 *	0.39	1.6	12,000	110,000	No	B, S, G
Copper	5/14	0.47 to 2.6	0.75 to 2.8	1.6	ND	8,200	76,000	No	S, G
Iron	13/14	0.92 to 37	5.7 to 503 *	138	264	61,000	480,000	No	S, G
Lead	14/14	0.32 to 5.7	0.35 to 14.5	2.8	3.9	¹⁵ 400	920	No	S, G
Magnesium	11/14	5.1 to 86	6.2 to 659	95.8	32.8	¹³ 1,000,000	NSC	No	E
Manganese	11/14	0.11 to 0.52	0.38 to 23.9	3.3	2.1	¹⁶ 4,100	22,000	No	S, G
Mercury	5/14	0.025 to 0.09	0.04 to 0.14*	0.07	ND	¹⁷ 61	26	No	S, G
Nickel	2/14	0.26 to 2.8	0.73 * to 2.3	1.5	ND	4,100	28,000	No	S, G
Selenium	1/14	0.13 to 5.7	0.85 *	0.85	1.3	1,000	10,000	No	B, S, G
Sodium	3/14	4.8 to 116	46 to 163	102	ND	¹³ 1,000,000	NSC	No	E
Vanadium	10/14	0.33 to 1.8	0.46 to 6.6 *	1.6	3.4	1,400	7,400	No	S, G
Zinc	7/14	0.26 to 6.1	0.34 to 44.4	7.9	5.6	61,000	560,000	No	S, G
Other (mg/kg)									
Total Petroleum Hydrocarbons	6/6	NA	8.2 to 209.7	47.3	NA	NSC	¹⁸ 2,500	No	G

See notes at end of table.

Table 8-3 (Continued)
Selection of Human Health Chemicals of Potential Concern
Subsurface Soil

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center
 Orlando, Florida

- ¹ Frequency of detection is the number of samples in which the analyte is detected over the total number of samples analyzed (excluding rejected values).
- ² A value indicated by an asterisk is the average of a sample and its duplicate. For duplicate samples having one nondetect, one-half of the reporting limit is used as a surrogate concentration for the nondetect.
- ³ The mean of detected concentrations is the arithmetic mean of all samples in which the analyte was detected. It does not include those samples with "R," "U," or "UJ" validation qualifiers.
- ⁴ The background screening concentration is twice the mean of detected concentrations for inorganic analytes. The background concentrations were obtained from the Naval Training Center Orlando *Background Sampling Report* (ABB Environmental Services, Inc., 1995).
- ⁵ For all chemicals except the essential nutrients (calcium, magnesium, potassium, and sodium), USEPA Region III RBCs industrial soil values were used (USEPA, 1999). The RBC values are based on a carcinogenic risk of 1×10^{-6} and an adjusted hazard index of 0.1. For the essential nutrients, screening values were derived based on recommended daily allowances (See Appendix E-3).
- ⁶ Values are for industrial cleanup goals in Florida Department of Environmental Protection (FDEP) Chapter 62-777 effective August 5, 1999 (FDEP, 1999).
- ⁷ Analyte was included or excluded from the risk assessment for the following reasons:
 B = the maximum detected concentration did not exceed twice the arithmetic mean of detected concentrations at background locations and will not be considered further;
 S = the maximum detected concentration did not exceed the risk-based screening concentration and will not be considered further;
 G = the maximum detected concentration did not exceed Florida guidance concentration and will not be considered further; and
 E = the maximum detected concentration did not exceed the essential nutrient screening concentration derived in Appendix E-3.
- ⁸ Value for cis-1,2-dichloroethene is used.
- ⁹ The value is Florida Cleanup Goal based on leaching because an analyte is selected as an HHCOPC in groundwater.
- ¹⁰ Value for pyrene is used as a surrogate.
- ¹¹ Value for polychlorinated biphenyls is used.
- ¹² Value is based on cadmium-food.
- ¹³ Essential nutrient value (see Appendix E-3).
- ¹⁴ Value is based on hexavalent chromium.
- ¹⁵ RBC is not available for lead; value is from Revised Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites (Office of Solid Waste and Emergency Response Directive 9355.4-12) (USEPA, 1994a).
- ¹⁶ Value is based on manganese-nonfood.
- ¹⁷ Value is for mercuric chloride.

Notes: USEPA = U.S. Environmental Protection Agency.
 RBC = USEPA Region III Risk-Based Concentration.
 HHCOPC = human health chemical of potential concern.
 $\mu\text{g}/\text{kg}$ = micrograms per kilogram.
 NA = not applicable.
 PCB = polychlorinated biphenyl.
 BHC = benzene hexachloride.

DDD = dichlorodiphenyldichloroethane.
 DDE = dichlorodiphenyldichloroethene.
 DDT = dichlorodiphenyltrichloroethane.
 mg/kg = milligrams per kilogram.
 * = Value is the average of a sample and its duplicate.
 ND = not detected.
 NSC = No screening concentration available.

Table 8-4 presents the analytes detected in groundwater at OU 4 and the COPCs selected. Four VOCs (*cis*-1,2-DCE, *trans*-1,2-DCE, PCE, TCE) and seven inorganics (aluminum, antimony, barium, chromium, iron, mercury, and sodium) were selected as COPCs.

8.2.2.4 Surface Water Five surface water samples and two duplicates were collected and submitted for chemical analysis during the RI. Surface water sample locations evaluated in the HHRA (U4W00703, U4W010XX [average of U4W01003, U4W01003D, and U4W01004] U4W01103, U4W01304, U4W01902, and a duplicate U4W01103D) are shown on Figure 5-9. Samples were averaged together because a location was sampled on several different sampling events. For each sampling event not all parameters were analyzed; therefore, samples were averaged together. Table 8-5 presents the analytes detected in surface water at OU 4 and the COPCs selected. Four VOCs (*cis*-1,2-DCE, tetrachloroethane, TCE, VC), two pesticides (4,4'-DDT and endrin ketone), and one inorganic (aluminum) were selected as COPCs.

8.2.2.5 Sediment Five sediment samples and two duplicates were collected for chemical analysis during the RI. Sediment sample locations evaluated in the HHRA (U4D00704, U4D010XX [average of U4D01003, U4D01003D, and U4D01004], U4D01104, U4D01305, U4D01902, and a duplicate U4D01104D) are shown on Figure 5-9. Samples were averaged together because a location was sampled on several different sampling events. For each sampling event not all parameters were analyzed; therefore, samples were averaged together.

Table 8-6 presents the analytes detected in sediment at OU 4 and the COPCs selected. One VOC (VC) and two inorganics (arsenic and thallium) were selected as COPCs.

8.3 EXPOSURE ASSESSMENT. The exposure assessment is conducted to estimate the pathways by which humans are potentially exposed to COPCs, the magnitude of actual and/or potential human exposure, and the frequency and duration of exposure. This process is performed for both current and future site land uses. This process involves three steps:

- characterization of the exposure setting in terms of physical characteristics and the populations that may potentially be exposed to site-related chemicals;
- identification of potential exposure pathways and receptors; and
- quantification of exposure for each population in terms of the amount of chemical either ingested, inhaled, or absorbed through the skin from all complete exposure pathways.

8.3.1 Characterization of Exposure Setting The physical setting and demographics near the former laundry facility and dry-cleaning area are identified in Chapter 3.0. In addition, the physical setting is characterized in terms of the following attributes: climate, meteorology, geology, vegetation, soil type, groundwater, and surface water. The information generated from the evaluation of the physical setting aids in defining the physical mechanisms that control or influence how people could be exposed at a waste site, and provides information on the potential migration of contaminants.

Table 8-4
Selection of Human Health Chemicals of Potential Concern
Unfiltered Groundwater

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Frequency of Detection ¹	Range of Reporting Limits	Range of Detected Concentrations ²	Mean of Detected Concentrations ³	Background Screening Concentration ⁴	USEPA Region III Tap Water RBC ⁵	Florida Groundwater Cleanup Target Level ⁶	Analyte HHCOPC? (Yes/No)	Reason ⁷
Semivolatile Organic Compounds (µg/L)									
cis-1,2-Dichloroethene	15/39	1 to 1,100	1 to 1,650	362	NA	6.1	70	Yes	
trans-1,2-Dichloroethene	1/39	1 to 1,100	1.4	1.4	NA	12	100	Yes	C
Chloroform	1/39	1 to 1,100	4	4	NA	0.15	5.7	No	F
Tetrachloroethene	20/39	1 to 1,600	1 to 29,800	1,582	NA	1.1	3	Yes	
Trichloroethene	19/39	1 to 1,100	0.7 to 2,475	325	NA	1.6	3	Yes	
Inorganic Analytes (µg/L)									
Aluminum	27/33	16.8 to 109	117 to 35,500	3,330	4,067	3,700	200	Yes	
Antimony	7/33	2.5 to 7.2	3.1 to 20.7	9.7	4.1	1.5	6	Yes	
Barium	33/33	NA	1.4 to 289	25.8	31.4	260	2,000	Yes	
Calcium	1/33	65 to 64,700	3,350	3,350	36,830	⁸ 1,055,398	NSC	No	B, E
Chromium	27/33	0.9	0.73* to 59.4	6	7.8	⁹ 11	100	Yes	
Copper	2/33	0.7 to 20.3	5.1 to 94.8	49.9	5.4	150	1,000	No	S, G
Iron	32/39	15.7 to 110	16.8 to 4,920	764	1,227	1,100	300	Yes	
Magnesium	1/33	6.7 to 8,450	1,340	1,340	4,560	⁸ 118,807	NSC	No	B, E
Mercury	4/33	0.1	0.13 to 3.7	1.1	0.12	¹⁰ 1.1	2	Yes	
Nickel	12/33	1.2	1.3* to 7.6	3.3	ND	73	100	No	S, G
Potassium	2/33	41.1 to 3,490	1,900 to 10,700	6,300	5,400	297,016	NSC	No	E
Selenium	3/33	3.6	3.0 * to 15.5	10.5	9.7	18	50	No	S, G
Sodium	2/33	307 to 115,500	13,000 to 1,120,000	566,500	ND	⁸ 396,022	160,000	Yes	
Vanadium	16/17	0.6	1.5 to 23	6.8	20.6	26	49	No	S, G
See notes at end of table.									

Table 8-4 (Continued)
Selection of Human Health Chemicals of Potential Concern
Unfiltered Groundwater

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center
 Orlando, Florida

Analyte	Frequency of Detection ¹	Range of Reporting Limits	Range of Detected Concentrations ²	Mean of Detected Concentrations ³	Background Screening Concentration ⁴	USEPA Region III Tap Water RBC ⁵	Florida Groundwater Cleanup Target Level ⁶	Analyte HHCOPC? (Yes/No)	Reason ⁷
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¹ Frequency of detection is the number of samples in which the analyte is detected over the total number of samples analyzed (excluding rejected values).
² A value indicated by an asterisk is the average of a sample and its duplicate. For duplicate samples having one nondetect, one-half of the reporting limit is used as a surrogate concentration for the nondetect.
³ The mean of detected concentrations is the arithmetic mean of all samples in which the analyte was detected. It does not include those samples with "R," "U," or "UJ" validation qualifiers.
⁴ The background screening concentration is twice the mean of detected concentrations for inorganic analytes. The background concentrations were obtained from the Naval Training Center Orlando *Background Sampling Report* (ABB Environmental Services, Inc., 1995).
⁵ For all chemicals except the essential nutrients (calcium, magnesium, potassium, and sodium), USEPA Region III RBCs tap water values were used (USEPA, 1999). The RBC values are based on a carcinogenic risk of 1×10^{-4} and an adjusted hazard index of 0.1. For the essential nutrients, screening values were derived based on recommended daily allowances (See Appendix E-3).
⁶ Florida Department of Environmental Protection (FDEP) Groundwater Cleanup Target Levels from Chapter 62-777 (FDEP, 1999).
⁷ Analyte was included or excluded from the risk assessment for the following reasons:
 B = the maximum detected concentration did not exceed twice the arithmetic mean of detected concentrations at background locations and will not be considered further;
 C = Included because one member of chemical class was selected as a COPC. Classes included carcinogenic PAHs, and PCBs;
 S = the maximum detected concentration did not exceed the risk-based screening concentration and will not be considered further;
 G = the maximum detected concentration did not exceed the Florida guidance concentration and will not be considered further;
 E = the maximum detected concentration did not exceed the essential nutrient screening concentration derived in Appendix E-3; and
 F = the analyte was detected in less than 5 percent of the samples and will not be considered further.
⁸ Essential nutrient value (see Appendix E-3).
⁹ Value is based on hexavalent chromium.
¹⁰ Value is for mercuric chloride.

Notes: USEPA = U.S. Environmental Protection Agency.
 HHCOPC = human health chemical of potential concern.
 $\mu\text{g}/\text{l}$ = micrograms per liter.
 NA = not available/not applicable.
 NSC = No screening concentration available.
 * = Value is the average of a sample and its duplicate.
 ND = not detected.
 PAH = polynuclear aromatic hydrocarbons.
 COPC = chemical of potential concern.

Table 8-5
Selection of Human Health Chemicals of Potential Concern
Surface Water

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Frequency of Detection ¹	Range of Reporting Limits	Range of Detected Concentrations ²	Mean of Detected Concentrations ³	Background Screening Concentration ⁴	USEPA Region IV Water Quality Standards ⁵	Florida Surface Water Cleanup Target Levels ⁶	USEPA Region III Tap Water RBC ⁷	Analyte HHCOPC? (Yes/No)	Reason ⁸
<u>Volatil Organic Compounds (µg/L)</u>										
cis-1,2-Dichloroethene	4/5	1	41* to 760	330	NA	NSC	NSC	6.1	Yes	
Acetone	1/2	2 to 10	6	6	NA	NSC	1,691	NA	No	G
Carbon disulfide	1/5	2 to 36	1	1	NA	NSC	105	NA	No	G
Tetrachloroethene	1/5	1 to 50	19	19	NA	0.8	8.85	NA	Yes	
Toluene	1/5	2 to 36	0.7	0.7	NA	6,800	475	NA	No	S, G
Trichloroethene	3/5	1 to 50	17 to 57	36.7	NA	2.7	80.7	NA	Yes	
Vinyl chloride	1/5	1 to 65	35	35	NA	2	NSC	NA	Yes	
<u>Semivolatile Organic Compounds (µg/L)</u>										
4-Methyphenol	1/1	NA	3.5	3.5	NA	NSC	70	NA	No	G
<u>Pesticides and PCBs (µg/L)</u>										
4,4'-DDT	1/1	NA	0.03	0.03	NA	0.00059	0.00059	NA	Yes	
Endrin Ketone	1/1	NA	0.01	0.01	NA	⁹ 0.76	⁹ 0.0023	NA	Yes	
gamma-BHC (Lindane)	1/1	NA	0.01	0.01	NA	0.019	0.063	NA	No	S, G
<u>Inorganic Analytes (µg/L)</u>										
Aluminum	1/1	NA	538	538	NA	NSC	13	NA	Yes	
Calcium	1/1	NA	7,220	7,220	NA	¹⁰ 1,000,000	NSC	NA	No	E
See notes at end of table.										

Table 8-5 (Continued)
Selection of Human Health Chemicals of Potential Concern
Surface Water

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Frequency of Detection ¹	Range of Reporting Limits	Range of Detected Concentrations ²	Mean of Detected Concentrations ³	Background Screening Concentration ⁴	USEPA Region IV Water Quality Standards ⁵	Florida Surface Water Cleanup Target Levels ⁶	USEPA Region III Tap Water RBC ⁷	Analyte HHCOPC? (Yes/No)	Reason ⁸
Inorganic Analytes (µg/l) (Continued)										
Iron	1/1	NA	176	176	NA	300	1,000	NA	No	S, G
Lead	1/1	NA	2.8	2.8	NA	NSC	NSC	¹¹ 15	No	W
Magnesium	1/1	NA	1,450	1,450	NA	¹⁰ 118,807	NSC	NA	No	E
Manganese	1/1	NA	4.3	4.3	NA	50	NSC	NA	No	S
Vanadium	1/1	NA	1.2	1.2	NA	NSC	NSC	26	No	W

¹ Frequency of detection is the number of samples in which the analyte is detected over the total number of samples analyzed.

² A value indicated by an asterisk is the average of a sample and its duplicate. For duplicate samples having one nondetect, one-half of the reporting limit is used as a surrogate concentration for the nondetect.

³ The mean of detected concentrations is the arithmetic mean of all samples in which the analyte was detected. It does not include those samples with "R," "U," or "UJ" validation qualifiers.

⁴ Background concentrations for surface water at NTC, Orlando have not been established.

⁵ For all chemicals except the essential nutrients (calcium, magnesium, potassium, and sodium), USEPA Region IV Water Quality Standards for human health criteria (water and organism consumption) were used (USEPA, 1996b).

⁶ Florida Surface Water Cleanup Target Levels for Freshwater from Chapter 62-777 (FDEP, 1999).

⁷ If no water quality standard is available then the USEPA RBC table for tap water exposure per January 1993 guidance (Selecting Exposure Routes and Contaminants of Concern by Risk-Based Screening, EPA/903/R-93-001) was used for screening. Actual values are taken from the USEPA Region III RBC Tables (USEPA, 1999), and are based on a excess lifetime cancer risk of 10⁻⁶ or an adjusted hazard quotient of 0.1.

⁸ Analyte was included or excluded from the risk assessment for the following reasons:
 S = the maximum detected concentration did not exceed the Region IV Water Quality Standards and will not be considered further;
 G = the maximum detected concentration did not exceed the Florida Water Quality Standards and will not be considered further;
 W = the maximum detected concentration did not exceed the Region III RBC for tap water and will not be considered further; and
 E = the maximum detected concentration did not exceed the essential nutrient screening concentration derived in Appendix E-3.

⁹ Value is based on endrin as a surrogate.

¹⁰ Essential nutrient value (see Appendix E-3).

¹¹ Treatment technology action level for lead in drinking water (USEPA Drinking Water Standards and Health Advisories, May 1996 [USEPA, 1996c]).

Notes: USEPA = U.S. Environmental Protection Agency. NA = not available/not applicable.
 RBC = USEPA Region III Risk-Based Concentration. NSC = No screening concentration available.
 HHCOPC = human health chemical of potential concern. PCB = polychlorinated biphenyl.
 µg/l = micrograms per liter. DDT = dichlorodiphenyltrichloroethane.
 * = Value is the average of a sample and its duplicate. BHC = benzene hexachloride.

Table 8-6
Selection of Human Health Chemicals of Potential Concern
Sediment

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center
 Orlando, Florida

Analyte	Frequency of Detection ¹	Range of Reporting Limits	Range of Detected Concentrations ²	Mean of Detected Concentrations ³	Background Screening Concentration	USEPA Region III Residential RBC ⁴	Florida Soil Cleanup Target Level ⁵	Analyte HHCOPC? (Yes/No)	Reason ⁶
<u>Volatile Organic Compounds (µg/kg)</u>									
1,1-Dichloroethene	1/5	13 to 110	13	13	NA	1,100	90	No	S, G
1,2-Dichloroethene (total)	4/5	13 to 110	16* to 1,300	510	NA	70,000	⁷ 19,000	No	S, G
Acetone	1/5	13 to 110	45.6	45.6	NA	780,000	780,000	No	S, G
Methylene chloride	3/5	13 to 110	54 to 130	82	NA	85,000	16,000	No	S, G
Tetrachloroethene	2/5	13 to 110	3 to 19	11	NA	12,000	8,900	No	S, G
Toluene	1/5	13 to 110	12.9	12.9	NA	1,600,000	380,000	No	S, G
Trichloroethene	2/5	13 to 110	21 to 280	151	NA	58,000	6,000	No	S, G
Vinyl chloride	2/5	13 to 110	25 to 564	295	NA	340	30	Yes	
<u>Semivolatile Organic Compounds (µg/kg)</u>									
bis(2-Ethylhexyl)phthalate	1/1	NA	5,585	5,585	NA	46,000	76,000	No	S, G
Fluoranthene	1/1	NA	3,525	3,525	NA	310,000	2,900,000	No	S, G
Pyrene	1/1	NA	3,400	3,400	NA	230,000	2,200,000	No	S, G
<u>Pesticides and PCBs (µg/kg)</u>									
4,4'-DDE	1/1	NA	7.6	7.6	NA	1,900	3,300	No	S, G
alpha-Chlordane	1/1	NA	2	2	NA	⁸ 1,800	⁸ 3,100	No	S, G
Aroclor-1254	1/1	NA	67.5	67.5	NA	¹⁸ 160	⁹ 500	No	S, G
Endosulfan I	1/1	NA	4.6	4.6	NA	¹⁰ 47,000	¹⁰ 410,000	No	S, G
delta-BHC	1/1	NA	6.1	6.1	NA	¹¹ 350	22,000	No	S, G
gamma-BHC (Lindane)	1/1	NA	2.8	2.8	NA	490	700	No	S, G
Heptachlor	1/1	NA	2.6	2.6	NA	140	200	No	S, G

See notes at end of table.

Table 8-6 (Continued)
Selection of Human Health Chemicals of Potential Concern
Sediment

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Frequency of Detection ¹	Range of Reporting Limits	Range of Detected Concentrations ²	Mean of Detected Concentrations ³	Background Screening Concentration	USEPA Region III Residential RBC ⁴	Florida Soil Cleanup Target Level ⁵	Analyte HHCOPC? (Yes/No)	Reason ⁶
Inorganic Analytes (mg/kg)									
Aluminum	1/1	NA	7,750	7,750	NA	7,800	72,000	No	S, G
Arsenic	1/1	NA	6.3	6.3	NA	0.43	0.8	Yes	
Barium	1/1	NA	31.3	31.3	NA	550	110	No	S, G
Beryllium	1/1	NA	0.3	0.3	NA	16	120	No	S, G
Cadmium	1/1	NA	0.39	0.39	NA	¹² 7.8	75	No	S, G
Calcium	1/1	NA	7,080	7,080	NA	¹³ 1,000,000	NSC	No	E
Chromium	1/1	NA	18.9	18.9	NA	¹⁴ 23	¹⁴ 210	No	S, G
Cobalt	1/1	NA	0.75	0.75	NA	470	4,700	No	S, G
Copper	1/1	NA	16.8	16.8	NA	310	110	No	S
Iron	1/1	NA	1,240	1,240	NA	2,300	23,000	No	S, G
Lead	1/1	NA	38.1	38.1	NA	¹⁵ 400	400	No	S, G
Manganese	1/1	NA	6.9	6.9	NA	¹⁶ 160	1,600	No	S, G
Mercury	1/1	NA	0.31	0.31	NA	¹⁷ 2.3	3.4	No	S, G
Nickel	1/1	NA	4.2	4.2	NA	160	110	No	S, G
Selenium	1/1	NA	4.7	4.7	NA	39	390	No	S, G
Silver	1/1	NA	0.85	0.85	NA	39	390	No	S, G
Thallium	1/1	NA	5.4	5.4	NA	0.55	NSC	Yes	
Vanadium	1/1	NA	6.7	6.7	NA	55	15	No	S, G
Zinc	1/1	NA	109	109	NA	2,300	23,000	No	S, G
See notes at end of table.									

Table 8-6 (Continued)
Selection of Human Health Chemicals of Potential Concern
Sediment

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

- ¹ Frequency of detection is the number of samples in which the analyte is detected over the total number of samples analyzed.
- ² A value indicated by an asterisk is the average of a sample and its duplicate. For duplicate samples having one nondetect, one-half of the reporting limit is used as a surrogate concentration for the nondetect.
- ³ The mean of detected concentrations is the arithmetic mean of all samples in which the analyte was detected. It does not include those samples with "R," "U," or "UJ" validation qualifiers.
- ⁴ For all chemicals except the essential nutrients (calcium, magnesium, potassium, and sodium), USEPA Region III RBCs residential soil values were used (USEPA, 1999). The RBC values are based on a carcinogenic risk of 1×10^{-6} and an adjusted hazard index of 0.1. For the essential nutrients, screening values were derived based on recommended daily allowances (See Appendix E-3).
- ⁵ Values are from residential cleanup goals in Florida Department of Environmental Protection Chapter 62-777 (FDEP, 1999).
- ⁶ Analyte was included or excluded from the risk assessment for the following reasons:
 S = the maximum detected concentration did not exceed the risk-based screening concentration and will not be considered further;
 G = the maximum detected concentration did not exceed the Florida guidance concentration and will not be considered further; and
 E = the maximum detected concentration did not exceed the essential nutrient screening concentration derived in Appendix E-3.
- ⁷ Value for cis-1,2-dichloroethene is used.
- ⁸ Value for chlordane is used.
- ⁹ Value for polychlorinated biphenyls is used as a surrogate.
- ¹⁰ Value is based on a mixture of endosulfan isomers.
- ¹¹ Value for technical BHC is used.
- ¹² Value is based on cadmium-food.
- ¹³ Essential nutrient value (see Appendix E-3).
- ¹⁴ Value is based on hexavalent chromium.
- ¹⁵ RBC is not available for lead; value is from Revised Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites (Office of Solid Waste and Emergency Response Directive 9355.4-12) (USEPA, 1994a).
- ¹⁶ Value is based on manganese-nonfood.
- ¹⁷ Value for mercuric chloride is used as a surrogate.
- ¹⁸ Value is based on a hazard quotient of 0.1.

Notes: USEPA = U.S. Environmental Protection Agency.
 HHCOPC = human health chemical of potential concern.
 $\mu\text{g}/\text{kg}$ = micrograms per kilogram.
 NA = not available.
 * = Value is the average of a sample and its duplicate.
 PCB = polychlorinated biphenyl.
 DDE = dichlorodiphenyldichloroethene.
 BHC = benzene hexachloride.
 mg/kg = milligrams per kilogram.
 PCB = polychlorinated biphenyl.

Demographics are also characterized and identified for (1) the populations residing or working near the site; (2) the activity patterns of residents and/or workers; and (3) if any exist, the locations of potentially sensitive subgroups. Sources of this information include (1) site visits, (2) previous investigations, (3) information generated during the RI, (4) maps, (5) aerial and standard photographs, and (6) Navy personnel interviews. Determining current and foreseeable future land use of the waste site and surrounding areas (e.g., residential, commercial, trespasser, industrial, or recreational) is key to this activity.

SAs at OU 4 are located 1 mile west of the Main Base and are adjacent to Lake Druid (Figures 1-2 and 2-1). Current land use at the Main Base consists of activities associated with the barracks, training facilities, administrative buildings, drill fields, and recreational areas. The Main Base is surrounded by urban development, including single and multifamily housing, schools, and commercial development. Land uses directly west and northwest of the facility are mainly residential. To the southwest of the Main Base, land use is commercial. Herndon Airport is located 1.5 miles to the south of the Main Base. No industrial facilities exist adjacent to the Main Base, except for automotive repair facilities on the southwest property line (ABB-ES, 1994).

Area C occupies 46 acres and is located approximately 1 mile west of the Main Base off Maguire Boulevard. Area C is surrounded by urban development with multifamily residential development to the north, an office park to the east, single family residences to the west and south, and a single family residential development to the west, across Lake Druid. No industrial facilities exist adjacent to Area C. According to City of Orlando records, no permitted irrigation or domestic wells are present within the vicinity of OU 4. Similarly, there are no production wells within 1/2 mile of OU 4.

The Main Base obtains its drinking water supply from the Orlando Utilities Commission and Winter Park Utilities (ABB-ES, 1994). One of the Orlando Utilities Commission's supply wells is located at the southeast corner of the Main Base. In addition, ten irrigation wells are present on the Main Base. The groundwater at OU 4 is not presently used as a source of potable or nonpotable water.

8.3.2 Identification of Exposure Pathways and Receptors The purpose of this step in the exposure assessment is the identification of all relevant exposure pathways through which specific populations may be exposed, under current and future land use, to contaminants at the site. An exposure pathway consists of four necessary elements: a source or mechanism of chemical release, a transport or retention medium, a point of human contact, and a route of exposure at the point of contact (USEPA, 1989b). Exposure pathways that have these elements are considered complete pathways. Only complete exposure pathways are evaluated in the HHRA.

In most cases, the source of contamination is either in the soil, or soil is the initial receiving medium. There are several mechanisms for migration of contaminants from soil. Contaminants may accumulate in plants and animals that are in contact with soil or are in food chains that include biota in direct contact with soil. Mechanisms for migration into air include volatilization (primarily VOCs) and wind erosion of contaminated soil (all types of contaminants). Overland flow of water can result in migration of contaminants to surface water and sediment, and in relocation to other surface soil (all types

of contaminants). Infiltration can result in migration into subsurface soil and groundwater (soluble contaminants). Contaminants can be transported in groundwater (primarily soluble VOCs, SVOCs, and inorganics) and may potentially also discharge to surface water. Analytes can also be transferred to sediment (generally insoluble forms of inorganics and relatively insoluble SVOCs and pesticides) and to fish (primarily nonpolar organics and some inorganics that tend to accumulate in tissue) and other biota. The primary COPCs in surface water and sediment at this site are VOCs, which do not pose a bioaccumulation concern.

Human receptors are identified based on the current and potential future land uses. Receptors commonly include future residents (when reasonably expected), excavation workers, site workers, commercial workers, trespassers, and recreational users. Exposure scenarios are constructed to evaluate each receptor as described below and summarized in Table 8-7. Figure 8-1 presents a summary of the complete exposure pathways at the site.

Surface Soil. The DRMO area is currently being used as a warehouse area. Much of the area is paved with asphalt; therefore, it is unlikely that site maintenance workers would be exposed to contaminants in soil at this area. However, workers could be exposed to soil in unpaved areas outside the warehouse area. In addition, OU 4 is not in a restricted area of the installation, so adult and adolescent trespassers could obtain access to the site. Additionally, a recreational user (adult and adolescent) may access the area of the site by Lake Druid. Exposures to trespassers (adult and adolescent), recreational users (adult and adolescent), and site maintenance workers to surface soil contaminants through ingestion, dermal contact, and inhalation of particulates are evaluated in the HHRA.

Because the land reuse plan for OU 4 has not been finalized, it is possible that OU 4 may eventually be developed for residential use. Therefore, future residential exposures to contaminants in surface soil are evaluated in the HHRA. Occupational worker exposures are considered part of future land use. Activities such as a installation of utility lines or construction could also occur in the future. Under these conditions, an excavation worker could be exposed to surface soil. Likewise, the land at OU 4 could be used as a recreational site in the future. Under these conditions, recreational users could be exposed to surface soil. Potential exposure to future residents (adult and child), future occupational workers, current and future site maintenance workers, future excavation workers, and current and future recreational users (adult and adolescent) to surface soil contaminants through ingestion, dermal contact, and inhalation of particulates are evaluated in the HHRA.

Subsurface Soil. There are no current exposures to subsurface soil because no excavation or construction activities are ongoing at OU 4. However, if OU 4 is developed for residential or industrial use, or if excavation activities occur in the future, an excavation worker could be exposed to contaminants in subsurface soil. Therefore, exposure of this receptor to subsurface soil (incidental ingestion, dermal contact, and inhalation of fugitive dust) is evaluated in the HHRA.

Groundwater. Currently, no humans reside at OU 4 and groundwater is not used for any potable or nonpotable purpose. However, if OU 4 was developed for residential use, exposure to future adult and child residents (ingestion of drinking water

Table 8-7
Summary of Potential Exposure Pathways

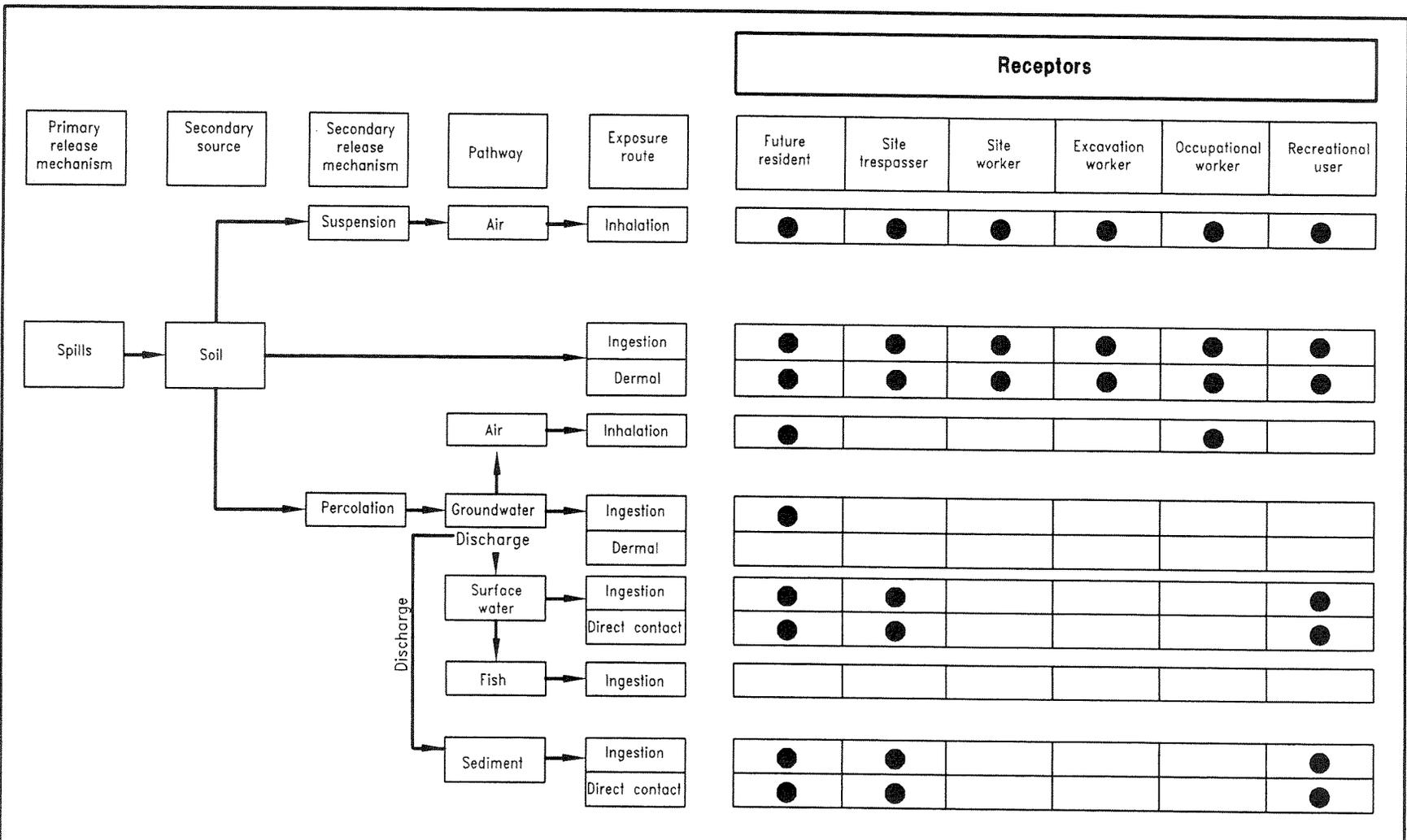
Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center
 Orlando, Florida

Medium of Exposure	Route of Exposure	Potentially Exposed Population	Selected for Evaluation ?	Reason for Selection or Evaluation
Current Land Use				
Surface Soil	Dermal contact with soil, ingestion of soil, and inhalation of fugitive dust.	Resident (adult and child) Trespasser (adult and adolescent) Occupational worker (adult) Site maintenance worker (adult) Excavation worker (adult)	No Yes No Yes No	No humans currently reside at Operable Unit (OU) 4. Adolescents and adults may be exposed to contaminants in the surface soil while trespassing. The site maintenance workers may be exposed to contaminants in surface soil while performing routine site activities.
Subsurface Soil	Dermal contact with soil, ingestion of soil, and inhalation of fugitive dust.	Excavation worker (adult)	No	There are no excavation activities currently at OU 4.
Groundwater	Ingestion of groundwater as drinking water	Resident (adult)	No	There are no current exposures to groundwater.
Surface water	Ingestion and dermal contact with surface water.	Trespasser (adult and adolescent)	Yes	Adolescent and adult receptors may be exposed to contaminants in surface water while trespassing at Lake Druid.
Sediment	Dermal contact with sediment.	Trespasser (adult and adolescent)	Yes	Adolescent and adult receptors may be exposed to contaminants in sediment while trespassing at Lake Druid.

Table 8-7 (Continued)
Summary of Potential Exposure Pathways

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Medium of Exposure	Route of Exposure	Potentially Exposed Population	Selected for Evaluation ?	Reason for Selection or Evaluation
Future Land Use				
Surface soil	Dermal contact with soil, ingestion of soil, and inhalation of fugitive dust.	Resident (child and adult)	Yes	The future of OU 4 is assumed to include residential, recreational users, and/or commercial use.
		Recreational User (adolescent and adult)	Yes	
		Occupational worker (adult)	Yes	
		Site maintenance worker (adult)	Yes	
		Excavation worker (adult)	Yes	
Subsurface soil	Dermal contact with soil, ingestion of soil, and inhalation of fugitive dust.	Excavation worker (adult)	Yes	It is possible that an excavation worker could be exposed to subsurface soil in the future if the site is developed.
Groundwater	Ingestion of groundwater as drinking water and inhalation of volatiles while showering; inhalation of volatiles migrating from groundwater to indoor air.	Resident (adult and child) Occupational worker (adult)	Yes	If OU 4 is developed for residential use, drinking water wells in the surficial aquifer could be influenced by contaminants in the groundwater associated with OU 4. Therefore, future residents could be exposed to contaminants in the surficial aquifer. Residents and occupational workers may be exposed to volatiles migrating from groundwater to indoor air.
Surface Water	Ingestion and dermal contact with surface water.	Resident (adult and child) Recreational user (adult and adolescent)	Yes Yes	If OU 4 is developed for residential use, residents could be exposed to contaminants in surface water. Recreational users could be exposed to chemicals in surface water while wading in Lake Druid.
Sediment	Dermal contact with sediment.	Resident (adult and child) Recreational user (adult and adolescent)	Yes Yes	If OU 4 is developed for residential use, residents could be exposed to contaminants in sediment. Recreational users could be exposed to chemicals in sediment while wading in Lake Druid.



**FIGURE 8-1
COMPLETE EXPOSURE PATHWAYS
FOR HUMAN RECEPTORS**



**REMEDIAL INVESTIGATION
OPERABLE UNIT 4**

**NAVAL TRAINING CENTER
ORLANDO, FLORIDA**

and inhalation of volatiles while showering) could occur and is therefore evaluated in the HHRA as a conservative measure.

Because of the shallow groundwater, the migration of VOCs to indoor air is possible even for buildings constructed on slabs. The migration of VOCs to indoor air is identified as a potential exposure pathway for residential (adult and child) and occupational receptors

Surface Water. Potential exposures to Lake Druid surface water in the vicinity of OU 4 were evaluated for wading activities by a current trespasser, future resident living at OU 4, or a future recreational user. Potential exposures to surface water from wading, rather than from swimming in the lake, were evaluated because the affected area is too heavily vegetated and shallow to permit swimming. Potential exposure to surface water COPCs from consuming fish taken from the lake would be considered low because VOCs do not substantially accumulate in fish tissue. Therefore, exposures to current trespassers, future recreational users (adult and adolescent) and future residents (adult and child) to surface water through ingestion and dermal contact are evaluated in the HHRA.

Sediment. Potential exposures to sediment in Lake Druid were evaluated for wading activities by trespasser, under current land use, a recreational user under future land use, and future residents. Evaluation of this exposure pathway is conservative because sediment is always covered by surface water; potential exposure to sediment via dermal exposure to the lower legs and feet was the only exposure route considered reasonable, because the sediment is submerged.

8.3.3 Quantification of Exposures Once complete exposure pathways are selected for evaluation (Subsection 8.3.2), the final step of the exposure assessment is to quantify exposure (i.e., intake) for each pathway. This quantification process involves developing assumptions regarding exposure conditions and exposure scenarios for each receptor to estimate the total amount of COPCs that a potential receptor may ingest, dermally absorb, or inhale from each exposure pathway. These exposure scenarios are based on several variables, which can be grouped into chemical-, population-, and assessment-related variables.

The ultimate goal of this step, as defined in USEPA guidance, is to identify the combination of these exposure variables or parameters that result in the most intense level of exposure that may "reasonably" be expected to occur under current and future site conditions (USEPA, 1989b). This is performed for every complete exposure pathway selected for evaluation (Appendix E-4). The resulting exposure scenarios are referred to as the reasonable maximum exposure (RME) for each exposure pathway. More recent USEPA guidance (USEPA, 1992b) recommends developing two exposure scenarios, an average exposure, or central tendency (CT), in addition to a "high end," or RME. This guidance also suggests that other uncertainty analyses, including Monte Carlo analysis, can be useful in putting risk estimates into perspective. In this HHRA, CT evaluations are performed if risks for a receptor exceed the FDEP risk threshold.

Chemical-Related Variable. The chemical-related variable is the exposure point concentration (EPC). An exposure point consists of a receptor and an exposure locale. For example, if a residential development at a hypothetical site used a private well screened in the contaminated aquifer, then the tap would be the exposure point. The EPC is the COPC concentration that is representative of potential exposures at the exposure point. The EPCs are calculated in a manner

consistent with USEPA guidance (USEPA, 1989b; 1992e; 1995a). The EPCs for surface soil, subsurface soil, sediment, and surface water are, with the exceptions noted below, the 95 percent upper confidence limit (UCL) on the arithmetic mean of the concentrations in the data set used to evaluate exposure. The following equation for calculating the UCL on the arithmetic mean for a lognormal distribution (USEPA, 1991a; 1992e) is used to calculate all UCLs:

where:

$$UCL = e^{(\bar{x} + 0.5 s^2 + \frac{s H}{\sqrt{n-1}})} \quad (2)$$

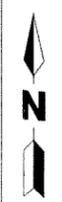
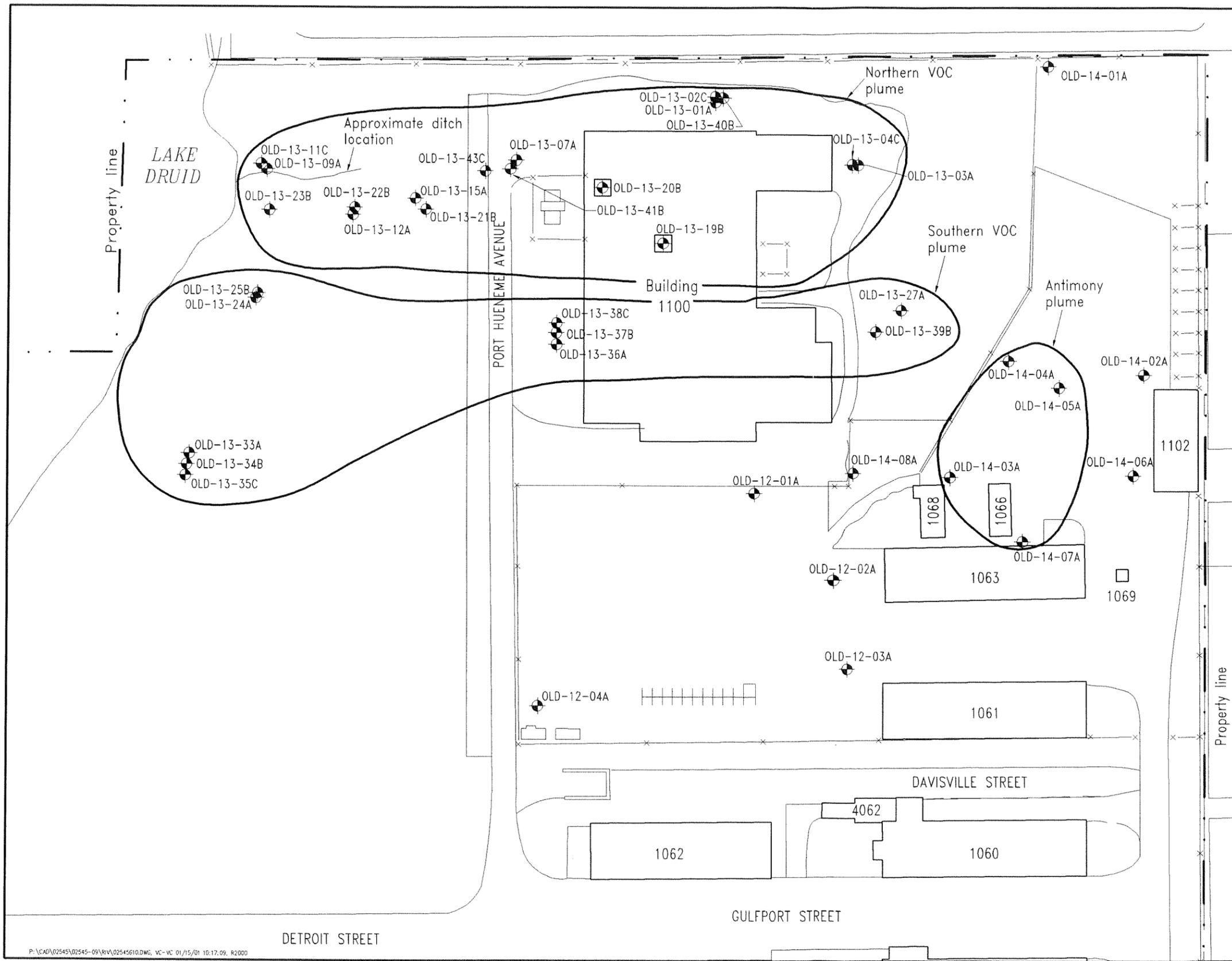
- UCL = upper confidence limit on the mean,
- e = constant (base of the natural log, equal to 2.718),
- xbar = mean of transformed data,
- s = standard deviation of the transformed data,
- H = H-statistic (from table published in Gilbert, 1987), and
- n = number of samples.

In calculating the 95 percent UCLs, nondetects are assigned a value of one-half the associated SQLs in the calculation of the arithmetic mean. In cases where there are fewer than ten samples or where the UCL is greater than the maximum detected concentration, the maximum detected concentration is identified as the EPC.

According to USEPA Region IV guidance, the groundwater EPC is the arithmetic mean concentration of wells within the groundwater plume (USEPA, 1995a). Therefore, the groundwater data were segregated by plume areas. As described in Section 5.3, there are three separate plume areas: northern VOC plume, southern VOC plume, and antimony plume. The northern VOC plume sample locations evaluated in the HHRA are 13G00103 through 13G00403, U4G007XX, U4G009XX, U4G012XX, U4G015XX, U4G01902, U4G02003, U4G021XX, U4G022XX, U4G023XX, U4G04001, U4G041014, U4G04101D, U4G04301, and U4G04301D. The southern VOC plume sample location evaluated in the HHRA are U4G024XX, U4G025XX, U4G02701, U4G03301, U4G03401, U4G03601, U4G03701/U-4G03701D, and U4G03901. The antimony plume sample locations evaluated in the HHRA are 14G00304, 14G00403, 14G00501, 14G00701. The groundwater plumes and sample locations included in the EPC calculations are shown on Figure 8-2. The EPC for each plume is the lesser of the maximum detected concentration or the arithmetic mean of all samples within the plume, calculated using one-half the associated reporting limits for nondetects.

The EPCs for analytes selected as COPCs in surface soil, subsurface soil, groundwater plumes, surface water, and sediment are presented in Tables 8-8 to 8-14.

An additional analysis was performed for the carcinogenic polynuclear aromatic hydrocarbon (cPAH) EPCs to calculate total benzo(a)pyrene equivalents. For each sample in a given medium, the concentration of each of the seven cPAHs were adjusted by their respective toxicity equivalency factor (TEF) (Table 8-15).



LEGEND

	OLD-13-11C Monitoring well location and designation
	OLD-13-19B Microwell location and designation
	Fence
	Volatile organic compound

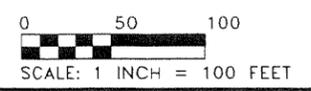


FIGURE 8-2
GROUNDWATER EXPOSURE POINTS



REMEDIAL INVESTIGATION
OPERABLE UNIT 4

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

**Table 8-8
Exposure Point Concentrations
for Human Health Chemicals of Potential Concern
for Surface Soil**

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Frequency of Detection ¹	Maximum Detected Concentration	95% UCL ²	Exposure Point Concentration ³
<u>Volatile Organic Compounds (µg/kg)</u>				
Tetrachloroethene	7/20	110	27	27
<u>Semivolatile Organic Compounds (µg/kg)</u>				
Benzo(a)anthracene	5/20	260	556	260
Benzo(a)pyrene	5/20	330	550	330
Benzo(b)fluoranthene	7/20	630	645	630
Benzo(k)fluoranthene	5/20	230	567	230
Chrysene	7/20	460	602	460
Indeno(1,2,3-cd)pyrene	5/20	200	545	200
Benzo(a)pyrene equivalent	7/20	442	265	265
<u>Pesticides and PCBs (µg/kg)</u>				
Aroclor-1254	2/20	210	69.4	69.4
Aroclor-1260	1/20	25	40.5	25
<u>Inorganic Analytes (mg/kg)</u>				
Aluminum	20/20	9,740	27,447	9,740
Barium	18/20	167	59.7	59.7
Chromium	19/20	45.2	14.6	14.6
Iron	18/20	6,400	29,144	6,400
Vanadium	16/20	17.7	4.8	4.8

¹ Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed (excluding rejected values).

² 95% UCL of the arithmetic mean is calculated using all samples. One-half the reporting limit is used as a surrogate for nondetects.

³ Exposure point concentration is the lower of either the 95% UCL concentration or maximum detected concentration.

Notes: % = percent.

µg/kg = micrograms per kilogram.

PCB = polychlorinated biphenyl.

mg/kg = milligrams per kilogram.

Table 8-9
Exposure Point Concentrations
for Human Health Chemicals of Potential Concern
for Subsurface Soil

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Frequency of Detection ¹	Maximum Detected Concentration	95% UCL ²	Exposure Point Concentration ³
<u>Volatile Organic Compounds (µg/kg)</u>				
Tetrachloroethene	3/14	31	10.5	10.5

¹ Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed (excluding rejected values).

² 95% UCL of the arithmetic mean is calculated using all samples. One-half the reporting limit is used as a surrogate for nondetects.

³ Exposure point concentration is the lower of either the 95% UCL concentration or maximum detected concentration.

Notes: % = percent.

µg/kg = micrograms per kilogram.

Table 8-10
Exposure Point Concentrations
for Human Health Chemicals of Potential Concern
for Unfiltered Groundwater (Northern VOC Plume)

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Frequency of Detection ¹	Maximum Detected Concentration	Arithmetic Mean ²	Exposure Point Concentration ³
<u>Volatile Organic Compounds (µg/l)</u>				
cis-1,2-Dichloroethene	10/16	1,650	350	350
Tetrachloroethene	10/16	29,800	1,900	1,900
Trichloroethene	11/16	2,475	410	410
<u>Inorganic Analytes (µg/l)</u>				
Aluminum	10/12	35,500	4,630	4,630
Barium	12/12	289	46	46
Chromium	10/12	59.4	8.4	8.4
Iron	14/16	4,920	751	751
Mercury	2/12	3.7	0.39	0.39

¹ Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed (excluding rejected values).

² Arithmetic mean of all samples calculated using one-half the reporting limit for nondetects.

³ Exposure point concentration is the lower of either the arithmetic mean or maximum detected concentration.

Note: VOC = volatile organic compound.
µg/l = micrograms per liter.

Table 8-11
Exposure Point Concentrations
for Human Health Chemicals of Potential Concern
for Unfiltered Groundwater (Southern VOC Plume)

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Frequency of Detection ¹	Maximum Detected Concentration	Arithmetic Mean ²	Exposure Point Concentration ³
<u>Volatile Organic Compounds (µg/l)</u>				
cis-1,2-Dichloroethene	5/8	43.6	12	12
trans-1,2-Dichloroethene	1/8	1.4	4.1	1.4
Tetrachloroethene	6/8	390	110	110
Trichloroethene	7/8	105	23	23
<u>Inorganic Analytes (µg/l)</u>				
Aluminum	5/6	12,700	3,780	3,780
Barium	6/6	65.35	25.2	25.2
Chromium	5/6	22.9	6.8	6.8
Iron	8/8	3,350	738	738
Mercury	2/6	0.265	0.1	0.1

¹ Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed (excluding rejected values).

² Arithmetic mean of all samples calculated using one-half the reporting limit for nondetects.

³ Exposure point concentration is the lower of either the arithmetic mean or maximum detected concentration.

Note: VOC = volatile organic compound.
µg/l = micrograms per liter.

Table 8-12
Exposure Point Concentrations
for Human Health Chemicals of Potential Concern
for Unfiltered Groundwater (Antimony Plume)

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Frequency of Detection ¹	Maximum Detected Concentration	Arithmetic Mean ²	Exposure Point Concentration ³
<u>Volatile Organic Compounds (µg/l)</u>				
Tetrachloroethene	2/4	28	7.5	7.5
Trichloroethene	1/4	2	0.88	0.88
<u>Inorganic Analytes (µg/l)</u>				
Aluminum	3/4	217	170	170
Antimony	4/4	20.7	14.1	14.1
Barium	4/4	5.2	3.4	3.4
Chromium	3/4	1.4	0.99	0.99
Iron	2/4	53.4	28.4	28.4

¹ Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed (excluding rejected values).

² Arithmetic mean of all samples calculated using one-half the reporting limit for nondetects.

³ Exposure point concentration is the lower of either the arithmetic mean or maximum detected concentration.

Note: µg/l = micrograms per liter.

Table 8-13
Exposure Point Concentrations
for Human Health Chemicals of Potential Concern
for Surface Water

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Frequency of Detection ¹	Maximum Detected Concentration	95% UCL ²	Exposure Point Concentration ³
<u>Volatile Organic Compounds</u> ($\mu\text{g}/\text{L}$)				
cis-1,2-Dichloroethene	4/5	760	NC	760
Tetrachloroethene	1/5	19	NC	19
Trichloroethene	3/5	57	NC	57
Vinyl chloride	1/5	35	NC	35
<u>Pesticides and PCBs</u> ($\mu\text{g}/\text{L}$)				
4,4'-DDT	1/1	0.03	NC	0.03
Endrin ketone	1/1	0.01	NC	0.01
<u>Inorganic Analytes</u> ($\mu\text{g}/\text{L}$)				
Aluminum	1/1	538	NC	538

¹ Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed (excluding rejected values).

² 95% UCL of the arithmetic mean is calculated using all samples. One-half the contract-required quantitation limit/contract-required detection limit is used as a surrogate for nondetects.

³ Exposure point concentration is the lower of either the 95% UCL concentration or maximum detected concentration.

Notes: $\mu\text{g}/\text{L}$ = micrograms per liter.

NC = not calculated because there are fewer than 10 samples in the data set.

PCB = polychlorinated biphenyl.

DDT = dichlorodiphenyltrichloroethane.

Table 8-14
Exposure Point Concentrations
for Human Health Chemicals of Potential Concern
for Sediment

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Frequency of Detection ¹	Maximum Detected Concentration	95% UCL ²	Exposure Point Concentration ³
<u>Volatile Organic Compounds (mg/kg)</u>				
Vinyl chloride	2/5	564	NC	564
<u>Inorganic Analytes (mg/kg)</u>				
Arsenic	1/1	6.3	NC	6.3
Thallium	1/1	5.4	NC	5.4

¹ Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed (excluding rejected values).

² 95% UCL of the arithmetic mean is calculated using all samples. One-half the contract-required quantitation limit/contract-required detection limit is used as a surrogate for nondetects.

³ Exposure point concentration is the lower of either the 95% UCL concentration or maximum detected concentration.

Notes: % = percent.

mg/kg = milligrams per kilogram.

NC = not calculated, because there are fewer than 10 samples in the data set.

Table 8-15
Toxicity Equivalency Factors for
Carcinogenic Polynuclear Aromatic Hydrocarbons

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center
 Orlando, Florida

Polynuclear Aromatic Hydrocarbon	Toxicity Equivalency Factors
Benzo(a)pyrene	1
Benzo(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.01
Chrysene	0.001
Dibenz(a,h)anthracene	1
Indeno(1,2,3-c,d)pyrene	0.1
Source: U.S. Environmental Protection Agency (USEPA, 1995a).	

The benzo(a)pyrene equivalent concentration relative to a single cPAH in a single sample is calculated by the following equation:

$$C_{\text{BEQ}} = \text{toxicity equivalence factor (TEF)}_A \times C_A$$

where:

C_{BEQ} = benzo(a)pyrene equivalent concentration;

TEF_A = toxicity equivalency factor (TEF) for a given cPAH; and

C_A = concentration for a given cPAH.

The equivalent concentrations for the seven cPAHs were then summed to determine a total benzo(a)pyrene equivalent for each sample (Appendix E-5). The EPC (449 $\mu\text{g}/\text{kg}$) was then determined for total benzo(a)pyrene equivalents in the same manner as the other COPCs. The benzo(a)pyrene equivalent concentration for the data set was used as the EPC in the calculation of cancer risks. For the calculation of noncancer risks, the EPC for each cPAH compound, unadjusted for TEFs, was used as the EPC.

The published cancer slope factor (CSF) for benzo(a)pyrene has been applied to the benzo(a)pyrene equivalent concentration calculated for cPAHs. The equivalent concentration is based on the TEFs shown in Table 8-15.

Population-Related Variables. Population-related variables describe the characteristics of an individual receptor within each potentially exposed population. These variables include contact rates, such as exposure frequencies and ingestion rates, and physical characteristics of human bodies, such as body weights and surface areas. When applicable, contact rates are selected from USEPA standard default exposure factor guidance (USEPA, 1991a) or USEPA dermal guidance (USEPA, 1992c). If site-specific factors indicate that such parameters are not appropriate, alternative parameters are used based on knowledge of human behavior and the relative accessibility of a site. Parameters describing the physical characteristics of the potentially exposed receptors identified in Subsection 8.3.2 are selected from appropriate USEPA guidance (USEPA, 1989a; 1989b; 1991a; 1996b) and are presented in Appendix E-4.

Assessment-Related Variable. The assessment-related variable involved in exposure quantification is the averaging time. Averaging time reflects the duration of exposure and depends on the type of effect being evaluated. Exposure intake during a defined interval (e.g., a lifetime) is averaged over the entire period, resulting in an estimate of average daily intake.

There are essentially two types of effects typically evaluated in HHRA: carcinogenic effects and noncarcinogenic effects. According to USEPA guidance, the averaging time for carcinogenic effects is assumed to be a 70-year lifetime (USEPA, 1989b). The averaging times for noncarcinogenic effects are equivalent to the duration of exposure and may vary depending on the nature of exposure. There is a wide range of possible estimates, from a day to a lifetime. However, based on USEPA guidance, exposure duration for noncarcinogenic effects can roughly be categorized into one of three periods: (1) chronic exposures, 7 years to a lifetime; (2) subchronic exposures, 2 weeks to 7 years; and (3) acute exposures, less than 2 weeks (USEPA, 1989b). The length of the exposure period depends on the potentially exposed population and the characteristics of exposure. The averaging times applied to receptors are used in the risk calculations. With the exception of the excavation worker scenario, all exposure scenarios evaluated for noncarcinogenic effects at NTC, Orlando are considered

chronic exposures; the excavation worker scenario is considered as subchronic exposure because the exposure duration is only 30 days.

Calculation of Intakes. The equations used to calculate COPC intake are those presented in USEPA guidance (USEPA, 1989b). The general equation for calculating chemical intake is as follows:

$$Intake = \frac{C \times CR \times EF \times ED}{BW \times AT} \quad (3)$$

where:

- Intake = daily chemical intake per unit body weight averaged over the exposure period,
- C = concentration of the chemical in the exposure medium,
- CR = contact rate for the medium of concern,
- EF = exposure frequency,
- ED = exposure duration,
- BW = body weight of the potentially exposed individual,
- AT = averaging time (for carcinogens, AT = 70 years for 365 days per year; for noncarcinogens, AT = ED).

The COPC exposure intakes for the receptors that were evaluated are presented in the risk calculation spreadsheets in Appendix E-6.

Some of the exposure pathways require additional calculations before intake values can be calculated. Brief explanations of the additional calculations required for the inhalation of particulates, inhalation of vapors while showering, inhalation of vapors migrating from groundwater, and dermal absorption are provided below.

Inhalation of Particulates from Soil. This evaluation is conducted to estimate levels of site COPCs that could occur in ambient air as a result of wind erosion and volatilization. A particulate emission factor (PEF) estimates the concentration of soil-derived particulates in air. A default PEF of 1.24×10^9 cubic meters per kilograms is used as obtained from FDEP guidance (FDEP, 1995). A volatilization factor (VF) estimates the concentration of volatilized COPCs in air. Chemical-specific VFs are calculated in Appendix E, according to the methodology described in USEPA *Soil Screening Guidance* (USEPA, 1996d). It is assumed that COPC concentrations in "air-borne" particulates are identical to soil EPCs.

Dermal Absorption from Soil. Dermal absorption from soil is calculated in accordance with the USEPA *Dermal Exposure Assessment: Principles and Applications*, Interim Report (USEPA, 1992c). Percutaneous absorption of chemicals detected in soil is chemical and matrix dependent. According to USEPA Region IV guidance (USEPA, 1995a), absorption factors for organics and inorganics are 0.1 percent and 0.01 percent, respectively. A soil adherence factor of 1 milligram of soil per square centimeter of skin per event is used in the dermal intake equations (USEPA, 1992c). The equations used to describe dermal absorption from soil are located in Appendix E-7.

Inhalation of Vapors while Showering. For this exposure scenario, the contaminant concentrations in air are estimated based on release rates of volatiles in shower water. After reviewing the literature, the Foster and

Chrostowski model (1987) was selected to predict bathroom air concentrations of volatiles from groundwater. The specific equations used to determine concentrations of contaminants in bathroom air are presented in Appendix E-8.

Inhalation of Exposure to Indoor Air. This evaluation was performed to estimate the indoor air concentration that may result from the migration of VOCs from groundwater to indoor air. The Johnson-Ettinger model, as recommended in USEPA's *Soil Screening Guidance* (USEPA, 1996d), was the fate and transport model used for this evaluation. Estimates were calculated for commercial buildings and for residential buildings assuming that the buildings are built on cement slabs (i.e., no basements) and are located directly over the groundwater plume. The equations and theory supporting the model development are provided in Appendix E-9.

Receptor-specific exposure parameters for each exposure scenario are presented in Appendix E-4. The risk calculation spreadsheets in Appendix E-6 to this report also contain the exposure parameters for each exposure scenario.

8.4 TOXICITY ASSESSMENT. The purpose of the toxicity assessment is to identify the adverse effects that are associated with exposure to each COPC and to identify the relationship between the level of exposure and the severity or likelihood of adverse effects. The toxicity assessment evaluates the available evidence on the potential adverse effects associated with exposure to each COPC. With this information, a relationship between the extent of exposure and the likelihood or severity of adverse human health effects is developed. Two steps are typically associated with toxicity assessment: hazard identification and dose-response assessment.

8.4.1 Hazard Identification Hazard identification is the process of determining if exposure to an agent can cause a particular adverse health effect and, more importantly, if that effect will occur in humans. Characterizing the nature and strength of causation is a part of the hazard identification step. For a number of the chemicals at hazardous waste sites, potential toxic effects have already been identified. Consequently, the objectives of the hazard identification in the HHRA are to (1) identify which of the contaminants detected at the site are potential hazards, and (2) summarize their potential toxicity in brief narrative profiles. Toxicity profiles for COPCs are presented in Appendix E-10.

8.4.2 Dose-Response Assessment A dose-response assessment is conducted to characterize and quantify the relationship between intake, or dose, of a COPC and the likelihood of a toxic effect, or response. There are two major types of toxic effects evaluated in an HHRA: carcinogenic and noncarcinogenic. Following USEPA guidance for HHRAs (USEPA, 1989b), these two endpoints (cancer and noncancer) are evaluated separately. As a result of the dose-response assessment, identified dose-response values are used to estimate the incidence of adverse effects as a function of human exposure to a chemical.

There are two types of dose-response values: CSFs for carcinogens and reference doses (RfDs) for noncarcinogens. For many compounds, both types of values have been developed by the USEPA because many compounds cause both carcinogenic and noncarcinogenic effects. In addition, because the toxicity and/or carcinogenicity of a compound can depend on the route of exposure (i.e., oral, inhalation, or dermal), unique dose-response values are developed for the oral, dermal, and

inhalation exposure routes. The source of the dose-response values is described below. All dose-response values for analytes evaluated in this risk assessment are presented in Appendix E-11.

Cancer Toxicity Values. The CSF is a chemical-specific toxicity value developed by the USEPA Cancer Risk Assessment Verification Endeavor based upon the dose of a chemical and the probability of a carcinogenic response. The unit risk, a toxicity value developed by the USEPA, is an estimate of the relationship between the inhaled concentration of a chemical and the probability of a carcinogenic response from the exposure during the lifetime of the individual.

As required by USEPA Region IV guidance (USEPA, 1995a), risks associated with dermal exposures (most commonly for soil and water dermal contact) are evaluated using CSFs that are specific to dermally absorbed doses. Most oral CSFs are based on administered dose rather than the absorbed dose (TCE's CSF is a notable exception). Therefore, it is necessary to adjust toxicity values that are based on administered doses so that they can be used for evaluation of absorbed doses. For dermal exposures, the toxicity values are adjusted as follows:

$$CSF_{adjusted} = \frac{CSF_{oral}}{ABSEFF_{oral}} \quad (4)$$

where $ABSEFF_{oral}$ is the absorption efficiency in the study that is the basis of the oral toxicity value.

If there is no information available on oral absorption efficiency, the conservative default values of 80 percent for VOCs, 50 percent for SVOCs, and 20 percent for inorganics are used (USEPA, 1995a).

The oral CSF, inhalation CSF and unit risk, dermal CSF, weight of evidence classification, and cancer type observed for each carcinogenic COPC analyzed in the HHRA are provided in Appendix E-11.

Noncancer Toxicity Values. The RfD is an estimate (with uncertainty spanning an order of magnitude or more) of a daily intake for the human population, including sensitive subpopulations, that is likely to be without appreciable risk of deleterious effects during a lifetime.

As required by USEPA Region IV guidance (USEPA, 1995a), risks associated with dermal exposures (most commonly for soil and water dermal contact) are evaluated using RfDs that are specific to absorbed doses. Most oral RfDs are based on an administered dose rather than the absorbed dose. It is, therefore, necessary to adjust toxicity values that are based on administered doses so that they can be used for evaluation of absorbed doses. For dermal exposures, toxicity values are adjusted as follows:

$$RfD_{adjusted} = RfD_{oral} \times ABSEFF_{oral} \quad (5)$$

where $ABSEFF_{oral}$ is the absorption efficiency in the study that is the basis of the oral toxicity value.

If there is no information available on oral absorption efficiency, the conservative default values of 80 percent for VOCs, 50 percent for SVOCs, and 20 percent for inorganics are used (USEPA, 1995a).

Separate sets of RfDs have been developed for several chemicals for evaluating chronic and subchronic exposures. When available, subchronic RfDs are used for evaluating exposures with a duration less than 7 years but more than 2 weeks. Chronic RfDs are used when subchronic values are unavailable and when the exposure duration is greater than 7 years. There are no analogous reference values for evaluating acute exposures (those lasting less than 2 weeks).

The oral RfD, inhalation reference concentration (RfC), dermal RfD, critical study on which the RfD is based, critical effect in the study, any uncertainty and modifying factors applied to the RfD or RfC, and the degree of confidence assigned to the RfD or RfC for each COPC analyzed in the HHRA are provided in Appendix E-11.

8.4.3 Source of Dose-Response Values The primary source for obtaining dose-response values is the USEPA Integrated Risk Information System (IRIS), which is an on-line database containing health risk and USEPA regulatory information about specific chemicals (USEPA, 2000). Health risk information is included on IRIS only after a comprehensive review of chronic toxicity data by work groups composed of USEPA scientists. If no information is found in IRIS, the USEPA Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997a) are used as a source of information. If appropriate dose-response values are not located from either of these two sources, other USEPA sources (including past versions of IRIS and HEAST and the documents produced by the USEPA's National Center for Environmental Assessment [formerly the Environmental Criteria and Assessment Office] are consulted. If no USEPA dose-response value is identified, surrogate values from structurally similar compounds may be assigned.

Dose-response values for each of the COPCs in the HHRA are provided in Appendix E-11.

8.5 RISK CHARACTERIZATION. Risk characterization is the final step in the risk assessment process. This step involves the integration of the exposure and toxicity assessments into a qualitative or quantitative expression of potential human health risks associated with contaminant exposure. Quantitative estimates of both carcinogenic and noncarcinogenic risks are made for each COPC and each complete exposure pathway identified in the exposure assessment.

Carcinogenic Risks. Carcinogenic risks associated with exposure to individual COPCs are estimated by multiplying the chemical intake for each potentially carcinogenic COPC by its CSF or unit risk. The value that is calculated is a chemical-specific excess lifetime cancer risk (ELCR) and represents an upper bound of the probability of an individual developing cancer over a lifetime as the result of exposure to the COPCs. For each exposure pathway, the chemical-specific risks for all potentially carcinogenic COPCs are summed to determine the pathway-specific ELCR. The following equations are used to estimate the chemical- and pathway-specific cancer risks:

Chemical-Specific Excess Lifetime Cancer Risk:

$$Risk_i = CDI_i \times CSF_i \quad (6)$$

where:

- Risk_i = unitless probability of an individual developing cancer as the result of exposure to a COPC i,
CDI_i = chronic daily intake of COPC i averaged over 70 years and expressed as mg/kg body weight per day (mg/kg-day), and
CSF_i = USEPA cancer slope factor for COPC i (mg/kg-day)⁻¹.

Pathway-Specific Incremental Lifetime Cancer Risk:

$$Risk_T = \Sigma Risk_i \quad (7)$$

where:

- Risk_T = unitless probability of an individual developing cancer as the result of multiple COPC exposures and
Risk_i = unitless cancer risk estimate for the ith COPC associated with an exposure pathway.

The results from the carcinogenic risk assessment are compared with acceptable risks established by the USEPA. The USEPA guidelines, established in the National Oil and Hazardous Substances Contingency Plan, indicate that the total lifetime cancer risk due to exposure to the COPCs at a site, by each complete exposure pathway, should not exceed a range of 1 in 1,000,000 (1×10⁻⁶) to 1 in 10,000 (1×10⁻⁴) (USEPA, 1990). The FDEP has indicated that an ELCR of 1×10⁻⁶ is their risk threshold. For reference, the average cancer burden in the United States in 1993 was 1 in 3 for women and 1 in 2 for men (American Cancer Society, 1994).

Noncarcinogenic Risks. Noncarcinogenic risk estimates are calculated by dividing chemical intake for each compound by the appropriate RfD. The result of this calculation is called the HQ. The HQs for individual compounds within an exposure pathway were summed to obtain the hazard index (HI) for that particular pathway.

The following equation is used to determine the HQ:

$$HQ_i = \frac{I_i}{RfD_i} \quad (8)$$

where:

- HQ_i = HQ of chemical i,
I_i = intake of COPC i averaged over the exposure period (mg/kg-day), and
RfDi = reference dose for COPC i corresponding to the same exposure duration as the intake (mg/kg-day).

The following equation is used to determine the HI:

where:

$$HI = \sum HQ_i \quad (9)$$

- HI = potential for noncarcinogenic effects from multiple COPC exposures and
HQ_i = HQ for ith COPC associated with an exposure pathway.

An HQ less than 1 indicates that noncarcinogenic effects are not expected to occur due to COPC exposure. HIs greater than 1 may be indicative of a possible noncarcinogenic toxic effect but the circumstances must be evaluated on a case-by-case basis (USEPA, 1989b). As the HI increases, so does the likelihood that adverse effects might be associated with exposure.

Risk estimates are calculated for each exposure pathway and receptor at OU 4. They are summarized in Table 8-16 and Table 8-17 for both current and future land use, respectively. The relative significance of risk estimates are evaluated in terms of a comparison with acceptable risk limits established by USEPA and the State and by comparison of site concentrations to Applicable or Relevant and Appropriate Requirement and Florida Contaminant Cleanup Target Levels (FDEP, 1999).

Both carcinogenic and noncarcinogenic risks were estimated for each human health COPC and each complete exposure pathway selected for evaluation in the exposure assessment. Risk calculations are documented in spreadsheets in Appendix E-6.

Risk estimates for potential exposures under current land use are discussed in Subsection 8.5.1, and future land use risk summaries are discussed in Subsection 8.5.2 along with a summary of risks for potential exposure to multimedia.

The relative confidence in risk estimates is discussed in the uncertainty discussion (Section 8.6).

8.5.1 Current Land Use

Surface Soil. The risk characterization results for current land use surface soil exposure scenarios are shown in Tables E-6.1 through E-6.6 in Appendix E-6 to this report and are summarized in Table 8-16. For the current land-use scenario, the cancer risks associated with exposure to surface soil (ingestion, dermal contact, and fugitive dust inhalation) are 3×10^{-7} for an aggregate trespasser (combined adult and adolescent), and 1×10^{-7} for a site maintenance worker. Both receptors' cancer risk values are at or below the USEPA acceptable cancer risk range of 1 in 10,000 to 1 in 1,000,000 and the Florida level of concern of 1×10^{-6} . Figure 8-3 presents a summary of cancer risk associated with current land-use exposure to surface soil.

The noncancer risks associated with surface soil ingestion, dermal contact and fugitive dust inhalation under the current land-use scenarios (adolescent and adult trespasser, and site maintenance worker) are below USEPA's and FDEP's target HI of 1. Figure 8-4 presents a summary of the HIs associated with current land-use exposure to surface soil.

Subsurface Soil. There are no current exposures to subsurface soil. Therefore, risk was not evaluated for the current land-use scenario.

Table 8-16
Risk Summary, Current Land Use

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center Orlando
Orlando, Florida

Land Use	Exposure Route	HI *	ELCR *
Surface Soil:			
Adult Trespasser:	Incidental ingestion	0.007	1 x 10 ⁻⁷
	Dermal contact	0.02	1 x 10 ⁻⁷
	Inhalation of particulates	0.00003	2 x 10 ⁻⁸
	Total Adult Trespasser:	0.03	2 x 10 ⁻⁷
Adolescent Trespasser:	Incidental ingestion	0.01	8 x 10 ⁻⁸
	Dermal contact	0.02	6 x 10 ⁻⁸
	Inhalation of particulates	0.000007	2 x 10 ⁻⁸
	Total Adolescent Trespasser:	0.03	1 x 10 ⁻⁷
Total Risk to Trespasser (Adult and Adolescent) Exposed to Surface Soil:			
		NC	3 x 10 ⁻⁷
Site Maintenance Worker:	Incidental ingestion	0.002	4 x 10 ⁻⁸
	Dermal contact	0.008	6 x 10 ⁻⁸
	Inhalation of particulates	0.00003	2 x 10 ⁻⁸
	Total Site Maintenance Worker:	0.01	1 x 10 ⁻⁷
Surface Water:			
Adult Trespasser:	Incidental ingestion	0.004	9 x 10 ⁻⁷
	Dermal contact	0.2	7 x 10 ⁻⁶
	Total Adult Trespasser:	0.2	8 x 10 ⁻⁶
Adolescent Trespasser:	Incidental ingestion	0.006	7 x 10 ⁻⁷
	Dermal contact	0.2	4 x 10 ⁻⁶
	Total Adolescent Trespasser:	0.2	5 x 10 ⁻⁶
Total Risk to Trespasser (Adult and Adolescent) Exposed to Surface Water:			
		NC	1 x 10 ⁻⁵

See notes at end of table.

Table 8-16 (Continued)
Risk Summary, Current Land Use

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center Orlando
 Orlando, Florida

Land Use	Exposure Route	HI *	ELCR *
Sediment:			
Adult Trespasser:	Dermal contact	0.0005	2×10^{-6}
	Total Adult Trespasser:	0.0005	2×10^{-6}
Adolescent Trespasser:	Dermal contact	0.001	9×10^{-9}
	Total Adolescent Trespasser:	0.001	9×10^{-9}
	Total Risk to Trespasser (Adult and Adolescent) Exposed to Sediment:	NC	3×10^{-8}
Notes: * = receptor totals may vary from spreadsheets due to rounding algorithm. HI = hazard index. ELCR = excess lifetime cancer risk. NC = Not calculated because child and adult HIs are not additive.			

Table 8-17
Risk Summary, Future Land Use

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Land Use	Exposure Route	HI ¹	ELCR ¹
Surface Soil			
Adult Recreational User:	Incidental ingestion	0.007	1×10 ⁻⁷
	Dermal contact	0.02	1×10 ⁻⁷
	Inhalation of particulates	0.00003	2×10 ⁻⁸
	Total Adult Recreational User:	0.03	2×10 ⁻⁷
Adolescent Recreational User:	Incidental ingestion	0.01	8×10 ⁻⁸
	Dermal contact	0.02	6×10 ⁻⁸
	Inhalation of particulates	0.000007	2×10 ⁻⁸
	Total Adolescent Recreational User:	0.03	1×10 ⁻⁷
Total Risk to Recreational User (Adult and Adolescent) Exposed to Surface Soil:		NC	3×10 ⁻⁷
Adult Resident:	Incidental ingestion	0.06	1×10 ⁻⁶
	Dermal contact	0.1	9×10 ⁻⁷
	Inhalation of particulates	0.0004	3×10 ⁻⁷
	Total Adult Resident:	0.2	2×10 ⁻⁶
Child Resident:	Incidental ingestion	0.5	2×10 ⁻⁶
	Dermal contact	0.2	4×10 ⁻⁷
	Inhalation of particulates	0.001	3×10 ⁻⁷
	Total Child Resident:	0.7	3×10 ⁻⁶
Total Risk to Resident (Adult and Child) Exposed to Surface Soil:		NC	5×10 ⁻⁶
Occupational Worker:	Incidental ingestion	0.02	4×10 ⁻⁷
	Dermal contact	0.03	3×10 ⁻⁷
	Inhalation of particulates	0.0001	9×10 ⁻⁸
	Total Occupational Worker:	0.05	8×10 ⁻⁷
Site Maintenance Worker:	Incidental ingestion	0.002	4×10 ⁻⁸
	Dermal contact	0.008	6×10 ⁻⁸
	Inhalation of particulates	0.00003	2×10 ⁻⁸
	Total Site Maintenance Worker:	0.01	1×10 ⁻⁷
Excavation Worker:	Incidental ingestion	0.2	1×10 ⁻⁸
	Dermal contact	0.07	2×10 ⁻⁸
	Inhalation of particulates	0.0003	9×10 ⁻¹⁰
	Total Excavation Worker:	0.3	1×10 ⁻⁸
See notes at end of table.			

Table 8-17 (Continued)
Risk Summary, Future Land Use

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Land Use	Exposure Route	HI*	ELCR*
Subsurface Soil			
Excavation Worker:	Incidental ingestion	0.0000005	3×10 ⁻¹²
	Dermal contact	0.00000006	4×10 ⁻¹³
	Inhalation of particulates	0.00005	1×10 ⁻¹¹
	Total Excavation Worker:	0.00005	1×10 ⁻¹¹
	Total Risk to Excavation Worker Exposed to Surface Soil and Subsurface Soil:	0.3	1×10 ⁻⁸
Northern Plume VOC Groundwater			
Occupational Worker	Inhalation of VOCs from groundwater to indoor air	0.0001	1×10 ⁻⁸
	Total Occupational Worker:	0.0001	1×10 ⁻⁸
Adult Resident	Ingestion of groundwater as drinking water	8	1×10 ⁻³
	Inhalation of VOCs while Showering	0.1	2×10 ⁻⁵
	Inhalation of VOCs from groundwater to indoor air	0.02	4×10 ⁻⁶
	Total Risk to Adult Resident:	8	1×10 ⁻³
Child Resident	Ingestion of groundwater as drinking water	20	6×10 ⁻⁴
	Inhalation of VOCs from groundwater to indoor air	0.02	9×10 ⁻⁷
	Total Risk to Child Resident:	20	6×10 ⁻⁴
	Total Risk to Resident (Adult and Child) Exposed to Groundwater:	NC	2×10 ⁻³
Southern Plume VOC Groundwater			
Occupational Worker	Inhalation of VOCs from groundwater to indoor air	0.000004	6×10 ⁻¹⁰
	Total Occupational Worker:	0.000004	6×10 ⁻¹⁰
Adult Resident	Ingestion of groundwater as drinking water	0.7	6×10 ⁻⁵
	Inhalation of VOCs while showering	0.007	1×10 ⁻⁶
	Inhalation of VOCs from groundwater to indoor air	0.001	2×10 ⁻⁷
	Total Risk to Adult Resident:	0.7	6×10 ⁻⁵
Child Resident	Ingestion of groundwater as drinking water	2	3×10 ⁻⁵
	Inhalation of VOCs from groundwater to indoor air	0.001	5×10 ⁻⁸
	Total Risk to Child Resident:	2	3×10 ⁻⁵
	Total Risk to Resident (Adult and Child) Exposed to Groundwater:	NC	9×10 ⁻⁵
See notes at end of table.			

Table 8-17 (Continued)
Risk Summary Future Land Use

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Land Use	Exposure Route	HI ¹	ELCR ¹
Antimony Plume Groundwater			
Occupational Worker	Inhalation of VOCs from groundwater to indoor air	0.0000003	4×10 ⁻¹¹
	Total Occupational Worker:	0.0000003	4×10 ⁻¹¹
Adult Resident	Ingestion of groundwater as drinking water	1	4×10 ⁻⁶
	Inhalation of VOCs while showering	0.0005	7×10 ⁻⁸
	Inhalation of VOCs from groundwater to indoor air	0.00008	1×10 ⁻⁸
	Total Risk to Adult Resident:	1	4×10 ⁻⁶
Child Resident:	Ingestion of groundwater as drinking water	2	2×10 ⁻⁶
	Inhalation of VOCs from groundwater to indoor air	0.00008	1×10 ⁻⁸
	Total Risk to Child Resident:	2	2×10 ⁻⁶
	Total Risk to Resident (Adult and Child) Exposed to Groundwater:	NC	6×10 ⁻⁶
Surface Water			
Adult Recreational User:	Incidental ingestion	0.004	9×10 ⁻⁷
	Dermal contact	0.2	7×10 ⁻⁶
	Total Adult Recreational User:	0.2	8×10 ⁻⁶
Adolescent Recreational User:	Incidental ingestion	0.006	7×10 ⁻⁷
	Dermal contact	0.2	4×10 ⁻⁶
	Total Adolescent Recreational User:	0.2	5×10 ⁻⁶
	Total Risk to Recreational User (Adult and Adolescent) Exposed to Surface Water:	NC	1×10 ⁻⁵
Adult Resident:	Incidental ingestion	0.009	2×10 ⁻⁶
	Dermal contact	0.4	2×10 ⁻⁶
	Total Adult Resident:	0.4	2×10 ⁻⁶
Child Resident:	Incidental ingestion	0.2	1×10 ⁻⁶
	Dermal contact	0.5	7×10 ⁻⁶
	Total Child Resident:	0.8	2×10 ⁻⁶
	Total Risk to Resident (Adult and Child) Exposed to Surface Water:	NC	4×10 ⁻⁶
See notes at end of table.			

Table 8-17 (Continued)
Risk Summary Future Land Use

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center
 Orlando, Florida

Land Use	Exposure Route	HI*	ELCR*
Sediment			
Adult Recreational User:	Dermal contact	0.0005	2×10 ⁻⁶
	Total Adult Recreational User:	0.0005	2×10 ⁻⁶
Adolescent Recreational User:	Dermal contact	0.001	9×10 ⁻⁶
	Total Adolescent Recreational User:	0.001	9×10 ⁻⁶
	Total Risk to Recreational User (Adult and Adolescent) Exposed to Sediment:	NC	3×10 ⁻⁶
Adult Resident:	Dermal contact	0.001	4×10 ⁻⁶
	Total Adult Resident:	0.001	4×10 ⁻⁶
Child Resident:	Dermal contact	0.006	5×10 ⁻⁶
	Total Child Resident:	0.006	5×10 ⁻⁶
	Total Risk to Resident (Adult and Child) Exposed to Sediment:	NC	9×10 ⁻⁶

¹ Receptor totals may vary from spreadsheets due to rounding algorithm.

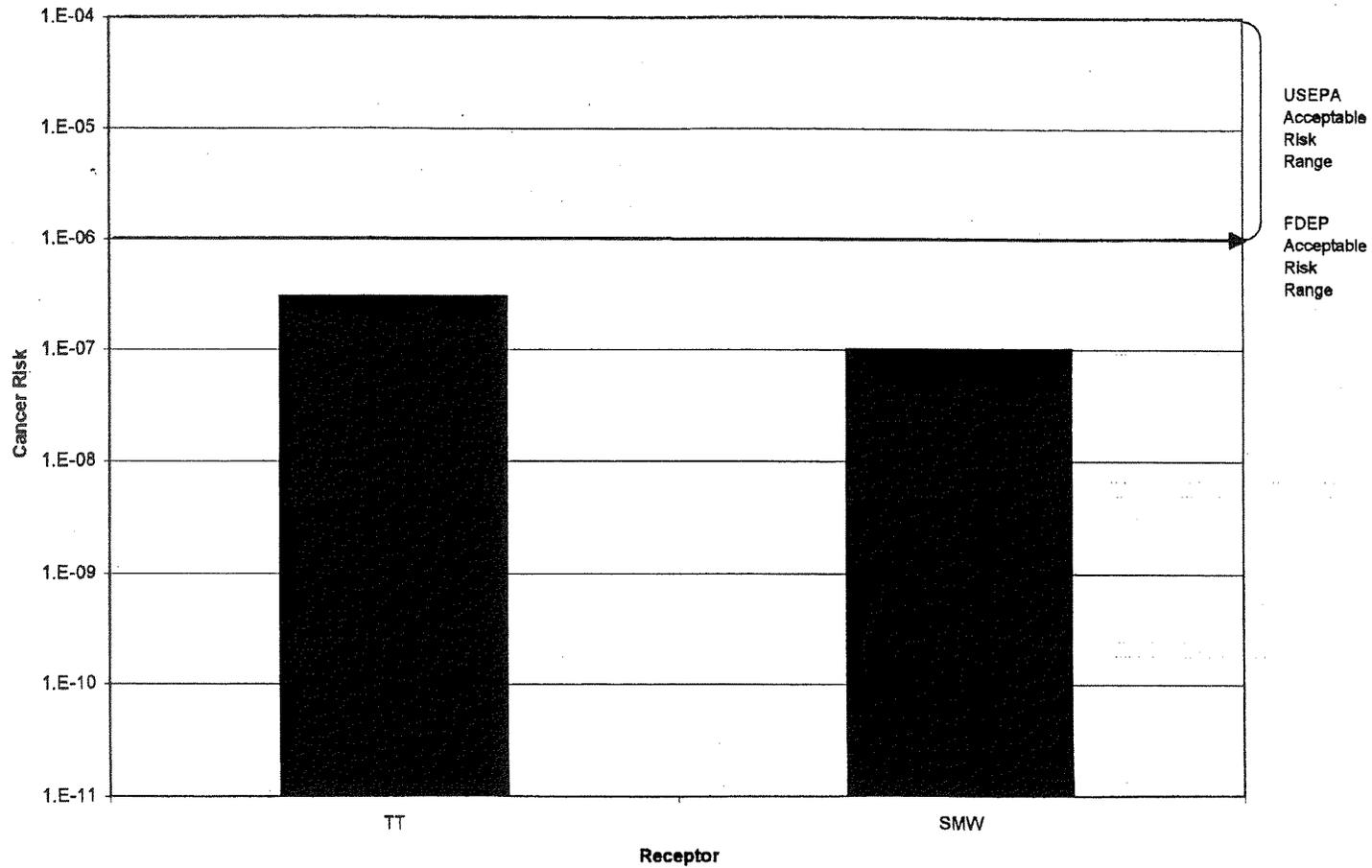
Notes: * = receptor totals may vary from spreadsheets due to rounding algorithm.

HI = hazard index.

ELCR = excess lifetime cancer risk.

NC = Not calculated because child and adult HIs are not additive.

VOC = volatile organic compound.



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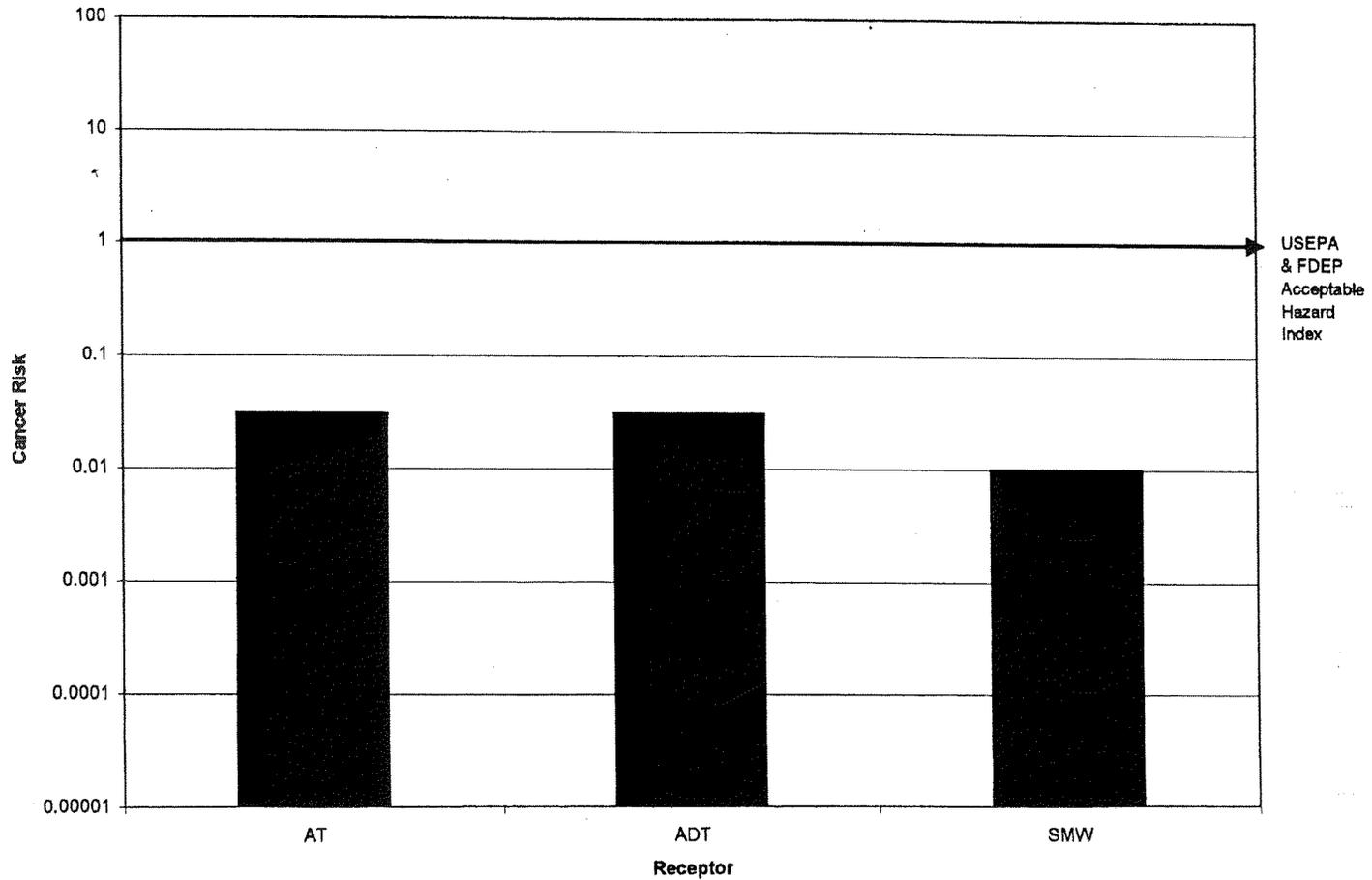
- USEPA U.S. Environmental Protection Agency
- FDEP Florida Department of Environmental Protection
- TT Total trespasser
- SMW Site maintenance worker

**FIGURE 8-3
CANCER RISK SUMMARY
CURRENT LAND USE FOR SURFACE SOIL**



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LEGEND

- USEPA U.S. Environmental Protection Agency
- FDEP Florida Department of Environmental Protection
- AT Adult trespasser
- ADT Adolescent trespasser
- SMW Site maintenance worker

**FIGURE 8-4
NONCANCER RISK SUMMARY
CURRENT LAND USE FOR SURFACE SOIL**



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Groundwater. There are no current exposures to groundwater. Therefore, risk was not evaluated for the current land-use scenario.

Surface Water. The risk characterization results for current land-use surface water exposure scenarios are shown in Tables E-6.35 through E-6.36 in Appendix E-6 to this report and are summarized in Table 8-16. For the current land-use scenario, the cancer risks associated with exposure to surface water (ingestion and dermal contact) are 1×10^{-5} for an aggregate trespasser (combined adult and adolescent). These cancer risk values are within the USEPA acceptable cancer risk range of 1 in 10,000 to 1 in 1,000,000, but exceed the Florida level of concern of 1×10^{-6} . Figure 8-5 presents a summary of cancer risk associated with current land-use exposure to surface water.

The noncancer risks associated with surface water ingestion and dermal contact under the current land-use scenario (adolescent and adult trespasser user) are below USEPA's and FDEP's target HI of 1. Figure 8-6 presents a summary of the HIs associated with current land use exposure to surface water.

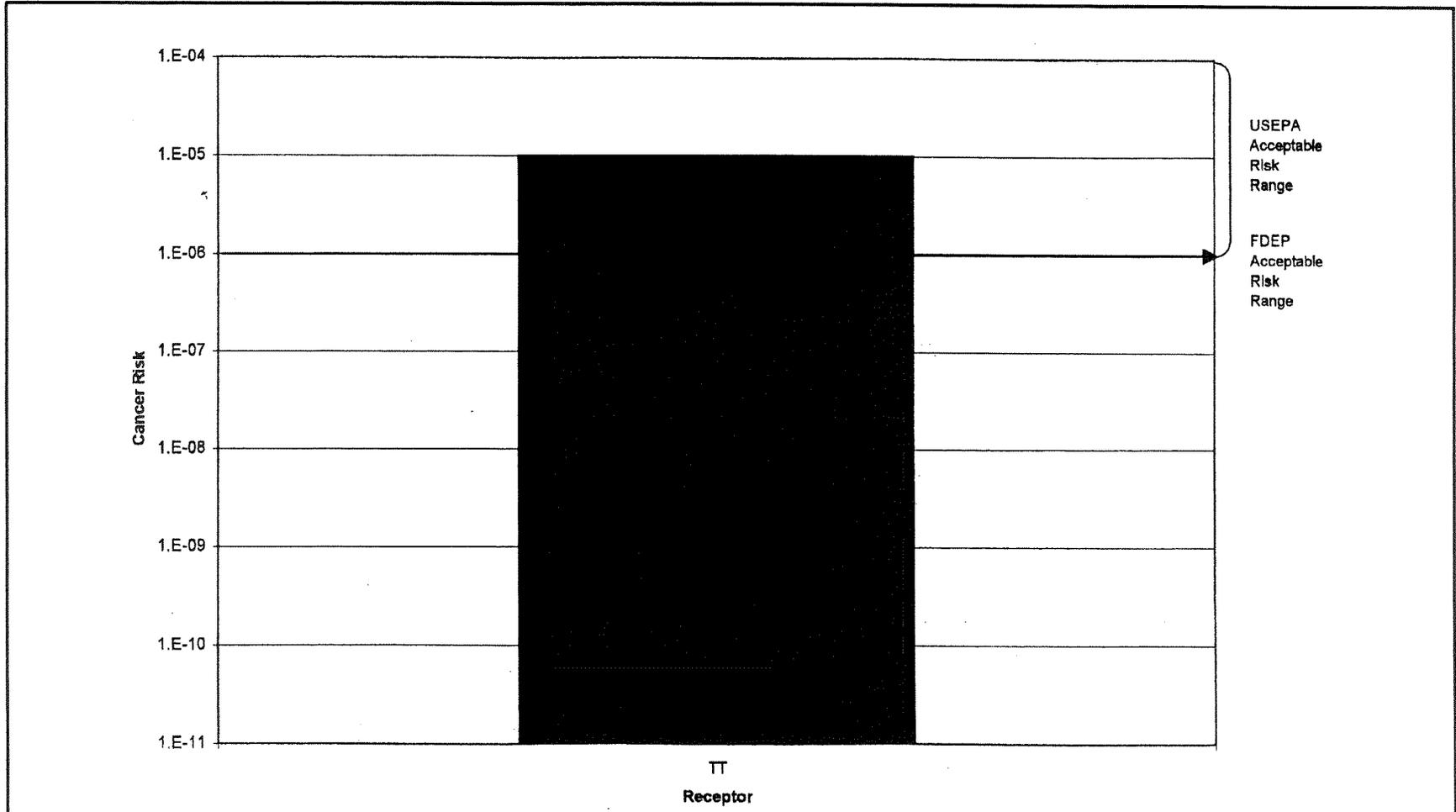
Sediment. The risk characterization results for current land-use sediment exposure scenarios are shown in Tables E-6.40 through E-6.41 in Appendix E-6 to this report and are summarized in Table 8-16. For the current land-use scenario, the cancer risks associated with exposure to sediment (dermal contact) are 3×10^{-8} for an aggregate trespasser (combined adult and adolescent). These receptors' cancer risk values are below the USEPA acceptable cancer risk range of 1 in 10,000 to 1 in 1,000,000 and the Florida level of concern of 1×10^{-6} . Figure 8-7 presents a summary of cancer risk associated with current land-use exposure to sediment.

The noncancer risks associated with sediment dermal contact under the current land-use scenario (adolescent and adult trespasser user) are below USEPA's and FDEP's target HI of 1. Figure 8-8 presents a summary of the HIs associated with current land use exposure to sediment.

8.5.2 Future Land Use

Surface Soil. The risk characterization results for potential future land-use surface soil exposure scenarios are shown in Tables E-6.1 through E-6.14 in Appendix E-6 to this report and are summarized in Table 8-17. For potential future land use, the cancer risks associated with exposure to surface soil (ingestion, dermal contact, and fugitive dust inhalation) are 3×10^{-7} for an aggregate recreational user (combined adult and adolescent), 1×10^{-7} for a site maintenance worker, 5×10^{-6} for an aggregate resident (combined adult and child), 8×10^{-7} for an occupational worker, and 1×10^{-8} for an excavation worker. All of these receptors' cancer risks are within or below the USEPA acceptable cancer risk range of 1 in 10,000 to 1 in 1,000,000; however, the aggregate resident cancer risk exceeds the Florida level of concern of 1×10^{-6} (primarily due to PAHs). Figure 8-9 presents a summary of cancer risk associated with future land-use exposure to surface soil.

The noncancer risks associated with surface soil ingestion, dermal contact, and fugitive dust inhalation under the future land-use scenario for all potential future receptors are below USEPA's and FDEP's target HI of 1. Figure 8-10 presents a summary of HIs associated with future land-use exposure to surface soil.



LEGEND

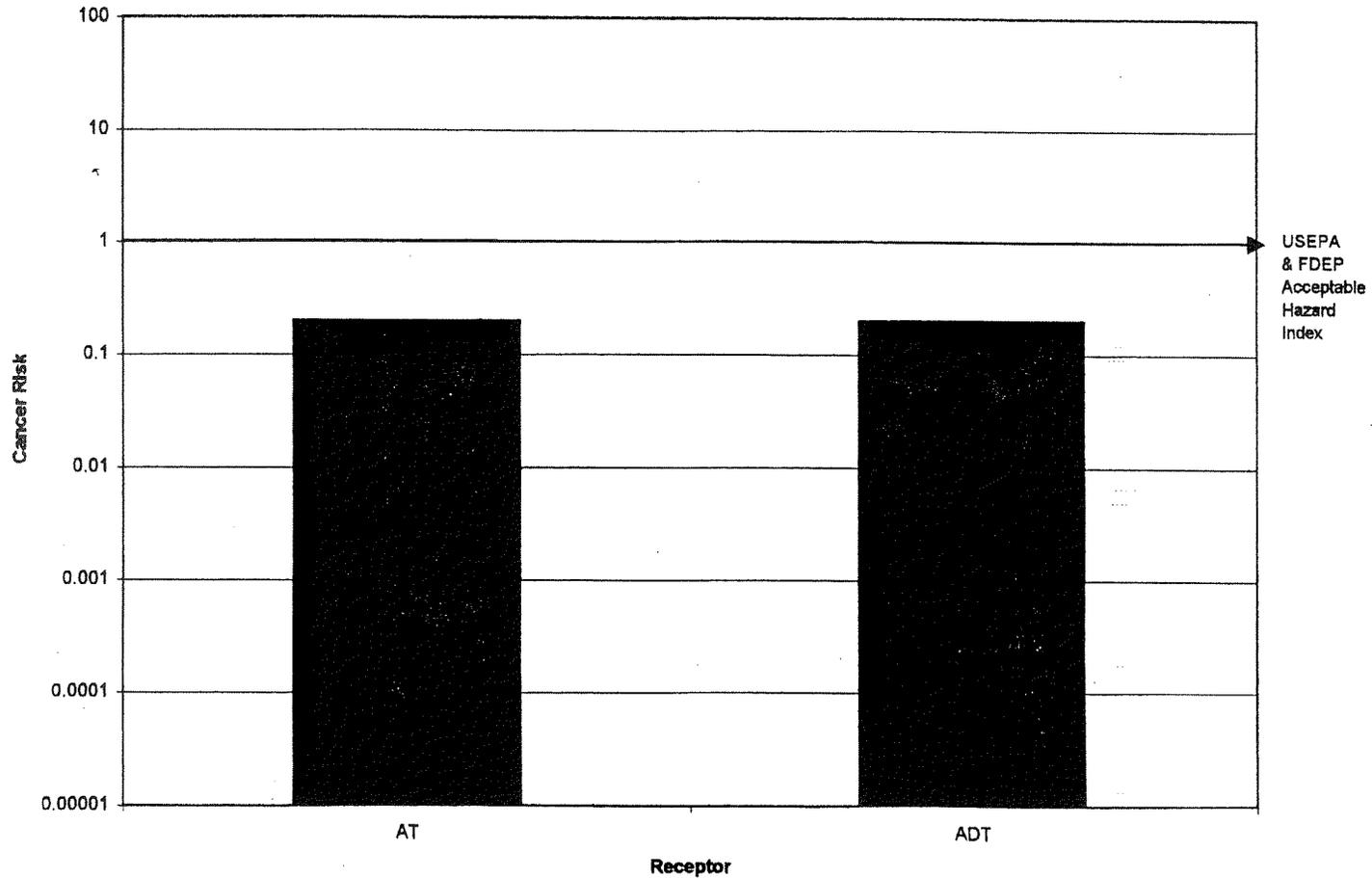
- USEPA U.S. Environmental Protection Agency
- FDEP Florida Department of Environmental Protection
- TT Total trespasser

**FIGURE 8-5
CANCER RISK SUMMARY
CURRENT LAND USE FOR SURFACE WATER**



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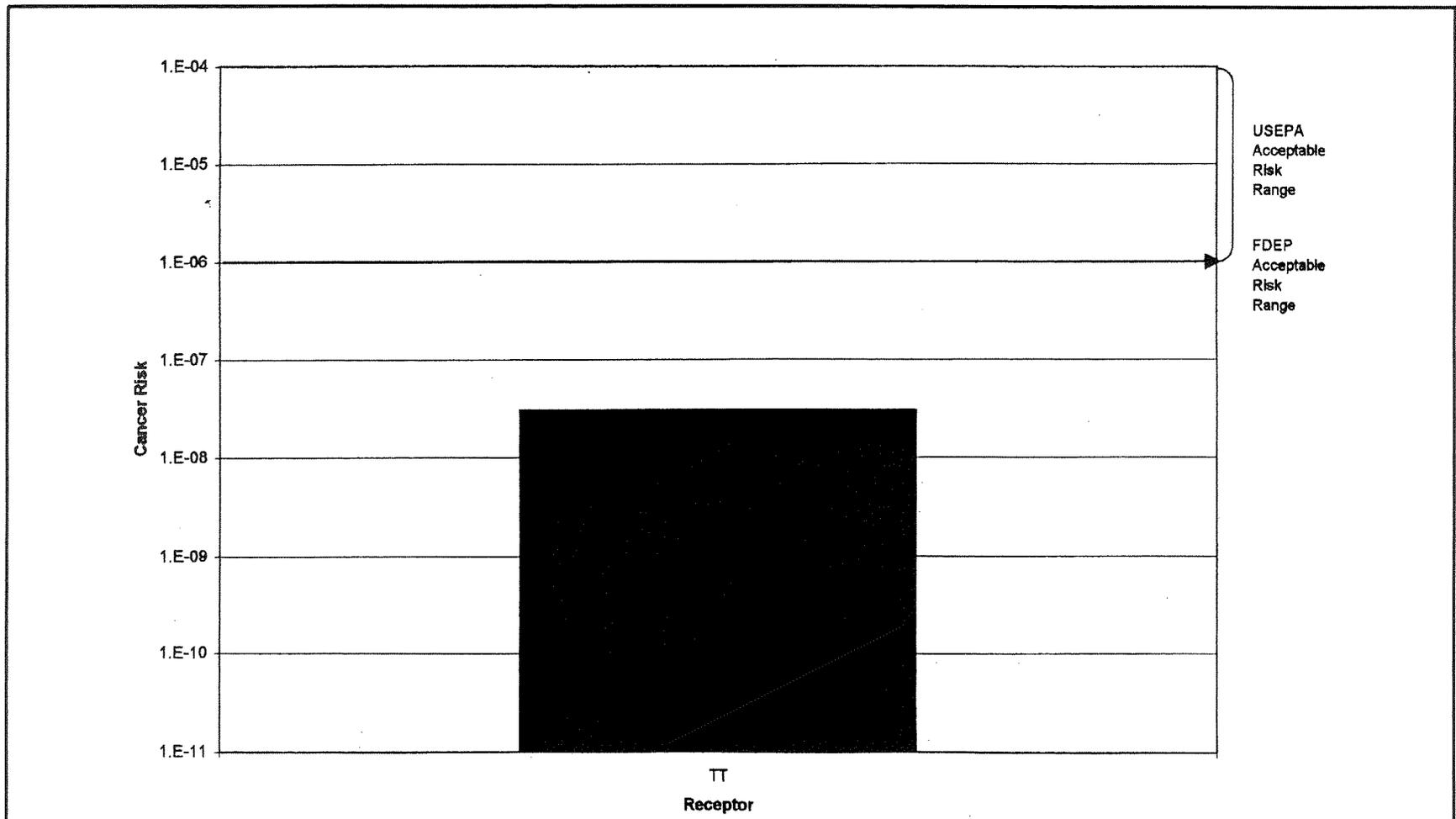
- USEPA U.S. Environmental Protection Agency
- FDEP Florida Department of Environmental Protection
- AT Adult trespasser
- ADT Adolescent trespasser

**FIGURE 8-6
NONCANCER RISK SUMMARY
CURRENT LAND USE FOR SURFACE WATER**



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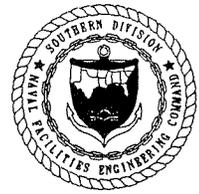
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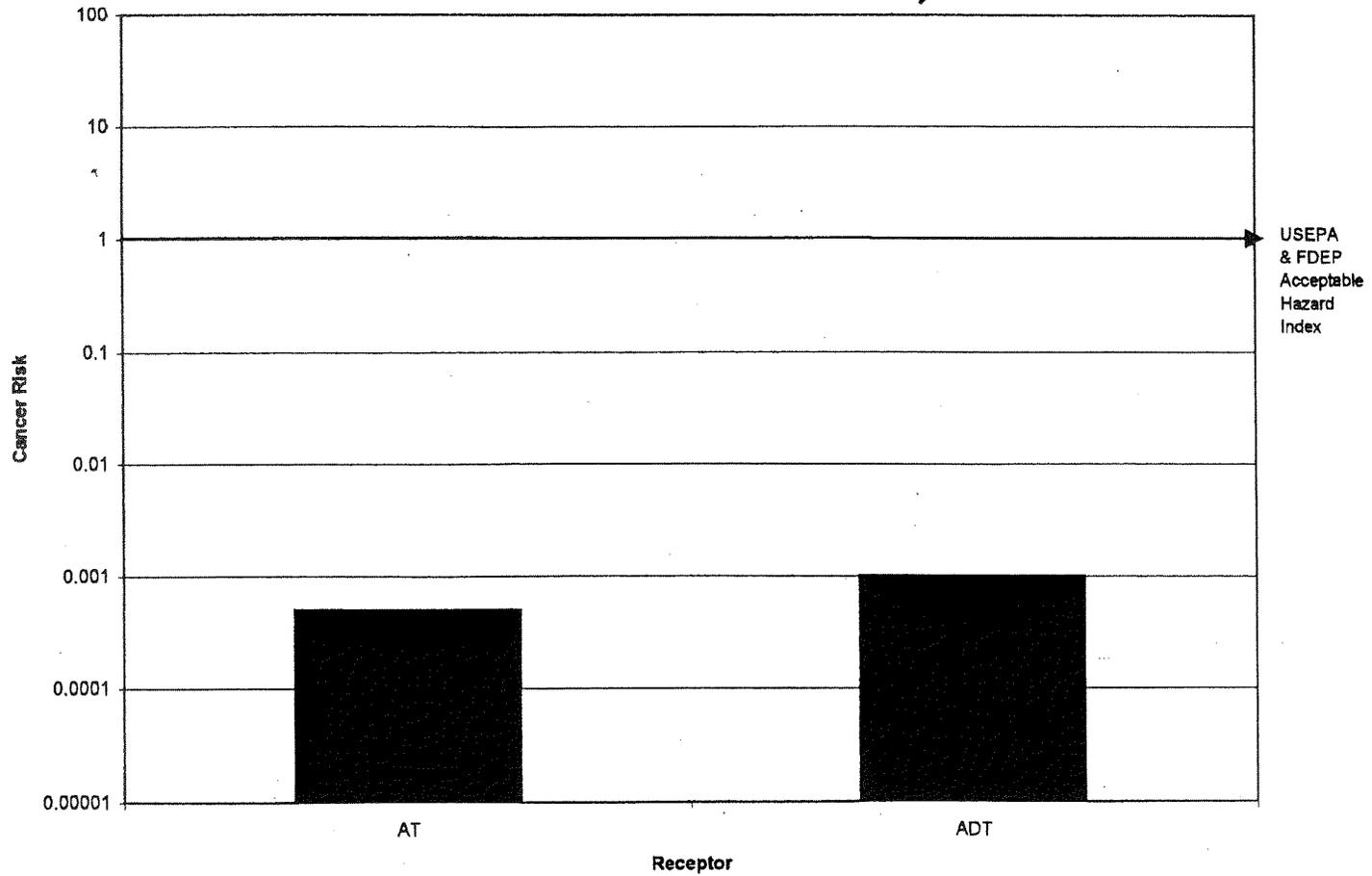
LEGEND

- USEPA U.S. Environmental Protection Agency
- FDEP Florida Department of Environmental Protection
- TT Total trespasser

**FIGURE 8-7
CANCER RISK SUMMARY
CURRENT LAND USE FOR SEDIMENT**



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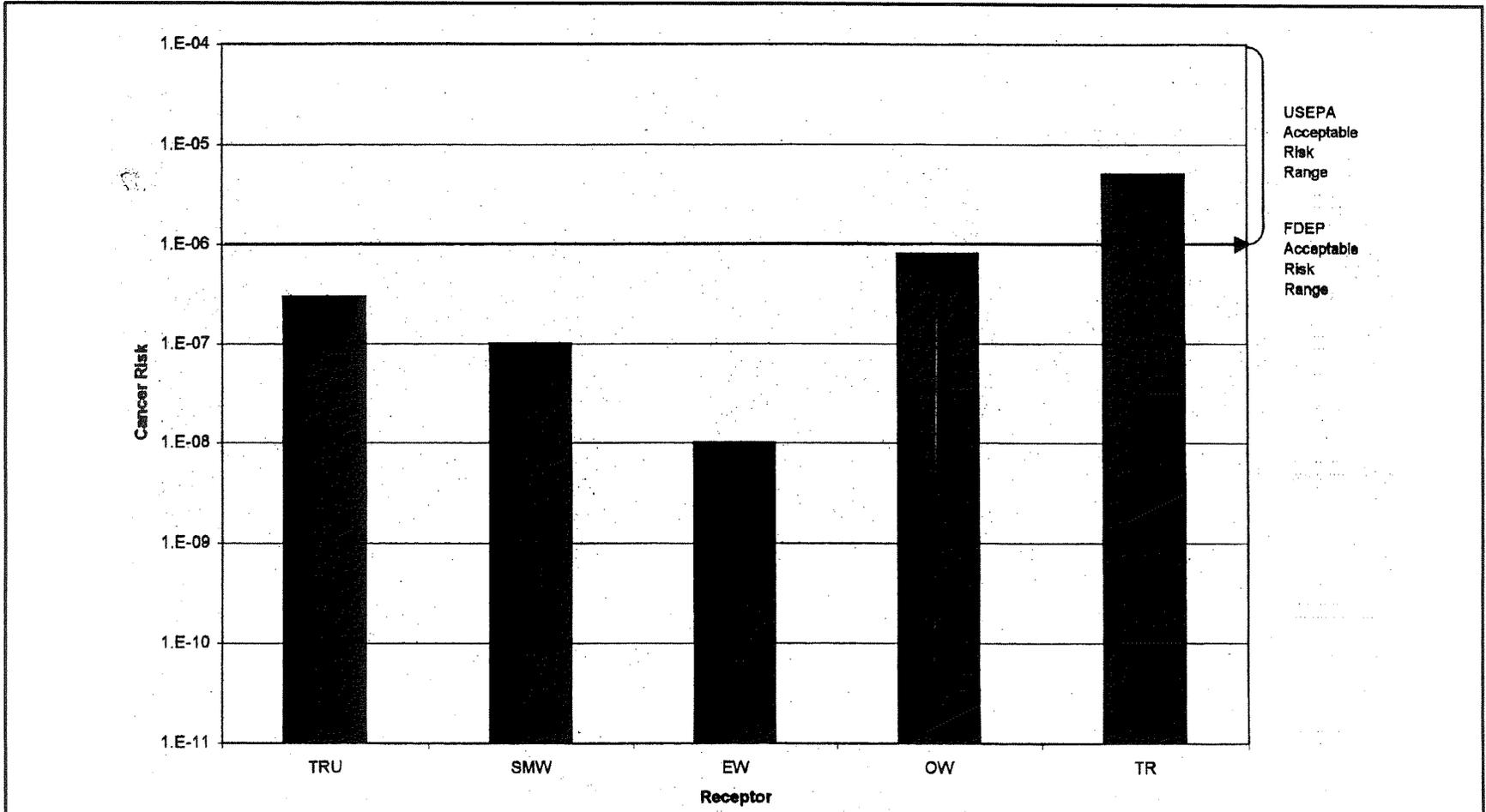
- USEPA U.S. Environmental Protection Agency
- FDEP Florida Department of Environmental Protection
- AT Adult trespasser
- ADT Adolescent trespasser

**FIGURE 8-8
NONCANCER RISK SUMMARY
CURRENT LAND USE FOR SEDIMENT**



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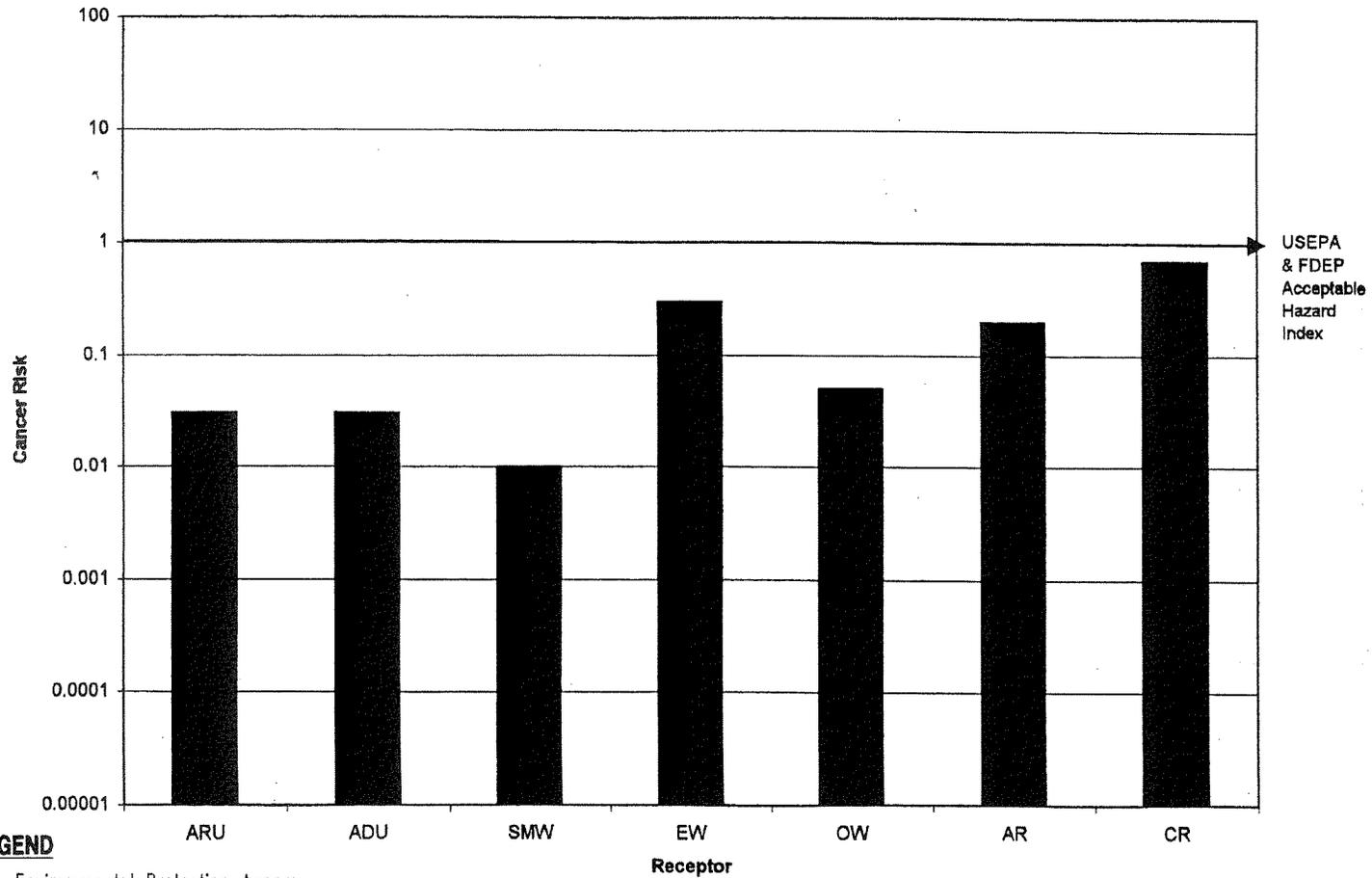
LEGEND

- USEPA U.S. Environmental Protection Agency
- FDEP Florida Department of Environmental Protection
- TRU Total recreational user
- SMW Site maintenance worker
- EW Excavation worker
- OW Occupational worker
- TR Total resident

**FIGURE 8-9
 CANCER RISK SUMMARY
 FUTURE LAND USE FOR SURFACE SOIL**



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LEGEND

- USEPA U.S. Environmental Protection Agency
- FDEP Florida Department of Environmental Protection
- ARU Adult recreational user
- ADU Adolescent recreational user
- SMW Site maintenance worker
- EW Excavation worker
- OW Occupational worker
- AR Adult resident
- CR Child resident

**FIGURE 8-10
NONCANCER RISK SUMMARY
FUTURE LAND USE FOR SURFACE SOIL**



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Subsurface Soil. The risk characterization results for potential future land-use subsurface soil exposure scenarios are shown in Tables E-6.15 through E-6.16 in Appendix E-6 to this report and are summarized in Table 8-17. For potential future land use, the cancer risks associated with exposure to subsurface soil (ingestion, dermal contact, and fugitive dust inhalation) are 1×10^{-8} for an excavation worker. This cancer risk is below the USEPA acceptable cancer risk range of 1 in 10,000 to 1 in 1,000,000 and below the Florida level of concern of 1×10^{-6} . Figure 8-11 presents a summary of cancer risk associated with future land-use exposure to subsurface soil.

The noncancer risks associated with subsurface soil ingestion, dermal contact, and fugitive dust inhalation under the future land-use scenario for excavation worker was below USEPA's and FDEP's target HI of 1. Figure 8-12 presents a summary of HIs associated with future land use.

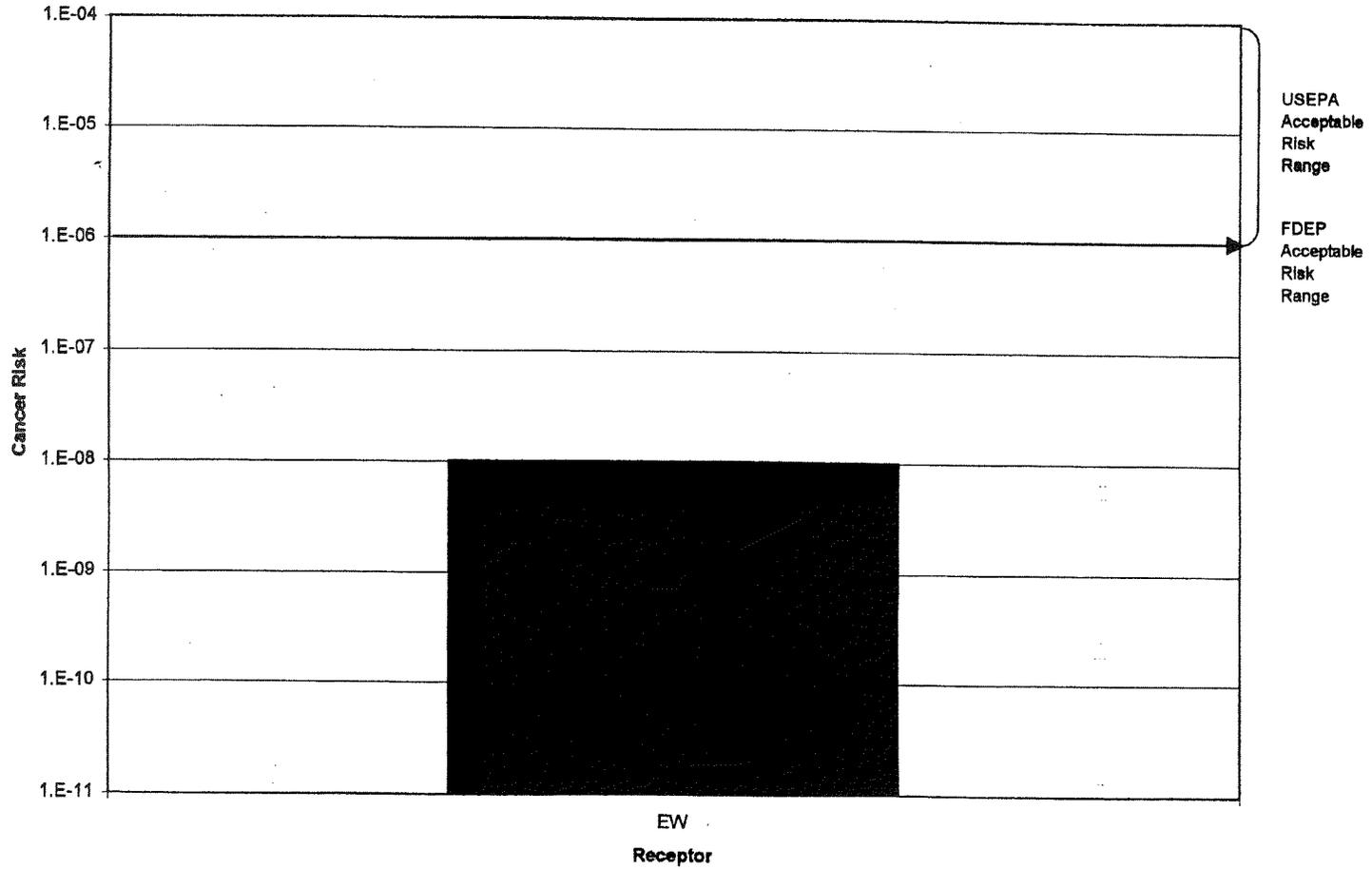
Groundwater. The risk characterization results for future land-use potential groundwater exposure scenarios are shown in Tables E-6.17 and E-6.34 in Appendix E-6 to this report and are summarized in Table 8-17.

For potential future land-use scenarios, the cancer risks associated with northern VOC plume groundwater ingestion, inhalation of VOCs while showering, and inhalation of VOCs that may migrate from groundwater to indoor air are 2×10^{-3} for an aggregate resident (combined adult and child) and 1×10^{-8} for an occupational worker (inhalation of VOCs that may migrate from groundwater to indoor air). The potential future residential receptor cancer risk for the northern VOC plume is above both the USEPA acceptable risk range of 1×10^{-4} to 1×10^{-6} and the FDEP level of concern of 1×10^{-6} (mainly due to PCE and TCE). However, the risk was primary due to potential ingestion of groundwater because risks for inhalation of VOCs that may migrate to indoor air were only 4×10^{-6} . The potential occupational receptor cancer risk was below the USEPA acceptable risk range and the FDEP level of concern. Figure 8-13 presents a summary of cancer risk associated with future land-use exposure to groundwater.

The noncancer risks associated with the northern VOC plume for groundwater ingestion under the future land-use scenario for potential future adult (HI of 8) and child (HI of 20) residential receptors are above USEPA's and FDEP's target HI of 1 (mainly due to *cis*-1,2-DCE, PCE, and TCE). Figure 8-14 presents a summary of HIs associated with future land-use exposure to groundwater.

For potential future land-use scenarios, the cancer risks associated with southern VOC plume groundwater ingestion, inhalation of VOCs while showering, and inhalation of VOCs that may migrate from groundwater to indoor air are 9×10^{-5} for an aggregate resident (combined adult and child) and 6×10^{-10} for an occupational worker (inhalation of VOCs that may migrate from groundwater to indoor air). The potential future residential and occupational worker receptor cancer risks for the northern VOC plume are within the USEPA acceptable risk range of 1×10^{-4} to 1×10^{-6} . However, risk for the resident exceed the FDEP level of concern of 1×10^{-6} (mainly due to PCE and TCE). However, the risk was primary due to potential ingestion of groundwater because risks for inhalation of VOCs that may migrate to indoor air were only 3×10^{-7} . Figure 8-15 presents a summary of cancer risk associated with future land-use.

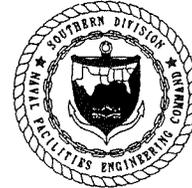
The noncancer risks associated with the southern VOC plume for groundwater ingestion under the future land-use scenario are an HI of 0.7 for the adult and



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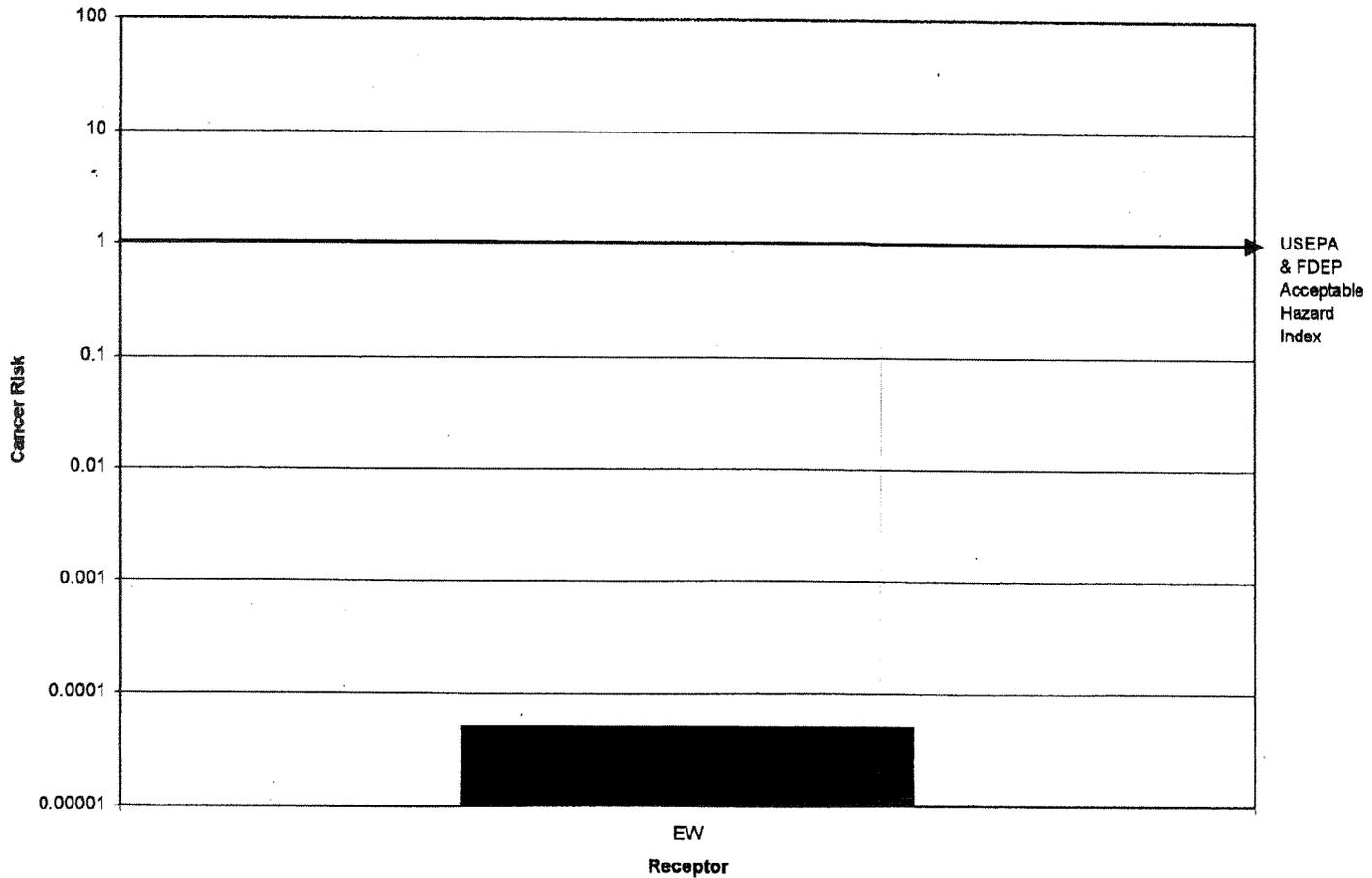
- USEPA U.S. Environmental Protection Agency
- FDEP Florida Department of Environmental Protection
- EW Excavation worker

**FIGURE 8-11
CANCER RISK SUMMARY
FUTURE LAND USE FOR SUBSURFACE SOIL**



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LEGEND

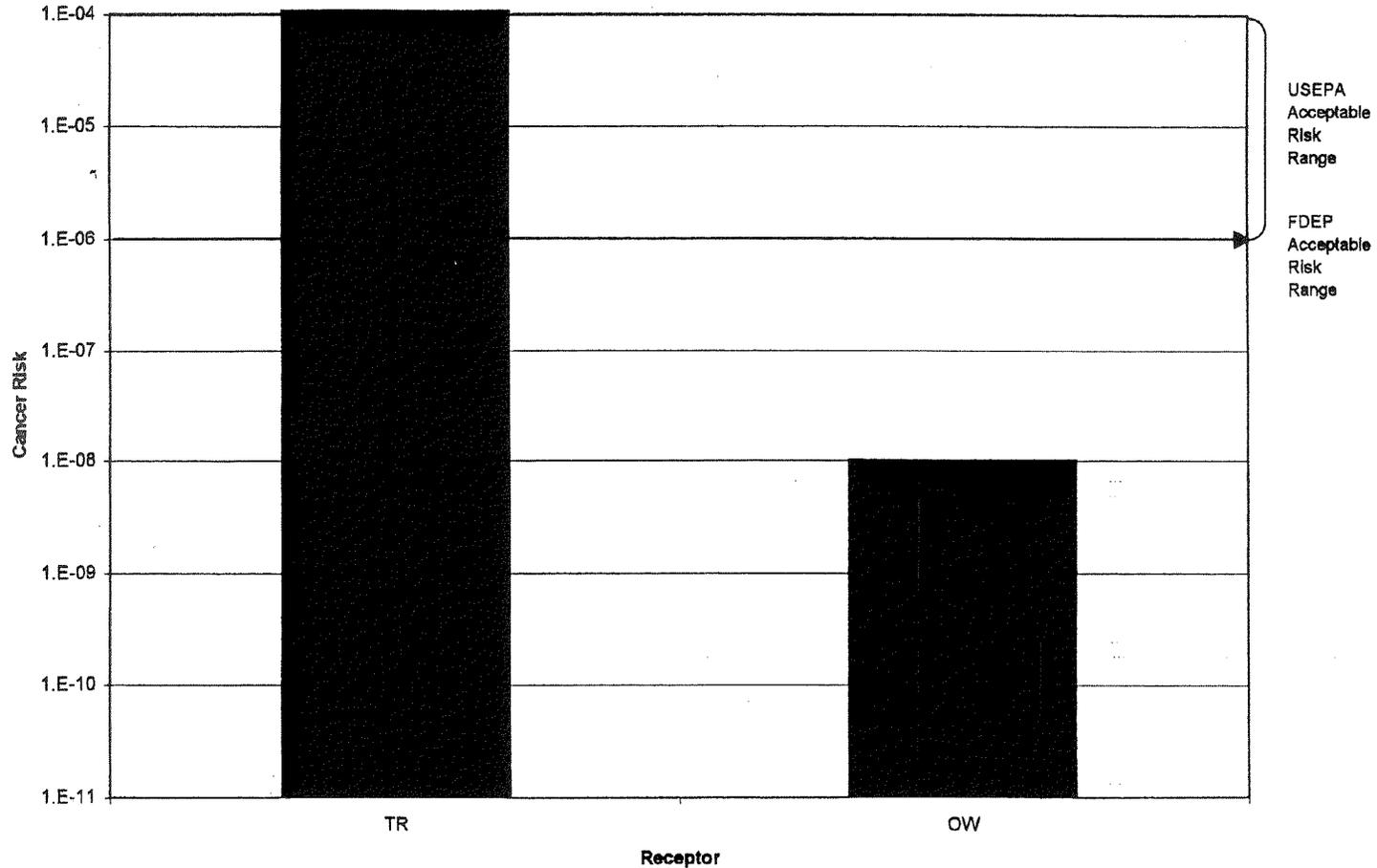
- USEPA U.S. Environmental Protection Agency
- FDEP Florida Department of Environmental Protection
- EW Excavation worker

**FIGURE 8-12
NONCANCER RISK SUMMARY
FUTURE LAND USE FOR SUBSURFACE SOIL**



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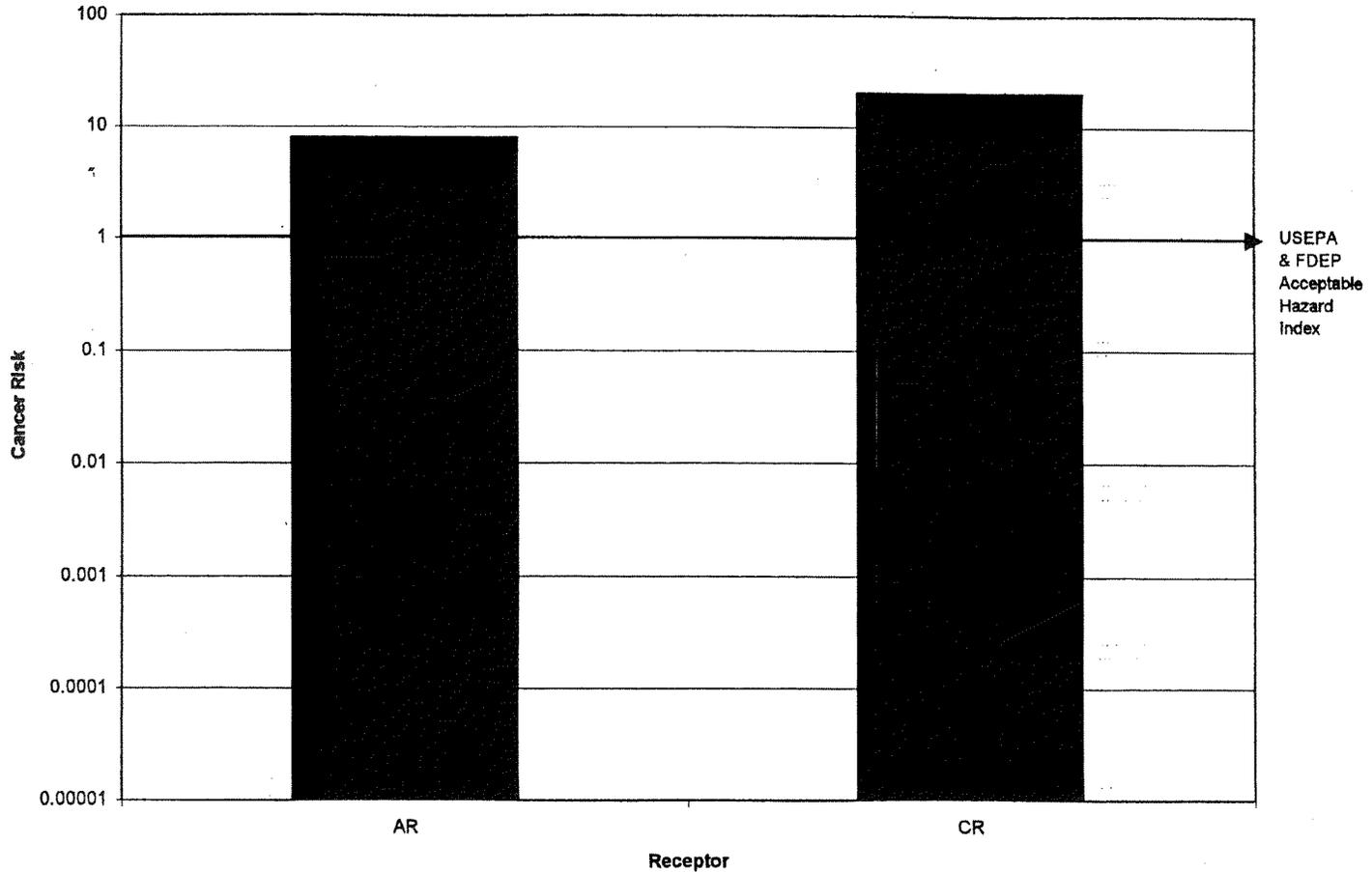
- USEPA U.S. Environmental Protection Agency
- FDEP Florida Department of Environmental Protection
- TR Total resident
- OW Occupational worker
- VOC Volatile organic compound

**FIGURE 8-13
CANCER RISK SUMMARY
FUTURE LAND USE FOR GROUNDWATER
NORTHERN VOC PLUME**



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LEGEND

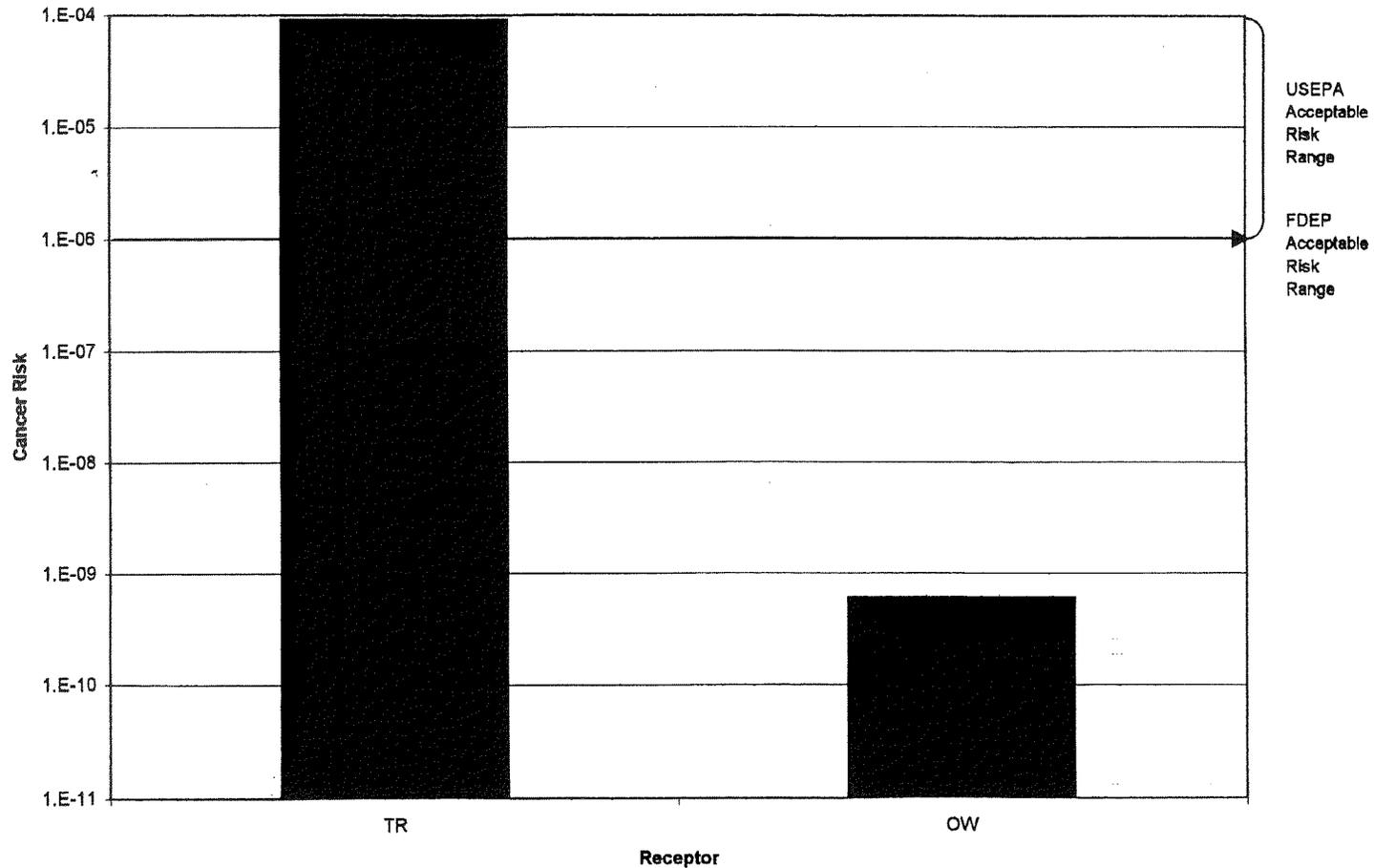
- USEPA U.S. Environmental Protection Agency
- FDEP Florida Department of Environmental Protection
- AR Adult resident
- CR Child resident
- VOC Volatile organic compound

**FIGURE 8-14
NONCANCER RISK SUMMARY
FUTURE LAND USE FOR GROUNDWATER
NORTHERN VOC PLUME**



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LEGEND

- USEPA U.S. Environmental Protection Agency
- FDEP Florida Department of Environmental Protection
- TR Total resident
- OW Occupational worker
- VOC Volatile organic compound

**FIGURE 8-15
CANCER RISK SUMMARY
FUTURE LAND USE FOR GROUNDWATER
SOUTHERN VOC PLUME**



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an HI of 2 for the child. The adult residential receptor was below USEPA's and FDEP's target HI of 1 but the child residential receptor HI exceeds both the USEPA's and FDEP' target HI (due to *cis*-1,2-DCE, PCE, and TCE). Figure 8-16 presents a summary of HIs associated with future land-use exposure to groundwater.

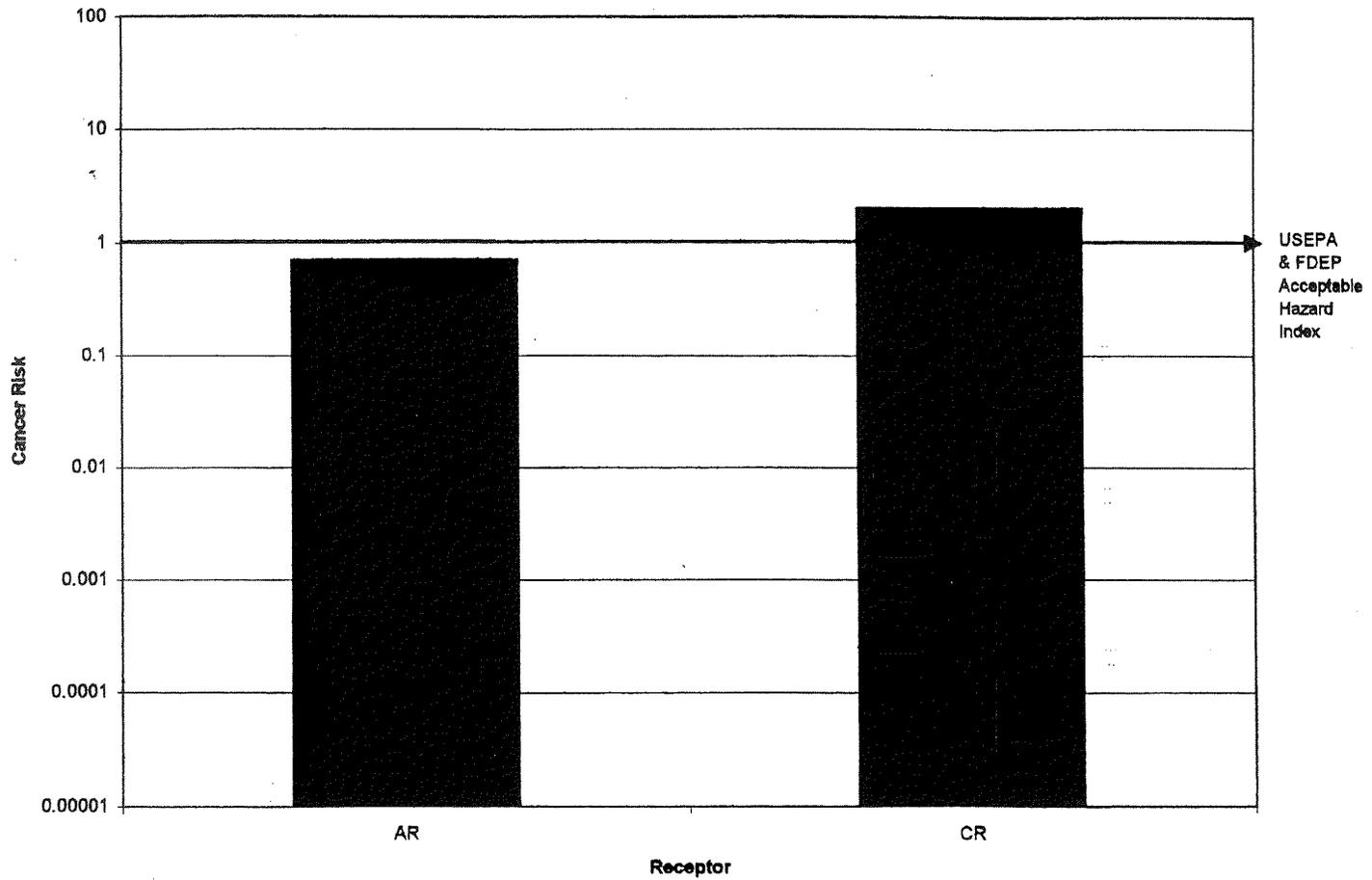
For potential future land-use scenarios, the cancer risks associated with antimony plume groundwater ingestion, inhalation of VOCs while showering, and inhalation of VOCs that may migrate from groundwater to indoor air are 6×10^{-6} for an aggregate resident (combined adult and child) and 4×10^{-11} for an occupational worker (inhalation of VOCs that may migrate from groundwater to indoor air). The potential future residential and occupational worker receptor cancer risk for the antimony plume are within the USEPA acceptable risk range of 1×10^{-4} to 1×10^{-6} . However, risk for the resident exceeds the FDEP level of concern of 1×10^{-6} only for the resident (mainly due to PCE and TCE). However, the risk was primary due to potential ingestion of groundwater because risks for inhalation of VOCs that may migrate to indoor air were only 1×10^{-8} . Figure 8-17 presents a summary of cancer risk associated with future land-use.

The noncancer risks associated with the antimony plume for groundwater ingestion under the future land-use scenario is an HI of 1 for adult and an HI of 2 for the child. The adult residential receptor was at USEPA's and FDEP's target HI of 1 but the child residential receptor HI exceeds both the USEPA's and FDEP' target HI (due to antimony). Figure 8-18 presents a summary of HIs associated with future land-use exposure to groundwater.

Surface Water. The risk characterization results for potential future land-use surface water exposure scenarios are shown in Tables E-6.35 through E-6.39 in Appendix E-6 to this report and are summarized in Table 8-17. For potential future land-use, the cancer risks associated with exposure to surface water (ingestion and dermal contact) are 1×10^{-5} for an aggregate recreational user (combined adult and adolescent) and 4×10^{-5} for a resident (combined adult and child). Both of these receptors' cancer risks are within or below the USEPA acceptable cancer risk range of 1 in 10,000 to 1 in 1,000,000; however, they exceed the Florida level of concern of 1×10^{-6} (primarily due to PCE, TCE, VC, and 4,4'-DDT). Figure 8-19 presents a summary of cancer risk associated with future land-use exposure to surface water.

The noncancer risks associated with surface water ingestion and dermal contact under the future land-use scenario for all potential future receptors are below USEPA's and FDEP's target HI of 1. Figure 8-20 presents a summary of HIs associated with future land-use exposure to surface water.

Sediment. The risk characterization results for potential future land-use sediment exposure scenarios are shown in Tables E-6.40 through E-6.43 in Appendix E-6 to this report and are summarized in Table 8-17. For potential future land-use, the cancer risks associated with exposure to sediment (dermal contact) are 3×10^{-8} for an aggregate recreational user (combined adult and adolescent) and 9×10^{-8} for a resident (combined adult and child). These cancer risks are below the USEPA acceptable cancer risk range of 1 in 10,000 to 1 in 1,000,000 and the Florida level of concern of 1×10^{-6} . Figure 8-21 presents a summary of cancer risk associated with future land-use exposure to sediment.



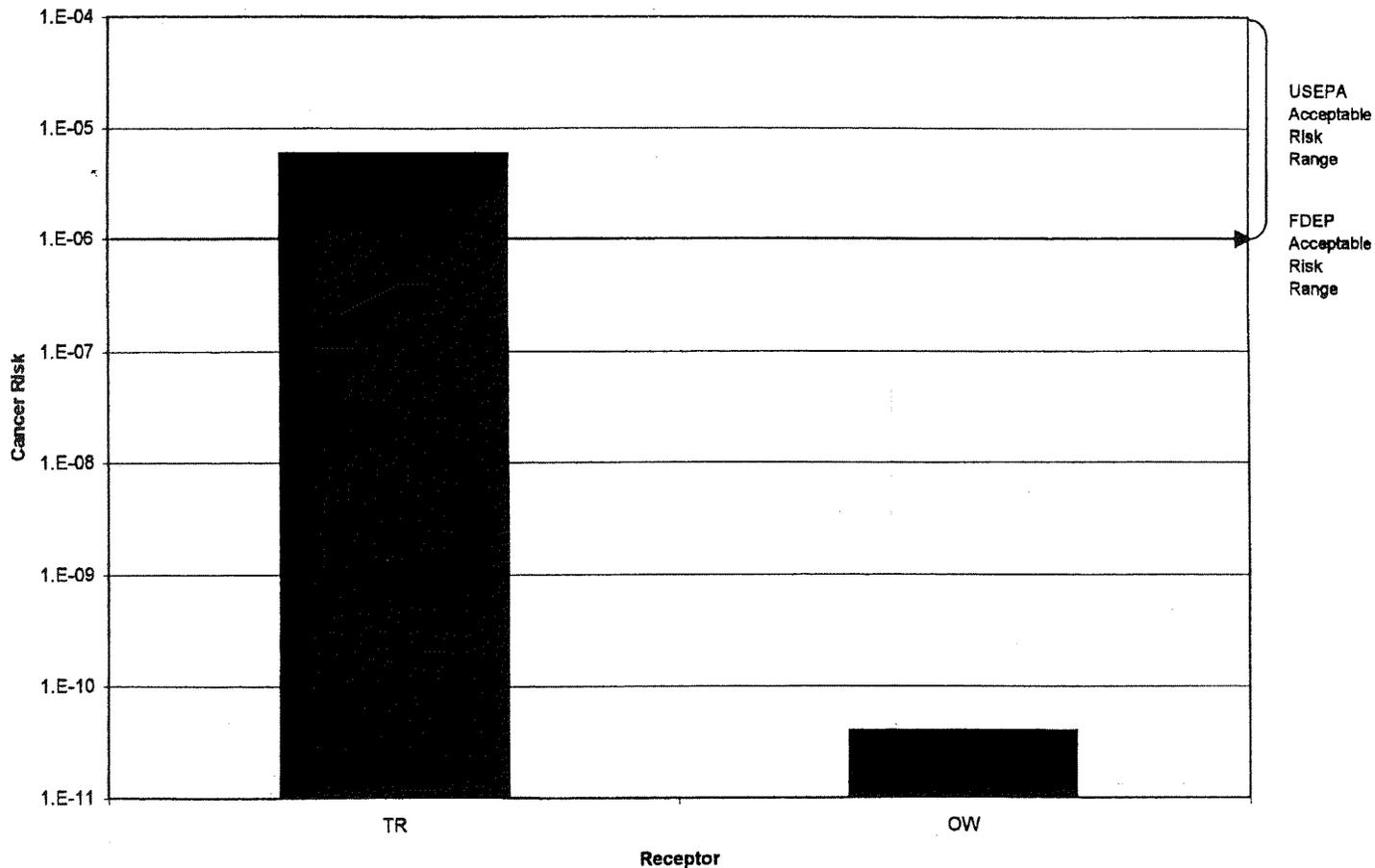
LEGEND

- USEPA U.S. Environmental Protection Agency
- FDEP Florida Department of Environmental Protection
- AR Adult resident
- CR Child resident
- VOC Volatile organic compound

**FIGURE 8-16
NONCANCER RISK SUMMARY
FUTURE LAND USE FOR GROUNDWATER
SOUTHERN VOC PLUME**



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LEGEND

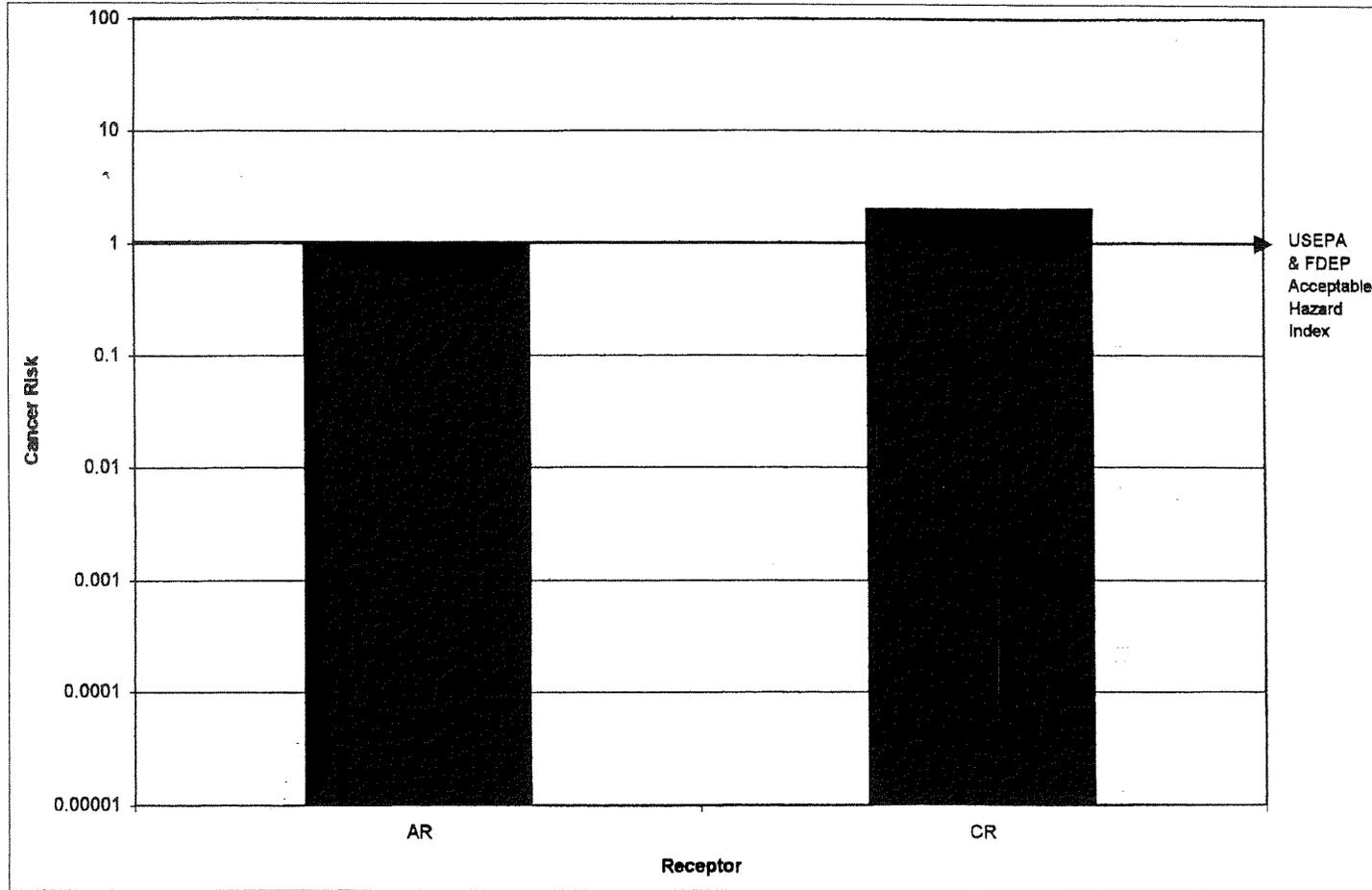
- USEPA U.S. Environmental Protection Agency
- FDEP Florida Department of Environmental Protection
- TR Total resident
- OW Occupational worker

**FIGURE 8-17
CANCER RISK SUMMARY
FUTURE LAND USE FOR GROUNDWATER
ANTIMONY PLUME**



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LEGEND

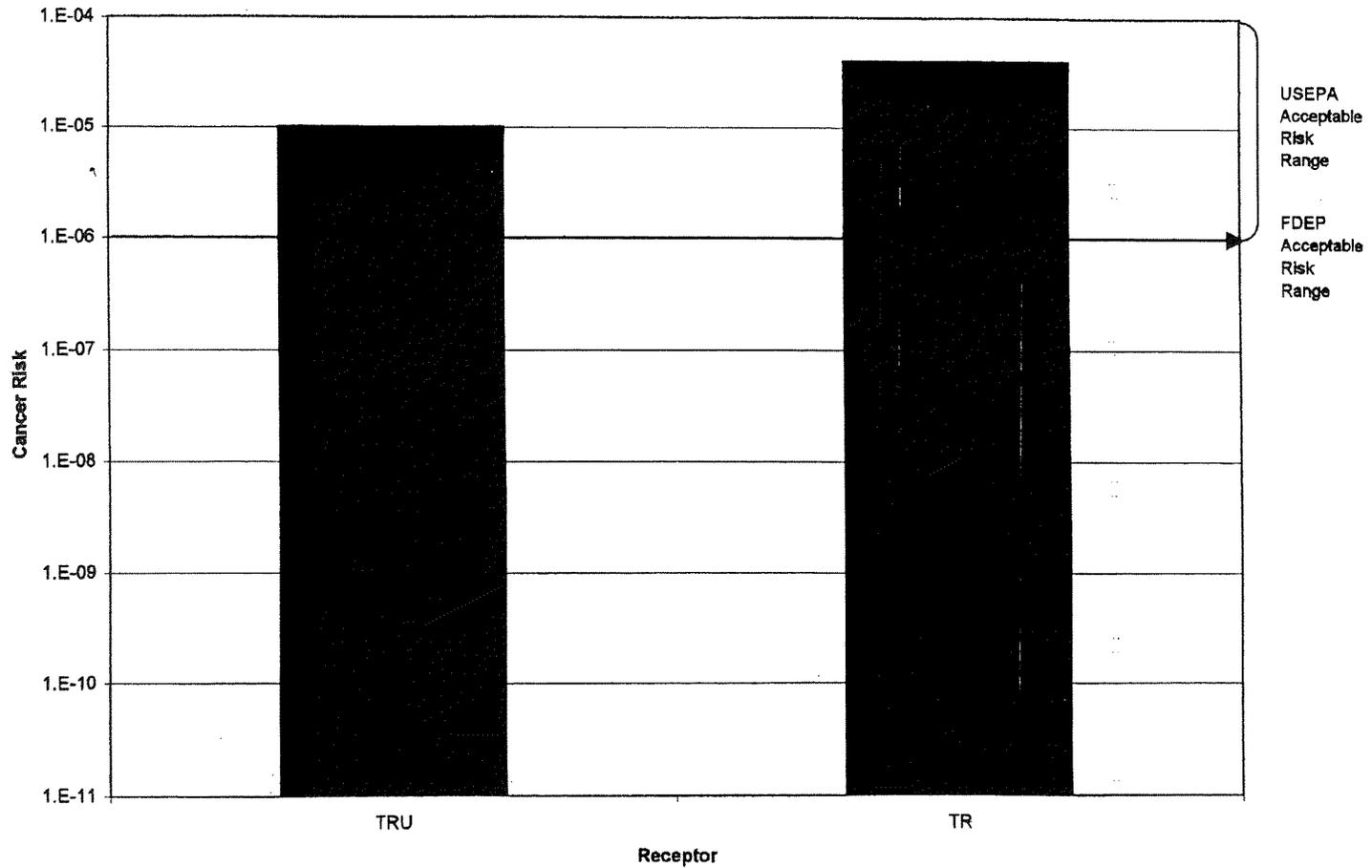
- USEPA U.S. Environmental Protection Agency
- FDEP Florida Department of Environmental Protection
- AR Adult resident
- CR Child resident

**FIGURE 8-18
NONCANCER RISK SUMMARY
FUTURE LAND USE FOR GROUNDWATER
ANTIMONY PLUME**



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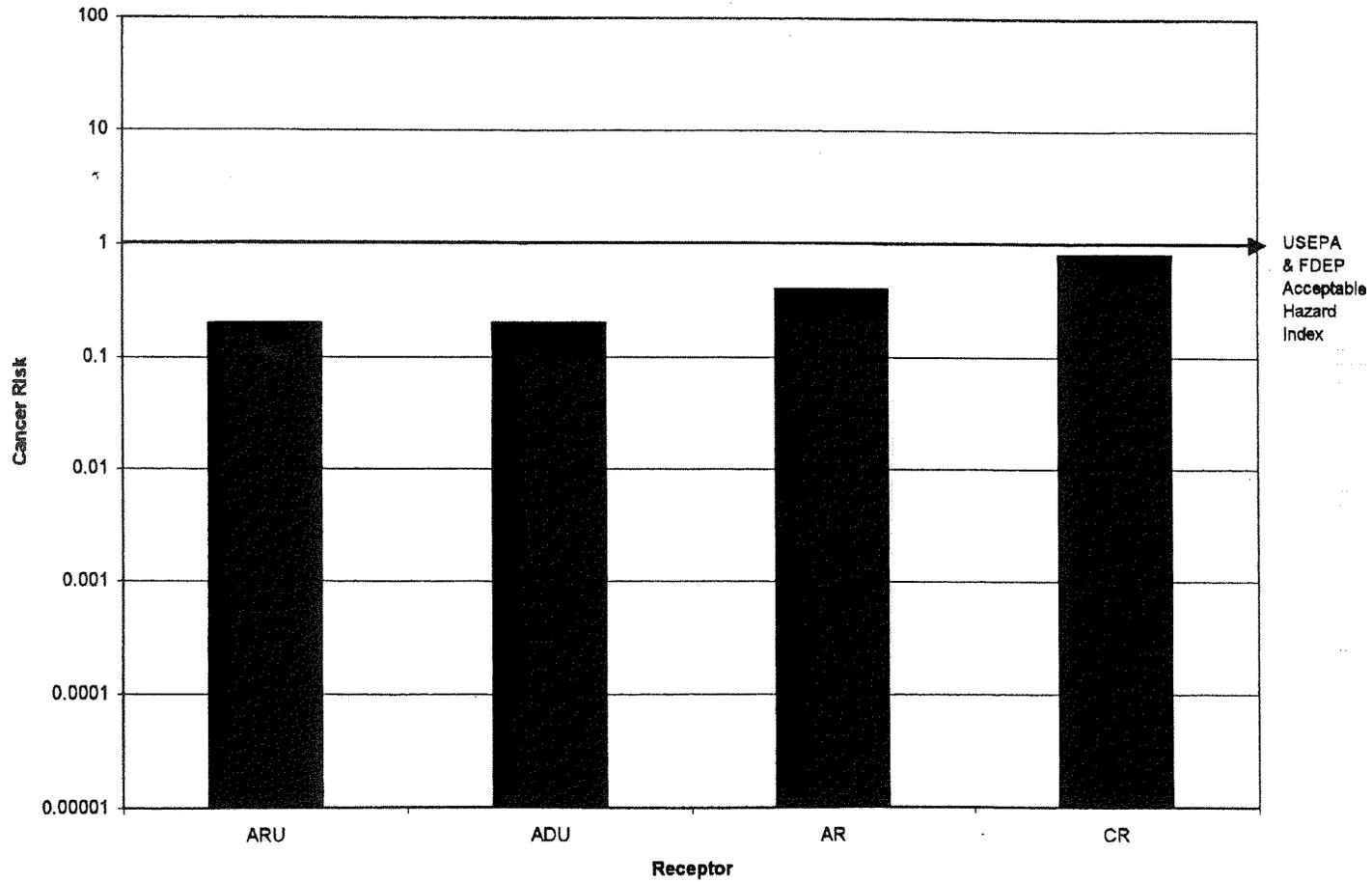
- USEPA U.S. Environmental Protection Agency
- FDEP Florida Department of Environmental Protection
- TRU Total recreational user
- TR Total resident

**FIGURE 8-19
CANCER RISK SUMMARY
FUTURE LAND USE FOR SURFACE WATER**



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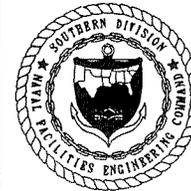
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LEGEND

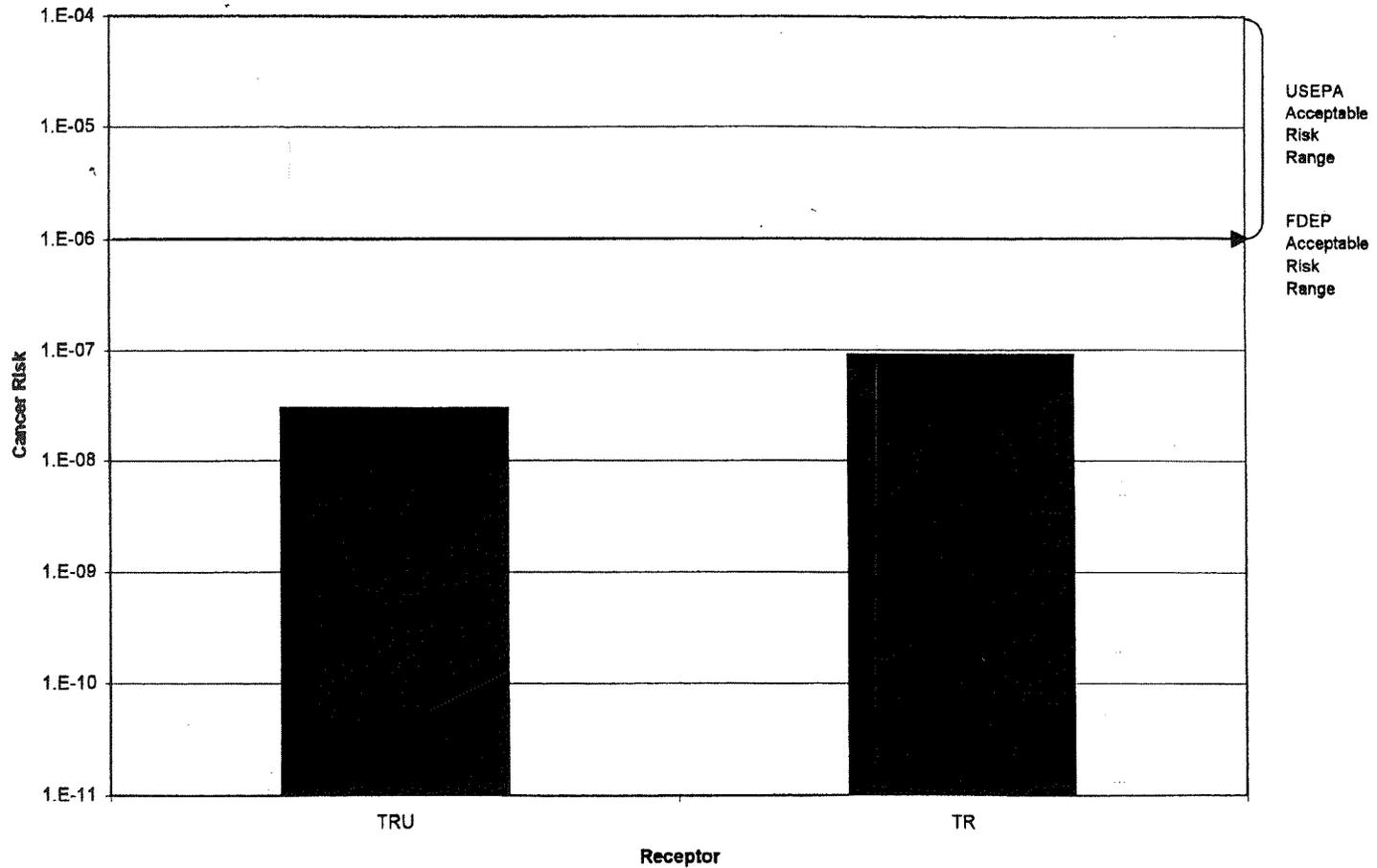
- USEPA U.S. Environmental Protection Agency
- FDEP Florida Department of Environmental Protection
- ARU Adult recreational user
- ADU Adolescent recreational user
- AR Adult resident
- CR Child resident

**FIGURE 8-20
NONCANCER RISK SUMMARY
FUTURE LAND USE FOR SURFACE WATER**



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LEGEND

- USEPA U.S. Environmental Protection Agency
- FDEP Florida Department of Environmental Protection
- TRU Total recreational user
- TR Total resident

**FIGURE 8-21
CANCER RISK SUMMARY
FUTURE LAND USE FOR SEDIMENT**



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The noncancer risks associated with sediment dermal contact under the future land-use scenario for all potential future receptors are below USEPA's and FDEP's target HI of 1. Figure 8-22 presents a summary of HIs associated with future land-use exposure to sediment.

8.5.3 Cumulative Risk Summary USEPA Region IV guidance requires an assessment of cumulative receptor risk. For current and future land-use, the trespasser and recreational user receptors, respectively, could potentially be exposed to surface soil, surface water, and sediment. For these receptors, the cumulative risk for exposure to these media is 1×10^{-5} , which is within the USEPA acceptable cancer risk range. Under potential future land-use, the residential receptor could potentially be exposed to surface soil, groundwater, surface water, and sediment. The cumulative cancer risk for the resident is 2×10^{-3} , which is above the USEPA acceptable cancer risk range and the FDEP target level of concern. This risk is primarily due to possible ingestion of VOCs in groundwater.

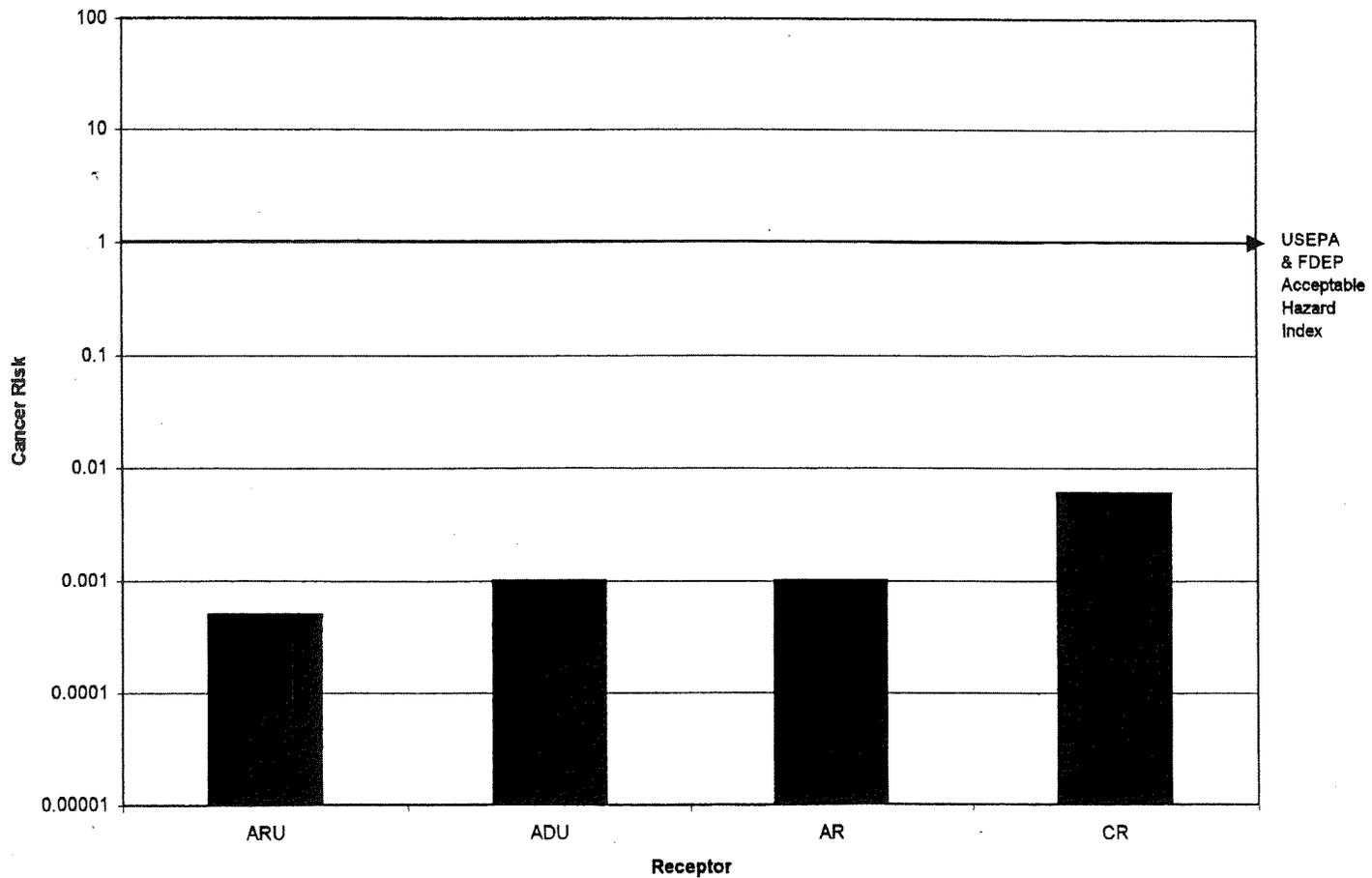
8.6 UNCERTAINTY ANALYSIS. Risk estimates are generally conservative values that result from multiple layers of conservative assumptions inherent in the risk assessment process. Quantitative estimates of risk are based on numerous assumptions, most of which are intended to be protective of human health (i.e., conservative). As such, risk estimates are not truly probabilistic estimates of risk, but rather conditional estimates given a series of conservative assumptions about exposure and toxicity.

8.6.1 General Source of Uncertainty A thorough discussion of all potential sources of uncertainty in risk assessment is not feasible. In general, sources of uncertainty can be categorized into site-specific factors (e.g., variability in analytical data and exposure assessment) and toxicity and risk characterization assessment factors. Most toxicity- and risk characterization-specific uncertainties apply to all HHRAs equally in their impact on the calculated risk estimates. Common (not site-specific) sources of uncertainty and their potential effects on the magnitude of estimated risks are discussed here. Table 8-18 summarizes some of the sources of uncertainty that are common to all HHRAs.

Data Collection, Analysis, and Evaluation. A certain amount of uncertainty is associated with the representative nature of the data collected to complete the risk evaluation at each site. Additional uncertainties associated with estimating exposure result from the variance in sampling and analytical techniques. There are three general uncertainties related to data collection, analysis, and evaluation.

- Nature and extent of contamination,
- adequate characterization of exposure areas, and
- differences between site-specific inorganic concentrations and background inorganic concentrations.

Nature and Extent of Contamination. The nature and extent of contamination is normally discussed in detail as part of the RI. The extensive sampling and analytical program of an RI should adequately characterize the types of contaminants present, the physical location of those contaminants, and the concentra-



LEGEND

- USEPA U.S. Environmental Protection Agency
- FDEP Florida Department of Environmental Protection
- ARU Adult recreational user
- ADU Adolescent recreational user
- AR Adult resident
- CR Child resident

**FIGURE 8-22
NONCANCER RISK SUMMARY
FUTURE LAND USE FOR SEDIMENT**



**REMEDIAL INVESTIGATION
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**Table 8-18
Potential Sources of Uncertainty**

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Potential Source	Direction of Effect	Justification
<u>Exposure Assessment</u>		
Likelihood of exposure pathways	Overestimate	Actual exposure may not occur
Exposure point concentrations	Unknown	Sampling data are assumed to be representative of the exposures.
Exposure assumptions (e.g., frequency)	Overestimate	Parameters selected are conservative estimates of exposure representing a reasonable maximum exposure.
Degradation of chemicals not considered	Overestimate	Risk estimates are based on recent chemical concentrations. Concentrations tend to decrease over time as a result of degradation for many organics.
Absorption of soil contaminants through the skin	Overestimate	Dermal absorption of chemicals is a function of the length of actual skin contact. Contact may be insufficient to result in the absorption assumed.
Modeled exposure point concentrations	Unknown, probably overestimate	Models are based on numerous assumptions resulting in conservative exposure point concentrations.
<u>Toxicity Assessment</u>		
Extrapolation of animal toxicity data to human	Unknown, probably overestimate	Animals and humans differ with respect to absorption, metabolism, distribution, and excretion of chemicals. The magnitude and direction of the difference varies with each chemical. Animal studies typically involve high-dose exposures, whereas humans are exposed to low doses.
Use of linearized, multistage model to derive cancer slope factors	Overestimate	Model assumes a nonthreshold, linear low dose-relationship for carcinogens. Many compounds induce cancer by nongenotoxic mechanisms. Model results in 95 percent upper confidence limits of cancer potency. Potency is unlikely to be higher and may be as low as zero.
Lack of oral toxicity values for lead	Underestimate	Dose-response values for lead are not available for exposures to lead in soil or groundwater. Risk from exposure to lead in soil and groundwater is not quantitatively evaluated.
Lack of inhalation toxicity values	Underestimate	Inhalation reference doses and cancer slope factors are not available for all human health chemicals of potential concern being evaluated for inhalation exposures (fugitive dust and volatiles while showering). Therefore, risks cannot be quantified and are underestimated.
<u>Risk Characterization</u>		
Summation of risk among chemicals within exposure pathways	Unknown	Little is known about the toxicity of chemical mixtures. In the absence of evidence to the contrary, additivity of risk is assumed.

tions that are present. There is inherent uncertainty in the assumption that the nature and extent of contamination has been adequately characterized.

Adequate Characterization of Exposure Areas. Contaminated areas, specifically soil, are sometimes small relative to the area in which a receptor would potentially be exposed. Nonrandom sampling may be conducted in areas of known or visible contamination. Because a receptor's exposure area may actually be larger than the area of contamination and a receptor's exposure would often be random, the nonrandom sampling may actually result in overestimation of exposures.

Differences between Site and Background Concentrations. A comparison between site-specific and background inorganic concentrations is conducted as part of the selection of COPCs (Paragraph 8.2.1.1). Both organic contaminants and inorganic analytes are commonly detected in surface soil and groundwater background locations.

Just because organics (e.g., pesticides) are sometimes detected in background samples does not indicate that the inorganic concentrations in those samples do not represent background RfC. The use of the background sample data as a reference point for inorganics detected in surface soil and groundwater is generally considered appropriate based on carefully chosen sampling locations.

Selection of COPCs. Although a USEPA approach is used in selecting COPCs (USEPA, 1989b), there are uncertainties in the process of selecting COPCs based on the use of RBCs and comparison to inorganic background screening concentrations.

The USEPA Region III RBC table does not provide values for all chemicals in surface soil or groundwater. For those chemicals without an associated USEPA Region III RBC, an RBC for a chemical in the table that is similar in structure and physical properties to the detected contaminant may be used (e.g., using the pyrene value as a surrogate for benzo(g,h,i)perylene). Based on the similarities in toxicological properties between the compounds and their surrogates, it is reasonable to conclude that the USEPA Region III RBCs for the chemicals detected are adequately protective of human health. Generally, the use of surrogates is an approach that helps focus effort on those contaminants that are contributing a significant amount of risk (e.g., cancer risk of greater than 1×10^{-6} and an HQ of greater than 0.1).

Background Screening for Inorganics. For a given inorganic analyte, the maximum reported soil or groundwater concentration at a waste site is compared to two times the average of the medium-specific detected concentrations in the background locations (Paragraph 8.2.1.1). This comparison is conducted as part of the selection of COPCs. If the maximum site concentration is less than two times the arithmetic mean of the inorganic RfCs, the analyte is considered to be consistent with background concentrations. This approach is conservative in that it is likely to identify certain analytes as being inconsistent with background (including them as COPCs) even though the distribution of concentrations onsite is very similar to that of the background data set. This can occur when the average inorganic screening concentration at a reference location is less than the maximum detected value at the site being investigated. For example, a site-specific inorganic could be present at a concentration greater than the corresponding screening concentration, including it as an COPC, but still be within the detected range of inorganic concentrations at the reference locations.

This is the result of natural variability for inorganic concentrations in soil. Therefore, it is quite possible that an analyte could have a concentration distribution at a site that is identical to the distribution of concentrations for that analyte in the background data set, but also would have a maximum detected concentration that is more than twice the arithmetic mean of the concentrations in the reference data set.

Toxicity Equivalency Factors for Carcinogenic PAHs. In selecting COPCs (Subsection 8.2.1), the selection of a single PAH in a particular medium requires that the additional PAHs detected in that medium be retained as COPCs even if the PAH is less than the available risk-based screening level. This is a protective approach that is unlikely to underestimate risks.

Exposure Assessment. There are four major issues that contribute to uncertainties in the exposure assessment of most HHRA's:

- land-use,
- use of the RME,
- determination of the EPC, and
- exposure parameters and pathways.

Land-Use. The potential future land-use for OU 4 is not defined. In the absence of a defined future land-use, the receptor scenarios evaluated were selected to provide assessment of potential exposures under the full spectrum of potential future land-uses.

Reasonable Maximum Exposure. The exposure assessments conducted in an HHRA can be characterized as an RME. As such, the exposure estimates represent a mix of "high end" exposure parameter values that result in an exposure estimate that is unlikely to be exceeded in an exposed population. Because some of these parameters are functions of the behavior patterns and personal habits of the exposed populations, no one value can be assumed representative of all possible exposure conditions. Further, uncertainties (e.g., body weight, surface area, and ingestion rates) associated with assigning single exposure parameters to a heterogeneous population, which includes both men and women and the young and the old, are considered significant. However, the risk assessment incorporates assumptions or procedures that result in the estimate of an upper bound of risk. This type of exposure assessment tends to overestimate risks for the large majority of an exposed population. To address the most conservative exposure scenario available, the future resident (an RME) is normally evaluated in an HHRA.

Central Tendency. The 50th percentile or average exposure parameters used in the assessment of CT risks is based on exposure parameters that are unlikely to be exceeded by an average member of the population. Again, these parameters are functions of individual habits, behavior, and location; therefore, no single value can be representative of all population members. In addition, CT parameters are not designed to be protective of extremely susceptible sub-populations. The CT risk assessment incorporates these parameters to complement the RME risk assessment and provide risk managers with a reasonable risk range. However, it is possible that the risk may be underestimated for a percentage of the population. A CT analysis was performed for several receptors evaluated in this HHRA, as described in Subsection 8.6.2.

Toxicity Assessment. Toxicity information for many chemicals is very limited, leading to varying degrees of uncertainty associated with calculated toxicity values obtained in IRIS or HEAST. General sources of uncertainty for calculating toxicity factors include extrapolation from animal to human populations, low to high dose extrapolation, short-term to long-term exposures, interspecies sensitivity variation, extrapolation from subchronic to chronic no observable adverse effect level (NOAEL), extrapolation from lowest observed adverse effect level (LOAEL) to NOAEL, amount of data supporting the toxicity factors (i.e., inadequate studies), consistency of different studies for the same chemical, and responses of various species to equivalent doses.

The identification of human carcinogens and noncarcinogens, based on animal data, is a primary source of uncertainty in the use of toxicity values. It is not certain that the identification of carcinogenic activity in an animal species means that carcinogenic activity in humans will occur. In some cases, the metabolic processes involved in carcinogenic activity in a particular organ in animals may not exist in humans. Available evidence indicates that there is a limited number of substances that are classified as human carcinogens (USEPA Class A substances). The extrapolation of short-term to long-term exposures is also a component in some cases for the carcinogen dose-response values. The use of toxicity measures (e.g., RfDs and CSFs) introduces additional uncertainties. These parameters are generally based on animal studies, many of which are performed at high doses relative to the site-specific exposures that potentially could occur. These data require interpretation and/or extrapolation in the low dose area of the dose-response curve. The CSFs used in the risk assessment generally represent a "high end" estimate. The CSFs are the 95 percent UCL on the actual slope derived from the scientific data and, therefore, are likely overestimates of the potency.

Risk Characterization. A mixture of analytes is present in each medium evaluated at NTC, Orlando. The USEPA's *Guidelines for the Health Risk Assessment of Chemical Mixtures* (USEPA, 1986a) states that if sufficient data are not available on the effects of the chemical mixture of concern, or a reasonably similar mixture, additivity of effects for constituents of the mixture should be assumed. This assumption, according to USEPA, is expected to yield generally neutral risk estimates (i.e., neither conservative nor lenient). More recent guidance from USEPA (USEPA, 1992c) also references the *Guidelines for the Health Risk Assessment of Chemical Mixtures*, but further states that the assumption of additivity assumes independence of action and that if this assumption is incorrect, overestimation or underestimation of the actual multiple substance risk may occur. In calculating HI values, additivity is assumed, but in some cases the analytes in a mixture have significantly different toxic mechanisms of action and impact different organs. In these cases, the overall HI likely overestimates noncancer risks.

8.6.2 Site-Specific Uncertainties

Groundwater Data. Some uncertainty is associated with the representativeness of the groundwater data collected to complete the risk evaluation at OU 4. Generally, because the low-flow method was used, turbidity in the unfiltered groundwater samples was minimal. However, the analytical data from some of the unfiltered samples may indicate high inorganic concentrations as a result of suspended solids.

Soil EPC. USEPA guidance specifies using the 95 percent UCL on the arithmetic mean concentration of the site sampling results for the concentration term in the intake equation for risk assessment calculations for soil (USEPA, 1995a). In order to use the UCL of the arithmetic mean, samples are collected randomly, based on the assumption that an exposed individual would move randomly across the site. However, as a result of the surface soil IRAs that have been performed at the site, there are no locations or discrete areas at the site with concentrations that are "elevated" with respect to other areas. Consequently, the 95% UCL concentrations for the site-wide surface soil or subsurface soil data sets provide a conservative estimate of the possible exposure point concentrations that a receptor would be exposed to at any area of the site.

Groundwater EPC. USEPA Region IV risk assessment guidance stipulates that the groundwater EPC be based on the arithmetic mean concentration of wells in the "concentrated" portion of the groundwater plume. For this risk assessment, the groundwater EPCs for each plume included analytical data for the wells that had detected concentrations; wells that did not have any detected COCs were excluded from the EPC calculations, even if they were within the groundwater plume. In general, the majority of wells included in the EPC for each plume had substantially elevated concentrations of COCs; there were few wells included with "low levels" of COCs relative to the total number of wells within the plumes. As illustrated by the following evaluation, risks associated with exposures to *only* the "most concentrated" portion of the groundwater plumes would be higher than those estimated in the risk assessment, but would not change the conclusions of the risk assessment.

The primary contributors to risk in the northern and southern VOC plumes are PCE and TCE. The four wells in the centroid of the northern VOC plume (OLD-13-07A, OLD-13-22B, OLD-13-23B, and OLD-13-41B) have concentrations of PCE and TCE that are higher than the surrounding wells. If the arithmetic mean of the PCE and TCE concentrations for these four wells are used as the EPCs in the risk calculations (EPC for PCE of 8270 $\mu\text{g}/\ell$ and EPC for TCE of 1380 $\mu\text{g}/\ell$, compared to the EPCs used in the risk assessment for the entire plume of 1900 $\mu\text{g}/\ell$ and 410 $\mu\text{g}/\ell$, respectively), the residential cancer risks for the northern VOC plume will be increased from 1×10^{-3} to approximately 6×10^{-3} , and the child resident HI will increase from approximately 20 to approximately 70. Similarly, if the southern VOC plume wells with the highest PCE and TCE concentrations (wells OLD-13-25B, OLD-13-37B, and OLD-13-39B) are used as the basis of the EPC calculation, the groundwater EPCs for PCE and TCE will be approximately two-times higher than those used in the risk calculations. Consequently, cancer risks would be increased from 9×10^{-5} to approximately 2×10^{-4} , and the child resident HI would be increased from 2 to approximately 4.

However, since the total receptor risks, as presented in the risk assessment, for all three groundwater plumes exceed the USEPA and FDEP risk threshold criteria, increasing the EPCs (and therefore the risks) by basing exposures on *only* the "most concentrated" portion of the groundwater plumes would not change the conclusions of the risk assessment. Moreover, revising the EPCs would not change the RGOs or the remedial objectives for the site.

Exposure Parameters. The selection and use of exposure parameters contribute to the uncertainty inherent in a risk estimate. There are several exposure parameters that impact most risk assessments as described below.

- Dermal Exposures to Groundwater. Ingestion of drinking water and inhalation exposure to VOCs that may volatilize from groundwater are normally the exposure pathways that produce the greatest risk associated with contaminated groundwater. Dermal exposure to groundwater while showering is not evaluated in the HHRA. Although this may result in an underestimation of risk, the underestimation is not substantial.

Dermal exposure to groundwater contributes exposures that are insignificant compared to ingestion and inhalation exposures. For example, the adult resident cancer and non-cancer risks for dermal contact exposures to TCE in water (based on exposure 0.2 hours per day - equal to the length of time typically spent showering) would be more than one order of magnitude lower than the ingestion risks, and nearly one order of magnitude lower than the inhalation risks. Therefore, quantification of dermal exposures would not measurably change the risk estimates for potential exposures to groundwater.

- PEF. The PEF that is used to calculate the concentration of soil particles that a receptor may inhale is the same for multiple receptors (e.g., resident and excavation worker). However, it is likely that more soil particles would be suspended in air during soil excavation activities and, therefore, an excavation worker would be exposed to greater concentrations of COPCs associated with airborne soil particles than a resident. Risk associated with inhalation exposures for the excavation worker may be underestimated in the HHRA. It is likely, however, that use of a PEF representing greater particulate concentrations would only result in additional risks of less than an order of magnitude. If risk estimates for inhalation for the excavation worker are orders of magnitude below USEPA threshold ranges, an excavation worker-specific PEF is not necessary.

Possible inhalation exposures associated with household potable use of groundwater were evaluated by estimating the amount of exposure that may occur during showering, since this is the household activity that is associated with the greatest potential for volatile inhalation exposure. The Foster and Chrostowski shower model (1987) is the exposure model most commonly used in risk assessment for evaluating possible inhalation exposures to VOCs during water spraying/dispersion activities. Although USEPA Region IV guidance suggests using the oral exposure risks for VOCs to estimate the inhalation exposure risks for VOCs, use of the shower model provides an exposure estimate that is associated with less uncertainty.

If the USEPA Region IV suggested approach to estimating volatile inhalation risks from groundwater was used in this risk assessment, groundwater risks would be approximately two-times the magnitude of the risk estimates reported in the risk summary table because volatile COPCs contributed the majority of the ingestion risk. However, even if it was assumed that the volatile inhalation risks were equal to the ingestion risk estimates, cancer and non-cancer risks would still exceed the USEPA and FDEP risk limits. Therefore, the conclusions of the risk assessment would not change. Moreover, because the health risks associated with possible ingestion exposures exceed FDEP risk criteria, and because the groundwater remedial objectives are to reduce groundwater concentrations to meet MCLs, any increases in total receptor risks will not affect the conclusions of the risk assessment.

Toxicity Assessment. The non-cancer hazard index for theoretical future residential potable use of groundwater at the antimony plume is 2 for the child resident. The majority of the non-cancer risk is attributable to antimony, which has a hazard quotient of 2. The hazard quotient of 2 for antimony indicates that the theoretical dose of antimony to the child resident exceeds the toxicity threshold (i.e., the RfD or "safe dose") by a factor of two. However, in developing the RfD, USEPA applied an uncertainty factor of 1000 to the dose of antimony which was used as the basis of the RfD. The dose was associated with no observable adverse effects in a toxicological study in which rats were administered antimony in drinking water. The uncertainty factor was applied to account for the extrapolation of animal study data to human populations and differences in human population sensitivities. Therefore, the dose of antimony that was actually associated with the no observable adverse effect level (NOAEL) was 500-times higher than the theoretical dose of antimony that was estimated for a child resident in this risk assessment; higher doses would be required to cause a measurable adverse effect. Given the large uncertainty factor applied to the RfD, and the fact that the RfD is based on a NOAEL dose, there is uncertainty in the interpretation of the significance of low risks; the HQ of 2 for theoretical exposure to antimony in groundwater does not necessarily represent a significant health concern.

Non-cancer inhalation dose-response values were not available for many of the COPCs evaluated in the risk assessment. Therefore, non-cancer risks associated with inhalation exposures were underestimated. USEPA does not approve nor recommend using oral dose-response values as surrogates for COPCs that do not have published inhalation dose-response values. However, even if oral dose-response values were used as surrogates to evaluate inhalation risks, the total receptor risk estimates for surface soil and subsurface soil would not substantially increase. This is because the COPC intakes received via inhalation exposures are three to five orders of magnitude lower than the ingestion and dermal intakes. Moreover, even if inhalation intakes were equal to ingestion intakes, the HIs for surface soil and subsurface soil would not exceed one (i.e., doubling the ingestion HIs to account for unavailable inhalation dose-response data would not result in HIs above 1). For groundwater, even if non-cancer inhalation risks were equal to ingestion risks, the HIs would still be greater than one. Therefore, the conclusions of the risk assessment would not change.

Sample Quantitation Limits. SQLs were compared to the risk-based screening criteria and Florida regulatory guidelines for all analytes not selected as COPCs to assess whether or not the detection limits were adequate to detect analytes at levels of concern (SQLs of analytes with 100 percent frequency of detection were not evaluated). The SQLs for analytes in surface soil, subsurface soil, groundwater, and surface water are adequate for this HHRA. The analyte detected in sediment with a higher reported SQL than the screening criteria was 1,1-DCE. Although the SQL for 1,1-DCE exceeded the screening criteria, the detected concentrations were less than the SQL. Because the laboratory equipment was able to detect concentrations lower than the SQL, it was assumed that the SQLs for 1,1-DCE were adequate for this HHRA.

Central Tendency. According to the methodology described in this HHRA, CT cancer risks are calculated for receptors that have RME cancer risks exceeding the Florida level of concern (1×10^{-6}). These receptors include the future resident for surface soil; future resident for groundwater (for all three plumes); and future resident and recreational user for surface water. The CT evaluation

involved using the same EPCs as the RME evaluation, with reasonable but less conservative exposure parameters. It is designed to provide a more probable risk level (USEPA, 1995a). The CT results and the CT exposure parameters are presented in Tables E-6.44 through E-6.54 in Appendix E-6 of this report.

Only CT ingestion and dermal exposures to soil and surface water were characterized because the contribution from inhalation was insignificant compared to the risk from the old oral and dermal routes. The CT aggregate residential cancer risk for surface soil is 1×10^{-7} . The CT aggregate residential cancer risk for northern VOC plume groundwater is 3×10^{-4} . The CT aggregate residential cancer risk for southern VOC plume groundwater is 2×10^{-5} . The CT aggregate residential cancer risk for antimony plume groundwater is 1×10^{-6} . The CT aggregate residential risk for surface water is 1×10^{-5} .

For noncarcinogenic CT risks, the potential future adult and child residential receptor exceeded the FDEP target HI of 1 only for groundwater. The child residential CT HIs exceeding the FDEP target HI is 14 for northern VOC plume groundwater, 1 for the southern plume, and 2 for the antimony plume. The adult residential CT HI exceeding the FDEP target HI for northern VOC plume groundwater is 6.

Based on the CT risk analysis, the only cancer risks that exceed USEPA criteria are for theoretical future potable use of groundwater in the Northern VOC plume. CT cancer risks for residential use of the surface water, and groundwater at all the plumes, exceed the FDEP cancer risk level of concern (1×10^{-6}), and CT HIs for the northern VOC and antimony plumes exceed the USEPA and FDEP target HIs of 1.

8.7 REMEDIAL GOAL OPTIONS. Those media with estimated RME incremental lifetime cancer risks above 1 in 10,000 or with a total HI greater than 1 are identified for OU 4. These media are selected for development of media cleanup levels in accordance with USEPA Region IV guidance (USEPA, 1995a). In addition, those media with cancer risks above the Florida target risk level of 1×10^{-6} , or EPCs above FDEP guidelines and standards, were also selected for RGO development. RGOs and available FDEP criteria are intended to provide the basis for the development of remedial alternatives in the FS, which will follow the RI.

The RME cancer risks for future residential potable use of the northern plume groundwater, and noncancer risks for future residential potable use of northern plume, southern plume, and antimony plume groundwater exceeded the USEPA threshold risk criteria. Therefore, RGOs were developed for these media. No other media were associated with current or future land-use RME risks in excess of USEPA risk threshold criteria. The RME cancer risks for future residential exposure to surface soil, and future residential and recreational receptor exposure to surface water, as well as risks for potential residential groundwater use as described above, exceeded the FDEP target cancer risk level of 1×10^{-6} . In addition, RME non-cancer risks for residential use of groundwater exceed the USEPA and FDEP threshold HI of 1. Therefore, RGOs were developed for these media.

The COPCs selected for RGO development in these media were those COPCs associated with a medium-specific ELCR of 1×10^{-6} or greater, or a medium-specific HQ of 0.1 or greater. Identification of COPCs requiring RGOs was based on the receptor scenario with the highest estimated risks for a given medium, usually the residential receptor scenario. RGOs were calculated as follows:

$$RGO_{chemical_i} = EPC_{chemical_i} \times \frac{TargetRisk}{CalculatedRisk_{chemical_i}}$$

The medium-specific risks incorporated in this equation were those estimated for the receptor scenario that was used to identify the media and COPCs requiring RGOs. RGOs based on cancer risks were calculated from aggregate receptor risks (generally the combined risk for the child and adult resident for a given medium), whereas RGOs based on noncancer risks were calculated from the receptor with the highest estimated HIs (usually the child resident HI for a given medium).

In addition, EPCs of several COPCs in each of the three groundwater plumes exceeded FDEP groundwater standards, and EPCs of three COPCs in surface water exceeded FDEP SWQSSs. Therefore, these COPCs were retained for RGO development; the RGOs for these COPCs were based on the FDEP applicable standards and guidelines.

RGOs for surface soil, groundwater, and surface water are presented in Tables 8-19 through 8-23.

8.8 SUMMARY OF HHRA. COPCs were identified and exposures and risks were quantified for surface soil, subsurface soil, groundwater, surface water, and sediment associated with OU 4. The relative significance of risk estimates was evaluated in terms of a comparison with acceptable risk limits established by USEPA and FDEP, and by comparison of site concentrations to risk-based screening concentrations and other guidance values. The conclusions below were drawn based on this HHRA.

- The COPCs detected in surface soil, subsurface soil, surface water, and sediment did not pose unacceptable cancer and noncancer risks to the current and future receptors evaluated, based on USEPA guidelines and target cancer risk range of 1 in 10,000 to 1 in 1,000,000 and threshold HI of 1. Only theoretical future potable use of groundwater posed risks above USEPA risk threshold criteria.
- The estimated ELCRs at OU 4 associated with potential residential RME and CT exposure to surface soil, groundwater, and surface water exceeded the FDEP target cancer risk level of concern of 1×10^{-6} .
- The estimated ELCRs at OU 4 associated with potential trespasser and future recreational users RME to surface water exceeded the FDEP target risk of 1×10^{-6} . However, the CT risk for these receptors was below the Florida target risk level of 1×10^{-6} .
- There is no current use of groundwater. Cancer risk levels for theoretical future use of groundwater as drinking water are above both the USEPA target cancer risk range and the FDEP target level of concern, primarily due to PCE and TCE. Noncancer risk levels for theoretical future use of groundwater as drinking water are above the

Table 8-19
Summary of Remedial Goal Options for
Surface Soil

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Range of Detected Concentrations	Exposure Point Concentration	Total Excess Lifetime Cancer Risk (Based on Risk to Resident [adult and child])			Total Hazard Index (Based on Risk to Child Resident)			Florida Soil Cleanup Target Level (Residential) ^{1,2}	Florida Soil Cleanup Target Level (Leaching) ^{2,3}	Background Screening Concentration
			10 ⁴	10 ⁵	10 ⁶	3	1	0.1			
Semivolatile Organic Compounds (µg/kg)											
Benzo(a)pyrene equivalents	52 to 442	265	NR	NR	70	NA	NA	NA	100	8,000	NA

¹ Values are for residential soil, from Florida Department of Environmental Protection (FDEP) Chapter 62-758 "Soil Cleanup Target Levels," dated May 26, 1999 (FDEP, 1999).

² Values are from the Florida Department of Environmental Protection Chapter 62-777 "Soil Cleanup Target Levels," dated May 26, 1999 (FDEP, 1999).

³ Value for benzo(a)pyrene.

Notes: µg/kg = micrograms per kilograms.

NA = not applicable.

mg/kg = milligrams per kilograms.

NR = not reported because the calculated remedial goal option exceeds the exposure point concentration.

NC = not calculated, as per FDEP, 1995.

Table 8-20
Summary of Remedial Goal Options for
Groundwater, Northern VOC Plume

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Range of Detected Concentrations	Exposure Point Concentration	Total Excess Lifetime Cancer Risk (Based on Risk to Resident [adult and child])			Total Hazard Index (Based on Risk to Child Resident)			Florida Groundwater Cleanup Target Level ¹	Federal MCL ²	Background Screening Concentration
			10 ⁴	10 ⁵	10 ⁶	3	1	0.1			
Volatile Organic Compounds (µg/l)											
cis-1,2-Dichloroethene	1 to 1,650	350	NA	NA	NA	NR	160	16	70	70	NA
Tetrachloroethene	2 to 29,800	1,900	130	13	1.3	480	160	16	3	5	NA
Trichloroethene	0.7 to 2,475	410	NR	61	6.1	280	93	9.3	3	5	NA
Inorganic Analytes (µg/l)											
Aluminum	117 to 35,500	4,630	NA	NA	NA	NR	NR	1,540	200	200	4,067
Chromium	0.95 to 59.4	8.4	NA	NA	NA	NR	NR	7.6	100	100	7.8
Iron	35.3 to 4,920	751	NA	NA	NA	NR	NR	470	300	300	1,227

¹ Florida Department of Environmental Protection (FDEP) Groundwater Cleanup Target Levels (Chapter 62-777; FDEP, 1999).

² Federal MCLs are taken from U.S. Environmental Protection Agency (USEPA) *Drinking Water Regulations and Health Advisories* from October 1996 (USEPA, 1996d).

Notes: MCL = maximum contaminant level.

µg/l = micrograms per liter.

NA = not applicable.

NR = not reported because the calculated remedial goal option exceeds the exposure point concentration.

VOC = volatile organic compound.

Table 8-21
Summary of Remedial Goal Options for
Groundwater, Southern VOC Plume

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Range of Detected Concentrations	Exposure Point Concentration	Total Excess Lifetime Cancer Risk (Based on Risk to Resident [adult and child])			Total Hazard Index (Based on Risk to Child Resident)			Florida Groundwater Cleanup Target Level ¹	Federal MCL ²	Background Screening Concentration
			10 ⁴	10 ⁵	10 ⁶	3	1	0.1			
<u>Volatile Organic Compounds (µg/l)</u>											
Tetrachloroethene	2 to 390	110	NR	13	1.3	NR	NR	16	3	5	NA
Trichloroethene	2 to 105	23	NR	NR	6	NR	NR	9.2	3	5	NA
<u>Inorganic Analytes (µg/l)</u>											
Aluminum	1,390 to 12,700	3,780	NA	NA	NA	NR	NR	1,580	200	200	4,067
Iron	16.8 to 3,350	738	NA	NA	NA	NR	NR	460	300	300	1,227

¹ Florida Department of Environmental Protection (FDEP) Groundwater Cleanup Target Levels (Chapter 62-777; FDEP, 1999).

² Federal MCLs are taken from U.S. Environmental Protection Agency (USEPA) *Drinking Water Regulations and Health Advisories* from October 1996 (USEPA, 1996d).

Notes: MCL = maximum contaminant level.
µg/l = micrograms per liter.
NR = not reported because the calculated RGO exceeds the EPC.
NA = not applicable.
VOC = volatile organic compound.

Table 8-22
Summary of Remedial Goal Options for
Groundwater, Antimony Plume

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Range of Detected Concentrations	Exposure Point Concentration	Total Excess Lifetime Cancer Risk (Based on Risk to Resident [adult and child])			Total Hazard Index (Based on Risk to Child Resident)			Florida Groundwater Cleanup Target Level ¹	Federal MCL ²	Background Screening Concentration
			10 ⁴	10 ⁵	10 ⁶	3	1	0.1			
<u>Volatile Organic Compounds (µg/l)</u>											
Tetrachloroethene	1 to 28	7.5	NR	NR	1.3	NA	NA	NA	3	5	NA
<u>Inorganic Analytes (µg/l)</u>											
Antimony	7.1 to 20.7	14.1	NA	NA	NA	NR	6.1	0.6	6	6	4.1
¹ Florida Department of Environmental Protection (FDEP) Groundwater Cleanup Target Levels (Chapter 62-777; FDEP, 1999). ² Federal MCLs are taken from U.S. Environmental Protection Agency (USEPA) <i>Drinking Water Regulations and Health Advisories</i> from October 1996 (USEPA, 1996d). Notes: MCL = maximum contaminant level. µg/l = micrograms per liter. NR = not reported because the calculated RGO exceeds the EPC. NA = not applicable.											

<p align="center">Table 8-23 Summary of Remedial Goal Options for Surface Water</p> <p align="center">Remedial Investigation Operable Unit 4, Study Areas 12, 13, and 14 (Area C) Naval Training Center Orlando, Florida</p>											
Analyte	Range of Detected Concentrations	Exposure Point Concentration	Total Excess Lifetime Cancer Risk (Based on Risk to Resident [adult and child])			Total Hazard Index (Based on Risk to Child Resident)			Florida Surface Water Cleanup Target Level ¹	Region IV Water Quality Standards ²	Background Screening Concentration
			10 ⁴	10 ⁵	10 ⁶	3	1	0.1			
<u>Volatile Organic Compounds (µg/l)</u>											
Tetrachloroethene	19	19	NR	11	1.1	NA	NA	NA	8.85	0.8	NA
Trichloroethene	17 to 57	57	NR	NR	9.8	NA	NA	NA	80.7	2.7	NA
Vinyl chloride	35	35	NR	22	2.2	NA	NA	NA	NSC	2	NA
<u>Pesticides (µg/l)</u>											
4,4'-DDT	0.03	0.03	NR	NR	0.008	NA	NA	NA	0.00059	0.00059	NA
Endrin	0.01	0.01	NA	NA	NA	NA	NA	NA	0.0023	0.76	NA
<p>¹ U.S. Environmental Protection Agency (USEPA), Region IV Water Quality Standards for human health criteria (water and organism consumption) (USEPA, 1996b).</p> <p>² Florida Surface Water Cleanup Target Levels for freshwater (Chapter 62-777; FDEP, 1999).</p> <p>Notes: µg/l = micrograms per kilograms. NR = not reported because the calculated RGO exceeds the EPC. NA = not applicable. NSC = no screening concentration. DDT = dichlorodiphenyltrichloroethane.</p>											

USEPA and FDEP target HI of one, primarily due to chlorinated VOCs and antimony (antimony plume).

- Groundwater risks in excess of risk thresholds are associated with theoretical future use of the groundwater as drinking water; risks for potential migration of VOCs from groundwater to indoor air are well below USEPA and Florida risk thresholds.

9.0 ECOLOGICAL RISK ASSESSMENT

This ERA evaluates actual and potential adverse effects to ecological receptors associated with exposure to contamination from OU 4 at NTC, Orlando. The ERA for OU 4 was completed in accordance with current guidance materials for ERAs at Superfund sites including the following:

- *Risk Assessment Guidance for Superfund: Environmental Evaluation Manual* (USEPA, 1989c),
- *Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference* (USEPA, 1989d),
- *Framework for Ecological Risk Assessment* (USEPA, 1992f),
- *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (USEPA, 1997b),
- *Supplemental Guidance to RAGS: Region 4 Bulletins on Ecological Risk Assessment* (USEPA, 1995b-e), and
- *Guidelines for Ecological Risk Assessment* (USEPA, 1998a).

Risk assessment guidance included in the USEPA "Eco Update" bulletins (published since 1991) and other recent publications (e.g., Maughan, 1993; Suter, 1993) were also consulted.

OU 4 consists of Sites 12, 13, and 14 (the former laundry facility and the DRMO), from which historic releases of dry-cleaning solvents have occurred to the ground surface. Insecticides, paints, and other hazardous materials have been stored and used at the site. No known spills or releases of these materials has occurred at the site. Subsequent leaching of chlorinated solvents to groundwater has occurred; chlorinated VOCs have migrated in groundwater and are discharging to Lake Druid, which is a nineteen-acre water body located approximately 300 feet west of OU 4. The primary purpose of the OU 4 ERA is to provide a screening-level evaluation of potential risks to semi-aquatic and aquatic receptors posed by the presence of chlorinated VOCs in groundwater, and to VOCs, PAHs, pesticides, and metals in surface water and sediment. In addition, the OU 4 ERA contains a screening-level evaluation of potential risks to terrestrial receptors from exposure to PAHs, pesticides and metals detected in surface soil.

A discussion of the history and layout of OU 4 is provided in Chapter 1.0, followed by a discussion of the nature and extent of contamination (Chapter 5.0) and contaminant fate and transport mechanisms (Chapter 7.0). The OU 4 ERA includes Site Characterization (Section 9.1); Problem Formulation and Conceptual Site Model (Section 9.2); Analysis (Section 9.3), including Identification of COPC (Subsection 9.3.1), Ecological Exposure Assessment (Subsection 9.3.2), and Ecological Effects Assessment (Subsection 9.3.3); Ecological Risk Characterization (Section 9.4); Uncertainty Analysis (Section 9.5); and Summary and Conclusions (Section 9.6).

9.1 SITE CHARACTERIZATION. OU 4 is located within Area C of NTC, Orlando and includes SA 12 (DRMO Warehouses and Salvage Yard), SA 13 (former base laundry and dry-cleaning facility), and SA 14 (DRMO storage area) (Figure 1-3). As previously described in Subsection 2.6.4, HLA ecologists visited OU 4 in October 1997 to characterize the habitats (shown on Figures 9-1 and 9-2) and to identify characteristic flora and fauna that exist at the site to determine appropriate ecological receptors in support of the ERA. HLA ecologists generally followed the field guidelines provided by USEPA (1989d).

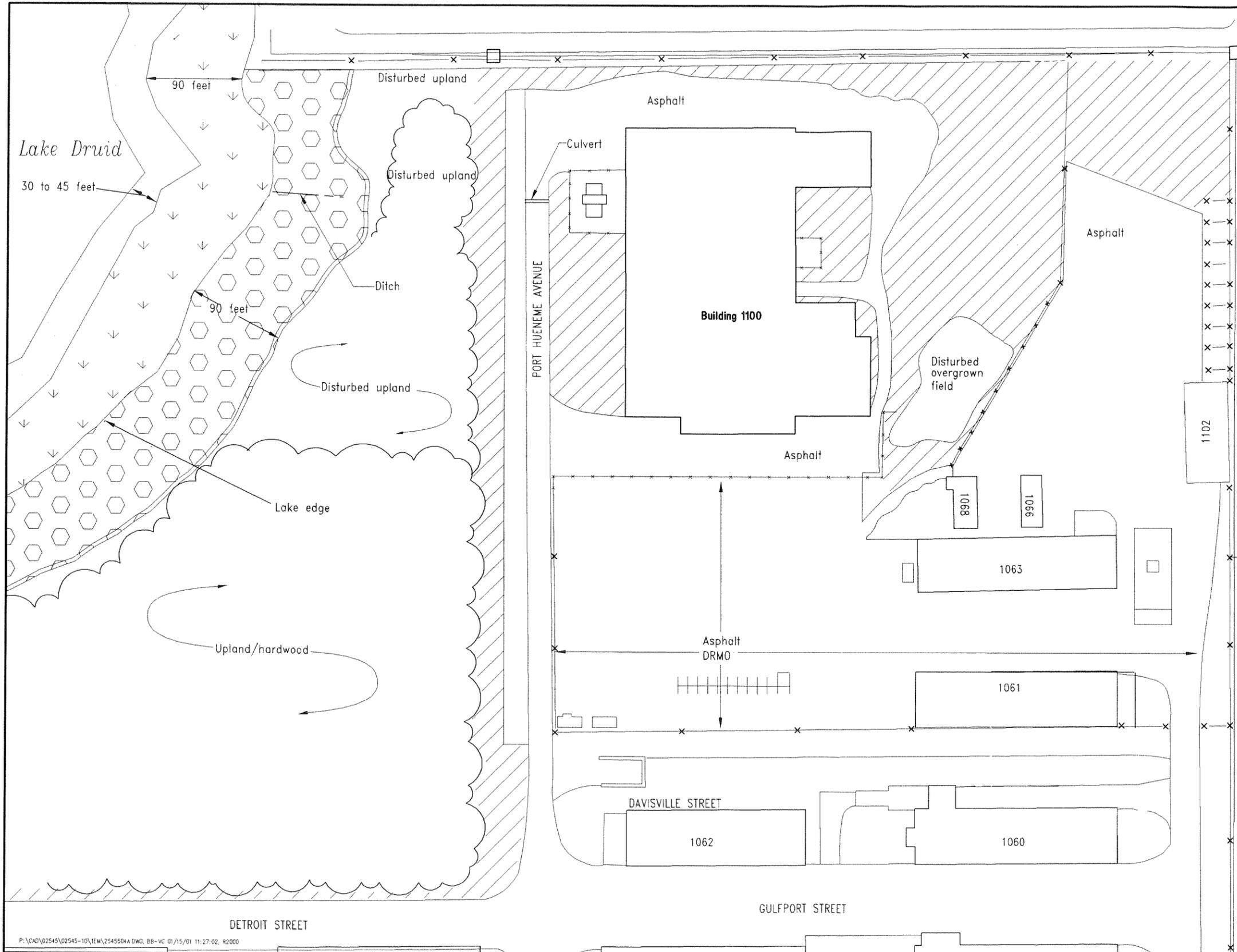
The site characterization is divided into five paragraphs: 9.1.1 discusses the terrestrial habitats at OU 4, 9.1.2 discusses terrestrial receptors, 9.1.3 discusses wetland and aquatic habitat at OU 4, 9.1.4 discusses aquatic receptors, and 9.1.5 provides a summary of rare, endangered, or commercially exploited species that may be potentially found at OU 4.

9.1.1 Terrestrial Habitats Approximately five percent of the NTC, Orlando installation (roughly 100 acres basewide) is undeveloped, providing a limited amount of habitat for ecological receptors. OU 4 is located in a developed portion of the base and is primarily paved or covered by buildings, with occasional mowed grass and ornamental shrubs. It is likely that the land use in the developed portions of the site will remain industrial in the future. A vegetative cover map of terrestrial habitats at OU 4 is provided on Figure 9-1. The entire area of SA 12, which includes DRMO warehouses, the salvage yard, and truck scales, is paved. The property surrounding Building 1100 at SA 13 is paved asphalt, except for small areas north, east, and west of the building that are landscaped and grass-covered. SA 14 includes Building 1102 and the surrounding paved and grass areas. A small culvert, which collects stormwater runoff from the site, runs under Port Hueneme Avenue. Storm water discharges from the culvert to a grassy clearing that does not typically retain surface water. The grassy clearing ends at the upland-forested area, which lacks any drainage features.

OU 4 also contains a forested area that is approximately 6 acres and lies between the former laundry facility and Lake Druid. Within the forested area, three vegetative communities were identified by HLA associates: disturbed upland forest, upland hardwood forest, and forested wetland. Dominant species in the disturbed upland forest include a scattered canopy of long leaf pine (*Pinus palustris*), slash pine (*P. elliottii*), and cabbage palm (*Sabal palmetto*). The upland hardwood forest is dominated by a closed canopy of live oak (*Quercus virginiana*) and pine trees (*Pinus* sp.), with a fairly dense understory of dwarf palmetto (*Sabal minor*). Other dominant species include wax myrtle (*Myrica cerifera*) and various vines, including muscadine grape (*Vitis rotundifolia*), Virginia creeper (*Parthenocissus quinquefolia*), and honeysuckle (*Lonicera* sp.).

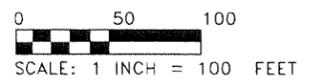
The characteristics of the forested wetland are discussed in Subsection 9.1.3. A complete list of plant species observed by HLA ecologists adjacent to OU 4 in the forested area is included in Appendix F-1, Table F-1-1.

9.1.2 Terrestrial Receptors The upland portions of OU 4 offer little, if any, habitat to ecological receptors because the majority of the sites are paved. However, the forested area between the former laundry facility and the shoreline of Lake Druid may support a variety of wildlife. During the ecological survey, a red fox (*Vulpes vulpes*), red-headed woodpecker (*Melanerpes erythrocephalus*), peacock, bluejay (*Cyanocitta cristata*), and numerous species of skinks,



LEGEND

- Fence
- Maintained grass
- Persistent emergent palustrine wetland
- Broad-leaved evergreen forested palustrine wetland
- Aquatic bed
- Tree line
- DRMO Defense Reutilization and Marketing Office



**FIGURE 9-1
ECOLOGICAL HABITAT COVER MAP
TERRESTRIAL AND WETLAND HABITATS**

**REMEDIAL INVESTIGATION
OPERABLE UNIT 4**

**NAVAL TRAINING CENTER
ORLANDO, FLORIDA**

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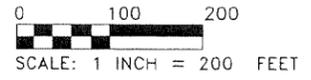
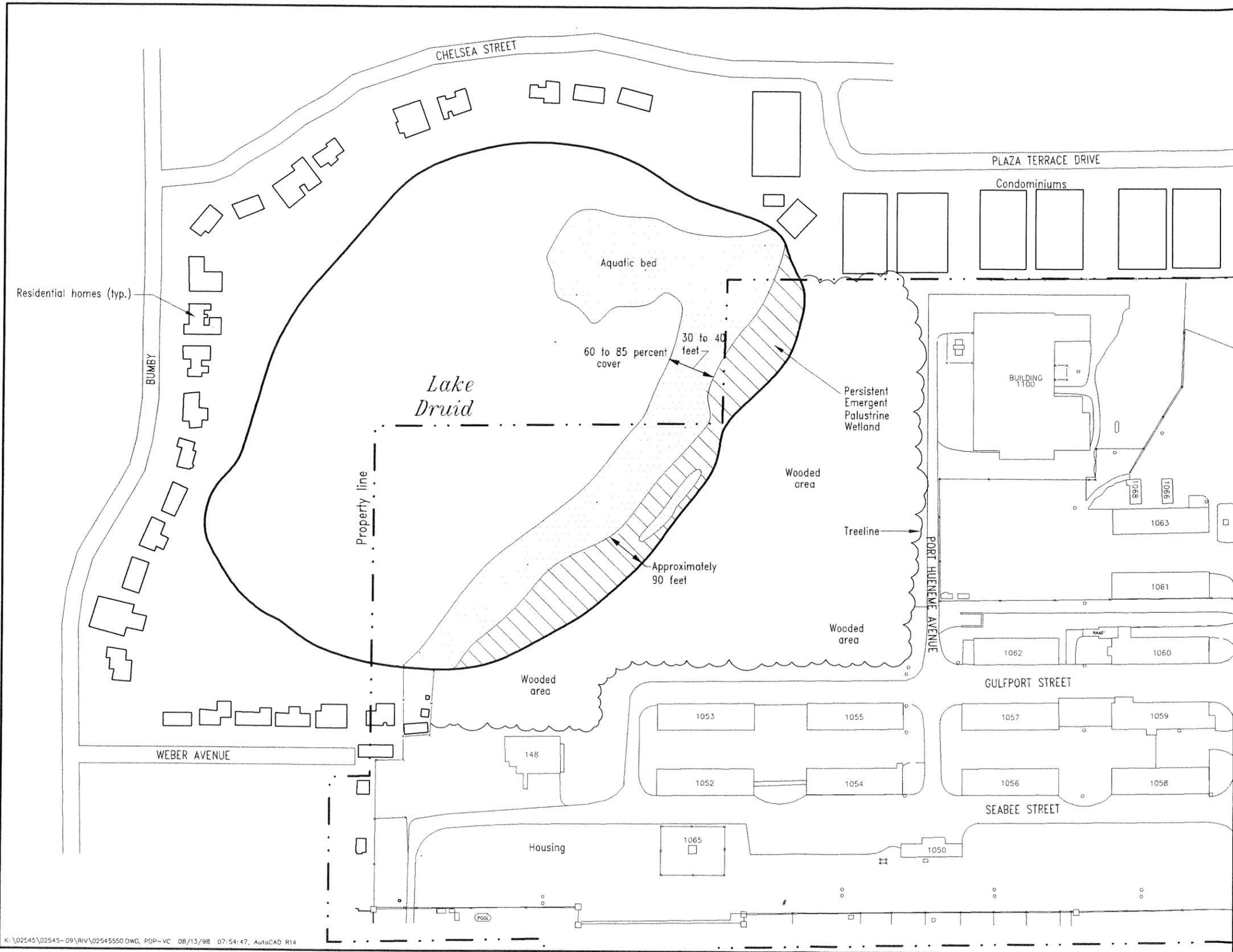


FIGURE 9-2
ECOLOGICAL HABITAT COVER MAP
LAKE DRUID



REMEDIAL INVESTIGATION
OPERABLE UNIT 4

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

blackbirds (*Euphagus* sp.), grackles (*Quiscalus* sp.), and swallows (*Progne* sp.) were observed in the upland forested areas. A number of burrows were also found in the upland forested areas. However, the shape of the burrows was not consistent with gopher tortoise burrows. In addition, the water table in the forested and wetland portions of the site (i.e., close to Lake Druid) may be too shallow for gopher tortoise habitation. Therefore, it is unlikely that gopher tortoises occur at OU 4.

Other wildlife species that may be found in the terrestrial portions of OU 4 include a variety of insects, frogs, squirrels, woodpeckers, barred owl (*Strix varia*), hawks (*Buteo* sp.), raccoon (*Procyon lotor*), eastern cottontail rabbit (*Sylvilagus floridanus*), hispid cotton rat (*Sigmodon hispidis*), cotton mouse (*Peromyscus gossypinus*), black vulture (*Coragyps atratus*), turkey vulture (*Cathartes aura*), mourning dove (*Zenaida macroura*), brown-headed cowbird (*Molothrus ater*), brown thrasher (*Toxostoma rufum*), bobwhite quail (*Colinus virginianus*), mockingbird (*Mimus polyglottos*), killdeer (*Charadrius vociferus*), northern cardinal (*Cardinalis cardinalis*), rufous-sided towhee (*Pipilo erythrophthalmus*), common flicker (*Colaptes auratus*), red-bellied woodpecker (*Melanerpes carolinus*), and great horned owl (*Bubo virginianus*).

Several species of venomous snakes may occur in the area, including the eastern coral snake (*Micrurus fulvius fulvius*), dusky pygmy rattlesnake (*Sistrurus miliaris barbouri*), and eastern diamondback rattlesnake (*Crotalus adamanteus*). These snakes are among the top predators in the food chain at the installation. Rattlesnakes feed on rodents, birds, amphibians, and small reptiles. Coral snakes ingest other snakes, lizards, and amphibians.

9.1.3 Wetland and Aquatic Habitat Lake Druid lies approximately 300 feet west of OU 4. Lake Druid is nineteen acres in size and is used for public recreation. The lake is classified by the State of Florida as Class III Water, suitable for fish and wildlife propagation. Figure 9-2 shows the aquatic habitats identified by HLA ecologists during the October 1997 site visit.

The forested wetland adjacent to Lake Druid extends approximately 100 feet to the east/southeast. This area is best characterized as a palustrine broad-leaved evergreen wetland forest. There are a network of drainage features present within the forested wetland. The thick canopy is dominated by evergreen bays, including magnolia (*Magnolia* sp.), sweet bay (*M. virginiana*), and bayberry (*Myrica cerifera*). Primrose willow (*Ludwigia peruviana*) dominates the perimeter of the forested wetland, near the edge of Lake Druid. The substratum is covered with dense patches of ferns including netted chain fern (*Woodwardia aerolata*), cinnamon fern (*Osmunda cinnomomea*), swamp fern, royal fern (*Osmunda regalis*), and marsh fern (*Thelypteris palustris*).

HLA ecologists observed that the forested wetland area transitions into a concentric band of palustrine persistent emergent wetland approximately 90 to 100 feet wide. The emergent wetland class is characterized by erect, rooted, herbaceous hydrophytes that are present for most of the growing season (Cowardin et al., 1979). Dominant vegetation in the emergent wetland area includes cattail (*Typha domingensis*), pickerel weed (*Pontederia cordata*), saw grass (*Cladium jamaicanse*), sedges (e.g., *Cyperus haspan*), and rushes (*Juncus* sp.). In addition, a species of orchid (*Habenaria repens*) was also observed in the emergent wetland.

The emergent wetland area transitions into a bed of floating aquatic vegetation. The floating aquatic bed extends approximately 30 to 40 feet beyond the emergent wetland on the eastern side of Lake Druid (in the vicinity of OU 4), and up to 120 feet beyond the emergent wetland areas in other portions of Lake Druid. Figure 9-2 depicts the approximate coverage of the emergent and aquatic bed wetland areas within Lake Druid. The aquatic bed is dominated by plants that principally grow on or below the surface of the water for most of the growing season (Cowardin et al., 1979). Fragrant white water lily (*Nymphaea odorata*) and yellow cow lily (*Nuphar luteum orbiculatum*) were the dominant vegetation in the aquatic bed portions of Lake Druid. During the ecological survey, a strong sulfide odor characteristic of anoxic conditions was detected in areas where the sediment was disturbed.

A complete list of plant species observed by HLA ecologists adjacent to OU 4 in the wetland and aquatic bed area included in Appendix F-1, Table F-1-1.

9.1.4 Aquatic Receptors Aquatic and semi-aquatic life observed in Lake Druid and the surrounding wetland area by HLA ecologists include gastropods (shell casings), mosquitofish (*Gambusia* sp.), and several birds including the American coot (*Fulica americana*), common gallinule (*Gallinula chloropus*), green heron (*Butorides striates*), and American anhinga (*Anhinga anhinga*).

The lake shore and small storm drainage ditches associated with Lake Druid may provide suitable habitat for populations of aquatic invertebrates, amphibians, and small fish species; great blue herons (*Ardea herodias*), which feed primarily on small fish and amphibians, could also forage in these ditches. Lake Druid also provides suitable habitat for a number of fish species, including smallmouth bass (*Micropterus salmoides*), bluegill sunfish (*Lepomis macrochirus*), redear sunfish (*Lepomis microlophus*), golden shiner (*Notemigonus crysoleuca*), yellow bullheads (*Ictalurus natalis*), and killifish (*Fundulus* spp.), as well as aquatic invertebrates (C.C. Johnson and Associates, 1985). According to the NTC, Orlando Master Plan Update (SOUTHNAVFACENCOM, 1985), grass carp (*Ctenopharyngodon idella*) have been introduced into several of the larger lakes to control Florida elodea (*Hydrilla verticillata*), an invasive, rapidly growing aquatic weed that can choke waterways (C.C. Johnson and Associates, 1985). However, grass carp are not believed to be present in Lake Druid.

Amphibians that may occur in the vicinity of OU 4 include frogs (e.g., members of the genera *Hyla*, *Rana*, and *Pseudacris*), toads (*Bufo* spp.), and possibly some salamanders. The Florida cottonmouth (*Agkistrodon piscivorus*), a venomous aquatic snake inhabiting lakes, rivers, swamps and ditches, may also occur in the ditches associated with Lake Druid. The cottonmouth feeds on fish, amphibians (e.g., frogs and salamanders), small to medium sized reptiles (e.g., lizards, small turtles, baby alligators), and small birds and mammals. Turtles and other aquatic and semi-aquatic reptiles (e.g., the American alligator, *Alligator mississippiensis*) may also occur in the vicinity of Lake Druid.

9.1.5 Rare, Endangered, and Threatened Species The Endangered Species Act of 1973 (Public Law 93-0205), as amended, defines a species as endangered when its prospects of survival and reproduction are in immediate jeopardy. A species is defined as threatened or rare when, although not immediately facing extinction, it occurs in such small numbers throughout its range that it may become endangered if its present environmental conditions deteriorate.

Federal- and State-listed threatened, endangered, and candidate species that occur or potentially occur at NTC, Orlando are listed in Table 9-1. In addition, cooperating biologists from the State of Florida and U.S. Department of Interior have surveyed NTC, Orlando Complex and have reported that a number of both state and federally-listed species are either resident or transients, and must be specifically protected (SOUTHNAVFACENCOM, 1984). These species are described in further detail below.

The gopher tortoise (*Gopherus polyphemus*) is listed as a species of special concern by the State of Florida (ABB-ES, 1994) and has been identified as a candidate species for special listing by the USFWS. Studies and visual observations of new burrows by base personnel support the supposition that the gopher tortoise is a confirmed resident. This species typically resides on the southern end of McCoy Annex and Herndon Annex (ABB-ES, 1994). Although gopher tortoise burrows have been observed at the golf course on the Main Base, none have been observed at OU 4 (the burrows observed at OU 4 were not the correct configuration for gopher tortoise burrows). It is possible that gopher tortoises do not inhabit the forested or wetland portions of OU 4 where the water table may be very close to the ground surface (i.e., 2 to 3 feet bls). The indigo snake (*Drymarchon corais*), listed as "threatened" by the USFWS and by the State of Florida, typically co-winters with the gopher tortoise. In a 1992 study, no indigo snakes were found at NTC, Orlando (SOUTHNAVFACENCOM, 1992).

The American alligator (*Alligator mississippiensis*), listed as a species of special concern in the State of Florida and threatened due to similar appearances by the USFWS, is a confirmed resident. The species typically resides in wetlands, lakes, and swamps found on the base (ABB-ES, 1994). Alligators currently inhabit several of the wetland areas on the base (SOUTHNAVFACENCOM, 1987).

The Main Base is in the habitat range of the threatened Florida scrub jay (*Aphelocoma coerulescens*), but this species has not been sighted at the base. McCoy Annex has the greatest potential for habitat for the jay, but no individuals were sighted in the 1984 survey (ABB-ES, 1996a). It is unlikely that the Florida scrub jay would take up residence at NTC, Orlando because of dwindling habitat in the region.

The Main Base is also in the habitat range of the southeastern American kestrel (*Falco sparverius*), which is listed as threatened by the State of Florida. In a 1987 study, the kestrel was not located at NTC, Orlando and, as a result, is not considered a likely resident. The Main Base is also in the habitat range of the Florida mouse (*Peromyscus floridanus*), which is listed as threatened by the State of Florida. In support of the Natural Resources Management Plan, efforts were made to locate the mouse via trapping; however, no Florida mice were caught. Therefore, it was concluded that the Florida mouse is not likely to be a resident of NTC, Orlando (SOUTHNAVFACENCOM, 1987).

9.2 PROBLEM FORMULATION AND CONCEPTUAL SITE MODEL. The problem formulation is the initial step of the ERA process. In this section, the general ecological concerns at the site are identified and a brief conceptual site model is outlined, which describes the ways in which ecological receptors could potentially be exposed to contaminated media at the site. Potentially exposed

**Table 9-1
Federal- and State-Listed Threatened, Endangered and Candidate Species that Occur or
Potentially Occur at the Naval Training Center, Orlando, Florida**

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Species		Residence Status ¹	Status ²	
Common Name	Scientific Name		USF&WS ³	FNAI ³
<u>Reptiles and Amphibians</u>				
Sand Skink	<i>Neoseps reynoldsi</i>	PR	T	T
Eastern Indigo Snake	<i>Drymarchon corais couperi</i>	PR	T	T
Florida Scrub Lizard	<i>Sceloporus woodi</i>	PR	C2	N
Short-Tailed Snake	<i>Stilosoma extenuatum</i>	PR	C2	T
Gopher Tortoise	<i>Gopherus polyphemus</i>	CR	C2	SC
American Alligator	<i>Alligator mississippiensis</i>	CR	T/SA	SC
<u>Birds</u>				
Florida Scrub Jay	<i>Aphelocoma coerulescens</i>	UR	T	T
Limpkin	<i>Aramus quarauna</i>	PM	--	SL
Florida Sandhill Crane	<i>Grus canadensis pratensis</i>	LM	--	T
Audubon's Crested Caracara	<i>Polyborus plancus audubonii</i>	PM	T	T
Wood Stork	<i>Mycteria americana</i>	LM	E	E
Red-Cockaded Woodpecker	<i>Picoides borealis</i>	UR	E	E
Everglade Snail Kite	<i>Rostrhamus sociabilis plumbeus</i>	UM	E	E
Bald Eagle	<i>Haliaeetus leucocephalus</i>	LM	E	T
Peregrine Falcon	<i>Falco peregrinus</i>	LM	E	E
Southeastern American Kestrel	<i>Falco sparverius</i>	UR	--	T
<u>Mammals</u>				
Florida Black Bear	<i>Ursus americanus floridanus</i>	UM	C2	T
Florida Mouse	<i>Podomys floridanus</i>	UR	C2	T
Sherman's Fox Squirrel	<i>Sciurus niger shermani</i>	PR	C2	SL
<u>Invertebrates</u>				
Wekiwa Spring Aphaostracon	<i>Aphaostracon monas</i>	UR	C2	--
Wekiwa Spring Snail	<i>Cincinnatia wekiwae</i>	UR	C2	--
Palm Springs Cave Crayfish	<i>Procambarus acheroniis</i>	UR	C2	--
See notes at end of table.				

Table 9-1 (Continued)
Federal- and State-Listed Threatened, Endangered and Candidate Species that Occur or Potentially Occur at the Naval Training Center, Orlando, Florida

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Species		Residence Status ¹	Status ²	
Common Name	Scientific Name		USF&WS ³	FNAI ³
Plants				
Papery Whitlow-Wort	<i>Paronychia chartacea</i>	UR	T	T
Scrub Lupine	<i>Lupinus aridorum</i>	UR	E	E
Rugel's Pawpaw	<i>Deeringothamnus rugelii</i>	UR	E	E
Florida Bonamia	<i>Bonamia grandiflora</i>	UR	T	E
Curtiss' Milkweed	<i>Asclepias curtissii</i>	UR	-	E
Beautiful Pawpaw	<i>Deeringothamnus pulchellus</i>	UR	E	E
Scrub Holly	<i>Ilex opaca var arenicola</i>	UR	3C	T
Nodding Pinweed	<i>Lechea cernua</i>	UR	3C	E
Fall-Flowering Ixia	<i>Nemastylis flordana</i>	PR	C2	E
Florida Bear-Grass	<i>Nolina atopocarpa</i>	UR	C2	E
Britton's Bear-Grass	<i>Nolina brittoniana</i>	UR	C1	E
Hand Fern	<i>Ophioglossum plamatum</i>	UR	3C	E
Lewton's Polygala	<i>Polygala lewtonii</i>	UR	C1	E
Small's Jointweed	<i>Polygonella myriophylla</i>	UR	C1	N
Scrub Plum	<i>Prunus geniculata</i>	UR	E	E
Scrub Bay	<i>Persea humilis</i>	UR	3C	N
Sand Butterfly Pea	<i>Centrosema arenicola</i>	UR	3C	N

¹ Residence Status: CR = Confirmed resident. CM = Confirmed migrant or occasional Visitor.
LR = Likely resident. LM = Likely migrant or occasional Visitor.
PR = Possible resident. PM = Possible migrant or occasional Visitor.
UR = Unlikely resident. UM = Unlikely migrant or occasional Visitor.

² Status: E = Endangered. 3C = Candidate species for federal listing, Category 3C.
T = Threatened. C2 = Candidate species for federal listing, Category 2.
SL = State-listed. T/SA = Threatened due to similarity of appearance.
SC = Of concern, State. CL = Proposed to be listed.
- = No status.

³ Agency: N = Not currently listed/not currently being considered to be listed by state and federal agencies.
USF&WS = U.S. Fish and Wildlife Service.
FNAI = Florida Natural Areas Inventory.

receptors, exposure pathways, and the assessment and measurement endpoints are identified in this section based on the site characterization.

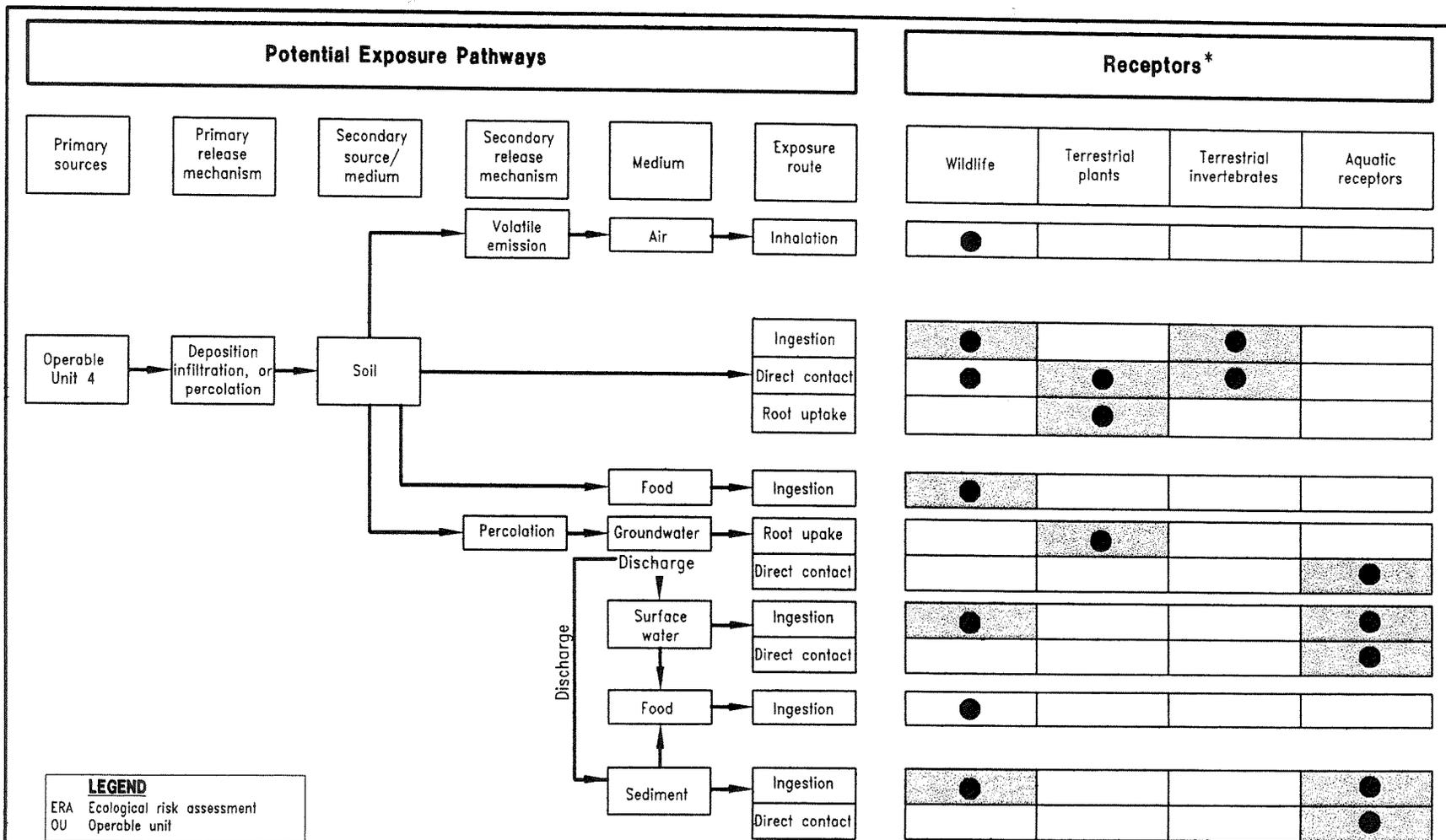
The information presented in Chapter 5.0 suggests that spills and improper disposal of chlorinated VOCs at OU 4 introduced chlorinated VOCs to environmental media. PCBs may be present in soil from historic transformer casings, and metals may be present due to paint storage at the DRMO. The source of PAHs detected in environmental media at OU 4 is unknown; however, it is believed these chemicals may be present as a result of common anthropogenic sources (e.g., road runoff). Pesticides, which were also detected in OU 4 media, were stored in small quantities at the DRMO. However they are not likely associated with historical activities at OU 4. Rather, the presence of pesticides at OU 4 is likely associated with historical pesticide land applications and subsequent drainage at NTC, Orlando and the surrounding neighborhood and adjacent office park.

The magnitude, pattern, and frequency of detection of chemicals in OU 4 media are also discussed in Chapter 5.0. The fate and transport of chlorinated VOCs and other chemicals detected in OU 4 media are discussed in further detail in Chapter 7.0. The primary ecological effects associated with chlorinated VOCs include depressed central nervous system (CNS) activity, or narcosis. Pesticides are known to bioaccumulate in the food chain, causing sublethal reproductive effects to avian species, including eggshell thinning, reduced egg hatchability, and lower hatchling survival. The numerous PAHs and metals detected in OU 4 media may also have a variety of growth, reproductive, and survival effects on wildlife.

9.2.1 Identification of Receptors Freshwater semi-aquatic and aquatic receptors (i.e., piscivorous birds, omnivorous birds and mammals, fish, invertebrates, amphibians, and aquatic plants) are found in Lake Druid, and are evaluated in the OU 4 ERA because groundwater from the site discharges to Lake Druid. Ecological receptors that may potentially utilize the forested portions of OU 4 include terrestrial wildlife (i.e., mammals, birds, reptiles, and amphibians), terrestrial plants, and soil invertebrates; these receptors are evaluated in the OU 4 ERA because they may be exposed to chemicals detected in surface soil.

Certain species that potentially reside at NTC, Orlando are protected by Federal and/or State laws. A list of state and federally protected species is provided in Table 9-1. Although gopher tortoises have been observed in the golf course, no state or federally listed rare, threatened, or endangered species or species of concern are known to inhabit OU 4. The gopher tortoise is not expected to occur in the forested or wetland portions of OU 4 where the water table may be very close to the surface (i.e., 2-3 feet).

9.2.2 Identification of Exposure Pathways Exposure pathways are identified for four groups of receptors (terrestrial wildlife, terrestrial plants, soil invertebrates, and aquatic receptors). A complete exposure pathway includes a source of contamination, an exposure route, and a receptor. The primary exposure pathway from the OU 4 contaminant source to sensitive ecological receptors includes solvents that were spilled on the ground or improperly disposed of at the former laundry facility, subsequent surface and subsurface soil contamination, leaching of solvents to groundwater, migration of contaminants in groundwater to Lake Druid (approximately 300 feet to the west), and discharge to surface water. A conceptual model of the exposure pathways from source to ecological receptors is depicted in the contaminant pathway model on Figure 9-3.



NOTE:

* Shading Indicates the exposure pathways that are quantitatively evaluated for receptors in the OU 3 ERA. Nonshaded pathways are evaluated qualitatively, not evaluated due to the lack of toxicity information, not evaluated because it is not considered a significant pathway, or evaluated under a different operable unit.

**FIGURE 9-3
CONTAMINANT PATHWAY MODEL FOR
ECOLOGICAL RECEPTORS**



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All potential routes of exposure considered in the ERA are presented in the contaminant pathway model. The model differentiates between those exposure routes that are quantitatively evaluated and those that are qualitatively discussed. Exposure pathways that are not shaded are either evaluated qualitatively or are not evaluated in this ERA. This limitation is necessary to focus the risk evaluation on those pathways for which contaminant exposures are the highest and most likely to occur based on the types of contaminants and receptors present at the site. Those pathways that cannot be quantitatively evaluated, due to a lack of toxicological information, are qualitatively discussed and addressed as uncertainties. The general approach used to identify exposure pathways for ecological receptors is explained below.

Terrestrial and Semi-Aquatic Wildlife. Terrestrial and semi-aquatic wildlife may be exposed to contaminants in surface soil, surface water, sediment, and food items via ingestion, dermal adsorption, and inhalation of fugitive dust and VOC emissions. The wildlife exposure routes that are believed to contribute the highest potential contaminant exposures include ingestion of food items (e.g., aquatic receptors) that are contaminated as a result of bioaccumulation of constituents (e.g., pesticides and PCBs) from site media (e.g., sediment).

Although dermal exposures may be a viable exposure pathway for amphibians, reptiles, and young, hairless mammals in subterranean dens (e.g., juvenile muskrats), dermal adsorption is considered to be a negligible exposure pathway because the presence of fur, feathers, or chitinous exoskeleton is likely to prevent contamination from contacting skin (USEPA, 1997c). Soil trapped in the fur or feathers is likely to be ingested during grooming or preening activities; this pathway is evaluated as part of the indirect ingestion exposure pathway.

Exposure via inhalation of fugitive dust is also not likely to be a significant exposure pathway because the vegetation in the forested portions of OU 4 would limit the release of fugitive dust. Although chlorinated VOCs are the primary contaminants associated with OU 4 groundwater, an evaluation of exposures to burrowing mammals from inhalation of VOC emissions is not included as part of the OU 4 ERA. This is due primarily to a lack of inhalation toxicity data relating groundwater concentrations of VOCs with air concentrations in subterranean dens, and the subsequent population-level effects on burrowing mammals (i.e., effects on survival, growth, or reproduction). Furthermore, mammals are not likely to burrow in areas where groundwater is near the ground surface. Therefore, inhalation of VOCs represents an incomplete exposure pathway, and was not evaluated in the ERA. This uncertainty is addressed in Section 9.5.

Potential contaminant exposures via the ingestion pathway for reptiles and adult amphibians exist at NTC, Orlando; however, ingestion toxicity data and bioaccumulation factors (BAFs) are generally not available for these receptors. Therefore, potential risks to these receptors associated with ingestion of surface soil and food items will be qualitatively addressed in the Section 9.5 (the Uncertainties Section of the ERA).

Terrestrial Plants and Invertebrates. Terrestrial plants and soil invertebrates may be exposed to contamination in surface soil by direct contact with and root uptake (plants) or ingestion (invertebrates) of soil. Terrestrial plants are not likely to be exposed to contamination in groundwater at OU 4 because groundwater is roughly 6 to 8 feet bls in the upland portions of the site.

Aquatic Receptors. Exposure pathways for aquatic receptors in Lake Druid include the following:

- direct contact of benthic (i.e., sediment dwelling) organisms with groundwater, prior to discharge to surface water of Lake Druid;
- direct contact of pelagic (i.e., water column) organisms with surface water; and
- direct contact of benthic organisms with sediment.

Although direct contact exposures to benthic organisms from chemicals in sediment and groundwater are similar (i.e., from the dissolved phase of chemicals detected in pore water), the means of evaluating risks to these receptors from exposure to target compounds is slightly different. For instance, effects data are available for chlorinated VOCs in water, but are not available for sediment. Also, certain chemicals (i.e., pesticides and PCBs) were detected in sediment, but not in groundwater. Therefore, direct contact exposures for benthic organisms are evaluated for both groundwater and sediment. It is conservatively assumed that concentrations of constituents in groundwater from OLD-13-09A and the well points adjacent to Lake Druid are representative of constituent concentrations in groundwater, just prior to discharge to Lake Druid.

Aquatic and wetland plants may also be exposed to groundwater constituents in the forested wetland portion of the site where groundwater may be 2 feet bls. This pathway was evaluated as part of the ERA; however for clarity, potential aquatic plant and benthic organism exposures to chemicals in groundwater are treated as one pathway in the OU 4 ERA.

9.2.3 Identification of Endpoints Based on USEPA guidance (USEPA 1989c, 1992f, 1997b), an important step in the problem formulation process is the identification of assessment and measurement endpoints, which must be completed before exposure, toxicity, or risk can be estimated. Endpoints are used in the ERA to define the ecological attributes to be protected or assessed (assessment endpoints) and to define measurable characteristics of those attributes that can be used to gauge the degree of impact that may occur (measurement endpoints). Assessment endpoints most often relate to attributes of biological populations or communities (e.g., abundance, productivity); individual-based assessment endpoints typically are relevant only if endangered species are present.

Assessment endpoints should have social relevance (i.e., be valued by society) and biological relevance, be measurable or predictable, and be susceptible to the hazard or stress while being evaluated. Measurement endpoints should be related to or predictive of the assessment endpoint; readily measurable; and appropriate to the exposures pathways, size, and temporal dynamics of the site (USEPA, 1997c).

As previously mentioned, the migration of chlorinated VOCs in groundwater and the subsequent discharge to Lake Druid is the primary exposure pathway at OU 4. Chlorinated VOCs are generally associated with depressed CNS activity, or narcosis. However, the effects data for aquatic organisms exposed to chlorinated VOCs are generally based on other, more measurable endpoints (e.g., survival, growth, reproduction, or immobility). Studies measuring immobility effects on fish (which may affect predator avoidance) may be related to the narcotic effects of chlorinated VOC exposure; however, this is not certain. Given this, the specific objective of the OU 4 ERA is to determine if the concentrations of VOCs

in environmental media are likely to cause a significant decline in aquatic receptor populations, either by causing direct mortality or by reducing the abundance of receptors within a population. Chlorinated VOCs do not bioaccumulate via the food chain; therefore, effects to terrestrial wildlife from exposure to these chemicals are unlikely.

PAHs may be directly toxic to aquatic life at high concentrations (i.e., tens of ppm), or may be related to carcinogenic effects in wildlife; little information is available on the toxic or reproductive effects PAHs have on wildlife. Pesticides, PCBs, and several metals are known to bioaccumulate via the food chain, which can subsequently result in a variety of reproductive effects (e.g., increased number of stillbirths and eggshell thinning) to predatory mammals and birds. A secondary objective of this ERA is to determine if the concentrations of pesticides, PCBs, and metals detected in surface soil, surface water, and sediment are likely to cause a significant decline in terrestrial and semi-aquatic receptor populations as a result of adverse reproductive effects.

In many cases the assessment endpoint cannot be readily measured or observed; therefore, measurement endpoints are often used as surrogates for assessment endpoints. For example, it is difficult and time-consuming to measure changes in abundance of a population, and even more difficult to attribute these changes in abundance to contaminant sources. Since site-specific toxicological data are not available, the measurement endpoints used to gauge the likelihood of population-level effects are toxicological benchmark values based on laboratory-measured effects. Dose-response data for survival, growth, reproduction, abundance, biomass, emergence, hatchability, immobility, and population growth were used as measurement endpoints because they can be measured relatively easily (i.e. from laboratory studies) and are directly related to the assessment endpoint of abundance. Benchmark values, also referred to as reference toxicity values (RTVs), represent threshold effect concentrations at, or below which, effects would not be expected.

Table 9-2 presents the medium, assessment endpoint, endpoint species, measurement endpoint, and decision point (i.e., the outcome at which additional evaluation may be warranted).

Several hypotheses were developed to gauge potential risks associated with exposure to OU 4 media. These hypotheses are designed for multiple species and trophic levels and represent both individual and community dynamics. The hypotheses for the OU 4 ERA are listed below.

1. Are ecological chemicals of potential concern (ECPCs) present in the surface water, sediment, and groundwater at concentrations sufficiently high to reduce the survival and maintenance of aquatic receptor populations along the OU 4 groundwater discharge zone of Lake Druid?
2. Are ECPCs (e.g., pesticides, PCBs, and mercury) present in surface water and sediment at concentrations sufficiently high as to adversely affect predatory mammal or piscivorous bird populations following consumption of contaminated prey?
3. Are ECPCs present in the surface soil at concentrations sufficiently high to reduce plant or soil invertebrate biomass or plant cover

Table 9-2
Endpoints for Ecological Risk Assessment, OU 4

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center
 Orlando, Florida

Medium	Study Area	Assessment Endpoint	Receptor	Measurement Endpoint	Decision Point
Surface Soil	Managed grass and forested areas of OU 4	Reduction in growth and yield of terrestrial plant populations.	Terrestrial Plants	Chemical concentrations (mg/kg) in surface soil that result in adverse effects on growth, reproduction, or survival to terrestrial plants.	The reasonable maximum exposure concentration (mg/kg) of an ECPC in surface soil is greater than the terrestrial plant RTV.
Surface Soil	Managed grass and forested areas of OU 4	Reduction in the abundance of soil invertebrate populations (e.g. earthworms).	Terrestrial Invertebrates	Chemical concentrations (mg/kg) in surface soil that result in adverse effects on survival (e.g. LC ₅₀ studies) or growth of terrestrial invertebrates.	The reasonable maximum exposure concentration (mg/kg) of an ECPC in surface soil is greater than the terrestrial invertebrate RTV.
Surface Soil	Managed grass and forested areas of OU 4	Survival and maintenance of wildlife populations.	Wildlife Species	Oral chemical dose (mg/kg BW/day) based on measured adverse effects on growth, reproduction, or survival (e.g., NOAEL, LOAEL and LD ₅₀ studies) of mammalian and avian laboratory test populations.	Comparison of potential dietary exposures in mammalian and avian wildlife with literature-derived RTVs. HQs > 1 indicate potential risk.
Surface Water/ Sediment	Lake Druid	Reduction in growth and yield of wetland plant populations	Wetland Plants	Chemical concentrations in surface water ($\mu\text{g}/\text{l}$) and sediment (mg/kg) that result in adverse effects on growth, reproduction, or survival to wetland plants.	The reasonable maximum exposure concentration of an ECPC in surface water ($\mu\text{g}/\text{l}$) or sediment (mg/kg) is greater than the plant RTV (in solution and soil, respectively).
Surface Water/ Sediment	Lake Druid	Survival and maintenance of fish, macroinvertebrate, amphibian populations.	Aquatic Receptors	Chemical concentrations in surface water ($\mu\text{g}/\text{l}$) and sediment (mg/kg) that result in adverse effects on survival (e.g. LC ₅₀ studies) or growth of fish, macroinvertebrates, and amphibians. Comparison of calculated fish tissue concentrations (mg/kg BW/day) to fish tissue concentrations associated with adverse effects.	The predicted exposure concentration in surface water and sediment in Lake Druid is greater than available criteria and aquatic-toxicity benchmark values. The calculated fish tissue concentrations, based on measured surface water and sediment concentrations exceed the measured fish tissue concentrations associated with adverse effects.
See notes at end of table.					

Table 9-2 (Continued)
Endpoints for Ecological Risk Assessment, OU 4

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Medium	Study Area	Assessment Endpoint	Receptor	Measurement Endpoint	Decision Point
Surface Water/ Sediment	Lake Druid/ Drainage Ditch	Survival and maintenance of semi-aquatic wildlife populations.	Semi-aquatic Wildlife Species	Oral chemical dose (mg/kg BW/day) based on measured adverse effects on growth, reproduction, or survival (e.g., NOAEL, LOAEL and LD ₅₀ studies) of mammalian and avian laboratory test populations.	Comparison of potential dietary exposures in mammalian and avian wildlife with literature-derived RTVs. HQs > 1 indicate potential risk.
Ground-water	Lake Druid	Reduction in growth and yield of terrestrial and wetland plant populations.	Terrestrial and Wetland Plants	Chemical concentrations in groundwater ($\mu\text{g}/\ell$) that result in adverse effects on growth, reproduction, or survival to terrestrial and wetland plants.	The reasonable maximum exposure concentration ($\mu\text{g}/\ell$) of an ECPC in groundwater discharging to Lake Druid is greater than the plant RTV (in solution).
Ground-water	Lake Druid	Survival and maintenance of fish, macro-invertebrate, amphibian populations.	Aquatic Receptors	Chemical concentrations in groundwater ($\mu\text{g}/\ell$) that result in adverse effects on survival (e.g. LC ₅₀ studies) or growth of fish, macroinvertebrates, and amphibians. Comparison of calculated fish tissue concentrations (mg/kg BW/day) to fish tissue concentrations associated with adverse effects.	The predicted exposure concentration of groundwater discharging to Lake Druid is greater than available criteria and aquatic-toxicity benchmark values. The calculated fish tissue concentrations exceed the measured fish tissue concentrations associated with adverse effects.
<p>Notes: OU = operable unit. mg/kg = milligrams per kilogram. ECPC = ecological chemical of potential concern. RTV = reference toxicity value. LC₅₀ = lethal concentration to 50 percent of a test population. LD₅₀ = lethal dose to 50 percent of a test population. BW/day = body weight per day. NOAEL = no observed adverse effect level. LOAEL = lowest observed adverse effect level. H1 = hazard quotient. > 1 = greater than. $\mu\text{g}/\ell$ = micrograms per liters.</p>					

availability such that small mammal and bird populations could be affected?

4. Are ECPCs concentrations in plants and invertebrates sufficiently high as to adversely affect foraging small mammal or bird populations following consumption of contaminated prey?
5. Are bioaccumulating chemicals sufficiently high in terrestrial wildlife prey items to reduce survivability, growth, or reproduction in top predators (e.g., foxes and owls)?

9.3 ANALYSIS. In the analysis phase, ECPCs are identified, and potential ecological exposures and associated effects are characterized in the exposure and effects assessments.

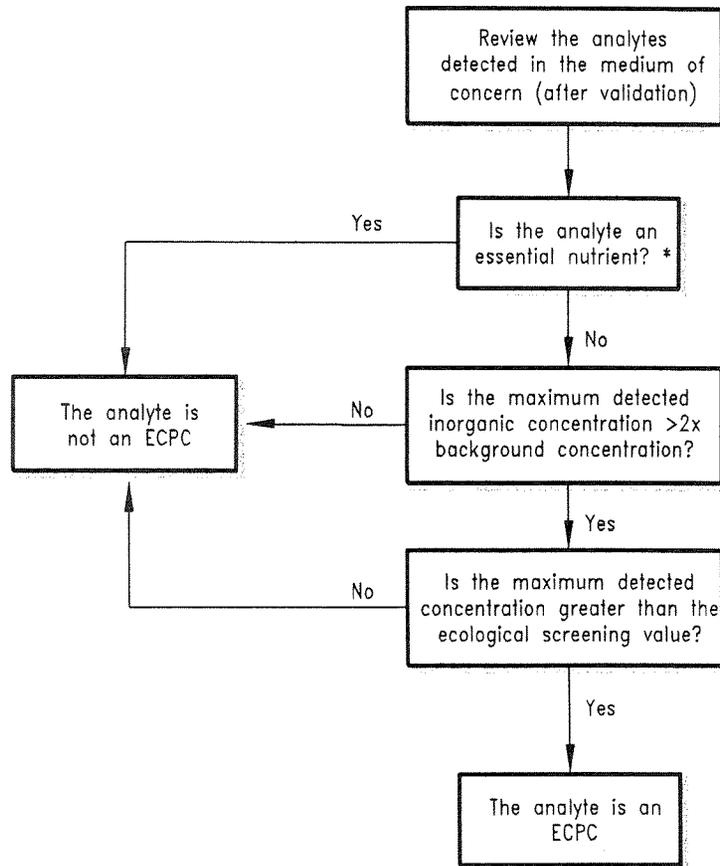
9.3.1 Hazard Assessment and Selection of ECPCs The hazard assessment includes a review of analytical data and selection of ECPCs. ECPCs represent analytes detected in environmental media (i.e., surface soil, surface water, sediment, and groundwater) that are considered in the ERA and could present a potential risk for ecological receptors. The process for selecting ECPCs is depicted on Figure 9-4.

Analytical data for OU 4 were evaluated for use in risk assessment pursuant to national guidance, *Guidance for Data Useability in Risk Assessment (Parts A and B)* (USEPA, 1992d).

Following the data validation step (as previously described in Section 4.2), analytes in environmental media were eliminated as potential ECPCs if the analyte was detected in 5 percent or fewer of the samples analyzed and was not detected in any other media. Calcium, magnesium, potassium, and sodium were excluded as ECPCs in all media, and iron was excluded as an ECPC for surface soil. Evidence suggests that there is little potential for toxic effects resulting from overexposure to these essential nutrients. The highly controlled physiological regulatory mechanisms of these inorganic analytes suggest that there is little, if any, potential for bioaccumulation, and available toxicity data demonstrate that high dietary intake of these nutrients are well tolerated (National Academy of Sciences, 1977; National Research Council, 1982; 1984).

Inorganic chemicals in surface soil and groundwater that are not elevated above background concentrations were not selected as ECPCs. Likewise, inorganic chemicals in surface water and sediment that are not elevated above control sample concentrations from Lakes Druid, Baldwin, and Susanna were also not selected as ECPCs. In accordance with USEPA Region IV guidance (USEPA, 1991c), an inorganic analyte was not selected as an ECPC if the maximum detected concentration in site samples was less than 2 times the average detected inorganic concentration in background or control samples.

A site-specific background investigation of surface soil and groundwater was conducted at NTC, Orlando, and the findings are presented in Sections 5.1 and 5.3, respectively, of the NTC, Orlando *Background Sampling Report* (ABB-ES, 1995). The site-specific background study used to establish background screening values for OU 4 surface soil consists of ten surface soil samples collected from surface soil at the Main Base, which is considered to be geologically similar to the soil



LEGEND

ECPC Ecological chemical of potential concern
NWS Naval Weapons Station
> Greater than
x Times
Iron is considered an essential nutrient for terrestrial receptors but is retained as an ECPC for aquatic receptors.
*

**FIGURE 9-4
ECOLOGICAL CHEMICAL OF POTENTIAL
CONCERN SELECTION PROCESS**



**REMEDIAL INVESTIGATION
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from OU 4. The site-specific background study used to establish background screening values for groundwater consists of ten groundwater samples collected from monitoring wells upgradient of any potential site-related contamination.

Surface water and sediment control samples collected from Lakes Druid, Baldwin, and Susanna were collected in areas that are believed to be unimpacted by any sites at NTC, Orlando currently under investigation, and are likely typical of local conditions. Inorganics data from these samples were reviewed and determined to be comparable (i.e., generally on the same order of magnitude); therefore, control inorganics data from these three lakes were combined in one data set. Two times the average of detected concentrations from control samples collected from all three lakes were used to select surface water and sediment ECPCs.

Inorganic analytes that exceed the background and control screening concentration and are not essential nutrients were also screened against ecological screening values for surface soil, surface water, sediment, and groundwater. The surface soil ecological screening values are from the Supplemental Guidance to RAGs Region 4 Bulletins, Ecological Risk Assessment (USEPA, 1998b). A representative from USEPA Region 4 has indicated that these values are appropriate to screen surface soil ECPCs (USEPA, 1997c). The surface water, sediment, and groundwater ecological screening values were obtained from the USEPA Region 4 Waste Management Division Screening Values for Hazardous Waste Sites (USEPA, 1995c). If the maximum detected concentration of an analyte is less than the ecological screening value, the analyte was eliminated as an ECPC.

All analytes detected in surface soil, surface water, sediment, and groundwater are summarized in tables that include the following: frequency of detection, range of detection limits, range of detected concentrations, average of detected concentrations, background screening values, and ecological screening values. For those analytes that are retained as ECPCs for the ERA, the following information is also provided: average of all concentrations, 95th percentile UCL of the arithmetic mean, and RME and CT EPCs. A discussion of how EPCs are determined is provided in Subsection 9.3.2.

9.3.1.1 Surface Soil Twenty surface soil samples (listed in Table 9-3) were collected at OU 4 (see Figure 5-1). Of these, 12 samples were collected from under pavement, including 12B00101 through 12B00401, 13B00501, 14B00101 through 14B00401, and U4S005 through U4S015. These samples were included in the risk assessment because it is not known if the areas from which these samples were collected will remain under pavement in the future, although the future reuse scenario for this parcel is an industrial complex. Sample U4S00601 was collected from the grassy terrestrial area, at the mouth of the culvert which runs under Port Hueneme Avenue. Sample U4S00501 was collected within the bottomland forest, from a terrestrial area adjacent to the small ditch formed by the surface expression of groundwater. Both of these locations were dry during sampling, and are areas which would not typically be inundated with water (i.e., these areas would not support aquatic receptors). However, during storm events, at high water, these locations may be flooded for short periods. Surface soil samples were analyzed for VOCs, SVOCs, pesticides and PCBs, inorganic analytes, and TPH. As shown in Table 9-3, ECPCs selected for surface soil include 3 VOCs, 12 SVOCs (primarily PAHs), 6 pesticide, 1 PCB, 10 inorganic analytes, and TPH.

Table 9-3
Selection of Ecological Chemicals of Potential Concern
for Surface Soil Associated with OU 4

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Frequency of Detection ¹	Reporting Limit Range	Range of Detected Concentration ²	Average of Detected Concentrations ³	Background Screening Concentration ⁴	Ecological Screening Value ⁵	Chemical of Ecological Concern ⁶	95% UCL ⁷	Average of All Samples ⁸	Exposure Point Concentration	
										RME ⁹	CT ¹⁰
Volatile Organic Compounds (µg/kg)											
1,1,2,2-Tetrachloroethane	1/20	10 to 15.5	1	1	NA	100	No ^{11,12}				
2-Hexanone	1/20	10 to 15.5	8	8	NA	NA	No ¹¹				
Acetone	4/20	10 to 15.5	10 to 42	19	NA	NA	Yes	9.9	8.2	9.9	8.2
Methylene chloride	2/20	10 to 25	38* to 44	41	NA	2,000	No ¹²	11	8.9	11	8.9
Tetrachloroethene	7/20	10 to 15.5	1 to 110	35	NA	10	Yes	27	16	27	16
Toluene	5/20	10 to 15.5	1 to 5.3*	2.6	NA	50	No ¹²				
Xylene (total)	1/20	10 to 15.5	1	1	NA	50	No ^{11,12}				
Semivolatile Organic Compounds (µg/kg)											
Benzo(a)anthracene	5/20	340 to 505	67 to 260	NA	NA	¹⁵ 100	Yes	560	160	260	160
Benzo(a)pyrene	5/20	340 to 505	57* to 330	NA	NA	100	Yes	550	160	330	160
Benzo(b)fluoranthene	7/20	340 to 505	49 to 630	NA	NA	¹⁵ 100	Yes	650	180	630	180
Benzo(g,h,i)perylene	5/20	340 to 505	65 to 220	NA	NA	¹⁵ 100	Yes	560	160	220	160
Benzo(k)fluoranthene	5/20	340 to 505	72 to 230	NA	NA	¹⁵ 100	Yes	570	160	230	160
bis(2-Ethylhexyl)phthalate	4/20	340 to 505	38 to 720	250	NA	¹⁵ 100	Yes	240	190	240	190
Butylbenzylphthalate	1/20	340 to 505	200	200	NA	¹⁵ 100	No ¹¹				
See notes at end of table.											

Table 9-3 (Continued)
Selection of Ecological Chemicals of Potential Concern
for Surface Soil Associated with OU 4

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center
 Orlando, Florida

Analyte	Frequency of Detection ¹	Reporting Limit Range	Range of Detected Concentration ²	Average of Detected Concentrations ³	Background Screening Concentration ⁴	Ecological Screening Value ⁵	Chemical of Ecological Concern ⁸	95% UCL ⁷	Average of All Samples ⁸	Exposure Point Concentration	
										RME ⁹	CT ¹⁰
Semivolatile Organic Compounds (Continued)											
Carbazole	2/20	340 to 505	58 to 200	130	NA	¹⁵ 100	Yes	200	180	200	180
Chrysene	7/20	340 to 505	48 to 460	NA	NA	¹⁵ 100	Yes	600	170	460	170
Fluoranthene	6/20	340 to 505	53 to 550	NA	NA	100	Yes	670	180	550	180
Indeno(1,2,3-cd)pyrene	5/20	340 to 505	57* to 200	NA	NA	¹⁵ 100	Yes	550	160	200	160
Phenanthrene	4/20	340 to 505	82* to 240	NA	NA	100	Yes	570	170	240	170
Pyrene	7/20	340 to 505	63 to 580	NA	NA	100	Yes	690	190	580	190
Pesticides and PCBs (µg/kg)											
4,4'-DDD	6/20	3.4 to 42	0.51* to 15	5	NA	¹⁶ 2.5	Yes	4.4	3.2	4.4	3.2
4,4'-DDE	6/20	1.8 to 17	2.1 to 60	18	NA	¹⁶ 2.5	Yes	11	7.3	11	7.3
4,4'-DDT	8/20	1.8 to 42	0.14 to 23	8.3	NA	¹⁶ 2.5	Yes	10	4.6	10	4.6
Aldrin	1/20	1.7 to 8.6	11	11	NA	¹⁶ 2.5	No ¹¹				
Aroclor-1254	2/20	34 to 170	79* to 210	NA	NA	20	Yes	69	36	69	36
Aroclor-1260	1/20	34 to 170	25*	25	NA	20	No ¹¹				
Dieldrin	1/20	3.4 to 17	28	28	NA	0.5	No ¹¹				
Endosulfan I	2/20	1.7 to 8.6	0.99 to 1.4	1.2	NA	¹⁶ 100	No ¹²				
Endosulfan II	5/20	3.4 to 17	0.31 to 29	6.8	NA	¹⁶ 100	No ¹²				
Endosulfan sulfate	3/20	3.4 to 17	1* to 5.8	2.9	NA	¹⁶ 100	No ¹²				
See notes at end of table.											

Table 9-3 (Continued)
Selection of Ecological Chemicals of Potential Concern
for Surface Soil Associated with OU 4

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center
 Orlando, Florida

Analyte	Frequency of Detection ¹	Reporting Limit Range	Range of Detected Concentration ²	Average of Detected Concentrations ³	Background Screening Concentration ⁴	Ecological Screening Value ⁵	Chemical of Ecological Concern ⁶	95% UCL ⁷	Average of All Samples ⁸	Exposure Point Concentration	
										RME ⁹	CT ¹⁰
<u>Pesticides and PCBs (µg/kg) (Continued)</u>											
Endrin	1/20	3.4 to 17	24	24	NA	1	No ¹¹	5.6	4.8	5.6	4.8
Endrin aldehyde	1/20	3.4 to 17	56	56	NA	¹⁷ 1	No ¹¹				
Endrin ketone	1/20	3.4 to 17	50	50	NA	¹⁷ 1	Yes				
Heptachlor	2/20	1.7 to 8.6	3.1 to 23	13	NA	¹⁶ 100	No ¹²				
Heptachlor epoxide	4/20	1.7 to 22	0.37* to 11	3.2	NA	¹⁶ 100	No ¹²	87	110	87	87
Methoxychlor	2/20	17 to 220	44 to 1,800	NA	NA	¹⁶ 100	Yes				
alpha-BHC	1/20	1.7 to 8.6	0.32	0.32	NA	2.5	No ^{11,12}				
alpha-Chlordane	4/20	1.7 to 8.6	1.8* to 56	15	NA	¹⁶ 100	No ¹²				
beta-BHC	1/20	1.7 to 8.6	30	30	NA	1.0	No ¹¹				
delta-BHC	2/20	1.7 to 8.6	0.76 to 2.1	1.4	NA	¹⁹ 2.5	No ¹²				
gamma-BHC (Lindane)	2/20	1.7 to 8.6	0.25 to 0.90	NA	NA	0.05	Yes	1.5	1.2	0.9	0.9
gamma-Chlordane	5/20	1.7 to 22	0.76 to 2.4	1.4	NA	¹⁶ 100	No ¹²				
<u>Inorganic Analytes (mg/kg)</u>											
Aluminum	20/20	0.0039 to 0.0045	8.8 to 9,740	NA	2,088	50	Yes	27,400	1,680	9,740	1,680
Arsenic	6/20	0.38 to 1.75	0.36* to 0.84	NA	1	10	No ^{12,13}				
Barium	18/20	0.18 to 2	0.25 to 167	NA	8.7	165	Yes	59.7	15.6	59.7	15.6
Beryllium	4/20	0.02 to 0.155	0.07 to 1.1	0.42	0.09	1.1	No ¹²				

See notes at end of table.

Table 9-3 (Continued)
Selection of Ecological Chemicals of Potential Concern
for Surface Soil Associated with OU 4

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Frequency of Detection ¹	Reporting Limit Range	Range of Detected Concentration ²	Average of Detected Concentrations ³	Background Screening Concentration ⁴	Ecological Screening Value ⁵	Chemical of Ecological Concern ⁶	95% UCL ⁷	Average of All Samples ⁸	Exposure Point Concentration	
										RME ⁹	CT ¹⁰
<u>Inorganic Analytes (mg/kg) (Continued)</u>											
Cadmium	3/20	0.06 to 0.74	0.84 to 1.9	1.5	0.98	1.6	Yes	1.3	0.37	1.3	0.37
Calcium	18/20	4.8 to 733	215 to 75,100	8,840	25,300	NA	No ¹⁴				
Chromium	19/20	0.5 to 0.6	0.59 to 45.2	NA	4.6	0.4	Yes	14.6	5.7	14.6	5.7
Cobalt	3/20	0.14 to 0.48	0.55 to 3.4	1.5	NA	20	No ¹²				
Copper	13/20	0.43 to 0.75	0.36* to 36.6	9.4	4.1	40	No ¹²				
Iron	18/20	1 to 12.1	14.4 to 6,400	711	712	200	No ¹⁴				
Lead	18/20	0.3 to 0.36	0.37 to 78	13	14.5	50	Yes	84.8	11.7	78	11.7
Magnesium	9/20	5 to 1,130	8.2 to 175	45.3	328	NA	No ^{12,14}				
Manganese	19/20	0.12 to 0.26	0.52 to 45.2	7.8	8.1	100	No ¹²				
Mercury	4/20	0.02 to 0.07	0.07 to 2.2	0.66	0.07	0.1	Yes	0.19	0.15	0.19	0.15
Nickel	14/20	1.9 to 2.3	0.27 to 9.2	2.7	4.4	30	No ¹²				
Selenium	1/20	0.45 to 1.3	1.3	1.3	0.95	0.81	Yes	0.52	0.42	0.52	0.42
Silver	3/20	0.16 to 0.65	1.4 to 31.3	11.5	1.8	2.0	Yes	2.2	1.9	2.2	1.9
Vanadium	16/20	0.41 to 0.5	0.58 to 17.7	2.8	3.1	2.0	Yes	4.8	2.3	4.8	2.3
Zinc	9/20	0.24 to 7.5	0.36 to 225	44.1	17.2	50	Yes	273	20.4	225	20.4
<u>TPH (µg/kg)</u>											
Total Petroleum Hydrocarbons	1/1	5	17.6	17.6	NA	NA	Yes	NC	17.6	17.6	17.6
See notes at end of table.											

9.3.1.2 **Surface Water** Unfiltered surface water data were used to screen potential ecological risks. Surface water was collected from five locations (listed in Table 9-4) at OU 4. Surface water data for locations U4W01003 and U4W01004 were averaged together prior to calculating the site average because these samples were collected at the same location but at different times (hereinafter referred to as SW-10). This location was also the only location that was analyzed for full suite analyses (i.e., VOCs, SVOCs, pesticides and PCBs, inorganics, and hardness), whereas the other locations were analyzed for VOCs only. As shown in Table 9-4, ECPCs selected for unfiltered surface water include 4 VOCs, and 2 pesticides.

9.3.1.3 **Sediment** Sediment was collected from five locations (listed in Table 9-5) at OU 4. Sediment data for locations U4D01003 and U4D01004 were averaged together prior to calculating the site average because these samples were collected at the same location but at different times (hereinafter referred to as SD-10). This location was also the only location that was analyzed for full suite analyses (i.e., VOCs, SVOCs, pesticides and PCBs, inorganics, and TOC), whereas the other locations were analyzed for VOCs only. As shown in Table 9-5, ECPCs selected for sediment include 4 VOCs, 3 SVOCs, 5 pesticides, 1 PCB, and 3 inorganic analytes.

9.3.1.4 **Groundwater** Unfiltered groundwater data collected from 13 locations (listed in Table 9-6) were used to screen potential ecological risks at OU 4. Groundwater was collected from 1 monitoring well (OLD-13-09A) and 12 drive points along the shoreline of Lake Druid. The data for OLD-13-09A represent an average of four rounds of sampling. OLD-13-09A was the only location that was analyzed for full suite analyses (i.e., VOCs, SVOCs, pesticides and PCBs, inorganics, and water chemistry), whereas the drive point locations were analyzed for organic analytes, iron, and manganese only. As shown in Table 9-6, ECPCs selected for unfiltered groundwater samples include two VOCs, manganese, and alkalinity.

9.3.2 Exposure Assessment The purpose of the ecological exposure assessment is to estimate or measure the amount of an ECPC to which an ecological receptor may be exposed. The following sections briefly describe how contaminant exposures are estimated or measured for terrestrial wildlife, plants, and invertebrates in the upland portions of OU 4, and for aquatic and semi-aquatic receptors in Lake Druid. The contaminant pathway model (Figure 9-3) provides a summary of the potential exposure pathways that exist at OU 4 for each group of receptors.

9.3.2.1 **Calculation of EPCs** The EPC is a representative concentration used for evaluating risks in the OU 4 ERA. RME and CT concentrations were derived for each ECPC. RME values are equal to the lesser of the maximum detected concentration and the 95 percent UCL calculated on the log-transformed arithmetic mean (USEPA, 1992b). One-half of the detection limit was used to represent sample results below the detection limit when calculating the 95 percent UCL. The 95 percent UCL is not calculated for data sets with fewer than 10 samples (USEPA, 1992e); therefore, for surface water, sediment, and groundwater, the RME value is equal to the maximum detected concentration. For SVOCs, pesticides, PCBs, and metals in surface water and sediment, the EPC is equal to the concentrations detected at SW-10 and SD-10, exclusively. The uncertainties associated with the extent of SVOC, pesticide, PCB, and metals characterization in surface water and sediment are discussed in Section 9.5.

Table 9-4
Selection of Ecological Chemicals of Potential Concern
for Surface Water Associated with OU 4

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Frequency of Detection ¹	Reporting Limit Range	Range of Detected Concentration ²	Average of Detected Concentrations ³	Background Screening Concentration ⁴	Ecological Screening Value ⁵	Chemical of Ecological Concern ⁶	Average of All Samples ⁷	Exposure Point Concentration	
									RME ⁸	CT ⁹
<u>Volatile Organic Compounds (µg/l)</u>										
cis-1,2-Dichloroethene	4/5	1	41* to 760	328	7.3	¹⁶ 590	Yes	260	760	260
Acetone	1/2	2 to 10	6	6	ND	¹⁶ 1,500	No ¹⁰			
Carbon disulfide	1/5	2 to 36	1	1	ND	¹⁶ 0.92	Yes	7.5	1	1
Tetrachloroethene	1/5	1 to 50	19	19	2	84	No ¹⁰			
Toluene	1/5	2 to 36	0.7	0.7	ND	175	No ¹⁰			
Trichloroethene	3/5	1 to 50	17 to 57	36.7	18	¹⁶ 47	Yes	22	57	22
Vinyl chloride	1/5	1 to 65	35	35	ND	NA	Yes	11	35	11
<u>Semivolatile Organic Compounds (µg/l)</u>										
4-Methylphenol	1/1	5.005	3.5	3.5	ND	^{16,17} 13	No ¹⁰			
<u>Pesticides and PCBs (µg/l)</u>										
4,4'-DDT	1/1	0.099	0.029	0.029	ND	0.001	Yes	0.029	0.029	0.029
Endrin ketone	1/1	0.1	0.01	0.01	ND	¹¹ 0.0023	Yes	0.01	0.01	0.01
gamma-BHC (Lindane)	1/1	0.0495	0.013	0.013	ND	0.08	No ¹⁰			
<u>Inorganic Analytes (µg/l)</u>										
Aluminum	1/1	19.5	538	538	810	¹² 87	No ¹³			
Calcium	1/1	7.4	7,220	7,220	29,500	NA	No ^{13,14}			
Iron	1/1	13.4	176	176	137	1,000	No ¹⁰			
Lead	1/1	1.9	2.8	2.8	6.2	¹⁵ 1.4	No ¹³			
Magnesium	1/1	1,450	1,450	1,450	4,240	NA	No ^{13,14}			
Manganese	1/1	0.1	4.3	4.3	9.6	¹⁶ 120	No ^{10,13}			
Vanadium	1/1	0.7	1.2	1.2	9.8	¹⁶ 120	No ^{10,13}			

See notes at end of table.

Table 9-4 (Continued)
Selection of Ecological Chemicals of Potential Concern
for Surface Water Associated with OU 4

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center
 Orlando, Florida

Analyte	Frequency of Detection ¹	Reporting Limit Range	Range of Detected Concentration ²	Average of Detected Concentrations ³	Background Screening Concentration ⁴	Ecological Screening Value ⁵	Chemical of Ecological Concern ⁶	Average of All Samples ⁷	Exposure Point Concentration	
									RME ⁸	CT ⁹
Water Chemistry (mg/l)										
Hardness as CaCO ₃	5/5	3	22.3 to 130	51	NA	NA	NA	NA	NA	NA

- ¹ Frequency of detection is the number of samples in which the analyte was detected divided by the total number of samples analyzed (excluding rejected data).
- ² The value indicated with an asterisk is the average of a sample and its duplicate. For duplicate samples having one nondetect value, one-half the detection limit is used as a surrogate for the nondetect value.
- ³ The average of detected concentrations is the arithmetic mean of all samples in which the analyte was detected. It does not include those samples with "R", "U", or "UJ" validation qualifiers.
- ⁴ The background screening value is twice the average of detected concentrations for inorganic analytes in background samples. Background screening values for organic analyte values are one times the average of detected concentrations. Organic values are included for comparison purposes only (i.e. not used to select ecological chemicals of potential concerns).
- ⁵ The ecological screening values from the Supplemental Guidance to RAGS: Region 4, Ecological Risk Assessment (USEPA, 1998b), unless otherwise noted.
- ⁶ "Yes" indicates that these chemicals are retained for further evaluation in the ecological risk assessment.
- ⁷ The average of all samples assigns a value of one-half of the detection limit as a surrogate concentration for nondetect values.
- ⁸ The RME exposure point concentration (EPC) is equal to the maximum detected concentration.
- ⁹ The CT EPC is equal to the lesser of the average of all samples or the RME concentration.
- ¹⁰ The maximum detected concentration is less than the ecological screening value.
- ¹¹ Ecological screening value for endrin used as a surrogate.
- ¹² Based on a pH of 6.5 to 9.
- ¹³ Maximum detected concentration is less than two times the average of detected background concentrations.
- ¹⁴ The analyte is an essential nutrient and not considered toxic.
- ¹⁵ Based on a measured hardness of 51 mg/l (i.e., average hardness) as CaCO₃.
- ¹⁶ Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Rev. (Suter and Tsao, 1996).
- ¹⁷ Value for 2-methylphenol used as a surrogate.

Samples: U4W00703, U4W01003, U4W01004, U4W01103, U4W01304, and U4W01902.
 Duplicates samples: U4W01003D and U4W01103D.
 Background samples: 07W00101 through 07W00501, 06W00101 through 06W00901, U4W05001, and U4W05002.
 Background duplicate samples: 06W00601D and 06W00901D.

- Notes: RME = reasonable maximum exposure. PCB = polychlorinated biphenyl.
 DDT = dichlorodiphenyltrichloroethane. OU = operable unit.
 μg/l = micrograms per liter. BHC = benzene hexachloride.
 * = The average of a sample and its duplicate is used for all table calculations. mg/l = milligrams per liter.
 NA = not available. CaCO₃ = calcium carbonate.
 ND = not detected in any background sample.

Table 9-5
Selection of Ecological Chemicals of Potential Concern
for Sediment Associated with OU 4

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Frequency of Detection ¹	Reporting Limit Range	Range of Detected Concentration ²	Average of Detected Concentrations ³	Background Screening Concentration ⁴	Ecological Screening Value ⁵	Chemical of Ecological Concern ⁸	Average of All Samples ⁷	Exposure Point Concentration	
									RME ⁶	CT ⁹
<u>Volatile Organic Compounds (µg/kg)</u>										
1,1-Dichloroethene	1/5	13 to 110	13	13	NA	NA	Yes	20	13	13
1,2-Dichloroethene (total)	4/5	13 to 110	16* to 1,300	510	74	¹⁴ 440	Yes	420	1,300	420
Acetone	1/5	13 to 110	46	46	1,000	NA	Yes	32	46	32
Methylene chloride	3/5	13 to 110	54 to 130	82	NA	¹⁵ 2,000	No ¹⁰			
Tetrachloroethene	2/5	13 to 110	3 to 19	11	6	¹⁶ 530	No ¹⁰			
Toluene	1/5	13 to 110	13	13	NA	¹⁶ 670	No ¹⁰			
Trichloroethene	2/5	13 to 110	21 to 280	151	51	¹⁶ 1,600	No ¹⁰			
Vinyl chloride	2/5	13 to 110	25 to 560	295	NA	¹⁶ 10	Yes	130	560	130
<u>Semivolatile Organic Compounds (µg/kg)</u>										
Fluoranthene	1/1	1,800	3,500	3,500	560	330	Yes	3,500	3,500	3,500
Pyrene	1/1	1,800	3,400	3,400	500	330	Yes	3,400	3,400	3,400
bis(2-Ethylhexyl)phthalate	1/1	1,800	5,600	5,600	1,200	182	Yes	5,600	5,600	5,600
<u>Pesticides and PCBs (µg/kg)</u>										
4,4'-DDE	1/1	32.5	7.6	7.6	10.4	3.3	Yes	7.6	7.6	7.6
Aroclor-1254	1/1	455	68	68	NA	33	Yes	68	68	68
Endosulfan I	1/1	16	4.6	4.6	NA	¹⁶ 2.9	Yes	4.6	4.6	4.6
Heptachlor	1/1	23.5	2.6	2.6	8	NA	Yes	2.6	2.6	2.6
alpha-Chlordane	1/1	23.5	2	2	5.2	1.7	Yes	2	2	2
delta-BHC	1/1	23.5	6.1	6.1	12	¹³ 3.3	Yes	6.1	6.1	6.1
gamma-BHC (Lindane)	1/1	16	2.8	2.8	NA	3.3	No ¹⁰			
See notes at end of table.										

Table 9-5 (Continued)
Selection of Ecological Chemicals of Potential Concern
for Sediment Associated with OU 4

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center
 Orlando, Florida

Analyte	Frequency of Detection ¹	Reporting Limit Range	Range of Detected Concentration ²	Average of Detected Concentrations ³	Background Screening Concentration ⁴	Ecological Screening Value ⁵	Chemical of Ecological Concern ⁶	Average of All Samples ⁷	Exposure Point Concentration	
									RME ⁸	CT ⁹
<u>Inorganic Analytes (mg/kg)</u>										
Aluminum	1/1	NA	7,750	7,750	7,610	NA	Yes	7,750	7,750	7,750
Arsenic	1/1	NA	6.3	6.3	6	7.24	No ¹⁰			
Barium	1/1	NA	31.3	31.3	52.8	NA	No ¹¹			
Beryllium	1/1	NA	0.30	0.30	0.56	NA	No ¹¹			
Cadmium	1/1	NA	0.39	0.39	1.6	1	No ^{10,11}			
Calcium	1/1	NA	7,080	7,080	6,470	NA	No ¹²			
Chromium	1/1	NA	18.9	18.9	10	52.3	No ¹⁰			
Cobalt	1/1	NA	0.75	0.75	3.8	NA	No ¹¹			
Copper	1/1	NA	16.8	16.8	15	18.7	No ¹⁰			
Iron	1/1	NA	1,240	1,240	1,320	NA	No ¹¹			
Lead	1/1	NA	38.1	38.1	33.4	30.2	Yes	38.1	38.1	38.1
Manganese	1/1	NA	6.9	6.9	14.6	NA	No ¹¹			
Mercury	1/1	NA	0.31	0.31	0.2	0.13	Yes	0.31	0.31	0.31
Nickel	1/1	NA	4.2	4.2	15	15.9	No ^{10,11}			
Selenium	1/1	NA	4.7	4.7	7.8	NA	No ¹¹			
Silver	1/1	NA	0.85	0.85	4.8	2	No ^{10,11}			
Thallium	1/1	NA	5.4	5.4	16	NA	No ¹¹			
Vanadium	1/1	NA	6.7	6.7	10	NA	No ¹¹			
Zinc	1/1	NA	109	109	38.2	124	No ¹⁰			
<u>General Chemistry (mg/kg)</u>										
Total Organic Carbon	5/5	50	11,900 to 16,000	14,500	NA	NA	NA			

See notes at end of table.

Table 9-5 (Continued)
Selection of Ecological Chemicals of Potential Concern
for Sediment Associated with OU 4

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center
 Orlando, Florida

- ¹ Frequency of detection is the number of samples in which the analyte was detected divided by the total number of samples analyzed (excluding rejected data).
- ² The value indicated by an asterisk is the average of a sample and its duplicate. For duplicate samples having one nondetect value, one-half the detection limit is used as a surrogate for the nondetect value.
- ³ The average of detected concentrations is the arithmetic mean of all samples in which the analyte was detected. It does not include those samples with "R", "U", or "UJ" validation qualifiers.
- ⁴ The background screening value is twice the average of detected concentrations for inorganic analytes in background samples. Background screening values for organic analyte values are one times the average of detected concentrations. Organic values are included for comparison purposes only (i.e. not used to select ECPCs).
- ⁵ The ecological screening values are from the Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment (USEPA, 1998b), unless otherwise notes.
- ⁶ Yes indicates that these chemicals are retained for further evaluation in the ecological risk assessment.
- ⁷ The average of all samples assigns a value of one-half of the detection limit as a surrogate concentration for nondetect values.
- ⁸ The reasonable maximum exposure (RME) exposure point concentration (EPC) is equal to the maximum detected concentration.
- ⁹ The central tendency (CT) EPC is equal to the lesser of the average of all samples or the RME concentration.
- ¹⁰ The maximum detected concentration is less than the ecological screening value.
- ¹¹ The maximum detected concentration is less than two times the average of detected background concentrations.
- ¹² The analyte is an essential nutrient and not considered toxic.
- ¹³ Ecological screening value for gamma-BHC used as a surrogate.
- ¹⁴ Final chronic value using equilibrium partitioning method (USEPA, 1989).
- ¹⁵ Dutch intervention value (+ by 10) (MHSPE, 1994).
- ¹⁶ EPA Ecotox threshold (USEPA, 1996).

Samples: U4D00704, U4D01003, U4D01004, U4D01104, U4D01305, and U4D01902.

Duplicates samples: U4D01003D and U4D01104D.

Background samples: 07D00101 through 07D01501, 06D00101 through 06D02701 (including 06D00401RE, 06D02401DL, and 06D02601DL), U4D05001, and U4D05002.

Background duplicate samples: 07D01201D, 06D01101D, 06D01201D, 06D02001D, and 06D02301D.

Notes: OU = operable unit.

µg/kg = micrograms per kilogram.

NA = not available.

PCB = polychlorinated biphenyl.

DDE = dichlorodiphenyldichloroethene.

BHC = benzene hexachloride.

mg/kg = milligrams per kilogram.

* = The average of a sample and its duplicate is used for all table calculations.

Table 9-6
Selection of Ecological Chemicals of Potential Concern
for Groundwater Associated with OU 4

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Frequency of Detection ¹	Reporting Limit Range	Range of Detected Concentration	Average of Detected Concentrations ²	Background Screening Concentration ³	Ecological Screening Value ⁴	Chemical of Ecological Concern ⁵	95% UCL ⁶	Average of All Samples ⁷	Exposure Point Concentration	
										RME ⁸	CT ⁹
Volatile Organic Compounds (µg/l)											
Tetrachloroethene	1/13	20 to 200	71.4	71.4	NA	84	No ¹⁰				
Trichloroethene	12/13	20 to 200	150 to 1,300	649	NA	¹⁷ 47	Yes	1,300	610	1,300	610
cis-1,2-Dichloroethene	13/13	20 to 200	1,200 to 5,600	3,363	NA	¹⁷ 590	Yes	4,300	3,400	4,300	3,400
Inorganic Analytes (µg/l)											
Aluminum	1/1	NA	117	NA	4,070	¹⁵ 87	No ¹¹				
Barium	1/1	NA	7.4	NA	31.4	¹⁷ 4.0	No ¹¹				
Calcium	1/1	NA	3,350	NA	36,800	NA	No ^{11,12}				
Chromium	1/1	NA	0.95	NA	7.8	¹³ 117	No ^{10,11}				
Iron	13/13	NA	51.4 to 740	460	1,230	1,000	No ^{10,11}				
Magnesium	1/1	NA	1,340	NA	4,560	NA	No ^{11,12}				
Manganese	3/13	12.1 to 15	19 to 42	30	17.0	¹⁷ 120	No ¹⁰				
Nickel	1/1	NA	1.3	NA	NA	¹⁴ 49	No ¹⁰				
Potassium	1/1	NA	1,900	NA	5,400	NA	No ^{11,12}				
Sodium	1/1	NA	13,000	NA	18,200	NA	No ^{11,12}				
Vanadium	1/1	NA	1.5	NA	20.6	¹⁷ 20	No ^{10,11}				
Water Chemistry (µg/l)											
Ethene	2/4	0.5 to 500	0.82 to 2,000	1,000	NA	NA	No ¹⁶				
Methane	4/4	0.5 to 500	7.5 to 33,000	8,270	NA	NA	No ¹⁶				
See notes at end of table.											

Table 9-6 (Continued)
Selection of Ecological Chemicals of Potential Concern
for Groundwater Associated with OU 4

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Frequency of Detection ¹	Reporting Limit Range	Range of Detected Concentration	Average of Detected Concentrations ²	Background Screening Concentration ³	Ecological Screening Value ⁴	Chemical of Ecological Concern ⁵	95% UCL ⁶	Average of All Samples ⁷	Exposure Point Concentration	
										RME ⁸	CT ⁹
Water Chemistry (mg/ℓ)											
Acid-insoluble sulfide	5/13	0.5	0.44 to 2	1.1	NA	NA	No ¹⁰				
Sulfate	12/13	5	5 to 26	14.1	NA	NA	No ¹⁰				
Total alkalinity	13/13	5	6.6 to 14.3	10.9	NA	NA	Yes	12.2	10.9	12	10.9
Total organic carbon	7/7	1	1 to 5	2.5	NA	NA	No ¹⁰				
Total phosphorus	5/13	0.1 to 1	0.063 to 4.1	1.1	NA	NA	No ¹⁰				

¹ Frequency of detection is the number of samples in which the analyte was detected divided by the total number of samples analyzed (excluding rejected data).

² The average of detected concentrations is the arithmetic mean of all samples in which the analyte was detected. It does not include those samples with "R", "U", "LU", "UR", or "UJ" validation qualifiers.

³ The background screening value is twice the average of detected concentrations for inorganic analytes in background samples. Background screening values for organic analyte values are one times the average of detected concentrations. Organic values are included for comparison purposes only (i.e., not used to select ecological chemicals of potential concerns [ECPC]).

⁴ The ecological screening values are the Region IV Waste Management Division Freshwater Surface Water Chronic Screening Values for Hazardous Waste Sites reported in the *Supplemental Guidance to Risk Assessment Guidance for Superfunds (RAGS): Region IV Bulletins* (U.S. Environmental Protection Agency [USEPA], 1998).

⁵ "Yes" indicates that these chemicals are retained for further evaluation in the ecological risk assessment.

⁶ The 95 % upper confidence limit (UCL) is calculated on the log-transformed average of all samples using the formula provided in the USEPA *Supplemental Guidance to RAGS: Calculating the Concentration Term*. (USEPA, 1992e)

⁷ The average of all samples assigns a value of one-half of the detection limit as a surrogate concentration for nondetect values.

⁸ The RME exposure point concentration (EPC) is equal to the lesser of the maximum detected concentration or the 95 % UCL.

⁹ The central tendency (CT) EPC is equal to the lesser of the average of all samples or the RME concentration.

¹⁰ The maximum detected concentration is less than the ecological screening value.

¹¹ The maximum detected concentration is less than the background screening concentration.

¹² The analyte is an essential nutrient and not considered toxic.

¹³ This value is based on trivalent chromium.

¹⁴ This value is hardness adjusted using a minimum hardness concentration of 25 mg/ℓ calcium carbonate (CaCO₃) (the calculated hardness concentration equaled 14 mg/ℓ CaCO₃ using mean calcium and magnesium concentrations [Greenberg et al., 1992]).

See notes at end of table.

Table 9-6 (Continued)
Selection of Ecological Chemicals of Potential Concern
for Groundwater Associated with OU 4

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center
 Orlando, Florida

Analyte	Frequency of Detection ¹	Reporting Limit Range	Detected Concentration Range	Average of Detected Concentrations ²	Background Screening Concentration ³	Ecological Screening Value ⁴	Chemical of Ecological Concern ⁵	95% UCL ⁶	Average of All Samples ⁷	Exposure Point Concentration	
										RME ⁸	CT ⁹

¹⁶ This value is based on a pH of 6.5 to 9.

¹⁸ This compound was analyzed for water quality purposes only. There are no toxicity values for which to evaluate potential effects to aquatic life; therefore, this analyte was not selected as an ECPC.

¹⁷ Toxicological benchmarks for screening potential contaminants of concern for effects on aquatic biota; 1996 revision (Suter and Tsao, 1996).

Samples: average of sample data from U4G009XX (U4G00903 through U4G00907), U4G00104 through U4G00107, U4G00206 through U4G00209, and U4G00303 through U4G00306.

Duplicate samples: none.

Background samples: ORG00101 through ORG01001.

Background duplicate samples: ORG00201D and ORG00701D.

Notes: % = percent.

UCL = upper confidence level on the arithmetic mean.

µg/l = micrograms per liter.

NA = not available.

mg/l = milligrams per liter.

RAGS = risk assessment guidance for Superfund.

CaCO₃ = calcium carbonate.

If potential risks were predicted based on the RME scenario, then the CT exposure scenario was also evaluated. The CT exposure concentration is represented by the arithmetic mean of all samples. In calculating the arithmetic mean, one-half of the detection limit was also used as a surrogate value for sample results that are below the detection limit. Tables 9-3 through 9-6 present the RME and CT EPCs for surface soil, surface water, sediment, and groundwater ECPCs, respectively.

9.3.2.2 **Terrestrial and Semi-Aquatic Wildlife** Exposure routes for wildlife receptors include direct and indirect ingestion of soil, surface water, sediment, and ingestion of food containing site-related chemicals. The actual amount of an ECPC taken in by wildlife species (i.e., ingestion dose in mg/kg-day) depends on a number of factors that can be obtained from the literature to estimate a potential dietary exposure (PDE). In calculating the PDE, wildlife species considered representative of the trophic guilds at the site are identified, quantitative exposure parameters are developed, and bioaccumulation through the food chain is considered.

Wildlife species from different trophic guilds that may be present at the site and in Lake Druid were selected for the PDE model. The model uses species-specific feeding and habitat characteristics to estimate chemical exposures to wildlife species respective to their position in the food chain. Terrestrial receptors were chosen to represent the trophic levels typically found in disturbed upland and hardwood forests, and semi-aquatic receptors were chosen to represent the trophic levels common to lakeshore communities. The representative wildlife species considered in the ERA for OU 4 are summarized in Table 9-7, and are discussed below.

- **Cotton mouse (*Peromyscus gossypinus*)**. The cotton mouse represents a small mammalian herbivore that could potentially be exposed to contamination in soil and in plant tissue (accumulated from the soil). The cotton mouse home range is estimated at 0.147 acre and could reside entirely on the site. The cotton mouse represents the small mammal herbivore community at OU 4.
- **Short-tailed shrew (*Blarina brevicauda*)**. The short-tailed shrew finds suitable habitat in forests, fields, marshes, and brush. It primarily feeds on earthworms, snails, centipedes, insects, small vertebrates, and slugs (DeGraaf and Rudis, 1986). Relative to other small mammals, insectivorous species such as the shrew may receive high doses of contamination as a result of their voracious appetite relative to their small body size and the ability of their prey items to accumulate constituents. The shrew represents small mammalian omnivores found at OU 4.
- **Mourning dove (*Zenaida macroura*)**. The mourning dove forages by ground-gleaning in roadsides and open fields with scattered shrubs and trees. It feeds almost entirely on seeds; however, it is also known to eat occasional insects, snails, and gravel to facilitate seed digestion (Terres, 1980). The mourning dove will nest in a variety of man-made or natural structures. The dove represents granivorous avian receptors at OU 4.

**Table 9-7
Ecological Receptors at Operable Unit 4**

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Method of Evaluation	Receptor			Media		
	Common	Scientific	Trophic Level	SS	SW/SD	GW
<u>Food-Web Modeling</u>						
	Cotton mouse	<i>Peromyscus gossypinus</i>	Herbivorous mammal	X		
	Mourning dove	<i>Zenaida macroura</i>	Gramnivorious bird	X		
	Short-tailed shrew	<i>Blarina brevicauda</i>	Insectivorous mammal	X		
	American woodcock	<i>Scolopax minor</i>	Insectivorous bird	X		
	Red fox	<i>Vulpes vulpes</i>	Predatory mammal	X		
	Great-blue heron	<i>Ardea herodias</i>	Omnivorous bird		X	
	Raccoon	<i>Procyon lotor</i>	Omnivorous mammal		X	
	Osprey	<i>Pandion haliactus</i>	Piscivorous bird		X	
<u>Benchmark Comparison</u>						
	Terrestrial Plants			X		X
	Soil Invertebrates			X		
	Aquatic Invertebrates				X	X
	Aquatic Plants				X	X
	Amphibians				X	X
	Fish				X	X

- **American woodcock (*Scolopax minor*)**. The woodcock is a vermivorous bird (i.e., feeding primarily on earthworms) that inhabits areas of fertile, moist soil. These areas include open pastures, cultivated fields, and stream banks (DeGraaf and Rudis, 1986). The woodcock represents avian receptors found in all areas of OU 4.
- **Red fox (*Vulpes vulpes*)**. This omnivorous mammal prefers open woodlands and grassy fields, and has been observed at OU 4. The red fox is most active at dawn, dusk, and night, and is an opportunistic forager, feeding on small mammals, birds, amphibians, reptiles, and invertebrates, as well as berries and other fruits (Burt and Grossenheider, 1976). The red fox represents predatory mammals at OU 4.
- **Raccoon (*Procyon lotor*)**. The raccoon represents an opportunistic species that may be exposed to contamination in surface water and sediment both as a result of direct ingestion and ingestion of aquatic prey. Aquatic prey at OU 4 (plants, aquatic invertebrates, and crayfish) may become contaminated as a result of bioaccumulation from the surface water and sediment. The raccoon represents higher trophic level omnivorous mammals found in the aquatic portions at OU 4.
- **Great blue heron (*Ardea herodias*)**. This species represents omnivorous wading avian receptors that may be exposed to surface water and sediment contamination at OU 4. Great blue herons feed primarily on aquatic life, including fish, frogs, and invertebrates. The great blue heron has been selected to represent all higher trophic level wading-bird receptors (e.g., egrets) potentially found in the wetlands and the lakeshore at OU 4.
- **Osprey (*Pandion haliaectus*)**. The osprey represents piscivorous avian receptors that may be exposed to contamination in surface water and sediment both as a result of direct ingestion of contaminated surface water and indirectly through ingestion of potentially contaminated fish that may have accumulated contaminants from contaminated surface water and sediment. The osprey represents higher trophic level piscivorous avian receptors that may be feeding on fish from Lake Druid adjacent to OU 4.

Parameters for quantitatively evaluating exposures to wildlife include body weight, food ingestion rate, home range, and relative consumption of food items. Exposure assumptions for each of the representative wildlife species for OU 4 are provided in Table 9-8. In addition to these parameters, the species foraging habits and bioaccumulation in food items are also considered.

The site foraging frequency (SFF) is an adjustment term that accounts for the frequency a receptor feeds within the site area. The SFF is based on both the acreage of the site relative to the receptor's home range and the fraction of the year the receptor would be exposed to site-related chemicals (i.e., the exposure duration). By definition the SFF cannot exceed 1. Most representative wildlife species (except the woodcock) are expected to actively forage at the site year round; for these receptors, the exposure duration is assumed to be 1.

Wildlife species may be exposed to ECPCs in surface soil, surface water, and sediment via incidental ingestion of these media or by ingesting prey items that

Table 9-8
Exposure Parameters for OU 4 Representative Wildlife Species

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Representative Wildlife Species	Body Weight (kg)	Reported Diet	Assumed Diet for Exposure Assessment (% of diet)	Food Ingestion Rate (kg/day)	Water Intake Rate (l/day)	Home Range (acres)
Short-tailed shrew (<i>Blarina brevicauda</i>)	0.017 [a]	Earthworms, slugs, snails, fungi, insects, and vegetation [b]	78% Invertebrates 12% Plants 10% Soil [c]	0.0024 [d]	0.0025 [e]	0.96 ± 0.09 [b]
Cotton mouse [f] (<i>Peromyscus gossypinus</i>)	0.040 [g]	Seeds and some insects [b]	88% Plants 10% Invertebrates 2% Soils [h]	0.0049 [d]	0.0055 [e]	0.147 [i]
Mourning dove (<i>Zenaida macroura</i>)	0.13 [k]	Seeds, some insects, weed seeds, waste grain of agriculture, occasionally takes small snails. [j]	94% Plants 1% Invertebrates 5% Soil [c]	0.015 [l]	0.015 [n]	5 [j]
American woodcock (<i>Scolopax minor</i>)	0.197 [n]	Primarily earthworms and insects with some plants [b]	80% Invertebrates 10% Plants 10% Soil [h]	0.02 [l]	0.020 [m]	80.1 ± 68.2 [b]
Red fox (<i>Vulpes vulpes</i>)	4.5 [o]	Small mammals, birds, eggs, invertebrates, acorns, and fruits [b]	57% Small mammals 20% Invertebrates 10% Small birds 10% Plants 3% Soil [h]	0.24 [d]	0.38 [e]	457 [j]
Raccoon (<i>Procyon lotor</i>)	3.99 [p]	Mostly fleshy fruits, nuts acorns, corn; also frogs, crayfish, and insects [b]	91% Aquatic organisms 9% Sediment [h]	0.214 [d]	0.344 [e]	385 [q]
Great blue heron (<i>Ardea herodias</i>)	2.23 ± 0.76 [b]	Mostly fish; some amphibians, crustaceans, and birds [b]	98% Aquatic organisms 2% Sediment [c]	0.0981 [l]	0.101 [m]	11 [r]
Osprey (<i>Pandion haliaetus</i>)	1.57 [b]	Feeds entirely on fish [b]	100% Aquatic organisms	0.08 [l]	0.08 [m]	2,242 [s]

See notes at end of table.

Table 9-8 (Continued)
Exposure Parameters for OU 4 Representative Wildlife Species

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

References:

- [a] Mean of means reported for male and female shrews in summer and fall (U.S. Environmental Protection Agency [USEPA], 1993a).
- [b] *Wildlife Exposure Factors Handbook* (USEPA, 1993a).
- [c] Estimated soil ingestion.
- [d] Calculated using the mammal equation based on body weight (Wt.) in kg. Food ingestion (kg/day) = $0.0687 \times \text{Wt}^{0.822}$ (kg) (USEPA, 1993a).
- [e] Calculated using the mammal equation based on body weight (Wt.) in kg. Water ingestion (l/day) = $0.099 \times \text{Wt}^{0.90}$ (kg) (USEPA, 1993a).
- [f] Values for the deer mouse are used for the cotton mouse when not available (USEPA, 1993a).
- [g] Average of values for cotton mice in the southeastern U.S. (USEPA, 1993a).
- [h] The value for the cotton mouse was estimated from the white-footed mouse, and the value for the gray fox was estimated from the red fox (USEPA, 1993a). The sediment ingestion for raccoons was estimated to be the same as their estimated soil ingestion (USEPA 1993a).
- [i] Average for male and female deer mice, Virginia/mixed deciduous forest (USEPA, 1993a).
- [j] DeGraaf & Rudis (1986).
- [k] Terres (1980).
- [l] Calculated using the bird equation based on body weight (Wt.) in kg. Food ingestion (kg/day) = $0.0582 \times \text{Wt}^{0.651}$ (kg) (USEPA, 1993a).
- [m] Calculated using the bird equation based on body weight (Wt.) in kg. Water ingestion (l/day) = $0.059 \times \text{Wt}^{0.87}$ (kg) (USEPA, 1993a).
- [n] Median of mean weights reported for adult male and female American woodcocks (USEPA, 1993a).
- [o] Average of values for gray foxes (USEPA, 1993a).
- [p] Median of mean weights for male and female raccoons in Alabama (USEPA, 1993a).[q] Average of adult male and female raccoons from May to December (USEPA, 1993a).
- [r] Average of feeding territory sizes for the Great Blue Heron presented in USEPA (1993a).
- [s] Based on the average foraging radius (1.7 km) for osprey in Minnesota.

- Notes: OU = operable unit.
kg = kilograms.
% = percent.
kg/day = kilograms per day.
l/day = liters per day.
± = plus minus.
g = grams.

have bioaccumulated ECPCs. To estimate this exposure, a PDE is estimated for all representative wildlife species for each ECPC according to the equations in Table 9-9. Representative species were selected based on the variety of chemicals detected and retained as ECPCs. A variety of receptors including herbivorous and insectivorous (e.g., the cotton mouse and mourning dove, and the short-tailed shrew and American woodcock, respectively) representing different trophic guilds were selected to evaluate uptake of ECPCs via the food chain.

BAFs and bioconcentration factors (BCFs) are used in the wildlife exposure models to estimate the transfer of chemicals between environmental media and plants or soil invertebrates, and between these organisms and primary consumer species. Tissue concentrations of ECPCs in prey items are estimated using BAFs for surface soil and sediment, and BCFs for surface water. BAFs and BCFs for most receptors are extrapolated from literature values or estimated using regression equations from scientific literature. The general approach used to select BAFs and BCFs for OU 4 is summarized in Table 9-10.

BAFs for invertebrate and plant food items are defined as the ratio of the ECPC concentration in plant or invertebrate tissue (mg chemical/kg tissue wet weight) to the ECPC concentration in surface soil or sediment (mg chemical/kg dry weight soil/sediment). BAFs reported in the scientific literature for avian and mammalian receptors are the reported ratios of ECPC concentrations in the tissues of these receptors (mg chemical/kg tissue wet weight) to the concentrations of ECPCs in their food items (mg chemical/kg tissue wet weight). BAFs for each of the surface soil and sediment ECPCs evaluated at OU 4 are included in Appendix F-1, Table F-1-2.

Bioaccumulation of hydrophobic organics from sediment to biota were estimated based on BAFs found in the literature, which are the reported ratio of the CPC in an aquatic invertebrate to the concentration in sediment. When sediment to aquatic invertebrate BAF information was lacking in the literature, BAFs based on terrestrial invertebrates were used instead. Sediment BAFs are presented in Appendix F-1, Table F-1-2.

BCFs for surface water were calculated primarily using literature values derived from the USEPA Aquatic Information Retrieval (AQUIRE) System database and Ambient Water Quality Criteria (AWQC) documents (presented in Appendix F-1, Table F-1-3) or by using a regression provided in Barnthouse et al. (1988).

Dietary exposures for semi-aquatic receptors can be estimated by multiplying sediment ECPC concentrations by aquatic invertebrate BAFs, or by multiplying surface water ECPC concentrations by BCFs (based primarily on fish uptake of contaminants by gill epithelial).

The PDEs calculated from exposure to surface soil ECPCs for each receptor, and the exposure assumptions used in calculating the PDEs, are presented in Appendix F-2, Tables F-2-1 and F-2-4. The PDEs calculated from exposure to surface water and sediment ECPCs for each receptor, and the exposure assumptions used in calculating the PDEs, are presented in Appendix F-2, Tables F-2-6 and F-2-9.

Although drinking water exposures to wildlife from groundwater ECPCs exist, this exposure pathway is not a significant route of exposure (compared to dietary exposure) and is unlikely to result in risk. Consequently, risks to wildlife from exposure to groundwater ECPCs were not evaluated at OU 4.

Table 9-9
Model for Estimation of Contaminant Exposures for Representative Wildlife Species

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center
 Orlando, Florida

Estimation of Contaminant Exposures Related to Surface Soil

Description: Estimates the amount (dose) of a contaminant ingested and accumulated by a species via incidental ingestion of contaminated surface soil and ingestion of contaminated food items.

Soil Contaminant Concentration: Maximum: The maximum detected concentration of the ecological chemicals of potential concern (COPC) when the sample size is ≤ 9 , and the lesser of the maximum detected concentration or the 95th percent upper confidence limit (UCL) on the arithmetic mean when the sample size is ≥ 10 .

Average: Average of all concentrations. If the average is greater than the maximum exposure point concentration (EPC), the maximum EPC was selected.

Soil Exposure:

$$\text{Soil Exposure (mg/kg)} = \left(\frac{\% \text{ of Diet as Soil}}{\text{as Soil}} \times \text{Soil Concentration (mg/kg)} \right)$$

Concentration of a Contaminant in Primary Prey Items (T_N):

$$\text{Primary Prey Item Concentration (mg/kg)} = \left(\text{BAF}_{\text{inv or plant}} \times \text{Soil Concentration (mg/kg)} \right)$$

Concentration of a Contaminant in Secondary Prey Items (T_N):

$$\text{Secondary Prey Item Concentration (mg/kg)} = \left(\text{BAF}_{\text{mam or bird}} \times \text{Tissue Concentration of Prey Items* (mg/kg)} \right)$$

where BAF = Bioaccumulation Factor or mg/kg fresh weight tissue over mg/kg dry weight soil for invertebrates and plants, and mg/kg fresh weight tissue over mg/kg fresh weight food for small mammals and small birds.

* For a discussion of the weighted contaminated concentration in prey items, see explanation of the PDE term below.

Total Exposure Related to Surface Soil:

$$\text{PDE (mg/kgBW-day)} = \frac{[P_1 \times T_1 + \dots + P_N \times T_N + \frac{\text{soil exposure}}{\text{BW}}] \times \text{IR}_{\text{diet}} \times \text{SFF} \times \text{ED}}{\text{BW}}$$

where PDE = Potential Dietary Exposure (mg/kgBW-day),
 P_N = percent of diet composed of food item N,
 T_N = tissue concentration in food item N (mg/kg),
 IR_{diet} = food ingestion rate of receptor (kg of food or dietary item per day),
 BW = body weight (kg) of receptor,
 SFF = Site Foraging Frequency (site area [acres] divided by home range [acres]).
 ED = Exposure Duration (fraction of year species is expected to occur on-site).

See notes at end of table.

Table 9-9 (Continued)
Model for Estimation of Contaminant Exposures for Representative Wildlife Species

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center
 Orlando, Florida

Estimation of Contaminant Exposures Related to Surface Water and Sediment

Description: Estimates the amount of a contaminant ingested and accumulated by a species resulting from incidental ingestion of surface water and sediment.

Contaminant Concentration: Same as described above for soil.

Surface Water Exposure:

$$\text{Surface Water Exposure (mg/day)} = (\text{IR}_{\text{sw}} \text{ (l/day)} \times \text{Surface Water Concentration (mg/l)})$$

where IR_{sw} = water ingestion rate of receptors (liters of water per day)

Sediment Exposure:

$$\text{Sediment Exposure (mg/day)} = (\% \text{ of Diet as Sediment} \times \text{Sediment Concentration (mg/kg)} \times \text{IR}_{\text{sd}} \text{ (kg/day)})$$

where IR_{sd} = sediment ingestion rate of receptors (kg of sediment per day)

Total Exposure Related to Surface Water and Sediment:

$$\text{PDE (mg/kgBW-day)} = \frac{ (\text{Surface Water Exposure (mg/day)} + \text{Sediment Exposure (mg/day)} + P_A \times T_A) \times \text{SFF} \times \text{ED} }{ \text{BW} }$$

where P_A = percent of diet composed of aquatic prey items
 T_A = tissue concentration in aquatic prey items (mg/kg)

Note: Food chain exposures from ingestion of aquatic prey items are evaluated in the same way as primary prey items.

Notes: mg/kg = milligram per kilogram.
 kg/day = kilogram per day.
 kg = kilogram.
 % = percent.
 mg/kg BW-day = milligram per kilogram of body weight per day.
 ≤ = less than or equal to.
 ≥ = greater than or equal to.

Table 9-10
Estimation of Bioaccumulation and Bioconcentration Factors

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center
 Orlando, Florida

Receptor Group	Nature of Approach	General Approach
Terrestrial Receptors		
Plants		
Unit: mg/kg wet tissue per mg/kg dry soil	Literature Values	When available, literature values were used to estimate plant BAFs. Evidence from the literature (Levine et al., 1989) suggests that lead does not bioaccumulate in plant tissue, therefore, a BAF of zero was assigned (i.e., a zero does not imply that literature information is lacking).
	SAR	When literature values were not available, plant BAFs for semivolatile organic compounds (SVOCs) were calculated using a regression equation based on the uptake of organic chemicals into plant tissue from Travis and Arms (1988). ¹
	Extrapolation and Empirical Data	When literature values were not available, plant BAFs for inorganic compounds were obtained from Baes et al. (1984). ²
	Assumption	Although evidence suggests that plants may transport organic analytes with $\log K_{ow} < 5$ (i.e., volatile organic compounds [VOCs]) from the roots into leafy portions (Briggs et al., 1982; Briggs et al., 1983), bioaccumulation data for VOCs is generally lacking in the scientific literature. In addition, evidence in the literature (Suter, 1993; Maughan, 1993) suggests that analytes with $\log K_{ow} < 3.5$ are not bioaccumulated into animal tissue. Therefore, it was assumed that transfer of VOCs from plant tissue to animal tissue does not occur.
Terrestrial Invertebrates		
Unit: mg/kg wet tissue per mg/kg dry soil	Literature Values	When available, literature values were used to estimate BAFs for invertebrates. If no literature values were available, the mammal BAF was used instead.
	Assumption	Earthworm data were used to represent all invertebrates.
	Empirical Data and Assumption	A single BAF for PAHs (used to estimate BAFs for all SVOCs) was calculated using data presented in Beyer (1990); dry weight was converted to wet weight assuming earthworms are 80 percent water.
	Assumption	Bioaccumulation data for VOCs is generally lacking in the scientific literature. In addition, evidence in the literature (Suter, 1993; Maughan, 1993) suggests that analytes with $\log K_{ow} < 3.5$ are not bioaccumulated into animal tissue. Therefore, it was assumed that soil invertebrates do not bioaccumulate VOCs.
See notes at end of table.		

Table 9-10 (Continued)
Estimation of Bioaccumulation and Bioconcentration Factors

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Receptor Group	Nature of Approach	General Approach
Small Mammals Unit: mg/kg wet tissue per mg/kg wet food	Literature Values SAR Extrapolation/ Empirical Data Assumption	When available, literature values were used to estimate BAFs for small mammals. When literature values were not available for SVOCs, BAFs for small mammals were estimated using a regression equation based on the uptake of organic chemicals into beef tissue from Travis and Arms (1988) ³ . When literature values were not available, BAFs for small mammals for inorganics were derived from ingestion-to-beef biotransfer factors (BTFs) presented in Baes et al. (1984) ⁴ . Bioaccumulation data for VOCs are generally lacking in the scientific literature. In addition, evidence in the literature (Suter, 1993; Maughan, 1993) suggests that analytes with log K_{ow} s < 3.5 are not bioaccumulated into animal tissue. Therefore, it was assumed that small mammals do not bioaccumulate VOCs.
Small Birds Unit: mg/kg wet tissue per mg/kg wet food	Literature Values No information	When available, literature values were used to estimate BAFs for small birds. BAFs were not obtained for SVOCs or for many inorganic compounds as there is little bioaccumulation data available for birds. It was assumed that small birds do not accumulate VOCs.
Semi-aquatic Receptors <u>Surface Water</u> Unit: mg/kg tissue per mg/l water	Empirical Data	When available, BCF data were obtained from the AQUIRE database and from AWQC documents. BCF values were obtained by calculating the species geometric mean BCFs, and then averaging the species mean BCFs to derive one BCF for each analyte (presented in Appendix F-1, Table F-1-2).
<u>Sediment</u> Unit: mg/kg wet tissue per mg/kg wet sediment	Literature Values Assumption	When available, literature values were used to estimate BAFs for aquatic plants and macroinvertebrates. When literature values were not available, terrestrial plant and invertebrate BAFs were used instead. Bioaccumulation data for VOCs are generally lacking in the scientific literature. Also, low Kows suggest that these CPCs will not accumulate. Therefore, it was assumed that aquatic organisms do not bioaccumulate VOCs.
See notes at end of table.		

Table 9-10 (Continued)
Estimation of Bioaccumulation and Bioconcentration Factors

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¹ Plant BAFs were calculated using the following Travis and Arms (1988) regression: $\log \text{BAF} = 1.588 + 0.578 \log K_{ow}$.

² BAFs were derived from Baes et al. (1984). Values are based on analysis of literature references, correlations with other chemical and physical parameters, or comparisons of observed and predicted elemental concentrations in vegetative and reproductive plant material and soil. Data are based on dry weight and were converted to a fresh weight basis assuming that plants are 80 percent water. This is generally consistent with the water content of berries (82 to 87 percent water) and leafy vegetables (87 to 95 percent water), presented in Suter (1993). Grains contain a much lower percentage of water (approximately 10 percent); therefore, this assumption likely underestimates exposure to graminivores.

³ Small mammal BAFs were calculated using the following Travis and Arms (1988) regression: $\log \text{BTF} = \log K_{ow} - 7.6$, where BTF = biotransfer factor (mg/kg tissue divided by mg chemical ingested per day).

⁴ BTFs were converted to a BAF (mg/kg tissue divided by mg/kg food) by multiplying by a food ingestion rate of 12 kg (dry weight) per day (average intake for lactating and nonlactating cattle reported in Travis and Arms, 1988).

⁵ Aquatic organism BCFs were calculated using the following Barnthouse et al. (1988) regression: $\log \text{BCF} = -0.56 + 0.96 \log K_{ow}$.

Notes: mg/kg = milligrams per kilogram.

USEPA = U.S. Environmental Protection Agency.

BAFs = bioaccumulation factors.

BCFs = bioconcentration factors.

SAR = Structural Activity Relationship.

AWQC = ambient water quality criteria.

AQUIRE = Aquatic Information Retrieval.

9.3.2.3 Terrestrial Plants and Invertebrates Terrestrial plants and invertebrates may be exposed to ECPCs via direct contact with and root uptake (plants) or ingestion (invertebrates) of OU 4 surface soil ECPCs. Exposures to terrestrial plants and invertebrates are assumed to occur within the top one-foot interval of surface soil.

9.3.2.4 Aquatic Receptors As previously discussed, the primary contaminant source at OU 4 is groundwater contaminated with chlorinated VOCs. Groundwater discharges to Lake Druid, approximately 300 feet west of the source area. Aquatic receptors in the vicinity of groundwater discharge can potentially be exposed to ECPCs through the following routes:

- ingestion of and/or direct contact with surface water, sediment, or pore water; and
- ingestion of prey items and bioaccumulation of chemicals via the food chain.

Direct contact exposures of aquatic receptors to ECPCs in surface water, sediment, and pore water are quantitatively evaluated in the ERA.

Food chain exposures for higher trophic level aquatic life (e.g., fish) are insignificant for VOCs detected in groundwater because these chemicals generally do not accumulate in tissue. Table F-1-2 in Appendix F-1 presents log K_{ow} s for all ECPCs. Log K_{ow} s measure a chemical's tendency to partition to lipid materials (including tissue). The log K_{ow} s for all VOCs are less than 3.5; analytes with log K_{ow} s less than 3.5 are unlikely to accumulate in tissue (Suter, 1993). Conversely, analytes with log K_{ow} s greater than 3.5 (and with BCFs greater than 300 [e.g., pesticides]) are more likely to bioconcentrate in tissue. Consequently, trophic transfer and exposures to aquatic life are likely limited to these analytes.

Potential exposures to aquatic receptors in Lake Druid and its associated wetlands were evaluated using measured surface water, sediment, and groundwater concentrations. Because there are fewer than ten samples in the surface water, sediment, and groundwater (except VOCs) data sets, the RME concentration is equal to the maximum concentration. The assumption that aquatic organisms are continually exposed to maximum concentrations is overly conservative. Therefore, the CT concentrations likely represent typical concentration of an ECPC to which an ecological receptor might be exposed.

Surface water concentrations are used to represent potential exposures to pelagic aquatic organisms. Benthic and epibenthic organisms may be directly exposed to pore water (i.e., groundwater prior to discharge to surface water) and sediment; therefore, groundwater and sediment concentrations are used to evaluate exposures to these receptors. Pore water exposure concentrations for benthic organisms are conservatively assumed to be equal to the concentrations of ECPCs detected in unfiltered groundwater samples from OLD-13-09A and several drive points that are adjacent to Lake Druid.

9.3.3 Ecological Effects Assessment The ecological effects assessment discusses which measurement endpoints were used to evaluate potential adverse impacts to the assessment endpoints (i.e., the survival and maintenance of receptor

populations) for each group of receptors (e.g., terrestrial and semi-aquatic wildlife, terrestrial plants, soil invertebrates, and aquatic organisms).

9.3.3.1 **Terrestrial and Semi-Aquatic Wildlife.** As identified in the problem formulation, the assessment endpoint selected for terrestrial and semi-aquatic wildlife is the survival and maintenance of wildlife populations present within the upland and wetland areas of OU 4. Because no long-term wildlife population data are available at NTC, Orlando, a direct measurement of this assessment endpoint is not possible. The literature-derived results of laboratory toxicity studies that relate the dose of a chemical in an oral exposure with an adverse response to growth, reproduction, or survival of a test population (avian or mammalian species) are used as a measure of the assessment endpoint. Wildlife ingestion toxicity data are presented in Appendix F-1, Table F-1-4.

RTVs were derived for each ECPC and representative wildlife species according to the data hierarchy presented in *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*, Interim Final (USEPA, 1997b). The RTV represents the highest exposure level (e.g., concentration in the diet) not shown or estimated to produce adverse effects (e.g., reduced growth, impaired reproduction, increased mortality). For each ECPC, two RTVs representing lethal and sublethal effects are selected for each representative wildlife species. Lethal effects are those that result in mortality while sublethal effects include those that impair or prevent reproduction or growth. The RTVs are assumed to be a measure of the assessment endpoints for the protection of the survival, growth, and reproduction of wildlife populations. Lethal RTVs are developed using the data hierarchy discussed in items 1, 2, and 3, while sublethal RTVs are derived using the methodology discussed in items 1 and 2.

- 1) For contaminants with well documented adverse effects, the highest reported exposure level not resulting in significant adverse effects (i.e., a NOAEL) was selected as the RTV.
- 2) Generally, one-tenth of the LOAEL was selected as the RTV for analytes lacking NOAEL values. However, application of the 10-fold uncertainty factor was based on consideration of the exposure duration, type of toxicity test, and the relationship between the selected measurement and assessment endpoints. Deviations from application of the 10-fold uncertainty factor are footnoted in Table F-1-4 of Appendix F-1.
- 3) The lowest reported oral LD₅₀ (oral dose [in mg/kg body weight-day] lethal to 50 percent of a test population) was used to derive the lethal RTV if NOAEL or LOAEL values (based on lethal effects) were not available. The lethal RTV is one-fifth of the lowest reported LD₅₀ value for the species most closely related to the representative wildlife receptor. One-fifth of an oral LD₅₀ value is considered to be protective against lethal effects for 99.9 percent of individuals in a test population (USEPA, 1986b). An assumption is made that the value represented by one-fifth of an oral LD₅₀ would be protective of 99.9 percent of the individuals within the wildlife populations and represents a level of acceptable risk.

A summary of lethal and sublethal RTVs selected from the ingestion toxicity data is provided in Table F-1-5 of Appendix F-1.

If neither lethal nor sublethal toxicity information were available for a taxonomic group, no RTVs were identified and risks associated with the respective ECPC were not quantitatively evaluated. However, the absence of specific data for a taxonomic group does not imply that there is no toxicological effect associated with contaminant exposure by these receptors; therefore, potential risks to these taxonomic groups are qualitatively discussed in the Uncertainties Section (Section 9.5).

9.3.3.2 Terrestrial Plants and Invertebrates. The assessment endpoints selected for terrestrial plants and soil invertebrates are reduction in the biomass of terrestrial plants and abundance of soil invertebrates used as forage prey by wildlife. Site-specific toxicity data for plants and invertebrates are not available for OU 4; therefore, the results of toxicity studies from the literature that relate the soil concentrations of a contaminant with adverse effects to a test population are used as a measure of the assessment endpoint. These study results are summarized for each ECPC in Appendix F-1, Tables F-1-6 (plants) and F-1-7 (invertebrates).

For plants, the effects primarily considered were measures of growth or yield because these response parameters are most common in phytotoxicity studies. For invertebrates, the effects primarily considered were measures of reproduction or mortality; when LC_{50} data were used, one-fifth of the LC_{50} was used to be protective of 99.9 percent of the population (USEPA, 1986a).

9.3.3.3 Aquatic Receptors. As mentioned in the problem formulation, chlorinated VOCs are associated with depressed CNS activity in humans and laboratory test organisms (USEPA, 1980). Studies have shown that depressed CNS activity may cause drowsiness, increased salivation, restlessness, irritability, and loss of equilibrium and coordination in rats. Other studies suggest that both avoidance and escape responses in rats were markedly reduced after exposure to PCE (USEPA, 1980). Teratogenic effects have also been observed in mice and rats exposed to PCE, such as decreased fetal body weight, increase in fetal resorptions, and delayed ossification of bones (USEPA, 1980).

However, there are few studies that evaluate these similar effects on aquatic organisms. Studies have shown that fish and aquatic invertebrates experience adverse effects on survival, growth, and reproduction at lower concentrations than studies measuring effects on immobility (possibly related to CNS depression). Adverse effects on survival may be related to depressed CNS activity. Given the volatile nature of chlorinated solvents, they are not likely to persist in the environment. This is supported by the fact that concentrations of chlorinated VOCs in groundwater are up to two orders of magnitude higher than concentration of chlorinated VOCs in surface water.

Impacts to aquatic life were evaluated by comparing surface water and groundwater concentrations to State of Florida Class III Freshwater Quality Standards (Florida Legislature, 1996), and the AWQC that are protective of aquatic life and its uses. Acute AWQC are defined as the one-hour concentrations not to be exceeded more than once every three years, and chronic AWQC are defined as the four-day average concentration not to be exceeded more than once every three years. AWQC incorporate available toxicity data for the most sensitive fish species, aquatic invertebrates, amphibians, and aquatic plants. USEPA chronic AWQC were used to evaluate potential risks to aquatic life from ECPCs present in surface water and groundwater. AWQC have not been established for any chlorinat-

ed solvents; therefore, the Lowest Observed Effect Concentrations (LOECs) cited by USEPA (1991b) were used as RTVs for these chemicals.

Additional effect concentrations were obtained from the AQUIRE database and from other literature sources for fish, aquatic invertebrates, and amphibians. These effects concentrations are included in Appendix F-1, Tables F-1-8 and F-1-9. If an analyte concentration exceeds an RTV, then a discussion about the relevance of this exceedance is discussed relative to the toxicity data presented in Appendix F-1, Tables F-1-8 and F-1-9.

Effects to aquatic organisms are also evaluated by comparing sediment concentrations with various sediment guidelines and criteria, including National Oceanic and Atmospheric Administration (NOAA) Effects Range-Low (ER-L) and Effects Range-Median (ER-M) sediment guidelines (Long et al., 1994), USEPA Sediment Quality Guidelines (SQGs) based on equilibrium partitioning (USEPA, 1988b; USEPA, 1993b), and Ontario Ministry of the Environment (OME) Lowest Effect Level (LEL) provincial SQGs (Persaud et al., 1996). These sediment benchmarks were derived by three different methods:

- the OME LELs were derived using the Apparent Effects Threshold method, which represents chemical concentrations below which biological effects are improbable;
- the NOAA ER-Ls and ER-Ms were derived using the National Status and Trends Program method, which represents a concentration at which aquatic organisms may rarely (i.e., 10th percentile) or sometimes (i.e., 50th percentile) experience toxic effects; and
- the USEPA SQGs were derived according to the Equilibrium Partitioning Theory, which uses bulk sediment concentrations and the organic carbon content in sediment to predict interstitial water concentrations that are equal to the chronic AWQC (anticipated to be protective of 95 percent of aquatic species) (USEPA, 1992g).

Risks to aquatic organisms was also evaluated by obtaining information from the Army Corps of Engineers (ACOE) Waterways Experiment Station, which maintains a database (Environmental Residue-Effects Database [ERED]) of effects data for fish and aquatic invertebrates. The observed effects presented in the database are related to measured tissue concentrations for these organisms. The effects data obtained from the ACOE database for surface water and sediment ECPCs are presented in Appendix F-1, Table F-1-10. Tissue concentrations for aquatic organisms in Lake Druid were estimated by multiplying the aquatic BAF by sediment concentrations, or the aquatic BCF by surface water concentrations. The calculated tissue concentrations for aquatic life (which are discussed in Paragraph 9.4.2.2 under the title Surface Water and Sediment) were compared directly with the ACOE effects concentrations to correlate potential adverse effects.

9.4 RISK CHARACTERIZATION. Using the assessment process described in Subsection 9.3.3, risks are characterized for ecological receptors exposed to ECPCs in surface soil, surface water, sediment, and groundwater at OU 4.

9.4.1 Surface Soil Potential risks associated with exposure to ECPCs in surface soil at OU 4 are discussed separately for wildlife, terrestrial plants, and soil invertebrates. Risks to wildlife are characterized by comparing PDE concentrations (based on RME and CT exposure concentrations) for each surface soil ECPC with a respective RTV (estimated threshold doses for toxicity). Risks for terrestrial plants and soil invertebrates are evaluated by comparing toxicity benchmarks to RME and CT exposure concentrations.

9.4.1.1 Terrestrial Wildlife Risks for the representative wildlife species associated with ingestion and bioaccumulation of ECPCs in surface soil and prey items are quantitatively evaluated using HQs. HQs are calculated for each ECPC by dividing the PDE concentration by the selected lethal and sublethal RTV. HIs are determined for each receptor by summing the HQs for all ECPCs. When the estimated PDE is less than the RTV (i.e., the $HQ < 1$), it is assumed that chemical exposures are not associated with adverse effects to receptors and risks to wildlife populations are unlikely to be significant. For instance, if the PDE calculated using the RME concentration is less than the RTV, then it is assumed that population-level adverse effects (e.g., reduction in population size, age class stability) are unlikely to occur. When an HI is greater than 1, a discussion of the ecological significance of the HQs comprising the HI is completed and risks from exposure to CT concentrations of ECPCs are evaluated.

This hazard ranking scheme evaluates potential ecological effects to individual organisms and does not evaluate potential population wide effects. Contaminants may cause population reductions by affecting birth and mortality rates, immigration, and emigration (USEPA, 1989c). In many circumstances, lethal or sublethal effects may occur to individual organisms with little population- or community-level impacts; however, as the number of individual organisms experiencing toxic effects increases, the probability that population effects will occur also increases. The number of affected individuals in a population presumably increases with increasing HQ or HI values; therefore, the likelihood of population-level effects occurring is generally expected to increase with higher HQ or HI values.

HQs and HIs based on lethal and sublethal RTVs are calculated for each ECPC and each representative wildlife species. Tables F-2-2, -3, and -5 of Appendix F-2 present the HQ and HI calculations for OU 4. A summary of risks to representative wildlife receptors is provided in Table 9-11.

Summary HIs for representative wildlife species exposed to RME concentrations of ECPCs for lethal effects are less than 1; therefore, no acute response is likely.

The sublethal HIs for the cotton mouse (RME HI of 7.1 and CT HI of 1.6) exceed 1 based on both RME and CT exposure concentrations. For the mourning dove, the sublethal HI also exceeds 1 based on RME and CT concentrations (RME HI of 4.9 and CT HI of 1.4). For the short-tailed shrew, the sublethal HI also exceeds 1 based on RME and CT concentrations (RME HI of 28 and CT HI of 6.1). The primary risk drivers, based on RME concentrations for both the cotton mouse and the short-tailed shrew, are aluminum and zinc; cadmium is a primary risk contributor for the cotton mouse and mourning dove. In addition, selenium is a primary risk contributor for the short-tailed shrew. The primary risk driver, based on CT exposure concentrations for both the cotton mouse and short-tailed shrew, is aluminum; in addition, cadmium is a primary risk contributor for the cotton mouse and mourning dove. Because the RME HI value for the cotton mouse and mourning

**Table 9-11
Summary of Risk for Representative Wildlife Species from OU 4 Surface Soil, Surface Water,
and Sediment [a]**

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Media Evaluated Receptors	Risks from Exposure to RME (Summary HIs)		Risks from Exposure to CT (Summary HIs)		Primary Risk Contributors
	Lethal	Sublethal	Lethal	Sublethal	
Surface Soil					
Cotton Mouse	0.27	7.1	NE	1.6	Aluminum, cadmium, zinc, selenium
Mourning dove	0.032	4.9	NE	1.9	Cadmium
Short-tailed shrew	0.54	28	NE	5	Aluminum, zinc, selenium
American woodcock	0.023	0.15	NE	0.058	NA
Red fox	0.0043	0.15	NE	0.038	NA
Surface Water and Sediment					
Great blue heron	0.022	1.3	NE	1.3	NA
Raccoon	0.0076	0.18	NE	0.18	NA
Osprey	0.00-	0.0072	NE	0.0072	NA

[a] The information listed below is a summary of Tables F.2-2,-3,-5,-7,-8,-10 in Appendix F-2.

Notes: OU = operable unit.
RME = reasonable maximum exposure.
CT = central tendency.
HI = hazard index.
NE = not evaluated.
NA = not applicable.

dove only slightly exceeds 1, population-level sublethal impacts to graminivorous small mammals, and small birds from exposure to aluminum and cadmium are unlikely. However, exposure of omnivorous small mammals to aluminum and zinc in the surface soil at OU 4 may cause a reduction in the growth and reproduction of these receptors. Although selenium was identified as a primary risk contributor to the cotton mouse and short-tailed shrew, population level effects are unlikely as this analyte was only detected at one sample location which has since been remediated.

The distribution of aluminum in the surface soil of OU 4 is shown on Figure 5-2. Aluminum was detected at 20 of 20 sampling locations at concentrations ranging from 8.8 to 9,740 mg/kg. Elevated concentrations of aluminum (greater than the background screening value of 2,088 mg/kg) were detected in three samples located in the forested area downgradient from the site (at locations U4S00500, U4S00600, and U4S01300), and one sample located to the north and east of Building 1100 (at location U4S00900). Cadmium was detected at 3 of 20 sampling locations at concentrations ranging from 0.84 to 1.9 mg/kg. Cadmium was detected in two separate areas of the site, occurring in both the downgradient forested area, and in the northeastern corner of OU 4 (at locations U4S00600, and 14B00100 and U4S00900, respectively). Selenium was only detected at 1 of 20 sampling locations at a concentration of 1.3 mg/kg. Zinc was detected at 9 of 20 sampling locations at concentrations ranging from 0.36 to 225 mg/kg. Zinc was detected at elevated concentrations (greater than the ecological screening value of 200 mg/kg) at only one location (U4S00600). The maximum detected concentration of aluminum, cadmium, and zinc was at location U4S00600. This sample location is located near the point where runoff from the roads and paved areas surrounding Building 1100 is channelized into the forested area.

9.4.1.2 Terrestrial Plants Risks for terrestrial plants are evaluated by comparing the selected phytotoxicity RTVs to the RME and CT exposure concentrations. The results of this comparison are summarized in Table 9-12. Phytotoxicity RTVs are not available for the acetone and carbazole.

The RME concentration for six inorganic analytes (aluminum, chromium, lead, silver, vanadium, and zinc) exceed their respective phytotoxicity benchmarks. Aluminum and vanadium CT exposure concentrations also exceeded phytotoxicity benchmarks. RME and CT exposure concentrations of all other surface soil ECPCs are well below their respective phytotoxicity benchmarks.

The phytotoxicity RTVs used for aluminum, chromium, lead, silver, vanadium, and zinc were obtained from Will and Suter (1994) and were derived to represent the 10th percentile of the LOECs for growth and yield endpoints. Because the number of aluminum, chromium, lead, silver, vanadium, and zinc studies included in the author's review was less than 10 (n=1, n=2, n=7, n=1, n=2, and n=6, respectively), a confidence level of "low" was assigned by Will and Suter to these benchmarks. Will and Suter (1994) suggest that the derived benchmarks are a conservative means for estimating population- or community-level impacts. This would suggest that an exceedance of these benchmarks may not be significant; therefore, risks to plants would be unlikely.

Although the RME (9,740 mg/kg) and CT (1,350 mg/kg) concentrations of aluminum exceed the benchmark value of 50 mg/kg by two orders of magnitude, these exposure concentrations are near the background screening value for aluminum of 2,088

Table 9-12
Summary of Ecological Risk for Plants and Invertebrates in Surface Soil

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Analyte	Exposure Point Concentration ¹		RTV		RTV Exceeded? ² (by RME/by CT)	
	RME	CT	Plant ²	Invertebrate ²	Plant	Invertebrate
Volatile Organic Compounds (mg/kg)						
Acetone	0.099	0.0082	NA	NA	NA/NA	NA/NA
Tetrachloroethene	0.027	0.016	> 1,000	150	No/No	No/No
Semivolatile Organic Compounds (mg/kg)						
Benzo(a)anthracene	0.37	0.16	25	34	No/No	No/No
Benzo(a)pyrene	0.33	0.16	25	34	No/No	No/No
Benzo(b)fluoranthene	0.63	0.18	25	34	No/No	No/No
Benzo(g,h,i)perylene	0.22	0.16	25	34	No/No	No/No
Benzo(k)fluoranthene	0.23	0.16	25	34	No/No	No/No
bis(2-Ethylhexyl)phthalate	0.24	0.19	> 1,000	478	No/No	No/No
Carbazole	0.2	0.18	NA	NA	NA/NA	No/No
Chrysene	0.46	0.17	25	34	No/No	No/No
Fluoranthene	0.55	0.18	25	34	No/No	No/No
Indeno(1,2,3-cd)pyrene	0.20	0.16	25	34	No/No	No/No
Phenanthrene	0.24	0.17	25	34	No/No	No/No
Pyrene	0.58	0.19	25	34	No/No	No/No
See notes at end of table.						

Table 9-12 (Continued)
Summary of Ecological Risk for Plants and Invertebrates in Surface Soil

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
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Analyte	Exposure Point Concentration ¹		RTV		RTV Exceeded? ² (by RME/by CT)	
	RME	CT	Plant ²	Invertebrate ²	Plant	Invertebrate
<u>Pesticides and PCBs (mg/kg)</u>						
4,4'-DDD	0.0044	0.0032	12.5	12	No/No	No/No
4,4'-DDE	0.011	0.0073	12.5	12	No/No	No/No
4,4'-DDT	0.010	0.0046	12.5	12	No/No	No/No
Aroclor-1254	0.069	0.036	40	NA	No/No	NA/NA
Endrin keytone	0.0056	0.0048	12.5	NA	No/No	NA/NA
Methoxychlor	0.087	0.087	12.5	NA	No/No	NA/NA
gamma-BHC (Lindane)	0.0009	0.0009	> 1,000	8	No/No	No/No
<u>Inorganic Analytes (mg/kg)</u>						
Aluminum	9,740	1,680	50	NA	Yes/Yes	NA/NA
Barium	59.7	15.6	500	NA	No/No	NA/NA
Cadmium	1.3	0.37	3	5	No/No	No/No
Chromium	14.6	5.7	1	50	Yes/Yes	No/No
Lead	78	11.7	50	500	Yes/No	No/No
Manganese	27.1	7.4	500	NA	No/No	NA/NA
Mercury	0.19	0.15	0.3	36	No/No	No/No
Selenium	0.52	0.42	1	NA	No/No	NA/NA
Silver	2.2	1.9	2	NA	Yes/No	NA/NA
Vanadium	4.8	2.3	2	NA	Yes/Yes	NA/NA
Zinc	225	20.4	50	130	Yes/No	Yes/No

¹ Exposure point concentrations (EPCs) are presented in Table 9-3.

² Plant and invertebrate RTVs are presented in Appendix F-1, Tables F-1-6 and F-1-7, respectively. Generally, the plant RTVs are the lowest observed effect concentration from among growth studies on plants in solid media, and invertebrate RTVs are the lowest concentration lethal to 50 percent of a test population from among chemicals in the same chemical class (applies to organic compounds). A conservative factor of 0.2 was applied to invertebrate RTVs; the resultant value should be protective of 99.9 percent of the population from acute effects (Neuhauser et al., 1986).

³ Comparison shown is RME EPC to RTV/CT EPC to RTV.

Notes: RME = Reasonable Maximum Exposure. mg/kg = milligrams per kilogram.
 CT = Central Tendency. NA = not available.
 RTV = Reference Toxicity Value. Shading indicates exceedances.

mg/kg. Therefore, it appears that detected concentrations of aluminum in OU 4 surface soil are not likely to be site-related.

The RME concentrations of lead, silver, and vanadium only slightly exceed the phytotoxicity RTVs; the RME concentration of zinc exceeds its phytotoxicity RTV by approximately four times. The CT exposure concentration of vanadium exceeds slightly its phytotoxicity RTV. However, no observations of stressed vegetation were evident at OU 4 during the October 1997 ecological survey.

Although benchmarks were exceeded for a number of inorganic constituents, no evidence of reduction in vegetative biomass was observed in the field at OU 4. In addition, the benchmarks for these analytes are conservative, benchmarks for inorganic analytes were exceeded in only a few locations, and the benchmarks were well below background for some ECPCs. Therefore, adverse impacts to small mammals and birds that rely on plant availability for forage and/or shelter are not anticipated.

9.4.1.3 Terrestrial Invertebrates Risks for terrestrial invertebrates are evaluated by comparing invertebrate toxicity benchmark values to RME and CT exposure concentrations of surface soil ECPCs. The results of this evaluation for OU 4 surface soil are also presented in Table 9-12. Invertebrate toxicity benchmark values are not available for acetone, carbazole, Aroclor-1254, methoxychlor, aluminum, beryllium, manganese, selenium, silver, and vanadium.

With the exception of zinc, RME concentrations of all ECPCs are well below the available invertebrate toxicity benchmark values. The RME exposure concentration of zinc (225 mg/kg) exceeds the invertebrate toxicity benchmark of 130 mg/kg by less than a factor of 2; the CT exposure concentration of 20.4 mg/kg is less than the benchmark value. Although the invertebrates benchmark is exceeded in one location, it is unlikely that invertebrate biomass would be reduced such that small mammal and bird populations would be affected at OU 4.

9.4.2 Surface Water and Sediment Potential risks associated with exposures to ECPCs in surface water and sediment are discussed separately for semi-aquatic wildlife and aquatic receptors.

9.4.2.1 Semi-Aquatic Wildlife Risks for the representative semi-aquatic wildlife species associated with ingestion and bioaccumulation of ECPCs in surface water and sediment and prey items are quantitatively evaluated using HQs, as discussed in Subsection 9.4.1.

HQs and HIs based on lethal and sublethal RTVs are calculated for each ECPC and each representative wildlife species. Tables F-2-7, -8, and -10 of Appendix F-2 present the HQ and HI calculations for surface water and sediment at OU 4. A summary of risks to representative wildlife receptors is provided in Table 9-11.

Summary HIs for all representative semi-aquatic wildlife species exposed to RME concentrations of ECPCs for lethal effects are less than 1; therefore, no acute response is likely.

The sublethal HI for the great-blue heron (RME and CT HI of 1.3) slightly exceeds 1 based on both RME and CT exposure concentrations. However, none of the HQs for the individual analytes detected in sediment and surface water exceed 1, for the great blue heron. Although the RME and CT HIs for the heron exceed 1, population

level impacts to the heron are unlikely, based on the low magnitude of the HI exceedances.

9.4.2.2 Aquatic Receptors Risks to aquatic receptors were evaluated by comparing the toxicity benchmarks described in Paragraph 9.3.3.3 with surface water and sediment ECPCs, and by comparing the effects concentrations from the ACOE database (also described in Paragraph 9.3.3.3) with estimated tissue concentrations for fish and invertebrates.

Surface Water. Table 9-13 shows the comparison of surface water ECPCs with surface water toxicity benchmarks. Benchmark values are not available for carbon disulfide, or VC; therefore, potential risks to pelagic aquatic receptors could not be evaluated for these analytes. This uncertainty is discussed more in Section 9.5. All exposure concentrations are less than toxicity benchmark values, which suggests that pelagic aquatic organisms are not at risk from exposure to surface water ECPCs in Lake Druid.

Sediment. Table 9-14 shows the comparison of sediment ECPCs with sediment toxicity benchmarks. Benchmark values are not available for any VOCs, bis(2-ethylhexyl)phthalate, endosulfan I, benthic aquatic organisms could not be evaluated for these analytes. This uncertainty is discussed more in Section 9.5. Exposure concentrations of all ECPCs (except alpha-chlordane) at SD-10 slightly exceed toxicity benchmark values.

Exposure concentrations of fluoranthene (3,500 $\mu\text{g}/\text{kg}$) and pyrene (3,400 $\mu\text{g}/\text{kg}$) at SD-10 exceed their NOAA ER-Ls and OME LELs by less than factors of 7. However, these benchmarks may be overly conservative because they do not consider the site-specific TOC of sediment. The USEPA sediment quality criterion for fluoranthene (8,990 $\mu\text{g}/\text{kg}$), which is adjusted to account for the measured 1.45 percent TOC of Lake Druid sediment, is greater than the exposure concentration for fluoranthene. This suggests that the NOAA and OME sediment toxicity benchmarks may be overly conservative, and that benthic aquatic organisms are not at risk from exposure to fluoranthene at SD-10. No USEPA sediment quality criterion is available for pyrene; however, it is likely that the NOAA and OME criteria for this analyte are equally conservative. Furthermore, these analytes are not related to the historical releases at OU 4.

Exposure concentrations of 4,4'-DDE (7.6 $\mu\text{g}/\text{kg}$), Aroclor-1254 (68 $\mu\text{g}/\text{kg}$), heptachlor (2.6 $\mu\text{g}/\text{kg}$), delta-BHC (6.1 $\mu\text{g}/\text{kg}$), lead (38.1 mg/kg), and mercury (0.31 mg/kg) at SD-10 all slightly exceed sediment toxicity benchmarks. However, all exceedances are of low magnitude (i.e., by less than a factor of 3.5). Given the low magnitude of exceedances, it is unlikely that benthic aquatic organisms are at risk from exposure to these analytes in Lake Druid sediment. Furthermore, the presence of pesticides in Lake Druid sediment is probably attributable to general pesticide applications at NTC, Orlando, rather than historical releases at OU 4. The origin of lead and mercury at SD-10 is unknown, but is not associated with the chlorinated VOC releases from the former laundry facility.

Aquatic Organisms. Risks to aquatic life from exposure to surface water and sediment ECPCs were also evaluated by comparing effects concentrations from the ACOE ERED with calculated tissue concentrations for aquatic life. This comparison is presented in Table 9-15. The database provides effect concentrations for fish for the surface water ECPCs, 4,4'-DDT, and endrin ketone. Effects data for invertebrates were available for the sediment ECPCs pyrene, 4,4'-DDE,

Table 9-13
Comparison of Surface Water ECPC Exposure Concentrations to
Toxicity Benchmark Values

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Exposure Point Concentration ¹ (µg/l)		Toxicity Benchmark Values (µg/l)					Result
	RME	CT	FDEP Class III Freshwater Quality Standards ²	Chronic AWQC ³	Range of Effects Concentrations for Fish ⁴	Range of Effects Concentrations for Aquatic Invertebrates ⁴	Range of Effects Concentrations for Amphibians ⁴	
<u>Volatile Organic Compounds (µg/l)</u>								
Carbon disulfide	1	1	NA	NA	NA	NA	NA	No TBV
cis-1,2-Dichloroethene	760	260	NA	NA	29,000 to 220,000	2,400 to 98,000	NA	Less than TBV
Trichloroethene	57	22	⁵ 80.7	⁶ 21,900	1,900 to 270,000	2,200 to 1,313,000	29,000 to 48,000	Less than TBV
Vinyl chloride	35	11	NA	NA	NA	NA	NA	No TBV
<u>Pesticides (µg/l)</u>								
4,4'-DDT	⁷ 0.029		⁸ 0.001	⁹ 0.001	0.2 to 600,000	0.04 to 100,000	30 to 100	Less than TBV
Endrin ketone	⁷ 0.01		⁸ 0.0023	⁹ 0.0023	NA	NA	2 to 290	Less than TBV
See notes at end of table.								

Table 9-13 (Continued)
Comparison of Surface Water ECPC Exposure Concentrations to
Toxicity Benchmark Values

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

¹ The exposure point concentrations are equal to the RME and CT concentrations from Table 9-4.

² Chapter 62-302, FAC, Surface Water Quality Standards (Florida Legislature, 1996).

³ Federal Ambient Water Quality Chronic Criteria (USEPA, 1991b).

⁴ From Appendix F-1, Tables F-1-8 and F-1-9. Values derived from AQUIRE and from Devillers and Exbrayat (1992). Only growth, mortality, reproduction, abundance, hatchability, biomass, and population endpoints were considered.

⁵ This standard is based on human health effects; therefore, it was not used to evaluate effects to aquatic life.

⁶ Insufficient data to develop criterion; value represents a Lowest Observed Effects Level.

⁷ Exposure concentration represents chemical concentrations at one sample location (SW-10).

⁸ Based on uptake into wildlife, and is overly conservative for aquatic life. Therefore, this criteria was not used to evaluate effects to aquatic life.

Notes: ECPC = ecological chemical of potential concern.

$\mu\text{g}/\text{l}$ = micrograms per liter.

RME = reasonable maximum exposure.

CT = central tendency.

FDEP = Florida Department of Environmental Protection.

AWQC = Ambient Water Quality Criteria.

AQUIRE = Aquatic Information Retrieval.

NA = not available.

TBV = toxicity benchmark value.

DDT = dichlorodiphenyltrichloroethane.

Table 9-14
Comparison of Sediment ECPC Exposure Concentrations to Toxicity Benchmark Values¹

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Exposure Point Concentration ¹		Toxicity Benchmark Values				Result
	RME	CT	USEPA Sediment Quality Guidelines ²	NOAA ER-L ³	NOAA ER-M ³	OME LEL ⁴	
<u>Volatile Organic Compounds (µg/kg)</u>							
Acetone	46	32	NA	NA	NA	NA	No TBV
1,1-Dichloroethene	13	13	NA	NA	NA	NA	No TBV
1,2-Dichloroethene	1,300	420	NA	NA	NA	NA	No TBV
Vinyl chloride	560	130	NA	NA	NA	NA	No TBV
<u>Semivolatile Organic Compounds (µg/kg)</u>							
bis(2-Ethylhexyl)phthalate	⁵ 5,600		NA	NA	NA	NA	No TBV
Fluoranthene	⁶ 3,500		8,990	600	5,100	750	TBV exceeded
Pyrene	⁶ 3,400		NA	665	2,600	490	TBV exceeded
<u>Pesticides and PCBs (µg/kg)</u>							
4,4'-DDE	⁷ 7.6		⁸ 12	2.2	27	5	TBV exceeded
Aroclor-1254	¹ 68		283	22.7	180	60	TBV exceeded
Endosulfan I	⁵ 4.6		NA	NA	NA	NA	No TBV
Heptachlor	² 2.6		1.6	NA	NA	⁷ 5	TBV exceeded
alpha-Chlordane	⁵ 2		NA	NA	NA	7	Less than TBV
delta-BHC	⁶ 6.1		2.3	NA	NA	⁸ 3	TBV exceeded
See notes at end of table.							

Table 9-14 (Continued)
Comparison of Sediment ECPC Exposure Concentrations to Toxicity Benchmark Values¹

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte	Exposure Point Concentration ¹		Toxicity Benchmark Values				Result
	RME	CT	USEPA Sediment Quality Guidelines ²	NOAA ER-L ³	NOAA ER-M ³	OME LEL ⁴	
Inorganic Analytes (mg/kg)							
Aluminum	⁵ 7,750		NA	NA	NA	NA	No TBV
Lead	⁶ 38.1		NA	46.7	218	31	TBV exceeded
Mercury	⁷ 0.31		NA	0.15	0.71	0.2	TBV exceeded

¹ The exposure point concentrations are equal to the RME and average concentrations from Table 9-5.

² (USEPA, 1988b; USEPA, 1993b) mean Sediment Quality Criteria adjusted values using 1.45 percent site-specific total organic carbon (TOC). The mean Final Residue Value was used when a mean Final Chronic Value was not available.

³ NOAA ER-L and ER-M Sediment Guidelines correspond to the concentration that is protective of 90 percent of the population and 50 percent of the population, respectively (Long et al., 1994).

⁴ OME LEL Provincial Sediment Quality Guidelines (Persaud et al., 1996) correspond to a concentration that can be tolerated by the majority of benthic organisms.

⁵ Exposure concentration represents chemical concentrations at one sample location (SD-10).

⁶ Value for 4,4'-DDT used as a surrogate.

⁷ Value for heptachlor epoxide used as a surrogate.

⁸ Value for gamma-benzene hexachloride used as a surrogate.

Notes: RME = reasonable maximum exposure.

CT = central tendency.

USEPA = U.S. Environmental Protection Agency.

NOAA = National Oceanic and Atmospheric Administration.

ER-L = effects range-low.

ER-M = effects range-medium.

OME = Ontario Ministry of the Environment.

LEL = lowest effect level.

µg/kg = micrograms per kilogram.

NA = not available.

TBV = toxicity benchmark value.

BHC = benzene hexachloride.

DDE = dichlorodiphenyldichloroethene.

BHC = benzene hexachloride.

mg/kg = milligrams per kilogram.

ECPC = ecological chemical of potential concern.

= concentration exceeds the most conservative toxicity benchmark.

Table 9-15
Comparison of Calculated Aquatic Organism Tissue Concentrations
with Effect Concentrations

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Analyte ¹	Calculated Tissue Concentration (mg/kg) ²		Range of Effect Concentrations (mg/kg) ³	
	RME	CT	Fish	Invertebrates
1,1-Dichloroethene	NC	NC	NA	NA
1,2-Dichloroethene (total)	NC	NC	NA	NA
Acetone	NC	NC	NA	NA
Carbon disulfide	NC	NC	NA	NA
Trichloroethene	NC	NC	NA	NA
Vinyl chloride	NC	NC	NA	NA
4-Methylphenol	NC	NC	NA	NA
Fluoranthene	⁴ 0.18	⁴ 0.18	182	NA
Pyrene	⁴ 0.17	⁴ 0.17	NA	1,270
bis(2-Ethylhexyl)phthalate	⁴ 0.28	⁴ 0.28	NA	NA
4,4'-DDE	⁴ 0.16	⁴ 0.16	NA	0.10 to 7.35
4,4'-DDT	⁵ 0.98	⁵ 0.98	3.8 to 19.7	0.014 to 19.7
Aroclor-1254	⁴ 0.83	⁴ 0.83	NA	NA
Endosulfan I	⁴ 0.025	⁴ 0.025	NA	NA
Endrin ketone	⁵ 0.055	⁵ 0.055	0.31 to 1.6	NA
Heptachlor	⁴ 0.003	⁴ 0.003	NA	NA
alpha-Chlordane	⁴ 0.003	⁴ 0.003	NA	NA
delta-BHC	⁴ 0.016	⁴ 0.02	NA	NA
Aluminum	⁴ 581	⁴ 581	NA	NA
Lead	⁴ 3.0	⁴ 3.0	NA	2.5
Mercury	⁴ 5.3	⁴ 5.3	NA	NA

¹ These analytes were identified as surface water and sediment ecological chemicals of potential concern.

² Tissue concentrations are calculated by multiplying the sediment or surface water concentration by a bioaccumulation factor (BAF) or bioconcentration factor (BCF), respectively.

³ Effect concentrations for fish and invertebrates are presented in Appendix F-1, Table F-1-10.

⁴ RME and CT exposure concentrations are based on sediment concentrations and BAFs.

⁵ RME and CT exposure concentrations are based on surface water concentrations and BCFs.

Notes: mg/kg = milligrams per kilogram. NA = not available.
RME = reasonable maximum exposure. DDE = dichlorodiphenyldichloroethene.
CT = central tendency. DDT = dichlorodiphenyltrichloroethane.
NC = not calculated. BHC = benzene hexachloride.

and lead. Effects data for fish are available for PCE and fluoranthene; however, these analytes were only detected in sediment. Therefore, the calculated tissue concentrations for these analytes represent invertebrate tissue concentrations and would not be comparable to the available effects concentrations for fish.

The calculated fish tissue concentration for 4,4'-DDT and endrin ketone (0.98 and 0.055 mg/kg) are well below the lowest effect concentrations for fish. The effect concentrations endpoints for 4,4'-DDT and endrin ketone included LOEC for reproductive effects and no observed effect concentrations (NOECs) for growth, respectively. The calculated invertebrate tissue concentration of pyrene (0.17 mg/kg) is well below the invertebrate effect concentration (1,270 mg/kg, based on amphipod mortality). The calculated invertebrate tissue concentrations of 4,4'-DDE and lead (0.16 and 3.0 mg/kg) slightly exceed the lowest invertebrate effect concentrations for these analytes (0.10 and 2.5 mg/kg). These effect concentrations are based on NOECs for behavioral and developmental endpoints, respectively. The range of data for 4,4'-DDE suggests that aquatic invertebrates can tolerate higher tissue levels; no additional data are available for lead. Based on these comparisons it is unlikely that aquatic receptor populations would be affected by ECPCs in sediment and surface water.

9.4.3 Groundwater Table 9-16 provides a comparison of RME and CT concentrations to surface water toxicity benchmarks. RME and CT concentrations of TCE and manganese are less than toxicity benchmark values, which indicates that benthic aquatic organisms are not at risk from exposure to these groundwater ECPCs in Lake Druid. The RME (4,300 $\mu\text{g}/\ell$) and CT (3,400 $\mu\text{g}/\ell$) concentrations of *cis*-1,2-DCE both exceed the most conservative benchmark for aquatic invertebrates (2,400 $\mu\text{g}/\ell$) by less than a factor of 2. Given the low magnitude of exceedance, it is unlikely that benthic invertebrates, or other benthic receptors, are at risk from exposure to *cis*-1,2-DCE in groundwater that discharges to the surface.

Exposure concentrations for alkalinity are less than the AWQC of greater than 20,000 $\mu\text{g}/\ell$ CaCO_3 . Alkalinity is a measure of the buffering capacity of water, which corresponds to the total of all components (e.g., borates, phosphates, silicates, carbonates, and bicarbonates) in water that elevate the pH of water above 4.5 (USEPA, 1976). Low pH can have direct and indirect (i.e., increased toxicity of certain metals to aquatic organisms) effects on aquatic organisms. Actual impacts to aquatic organisms related to the release of chlorinated VOCs from OU 4 is unclear, since the low alkalinity may be indicative of naturally low levels for Lake Druid.

9.5 UNCERTAINTY ANALYSIS. The objective of the uncertainty analysis is to discuss the assumptions of the ERA process that may influence the risk assessment results and conclusions. General uncertainties inherent in the risk assessment process and in the OU 4 ERA are included in Table 9-17.

Specific uncertainties associated with exposure to OU 4 environmental media are described below.

- Risks to avian species may have been underestimated because bioaccumulation and toxicity data for this taxonomic group are generally lacking in the literature. As a result, potential risks associated with several ECPCs were not evaluated for avian species. If the toxicological and contaminant transport data obtained from studies

Table 9-16
Comparison of Groundwater ECPC Exposure Concentrations to
Toxicity Benchmark Values

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center
 Orlando, Florida

Analyte	Exposure Point Concentration ¹ ($\mu\text{g}/\ell$)		Toxicity Benchmark Value ($\mu\text{g}/\ell$)					Result
	RME	CT	FDEP Class III Freshwater Quality Standards ² ($\mu\text{g}/\ell$)	Chronic AWQC ³ ($\mu\text{g}/\ell$)	Range of Effects Concentrations for Fish ⁴	Range of Effects Concentrations for Invertebrates ⁴	Range of Effects Concentrations for Amphibians ⁴	
<u>Volatile Organic Compounds ($\mu\text{g}/\ell$)</u>								
cis-1,2-Dichloroethene	4,300	3,400	NA	NA	29,000 to 220,000	2,400 to 98,000	NA	Exceeds TBV
Trichloroethene	1,300	610	⁵ 80.7	⁵ 21,900	1,900 to 270,000	2,200 to 1,313,000	29,000 to 48,000	Less than TBV
<u>Water Chemistry ($\mu\text{g}/\ell$)</u>								
Total alkalinity	12,000	10,900	>20,000	>20,000	NA	NA	NA	Does not meet criteria
<p>¹ The exposure point concentrations are equal to the RME and average concentrations from Table 9-6.</p> <p>² Chapter 62-302, FAC, Surface Water Quality Standards (Florida Legislature, 1996).</p> <p>³ Federal AWQC (USEPA, 1991b).</p> <p>⁴ From Appendix F-1, Tables F-1-8 and F-1-9. Values derived from Aquatic Information Retrieval and from Devillers and Exbrayat (1992). Only growth, mortality, reproduction, abundance, hatchability, biomass, and population endpoints were considered.</p> <p>⁵ This standard is based on human health effects; therefore, it was not used to evaluate effects to aquatic life.</p> <p>⁶ Insufficient data to develop criterion; value represents a Lowest Observed Effects Level.</p> <p>Notes: $\mu\text{g}/\ell$ = micrograms per liter. RME = reasonable maximum exposure. CT = central tendency. FDEP = Florida Department of Environmental Protection. AWQC = Ambient Water Quality Criteria. NA = not available. TBV = Toxicity benchmark value. = concentration does not meet criteria.</p>								

Table 9-17
Potential Sources of Uncertainty in Ecological Risk Assessment

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center
 Orlando, Florida

Potential Source	Direction of Effect	Justification
<u>Uncertainties Associated with Ecological Contaminant of Potential Concern (ECPC) Selection Process</u>		
Degradation of chemicals not considered	Overestimate	Risk estimates are based on recent chemical concentrations. Concentrations will tend to decrease over time from degradation and the formation of daughter products.
No evaluation of tentatively identified compound (TIC) data	Underestimate	Risk was not calculated for potential exposure to TICs.
Use of estimated data	Unknown	Using estimated data in the risk assessment may over or underestimate the actual concentration of an analyte in site media; therefore, risks may also be over or underestimated.
<u>Uncertainties Associated with Exposure Assessment</u>		
Food chain assumed to occur at site	Unknown	Occurrence of the food chain used in the models at the sites is unknown.
Food chain model exposure parameter assumptions	Possibly underestimate	Some exposure parameters are from the literature and some are estimated. Efforts were made to select exposure parameters representative of a variety of species or feeding guilds, so that exposure estimates would be representative of more than a single species.
Uncertain occurrence of receptors at sites	Unknown	Actual occurrence at the sites by receptors considered in the food chain models is uncertain.
Assumption that receptor species will spend equal time at all habitats within home range	Unknown	Organisms will spend varying amounts of time in different habitats, thus affecting their overall exposures.
Extrapolation of literature values from test species to representative wildlife species	Unknown	Species differ with respect to absorption, metabolism, distribution, and excretion of chemicals. The magnitude and direction of the difference will vary with each chemical.
Consumption of contaminated prey	Unknown	Toxicity to receptors may result in sickness or mortality, thus making fewer prey items available to predators. Predators may stop foraging in areas with reduced prey populations, or discriminate against, or, conversely, select contaminated prey.
Limited evaluation of dermal or inhalation exposure pathways	Underestimate	The dermal and inhalation exposure pathways are generally considered insignificant due to protective fur, feathers, chitinous exoskeletons, and the low concentration of contaminants under natural atmospheric conditions. However, under certain conditions, these exposure pathways may occur.
See notes at end of table.		

Table 9-17 (Continued)
Potential Sources of Uncertainty in Ecological Risk Assessment

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center
 Orlando, Florida

Potential source	Direction of Effect	Justification
Uncertainties Associated with Exposure Assessment (Continued)		
Reasonable maximum exposure (RME) scenario	Overestimate	In several cases, the RME concentration is equal to the maximum detected concentration because the 95 percent upper confidence limit (UCL) was not calculated. It is unlikely any receptor would be exposed concurrently to maximum concentrations of all ECPCs.
Bioaccumulation factor (BAF) estimation	Possibly underestimate	As many literature values were not available for some species and analytes, alternate BAFs were derived using regressions or surrogate values (Table 9-10 lists the rationale for the generation of alternate BAFs).
Continuous uptake and bioaccumulation of ECPCs by soil biota	Unknown	Tissue and organ responses to ECPC uptake were represented by a linear function, that is an oversimplification of a more complex system (i.e., trophic states and lipid concentrations may affect bioaccumulation, or contaminants may only be seasonally available).
Bioaccumulation of ECPCs in leafy portions of plants	Overestimate	Ryan et al. (1988) states that compounds with log K_{ow} s > 5 are unavailable to plants due to soil sorption. Compounds with log K_{ow} s > 5 will be taken into the roots of plants, but are not easily transported into the leafy parts of plants (Briggs et al., 1982; 1983). The surface soil ingestion exposure model overestimates ECPC exposure via plant ingestion to those receptors that only eat the leafy portions of plants.
Relative uptake of inorganics by different plant species	Unknown	Estimated plant BAFs for certain inorganics were based on BAF data for leafy produce grown in sewage sludge. Variability in type of plant and substrate may make the chosen BAF values an overestimate or underestimate of actual uptake.
Uncertainties Associated with Effects		
Lack of ingestion toxicity information for reptile and amphibian species	Unknown	Information is not available on the toxicity of contaminants to reptilian or amphibian species resulting from dietary or oral exposures; as a result, dietary exposures to these receptors were not quantitatively evaluated in the Operable Unit (OU) 4 ecological risk assessment (ERA). Assuming the toxicities of analytes to mammals and birds are similar for reptiles, and to the extent that the dietary exposures for reptiles and amphibians are the same as for the tertiary consumers evaluated in the OU 4 ERA, an assumption can be made that dietary exposures to reptiles and amphibians would result in similar risk-levels that were predicted for predatory mammals and birds. However, risks to reptiles and amphibians remain unknown.
See notes at end of table.		

Table 9-17 (Continued)
Potential Sources of Uncertainty in Ecological Risk Assessment

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
 Naval Training Center
 Orlando, Florida

Potential source	Direction of Effect	Justification
Use of measurement endpoints	Overestimate	Although an attempt was made to have measurement endpoints reflect assessment endpoints, limited available ecotoxicological literature resulted in the selection of certain measurement endpoints that may overestimate assessment endpoints.
<u>Uncertainties Associated with Risk Characterization</u>		
Risk evaluated for individual terrestrial receptors only	Overestimate	Effects on individual terrestrial organisms may occur with little population or community level effects. However, as the number of affected individuals increases, the likelihood of population-level effects increases.
Effect of decreased prey item populations on predatory receptors	Unknown	Adverse population effects to prey items may reduce the foraging population for predatory receptors, but may not necessarily adversely impact the population of predatory species.
Multiple conservative assumptions	Overestimate	Cumulative impact of multiple conservative assumptions yields high risk to ecological receptors, and may result in risk at background concentrations or the prediction of risks when there is no potential for adverse effects.
Summation of effects (hazard indices)	Unknown	The assumption that effects are additive ignores potential synergistic or antagonistic effects. It assumes similarity in mechanism of action, which is not the case for many substances. Compounds may induce toxic effects in different organs or systems.

conducted on mammals were used to estimate risks to avian species, then risk estimates for birds would be higher. However, there is also uncertainty in assuming that the metabolic functions of mammals and birds are similar enough to use intertaxonomic surrogates.

- Dietary exposures and risks to adult amphibians and reptiles species were not estimated for surface soil, surface water, or sediment ECPCs because bioaccumulation and toxicity data for this taxonomic group are generally lacking in the literature. As a result, potential risks associated with ECPCs are uncertain for these species. Intertaxonomic surrogates were not used to calculate dietary risks to reptiles because of the uncertainty associated with extrapolation of data between taxonomic groups.
- Site-specific toxicity data for OU 4 media are not available. Toxicity benchmark values used in the risk assessment were designed for risk screening purposes only and may not be relevant to the specific conditions at OU 4. The conservative nature of these screening tools may overestimate the actual risk to ecological receptors at OU 4.
- BAFs for plant material are based on the assumption that plants are 80 percent water. This assumption applies to berries and leafy vegetables, but does not apply to grains, which have a moisture content of only 10 percent. Since the diets of the mouse and the mourning dove consist primarily of grains, the risks to these receptors may be underestimated.
- There is uncertainty associated with the extent of SVOC, pesticide, PCB, and metals characterization in Lake Druid surface water and sediment, which was limited to one sample location (SW-10 and SD-10). Based on the history of chemical releases at OU 4, the Navy had proposed analyzing site media for VOCs only. At the request of the USEPA and FDEP, a full suite of analyses (including SVOCs, pesticides, PCBs, and metals) was performed at select few locations. The limited SVOC, pesticide, PCB, and metals data represent a single exposure point for aquatic receptors, and are not representative of the entire exposure area. Based on the results of the OU 4 ERA, the Navy concludes that there are no risks to receptors from exposure to site-related VOCs. There are no plans to collect additional surface water or sediment samples from Lake Druid for SVOC, pesticide, PCB, or metals analysis because these chemicals are not believed to be associated with the release of chlorinated VOCs from OU 4. The risk estimates for aquatic organisms and wildlife receptors exposed to SVOCs, pesticides, PCBs, and metals may underestimate or overestimate actual risks based on a larger distribution of these chemicals in Lake Druid surface water and sediment. However, the Navy believes that risk estimates for these receptors from exposure to chemicals released from OU 4 have been overestimated because of the non-site-related chemicals (e.g., SVOCs, pesticides, PCBs, and metals), which have also been detected in control samples from Lake Druid.
- There is uncertainty associated with the origin of PAHs, pesticides and PCBs detected in Lake Druid sediment. The Navy maintains that these analytes are present due to stormwater discharges to the lake from the

surrounding urban development. A comparison of data collected from sediments associated with urban runoff throughout the state and Lake Druid sediment data, presented in Appendix P, shows that concentrations detected in Lake Druid are consistent with what has been shown to be present in urban stormwater sediments. Based on this comparison, FDEP and OPT have concurred it is likely that these analytes are not present due to activities conducted by the Navy at Area C and OU 4 (Appendix P).

- There is uncertainty associated with the ingestion toxicity data derived from the IRIS and Registry of Toxic Effects of Chemical Substances (RTECS) database. The IRIS and RTECS data were obtained in 1993 and 1995, respectively, and the primary literature citations were not provided. As a result, the primary literature for these studies was not reviewed, which may have resulted in the selection of RTVs that may over or underestimate potential risks to wildlife receptors.
- Phytotoxicity and invertebrate benchmark values are unavailable for acetone and carbazole. If the phytotoxicity and invertebrate benchmark values for PCE and acenaphthylene are used as surrogate benchmark values, then exposure concentrations of acetone and carbazole in surface soil at OU 4 would not exceed their respective surrogate values.
- Surface water toxicity benchmarks are unavailable for carbon disulfide, and VC. If the toxicity benchmarks for *cis*-1,2-DCE were used as a surrogate for VC, then exposure concentrations of VC in surface water at OU 4 are less than their respective surrogate values, suggesting that pelagic aquatic organisms are not at risk. There are no suitable surrogate value for carbon disulfide.
- Sediment toxicity benchmarks are unavailable for VOCs, bis(2-ethylhexyl)phthalate, endosulfan I, or aluminum. If the toxicity benchmarks for 4,4'-DDE were used as a surrogate for endosulfan I, then exposure concentrations of endosulfan I in sediment at OU 4 are less than their respective surrogate values, suggesting that benthic aquatic organisms are not at risk. There are no suitable surrogate values for VOCs, bis(2-ethylhexyl)phthalate, or aluminum.
- Burrowing mammals may be exposed to chlorinated VOCs in air that have volatilized from groundwater; however, this pathway was not evaluated in the ERA due to the complexity of the pathway. Given the concentrations of chlorinated VOCs in groundwater (i.e., generally 1 part per million or less), it is unlikely that there would be appreciable levels of chlorinated solvents in air in the animal burrows. However, this may underestimate total risk to burrowing mammals because animal burrows have been observed at OU 4.
- There is uncertainty associated with the SVOC results for sediment because the detection limits were elevated to concentrations ranging from 30,350 to 77,200 $\mu\text{g}/\text{kg}$. Some SVOCs that are present in OU 4 sediment may have not have been detected due to the high detection limits, thus underestimating risk to aquatic and semi-aquatic recep-

tors. Detection limits may have been elevated due to matrix interference.

- Avian (i.e., small bird and predatory bird) lethal and sublethal RTVs are unavailable for VOCs and SVOCs. These analytes were detected at low frequency and concentrations in surface soil, surface water and sediment, and most of the detected concentrations were in a relatively small area as compared to available habitat at OU 4. Lethal RTVs for avian receptors were unavailable for two pesticides (gamma-BHC and methoxychlor) and several inorganics including aluminum, barium, beryllium, cadmium, silver and zinc. The pesticides were not CPCs in surface water or sediment, however they were retained as surface soil RPCs. Risks to avian receptors exposed to pesticides in surface soil may have been underestimated, although unlikely as these analytes were detected at low frequencies and concentrations. Risks to small terrestrial birds may have been underestimated due to the limited availability of lethal RTVs for inorganic analytes. Sublethal RTVs were unavailable for several pesticides (i.e., endosulfan I, endrin ketone, heptachlor, delta-BHC, gamma-BHC and methoxychlor), however most of these analytes had lethal RTVs and were evaluated in this risk assessment. Sublethal RTVs were also unavailable for several inorganics including aluminum, barium, beryllium, silver and zinc. Risks to small terrestrial birds may have been underestimated due to the limited availability of sublethal RTVs for inorganic analytes. The lethal RTV for carbon disulfide was unavailable for mammals, however this analyte was detected in a single surface water sample at a very low concentration. In addition, the HQ calculated based on the sublethal RTV was 4.3E-08. Therefore, not calculating risks for a lethal RTV would not likely impact the results of the risk assessment.
- Dietary ingestion rates for the cotton mouse, mourning dove, short-tailed shrew, woodcock, and red fox were calculated using allometric equations based on receptor body weight. Allometric equations were developed for birds and mammals, the calculated values are less than the values presented in the Wildlife Exposure Factors Handbook (USEPA, 1993) for the representative species (when available). Therefore, it is likely that risks to these receptors may have been underestimated.

9.6 SUMMARY OF ECOLOGICAL ASSESSMENT FOR OU 4. As stated in Subsection 9.2.3, the objectives of the OU 4 ERA are to answer the questions below.

1. Are ECPCs present in the surface water, sediment, and groundwater at concentrations sufficiently high to reduce the survival and maintenance of aquatic receptor populations along the OU 4 groundwater discharge zone of Lake Druid
2. Are ECPCs (e.g., pesticides, PCBs, and mercury) present in surface water and sediment at concentrations sufficiently high as to adversely affect omnivorous mammals and birds, or piscivorous bird populations that occur at the site following consumption of contaminated prey?
3. Are ECPCs present in the surface soil at concentrations sufficiently high to reduce plant or soil invertebrate biomass or plant cover

availability such that small mammal and bird populations could be affected?

4. Are ECPCs concentrations in plants and invertebrates sufficiently high as to adversely affect foraging small mammal or bird populations following consumption of contaminated prey?
5. Are bioaccumulating chemicals sufficiently high in terrestrial wildlife prey items to reduce survivability, growth, or reproduction in top predators (e.g., foxes and owls)?

Potential risks for ecological receptors exposed to ECPCs in OU 4 surface soil, surface water, sediment, and groundwater were determined to answer these questions. The results of the ERA for OU 4 are summarized in Table 9-18.

Risks associated with exposures to ECPCs in OU 4 surface soil were evaluated for terrestrial wildlife based on a model that estimates the amount of contaminant exposure obtained via the diet and incidental ingestion of surface soil.

Exposure to ECPCs in surface soil would not have an acute toxic effect (i.e., cause mortality) on the wildlife receptor populations at OU 4. Ingestion of aluminum and zinc in surface soil and food items could potentially affect omnivorous small mammals at OU 4 by impairing reproduction or inhibiting growth.

Reduction in terrestrial plant and soil invertebrate biomass used as forage material was evaluated by comparing exposure concentrations for surface soil with toxicity benchmarks. Based on this comparison, terrestrial plants could potentially experience adverse growth and reproduction effects from exposure to detected concentrations of aluminum, lead, silver, vanadium, and zinc in the surface soil at OU 4. Although phytotoxicity benchmarks were exceeded for these inorganic constituents, no evidence of reduction in vegetative biomass was observed in the field at OU 4. Therefore, impacts to small mammals and birds that rely on plant biomass as a forage base are unlikely. The results of the invertebrate benchmark comparison indicate that it is unlikely that invertebrate biomass and/or abundance would be reduced such that small mammal and bird populations would be affected at OU 4. The RME and CT concentrations for *cis*-1,2-dichloroethylene exceed the low end of the range of effect concentrations for invertebrates. However, based on the magnitude of this exceedance, population level risks to these receptors are unlikely. In addition, future impacts to invertebrate receptor populations are being addressed through the ongoing groundwater remediation at the site.

Potential risks associated with exposures to ECPCs in OU 4 surface water and sediment were evaluated for both semi-aquatic wildlife and aquatic receptors. Exposure to ECPCs in surface water and sediment would not have an acute toxic effect (i.e., cause mortality) on the wildlife receptor populations at OU 4. Sublethal risks (i.e., potential reductions in reproduction and growth of semi-aquatic wildlife associated with exposure to ECPCs in surface water and sediment would also not likely occurred at OU 4. The HIs for all of the representative ecological receptors at the site, with the exception of the great blue heron, are less than 1. The HI for the great blue heron only slightly exceeded 1 (i.e., the sublethal HI for the heron was 1.3).

Table 9-18
Ecological Risk Assessment Summary

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 (Area C)
Naval Training Center
Orlando, Florida

Receptor	Medium			
	Surface Soil	Surface Water	Sediment	Groundwater Discharge
Wildlife Receptors	NA	NA	None	NA
Terrestrial Plants	NA	NA	NA	NA
Soil Invertebrates	NA	NA	NA	NA
Pelagic Aquatic Receptors	NA	None	NA	NA
Benthic Aquatic Receptors	NA	NA	None	None
Notes: NA = not applicable. None = no effect.				

Potential risks associated with exposures to ECPCs in OU 4 surface water were evaluated for pelagic aquatic organisms in the wetland area and for aquatic receptors in Lake Druid. A comparison of surface water ECPCs with surface water toxicity benchmarks indicates that pelagic aquatic organisms are not at risk.

Potential risks associated with exposures to ECPCs in OU 4 sediment were evaluated for benthic aquatic organisms in the wetland area and for aquatic receptors in Lake Druid. Sediment ECPCs were compared to sediment criteria and guidelines. Although several exposure concentrations slightly exceed sediment toxicity benchmarks, the magnitude of exceedances was low (i.e., less than a factor of 3.5). The analytes that exceeded benchmarks are not related to site activities or the release of chlorinated VOCs from OU 4. Based on the data presented in Appendix P, it was determined that these analytes are likely related to stormwater discharges from off site, not activities conducted by the Navy at Area C and OU 4. Although sediment benchmarks are lacking for VOCs, effects to benthic organisms are evaluated using groundwater results (use to simulate pore water conditions). Therefore, the ERA concludes that benthic aquatic organisms are not at risk from exposure to sediment.

Potential risks associated with exposures to ECPCs in OU 4 groundwater were evaluated for benthic aquatic organisms in the wetland area and for aquatic receptors in Lake Druid. A comparison of groundwater ECPCs with surface water toxicity benchmarks indicate that pelagic aquatic organisms are not at risk from exposure to chlorinated VOCs or manganese. Although the alkalinity concentrations in the groundwater discharge area were less than the AWQC of greater than 20,000 $\mu\text{g}/\ell$, the direct adverse effects to aquatic organisms are unclear.

10.0 SUMMARY AND CONCLUSIONS

The summary and conclusions of the RI for OU 4 at NTC, Orlando are presented in this chapter.

10.1 SUMMARY. OU 4 is located within Area C and includes SA 12 (DRMO Warehouses and Salvage Yard), SA 13 (Former Base Laundry and Dry-Cleaning Facility), and SA 14 (DRMO Storage Area). Area C occupies 45.8 acres, and is located approximately 1 mile west of the Main Base off Maguire Boulevard.

The COC at OU 4 are primarily PCE and its degradation products (TCE, *cis*-1,2-DCE, and VC). PCE is known to have been historically stored and handled at OU 4 as part of the former laundry facility's operations. It is possible and most probable that multiple source areas exist at OU 4. The probable contaminant source/release mechanisms are from 1) operational spills on the ground surface outside Building 1100 during the loading and unloading of containers (5 and 55 gallons) of PCE; 2) leaks associated with the collection and transport of wastewater from laundry and dry-cleaning machines; and 3) spill inside the building transferring via leaks in floor drains, drainpipes, the surge tank, and/or sewer pipe and migrating to the subsurface.

The RI conducted at OU 4 included:

- installation, development, and sampling of 11 monitoring wells and 5 microwells,
- sampling of 24 existing monitoring wells and 5 drive points,
- evaluated *in situ* hydraulic conductivity in 9 representative monitoring wells,
- collection of 11 surface soil samples for analysis (grouped with results from 9 previously collected surface soil samples),
- collection of 20 subsurface soil samples for analysis (grouped with results from 12 previously collected subsurface soil samples),
- collection of 11 surface water and sediment samples,
- professional surveying of physical features and sampling locations,
- data validation and evaluation, and
- human health and ERAs.

Results of the analytical program indicated that COC are VOCs associated with multiple source locations caused by spills and releases of PCE during approximately 30 years of operation of the former laundry and dry-cleaner. The source area(s) are located under and to the north and northeast of Building 1100.

Three surface soil samples, adjacent to the northern part of Building 1100, had detections of PCE exceeding leachability SCTLs. Dry-cleaning machines were

housed inside the northern portion of the building, and former employees of the laundry facility recalled a chemical spill near the loading dock north of the building (see Subsection 2.3.4). Such a spill, as well as other small-scale spills that may have occurred periodically during dry-cleaning operations, would contribute to surface soil PCE contamination. In addition, the two subsurface soil samples detecting PCE above leachability SCTLs correspond to the surface soil boring locations. No other VOCs were detected above leachability SCTLs in surface soil or subsurface soil samples collected during the RI.

The VOCs detected in groundwater exceeding the GCTLs at OU 4 included PCE, TCE, *cis*-1,2-DCE, and VC. PCE was detected at a maximum concentration of 34,000 $\mu\text{g}/\ell$ at monitoring well OLD-13-07A, located near the northwest corner of the former laundry facility. In general, the highest detections of PCE were found adjacent and under the north and northwest portions of Building 1100, confirming that this is the area of the suspected source(s) of contamination.

TCE, a degradation product of PCE, is generally found moving with groundwater flow away from Building 1100 and towards Lake Druid. TCE was detected at a maximum concentration of 3000 $\mu\text{g}/\ell$. *Cis*-1,2-DCE, a further degradation product of PCE, is found at a maximum concentration in groundwater, collected from monitoring wells, of 2000 $\mu\text{g}/\ell$ and mimics the migration pattern taken by TCE.

As summarized in Subsection 2.2.2, two former production wells and a former drainage well are located within and north of Area C. All three wells are screened below the Hawthorn Group clay, which extends to a depth of approximately 150 feet bls. Chlorinated VOCs present in OU 4 groundwater are unlikely to contaminate deep aquifers via these conduits. The production well located in Area C has been abandoned by the St. John's Water Management District, and the drainage well also appears to have been abandoned. It is likely that the production well formerly located north of Area C in the area now occupied by the condominium complex was also abandoned. However, if the well does exist, it would not be in use and is located cross-gradient of the plume of chlorinated VOCs.

Contaminated groundwater entering Lake Druid was measured by sampling drive point wells around the eastern perimeter of the lake. PCE, TCE, *cis*-1,2-DCE, and VC all exceeded their GCTLs in two or more samples collected. These compounds then migrated into the sediment of Lake Druid. The contaminants found in the sediment were compared to the background or control samples collected and indicated approximate concentrations migrating into the surface water.

PCE, TCE, total 1,2-DCE, and VC were all detected in sediment at concentrations above the control samples. PCE and TCE were found in sediment samples at concentrations as high as 89 $\mu\text{g}/\text{kg}$ and 1400 $\mu\text{g}/\text{kg}$, respectively. Total 1,2-DCE was detected with concentrations as high as 1300 $\mu\text{g}/\text{kg}$. Finally, VC was detected with concentrations as high as 1100 $\mu\text{g}/\text{kg}$.

PCE was detected in surface water above its SWCTL in one sample; however, TCE was not detected above its SWCTL. The remaining VOCs in surface water were compared to control samples. *Cis*-1,2-DCE, *trans*-1,2-DCE, and VC were all detected above the control sample concentrations.

A continuing effort to remove high concentrations of VOCs in groundwater was initiated in January 1998 as a groundwater IRA. The objective of the IRA was to

contain and control groundwater containing VOCs through the use of recirculation well technology. This technology was designed to intercept and treat the VOC plume upgradient of Lake Druid. The average linear groundwater flow velocity for the upper unit (0 to 20 feet bls) of the surficial aquifer in the study area was calculated to be 0.27 ft/day, and the average rate in the lower portion (20 to 60 feet bls) of the aquifer was 1.07 ft/day. These calculations translate into flow rates of 97 ft/yr and 390 ft/yr, respectively, for the upper and lower aquifer units. Based on performance monitoring data (HLA, 1999c), VOC concentrations in groundwater entering Lake Druid had approached SWCTLs, likely also decreasing VOC concentrations in Lake Druid.

A surface soil IRA was conducted at OU 4 in May 1999 to address analytes detected in surface soil at concentrations above FDEP SCTLs, including arsenic, PAHs, and PCBs. Three excavations, each measuring 10 feet by 10 feet and extending to a depth of 2 feet bls, were centered around each of three surface soil sample locations at which elevated PAH, arsenic, and/or PCB concentrations had been detected during the RI field investigation. Post-excavation confirmatory samples collected from the four sidewalls of each excavation indicated that elevated concentrations of arsenic, PAHs, and PCBs had been significantly reduced or completely removed. Each excavation area was backfilled with clean fill.

One notable inorganic constituent found in groundwater samples collected as part of the RI was antimony at SA 14. A small isolated plume of antimony exists above FDEP primary groundwater guidance, but no known site-related source of this inorganic has been found. However, as previously discussed, flame retardants possibly used by the laundry to treat clothing are a suspected source.

As part of this RI, a HHRA was conducted. COPCs were identified and exposures and risks were quantified for surface soil, subsurface soil, groundwater, surface water, and sediment associated with OU 4. The relative significance of risk estimates was evaluated in terms of a comparison with acceptable risk limits established by USEPA and Florida, and by comparison of site concentrations to risk-based screening concentrations and other guidance values. The following conclusions were drawn based on this HHRA:

- The COPCs detected in surface soil, subsurface soil, surface water, and sediment did not pose unacceptable cancer risks to the current and future receptors evaluated, based on USEPA guidelines and target cancer risk range of 1 in 10,000 to 1 in 1,000,000.
- The estimated lifetime cancer risk at OU 4 associated with potential exposures to soil, groundwater, and surface water exceeded Florida's target cancer risk level of concern of 1×10^{-6} .
- No noncancer risks associated with potential exposure to any of the media at OU 4, except groundwater, exceed the USEPA or FDEP target HI.
- There is no current use of groundwater. Cancer risk levels for theoretical future use of groundwater as drinking water are above both the USEPA target cancer risk range and the FDEP target level of concern, primarily due to PCE and TCE. Noncancer risk levels for theoretical future use of groundwater as drinking water are above the USEPA and FDEP target HI of one primarily due to chlorinated VOCs and antimony (antimony plume).

- The cumulative risk associated with potential future residential exposure to surface soil, groundwater, surface water, and sediment is 2×10^{-3} , which is above the USEPA acceptable cancer risk range and the FDEP target level of concern. This risk is primarily due to VOCs in groundwater.
- The CT surface soil cancer risks for aggregate residential, aggregate recreational, and commercial workers were below the Florida level of concern. CT groundwater cancer risks for aggregate residential receptors are above the USEPA target risk range (1×10^{-4} to 1×10^{-6}) and Florida level of concern (1×10^{-6}). CT and RME residential risks provide the risk managers and decision makers with a perspective of the true hypothetical risk range to future residents.

In addition to the HHRA, an ecological assessment for OU 4 was performed. Potential risks for ecological receptors were evaluated for ECPCs in surface soil, surface water, sediment, and groundwater at OU 4.

Risks associated with exposures to ECPCs in OU 4 surface soil were evaluated for terrestrial wildlife based on a model that estimates the amount of contaminant exposure obtained via the diet and incidental ingestion of surface soil. Comparison of estimated doses for wildlife species with reference toxicity doses representing thresholds for lethal and sublethal effects is the basis of wildlife risk evaluation. Lethal risks were not identified for terrestrial wildlife resulting from exposure to ECPCs in surface soil; therefore, reductions in the survivability of wildlife receptor populations at OU 4 are not expected to occur. Sublethal risks (i.e., potential reductions in the reproduction and growth of terrestrial wildlife) associated with ingestion of aluminum and zinc in surface soil and food items are predicted for omnivorous small mammals at OU 4.

Reduction in terrestrial plant and soil invertebrate biomass used as forage material was evaluated by comparing exposure concentrations for surface soil with toxicity benchmarks. Based on this comparison, terrestrial plants could potentially experience adverse growth and reproduction effects from exposure to detected concentrations of aluminum, lead, silver, vanadium, and zinc in the surface soil at OU 4. Although phytotoxicity benchmarks were exceeded for these inorganic constituents, no evidence of reduction in vegetative biomass was observed in the field at OU 4. Therefore, impacts to small mammals and birds that rely on plant biomass as a forage base are unlikely. The results of the invertebrate benchmark comparison indicate that it is unlikely that invertebrate biomass and/or abundance would be reduced such that small mammal and bird populations would be affected at OU 4.

Potential risks associated with exposures to ECPCs in OU 4 surface water and sediment were evaluated for both semi-aquatic wildlife and aquatic receptors. The evaluation of risks to semi-aquatic wildlife indicates that lethal risks would not be expected to occur from exposure to ECPCs in surface water and sediment; therefore, reductions in the survivability of wildlife receptor populations at OU 4 are unlikely. Sublethal risks (i.e., potential reductions in the reproduction and growth of terrestrial wildlife) associated with ingestion of mercury in sediment and food items are predicted for piscivorous birds at OU 4.

Potential risks associated with exposures to ECPCs in OU 4 surface water were evaluated for pelagic aquatic organisms in the wetland area and for aquatic receptors in Lake Druid. Surface water ECPCs were compared to surface water toxicity benchmarks, and the results of the risk assessment indicate that pelagic aquatic organisms are not at risk.

Potential risks associated with exposures to ECPCs in OU 4 sediment were evaluated for benthic aquatic organisms in the wetland area and for aquatic receptors in Lake Druid. Sediment ECPCs were compared to sediment criteria and guidelines. Although several exposure concentrations slightly exceed sediment toxicity benchmarks, the results of the risk assessment indicate that benthic aquatic organisms are not at risk.

Potential risks associated with exposures to ECPCs in OU 4 groundwater were evaluated for benthic aquatic organisms in the wetland area and for aquatic receptors in Lake Druid. Groundwater ECPCs were compared to surface water toxicity benchmarks and the results of the risk assessment indicate that pelagic aquatic organisms are not at risk from exposure to chlorinated VOCs or manganese. However, the low alkalinity detected in the groundwater discharge area (which may or may not be reflective of the natural alkalinity concentrations in Lake Druid) may cause adverse effects to aquatic organisms directly, or may not adequately form complexes with heavy metals (thus reducing their overall toxicity to aquatic life).

10.2 RECOMMENDATIONS. Because the results of the RI indicate that risks to human health and the environment are present at OU 4, HLA recommends a feasibility study for the OU. The FS will evaluate potential remedial alternatives based on engineering factors, implementability, environmental and public health concerns, and costs. The results of the FS will be presented in the FS report. The groundwater IRA should continue to be operated and monitored.

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APPENDIX A

APPENDIX A
SUMMARY OF ANALYTICAL DETECTIONS
OU 4 PREVIOUS INVESTIGATIONS

**Table A-1
Summary of Detections in Surface Soil
Analytical Results, Study Area 12**

Remedial Investigation, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Lab Identifier: Collection Data: Feet bls:	Background ¹ Screening	SCG ²	RBC ³ for Residential Soil	RBC ³ for Industrial Soil	12B00101 02/25/95 1	12B00201 02/25/95 1	12B00301 02/25/95 1	12B00401 02/25/95 1	12B00401D 02/25/95 1
Volatile Organics (µg/kg)									
Acetone	--	260,000	7,800,000 n	200,000,000 n	--	--	--	--	16
General Chemistry (mg/kg)									
Total Petroleum Hydrocarbons	NA	ND	ND	ND	7.6	--	--	11.7	9.1
Inorganics (mg/kg)									
Aluminum	2,088	75,000	78,000 n	1,000,000 n	59.9	8.8 B	16.8 B	1,020	806
Arsenic	1.0	0.8	0.43 c/23 n	3.8 c/610 n	--	--	--	0.56 B	--
Barium	8.7	5,200	5,500 n	140,000 n	1.5 B	0.3 B	0.25 B	3.9 B	3.6 B
Calcium	25,295	ND	1,000,000	1,000,000	994 B	1,410	215 B	3,610	3,400
Chromium	4.6	290	390 n	10,000 n	0.71 B	--	0.84 B	3.1	1.1 B
Copper	4.1	ND	3,100 n	82,000 n	--	--	--	0.49 B	--
Iron	712	ND	23,000 n	610,000 n	19.8 B	14.4 B	--	373	322
Lead	14.5	500	400	400	0.46 B	--	0.37 B	1.6	2
Magnesium	328	ND	460,468	460,468	23 B	13.9 B	8.2 B	65.2 B	59.9 B
Manganese	8.1	370	1,800 n	47,000 n	0.68 B	0.52 B	0.53 B	2.7 B	2.2 B
Nickel	4.4	1,500	1,600 n	41,000 n	--	--	--	2.8 B	--
Vanadium	3.1	490	550 n	14,000 n	--	--	--	0.96 B	0.94 B
Zinc	17.2	23,000	23,000 n	610,000 n	0.97 B	--	--	1 B	0.96 B
See notes at end of table.									

**Table A-1 (Continued)
Summary of Detections in Surface Soil
Analytical Results, Study Area 12**

Remedial Investigation, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Lab Identifier:	Background ¹ Screening	SCG ²	RBC ³ for Residential Soil	RBC ³ for Industrial Soil	12B00101 02/25/95	12B00201 02/25/95	12B00301 02/25/95	12B00401 02/25/95	12B00401D 02/25/95
Collection Data:									
Feet bls:					1	1	1	1	1

- ¹ The background screening value is twice the average of detected background concentrations for inorganic analytes. For organic compounds, values are the mean of detected background concentrations, presented for comparison purposes only.
- ² SCG = Soil Cleanup Goals for Florida (Florida Department of Environmental Protection memorandum, September 29, 1995). Values indicated are from a residential scenario. Arsenic value is as revised in Applicability of Soil Cleanup Goals in Florida (FDEP memorandum, January 19, 1996).
- ³ RBC = Risk-Based Concentration Table, USEPA Region III, May, 1996, R.L. Smith. RBC for chromium is based on chromium VI. RBC for lead is not available, value is Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites (OSWER directive 9355-4-12). For essential nutrients (calcium, magnesium, potassium, and sodium) screening values were derived based on recommended daily allowances.

Notes:

- c = carcinogenic effects.
- n = noncarcinogenic effects.
- μg/kg = microgram per kilogram.
- mg/kg = milligram per kilogram.
- = Analyte/compound was not detected at reporting limit.
- NA = not applicable.
- ND = not determined.
- B = Reported concentration is between the instrument detection limit and the contract required detection limit.
- bls = below land surface.

All inorganic results expressed in mg/kg soil dry weight; organics in μg/kg soil dry weight.

**Table A-2
Summary of Detections in Subsurface Soil
Analytical Results, Study Area 12**

Remedial Investigation, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Lab Identifier: Collection Date: Feet bls:	Background ¹ Screening	SCG ²	RBC ³ for Residential Soil	RBC ³ for Industrial Soil	12B00102 02/27/95 6	12B00202 02/27/95 6	12B00302 02/28/95 6	12B00402 02/25/95 6
Volatile Organics (µg/kg)								
Acetone	--	NA	7,800,000 n	200,000,000 n	16	32	49	--
Tetrachloroethene	--	30 ⁴	12,000 c	110,000 c	11 J	--	--	--
General Chemistry (mg/kg)								
Total Petroleum Hydrocarbons	NA	NA	ND	ND	209.7	11.7	21.7	4.9
Semivolatile Organics (µg/kg)								
Fluoranthene	--	NA	3,100,000 n	82,000,000 n	260 J	--	110 J	--
Pyrene	--	NA	2,300,000 n	61,000,000 n	200 J	--	110 J	--
Chrysene	--	NA	88,000 c	780,000 c	160 J	--	110 J	--
Benzo(b)fluoranthene	--	NA	880 c	7,800 c	160 J	--	--	--
Benzo(k)fluoranthene	--	NA	8,800 c	78,000 c	130 J	--	--	--
Benzo(a)anthracene	--	NA	880 c	7,800 c	110 J	--	--	--
Benzo(g,h,i)perylene	--	NA	2,300 n	61,000 n	120 J	--	--	--
Pesticides/PCBs (µg/kg)								
4,4'-DDE	130	NA	1,900 c	17,000 c	5.2 J	--	--	--
4,4'-DDT	87	NA	1,900 c	17,000 c	23 J	--	--	--
Aroclor-1260	--	NA	83 c	740 c	110 J	--	--	--
Inorganics (mg/kg)								
Aluminum	2,119	NA	78,000 n	1,000,000 n	665	310	390	750
Arsenic	1.1	NA	0.43 c/23 n	3.8 c/610 n	0.6 B	--	0.67 J	--
See notes at end of table.								

**Table A-2 (Continued)
Summary of Detections in Subsurface Soil
Analytical Results, Study Area 12**

Remedial Investigation, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Lab Identifier: Collection Date: Feet bls:	Background ¹ Screening	SCG ²	RBC ³ for Residential Soil	RBC ³ for Industrial Soil	12B00102 02/27/95 6	12B00202 02/27/95 6	12B00302 02/28/95 6	12B00402 02/25/95 6
Inorganics (mg/kg) (Continued)								
Barium	3.6	NA	5,500 n	140,000 n	6.3 B	-	-	2.1 B
Beryllium	-	NA	0.15 c	1.3 c	0.11 B	-	-	-
Cadmium	-	NA	39 n	1,000 n	0.72 B	-	-	-
Calcium	115	NA	1,000,000	1,000,000	46,700 J	147 J	25,900 J	1,190
Chromium	3.7	NA	390 n	10,000 n	2.2 B	0.62 B	0.82 B	1.7 B
Iron	264	NA	23,000 n	610,000 n	208 J	5.7 J	143 J	52.1
Lead	3.9	NA	400	400	14.5 J	1.2 J	3 J	1.7
Magnesium	32.8	NA	460,468	460,468	659 B	6.2 B	192 B	16.5 B
Manganese	2.1	NA	1,800 n	47,000 n	23.9	-	4.5	0.8 B
Mercury	-	NA	23 n	610 n	0.05	0.06	0.05	-
Nickel	-	NA	1,600 n	41,000 n	2.3 B	-	-	-
Sodium	-	NA	1,000,000	1,000,000	46 B	-	-	-
Vanadium	3.4	NA	550 n	14,000 n	1.1 J	-	2 J	0.46 B
Zinc	5.6	NA	23,000 n	610,000 n	44.4	-	0.96 B	-
See notes at end of table.								

**Table A-2 (Continued)
Summary of Detections in Subsurface Soil
Analytical Results, Study Area 12**

Remedial Investigation, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Lab Identifier:					12B00102	12B00202	12B00302	12B00402
Collection Date:	Background ¹ Screening	SCG ²	RBC ³ for Residential Soil	RBC ³ for Industrial Soil	02/27/95	02/27/95	02/28/95	02/25/95
Feet bls:					6	6	6	6

- ¹ The background screening value is twice the average of detected background concentrations for inorganic analytes. For organic compounds, values are the mean of detected background concentrations, presented for comparison purposes only.
- ² SCG = Soil Cleanup Goals for Florida (Florida Department of Environmental Protection memorandum, September 29, 1995). Values indicated are for a leaching scenario, and only apply to tetrachloroethene (PCE). PCE is the only organic constituent present in subsurface soil and also present in groundwater above Florida Groundwater Guidance Concentrations.
- ³ RBC = Risk-Based Concentration Table, USEPA Region III, May, 1996, R.L. Smith. RBC for chromium is based on chromium VI. RBC for lead is not available, value is Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites (OSWER directive 9355-4-12). For essential nutrients (calcium, magnesium, potassium, and sodium) screening values were derived based on recommended daily allowances.
- ⁴ Leachability-based SCG.

Notes:

- n = noncarcinogenic effects.
- c = carcinogenic effects.
- µg/kg = microgram per kilogram.
- mg/kg = milligram per kilogram.
- = Analyte/compound was not detected at reporting limit.
- ND = not determined.
- NA = not analyzed.
- J = estimated value.
- B = Reported concentration is between the instrument detection limit and the contract required detection limit.
- bls = below land surface.
- PCB = polychlorinated biphenyl.
- DDE = dichlorodiphenyldichloroethene.
- DDT = dichlorodiphenyltrichloroethane.
- USEPA = U.S. Environmental Protection Agency.
- OSWER = Office of Solid Waste and Emergency Response.

All metals results expressed in mg/kg soil dry weight; organics in µg/kg soil dry weight.

**Table A-3
Summary of Detections in Groundwater
Analytical Results, Study Area 12**

Remedial Investigation, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Well ID:	Background ¹ Screening	FDEPG	FEDMCL	RBC ² for Tap Water	OLD-12-01A	OLD-12-02A	OLD-12-03A	OLD-12-04A
Lab Identifier:					12G00101	12G00201	12G00301	12G00401
Collection Date:					03/09/95	03/09/95	03/09/95	03/09/95
Volatiles (µg/l)								
Trichloroethene	--	3 ⁵	5	1.6 c	2	--	--	--
Tetrachloroethene	--	5 ⁵	5	1.1 c	0.8	--	--	--
Inorganics (µg/l)								
Aluminum	4,067	200 ³	--	37,000 n	409	930	179 B	486
Barium	31.4	2,000 ⁵	2,000	2,600 n	9.9 B	4.9 B	11.2 B	7.2 B
Beryllium	--	4 ⁵	4	0.016 c	1.1 B	0.31 B	--	--
Cadmium	5.6	5 ⁵	5	18 n	3.2 B	--	--	--
Calcium	36,830	ND	ND	1,000,000	125,000	33,300	46,200	48,100
Iron	1,227	300 ³	ND	11,000 n	223	34.9 B	54.6 B	27.1 B
Magnesium	4,560	ND	ND	118,807	5,030	2,610 B	3,890 B	1,680 B
Manganese	17.0	50 ³	ND	840 n	26.7	4.9 B	32.8	4.9 B
Mercury	0.12	2 ⁵	2	11 n	0.12 B	0.12 B	--	0.12 B
Potassium	5,400	ND	ND	297,016	1,380 B	1,860 B	3,560 B	911 B
Selenium	9.7	50 ⁵	50	180 n	--	--	5.5	3.1 B
Sodium	18,222	160,000 ⁵	ND	396,022	29,700	2,860 B	5,910	2,600 B
Vanadium	20.6	49 ⁴	ND	260 n	3.3 B	6.8 B	4 B	6.8 B

See notes at end of table.

**Table A-3 (Continued)
Summary of Detections in Groundwater
Analytical Results, Study Area 12**

Remedial Investigation, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Well ID:	Background ¹ Screening	FDEPG	FEDMCL	RBC ² for Tap Water	OLD-12-01A	OLD-12-02A	OLD-12-03A	OLD-12-04A
Lab Identifier:					12G00101	12G00201	12G00301	12G00401
Collection Date:					03/09/95	03/09/95	03/09/95	03/09/95

- ¹ Groundwater background screening value is twice the average of detected concentrations for inorganic analytes. For organic compounds, values are the mean of detected concentration, presented for comparison purposes only.
- ² RBC = Risk-Based Concentration Table, USEPA Region III, May 1996, R.L. Smith. RBC for chromium is based on chromium VI. RBC for lead is not available, value is treatment technology action limit for lead in drinking water distribution system identified in Drinking Water Standards and Health Advisories (USEPA, 1995). For essential nutrients (calcium, magnesium, potassium, and sodium) screening values were derived based on recommended daily allowances (RDAs).
- ³ Secondary Standard.
- ⁴ Systemic Toxicant.
- ⁵ Primary Standard.

Notes: $\mu\text{g}/\text{l}$ = microgram per liter
 - = Analyte/compound was not detected at reporting limit.
 B = Reported concentration is between the instrument detection limit and the contract required detection limit.
 n = noncarcinogenic effects
 ND = not determined
 c = carcinogenic effects
 MCL = maximum contaminant levels
 FDEPG = Florida Department of Environmental Protection, Groundwater Guidance Concentrations, June 1994.
 FEDMCL = Federal Maximum Contaminant Levels, Primary Drinking Water Regulations and Health Advisories, February 1996.

Bolded/shaded value indicate exceedance of regulatory guidance and background.

Table A-4
Field GC Results, Study Area 13

Remedial Investigation, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

SAMPLE ID	DEPTH (FT)	BENZENE	TOLUENE	ETHYLBENZENE	M-,P-XYLENE	O-XYLENE	TCE	PCE	DCA	ΣBETX	Σchlor	ΣVOCs
1 13P00201	6							601.0			601.0	601.0
2 13P00202	12							6.3			6.3	6.3
3 13P00203	18							0.5			0.5	0.5
4 13P00204	24		3.8					1252.0		3.8	1252.0	1255.8
5 13P00205	30							26.7			26.7	26.7
6 13P00206	36							6.3			6.3	6.3
7 13P00207	42							204.0			204.0	204.0
8 13P00208	48							13.1			13.1	13.1
9 13P00209	54							12.5			12.5	12.5
10 13P00210	60											
11 13P00211	64		12.0		3.9	0.7		6.5		16.6	6.5	23.1
12 13P00401	6							16.0			16.0	16.0
13 13P00402	8						2.6	115.0			117.6	117.6
14 13P00403	12							4.6			4.6	4.6
15 13P00404	18											
16 13P00405	24											
17 13P00406	30											
18 13P00407	36											
19 13P00408	42											
20 13P00409	48											
21 13P00410	54											
22 13P00411	60											
23 13P00412	66											
24 13P00601	6							9.1			9.1	9.1
25 13P00602	12											
26 13P00603	18			0.8	9.5	3.2		0.8		13.5	0.8	14.3
27 13P00604	24		4.0		4.9	6.9				15.8		15.8
28 13P00605	30					4.8				4.8		4.8
29 13P00606	36											
30 13P00607	42			1.0	10.0	4.4				15.4		15.4
31 13P00608	48				5.0					5.0		5.0
32 13P00609	54											
34 13P00610	60											
35 13P00801	6						21.0	702.0			723.0	723.0
36 13P00802	12						14.0	2522.0			2536.0	2536.0
37 13P00803	18						1294.0	3774.0			5068.0	5068.0
38 13P00804	24						284.0	5.8			289.8	289.8
39 13P00805	30							11.6			11.6	11.6
40 13P00806	36						8.6	9.3			17.9	17.9
41 13P00807	42											
42 13P00808	48											
43 13P00809	54											
44 13P00810	60							2.8			2.8	2.8
45 13P00811	64							6.6			6.6	6.6

**Table A-5
Summary of Detections in Soil
Analytical Results, Study Area 13**

Remedial Investigation, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Lab Identifier	Background ¹ (Subsurface/ Surface)	SCG ²	RBC ³ for Residential Soil	RBC ³ for Industrial Soil	13B00101 02/26/95 6	13B00401 03/31/95 6	13B00501 02/26/95 1	13B00701 04/03/95 16	13B00801 03/30/95 4	13B00802 03/30/95 62
Volatiles (µg/kg)										
Acetone	--	260,000	7,800,000 n	200,000,000 n	130	--	42	--	--	--
Carbon disulfide	--	5,200	7,800,000 n	200,000,000 n	--	--	--	--	--	1 J
2-Butanone	--	2,200,000	47,000,000 n	1,000,000,000 n	--	--	--	--	--	--
1,2-Dichloroethene (total)	--	62,000	700,000 n	18,000,000 n	6 J	--	--	10 J	--	--
Trichloroethene	--	6,500/10 ⁴	58,000 c	520,000 c	2 J	--	--	4 J	--	--
Tetrachloroethene	--	12,000/30 ⁴	12,000 c	110,000 n	31	--	4 J	220	2 J	--
General Chemistry										
pH	ND	ND	ND	ND	NA	NA	NA	7.42	NA	NA
Total Petroleum Hydrocarbons (mg/kg)										
Total Petroleum Hydrocarbons	NA/NA	ND	--	--	8.2	16.8	17.6	6.2	15.6	6.6
Inorganics (mg/kg)										
Aluminum	2,119/2,088	75,000	78,000 n	1,000,000 n	196	503	2,180	629	1,430	2,320
Arsenic	1.1/1.0	0.8	0.43 c/23 n	3.8 c/610 n	0.78 B	--	0.72 B	0.17 B	--	1.5 B
Barium	3.6/8.7	5,200	5,500 n	140,000 n	--	0.4 B	5.7 B	2.5 B	1.6 B	33.8 B
Beryllium	--/0.09	0.2	0.15 c	1.3 c	0.28 B	--	0.13 B	--	--	0.23 B
See notes at end of table.										

**Table A-5 (Continued)
Summary of Detections in Soil
Analytical Results, Study Area 13**

Remedial Investigation, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Lab Identifier Collection Date Feet bls	Background ¹ (Subsurface/ Surface)	SCG ²	RBC ³ for Residential Soil	RBC ³ for Industrial Soil	13B00101 02/26/95 6	13B00401 03/31/95 6	13B00501 02/26/95 1	13B00701 04/03/95 16	13B00801 03/30/95 4	13B00802 03/30/95 62
Inorganics (mg/kg) (Cont.)										
Cadmium	--/0.98	37	39 n	1,000 n	--	--	--	--	--	0.38 B
Calcium	115/25,295	ND	1,000,000	1,000,000	72.4 J	110 B	346 J	1,680	132 B	3,120
Chromium	3.7/4.6	290	390 n	10,000 n	0.97 B	1.1 B	8.6	2.5 J	1.6 B	4.9
Copper	--/4.1	ND	3,100 n	82,000 n	--	--	3.4 J	1.6 B	--	--
Iron	264/712	ND	23,000 n	610,000 n	17.9 J	96.8	36 J	91.7	280	1,480
Lead	3.9/14.5	500	400	400	0.43 J	0.35 B	8.4 J	2.2	0.7	1.8
Magnesium	32.8/328	ND	460,468	460,468	--	13.4 B	15.7 B	22.6 B	38.6 B	79.2 B
Manganese	2.1/8.1	370	1,800 n	47,000 n	--	0.78 B	1.6 B	1.9 J	0.8 B	4.1
Mercury	--/0.07	23	23 n	610 n	0.04 B	--	0.07	--	--	--
Nickel	--/4.4	1,500	1,600 n	41,000 n	--	--	3.1 B	--	--	2.5 B
Selenium	1.3/0.9	390	390 n	10,000 n	--	--	--	--	--	0.42 B
Sodium	--/91.4	ND	1,000,000	1,000,000	--	96.8 B	--	136 B	163 B	156 B
Thallium	--/2.0	ND	63 n	160 n	--	--	--	--	--	0.22 B
Vanadium	3.4/3.1	490	550 n	14,000 n	--	0.53 B	1.3 J	1.4 B	1.6 B	4.1 B
Zinc	5.6/17.2	23,000	23,000 n	610,000 n	0.34 B	--	0.36 B	--	--	4
See notes at end of table.										

Table A-5 (Continued)
Summary of Detections in Soil
Analytical Results, Study Area 13

Remedial Investigation, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Lab Identifier	Background ¹	SCG ²	RBC ³ for Residential Soil	RBC ³ for Industrial Soil	13B00901 02/25/95 6	13B01001 02/25/95 6	13B01101 02/25/95 4	13B01201 02/25/95 6	13B01301 02/25/95 6
Volatiles (µg/kg)									
Acetone	--	260,000	7,800,000 n	200,000,000 n	--	68	--	--	8 J
2-Butanone	--	2,200,000	47,000,000 n	1,000,000,000 n	--	--	4 J	--	--
Pesticides/PCB (µg/kg)									
4,4'-DDD	--	4,500	2,700 c	24,000 c	--	--	2.6 J	--	--
4,4'-DDE	--	3,000	1,900 c	17,000 c	--	--	2.8 J	--	--
Total Petroleum Hydrocarbons (mg/kg)									
Total Petroleum Hydrocarbons	--	ND	ND	ND	--	--	11.6	5.7	23.4
Inorganics (mg/kg)									
Aluminum	2,119	75,000	78,000 n	1,000,000 n	339	290	455	703	1,030
Arsenic	1.1	0.8	0.43 c/23 n	3.8 c/610 n	1.2 B	0.48 B	0.62 B	0.75 B	1.3 J
Barium	3.6	5,200	5,500 n	140,000 n	0.73 B	0.71 B	2.7 B	1.8 B	2.7 B
Calcium	115	ND	1,000,000	1,000,000	591 B	162 B	288 B	1070 B	394 B
Chromium	3.7	290	390 n	10,000 n	1.3 B	1.8 B	4.1	1.3 B	3.3
Copper	--	ND	2,900 n	76,000 n	--	--	2.8 B	0.75 B	1.3 B
Iron	264	ND	23,000 n	610,000 n	58.9	53.7	183	68.4	118
Lead	3.9	500	400	400	0.64 B	0.44 B	1.7	1.5	2.4
Magnesium	32.8	ND	460,468	460,468	18.7 B	16.4 B	31.9 B	27.4 B	33.8 B
Manganese	2.1	370	1,800 n	43,000 n	0.42 B	0.38 B	0.92 B	1.1 B	1.3 B
See notes at end of table.									

**Table A-5 (Continued)
Summary of Detections in Soil
Analytical Results, Study Area 13**

Remedial Investigation, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Lab Identifier Collection Date Feet bls	Background ¹	SCG ²	RBC ³ for Residential Soil	RBC ³ for Industrial Soil	13B00901 02/25/95 6	13B01001 02/25/95 6	13B01101 02/25/95 4	13B01201 02/25/95 6	13B01301 02/25/95 6
Inorganics (mg/kg) (Cont.)									
Vanadium	3.4	490	550 n	14,000 n	--	--	0.5 B	0.79 B	0.96 B
Zinc	5.6	23,000	23,000 n	610,000 n	1 B	--	4.5 B	1.3 B	2.6 B

¹ Background values are for subsurface soils and surface soils, respectively. The background screening value is twice the average of detected background concentrations for inorganic analytes.

² SCG = Soil Cleanup Goals for Florida (Florida Department of Environmental Protection memorandum, September 29, 1995). Arsenic value is as revised in Applicability of Soil Cleanup Goals for Florida (Florida Department of Environmental Protection memorandum, January 19, 1996). Values indicated are from a residential scenario, and apply only to surface soil sample 13B00501. Chromium values are for chromium VI.

³ RBC = Risk-Based Concentration Table, USEPA Region III, May, 1996, R.L. Smith. RBC indicated for arsenic is based on noncarcinogenic effects. RBC for chromium is based on chromium VI. RBC for lead is not available, value is Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites (OSWER directive 9355-4-12). RBC for thallium is based on thallium chloride. For essential nutrients (calcium, iron, magnesium, potassium, and sodium) screening values were derived based on recommended daily allowances (RDAs).

⁴ Residential/Leaching SCGs.

Notes:

- n = noncarcinogenic effects
- c = carcinogenic effects
- mg/kg = milligram per kilogram
- µg/kg = microgram per kilogram
- = Analyte/compound not detected at reporting limit.
- ND = Not determined
- J = Estimated value
- B = Reported concentration is between the instrument detection limit (IDL) and the Contract Required Detection Limit (CRDL).
- NA = Not analyzed
- bls = below land surface.
- PCB = polychlorinated biphenyl.
- DDE = dichlorodiphenyldichloroethene.
- DDT = dichlorodiphenyltrichloroethane.
- USEPA = U.S. Environmental Protection Agency.
- OSWER = Office of Solid Waste and Emergency Response.

All inorganic results expressed in mg/kg soil dry weight; organics in µg/kg soil dry weight.
Boded/shaded value indicate exceedance of regulatory guidance and background.

**Table A-6
Summary of Detections in Shallow Groundwater
Analytical Results, Study Area 13**

Remedial Investigation, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Well ID:	Background ¹ Screening	FDEPG	FEDMCL	RBC ² for Tap Water	OLD-13-01A 13G00101 03/09/95	OLD-13-01A 13G00101D 03/09/95	OLD-13-03A 13G00301 04/06/95	OLD-13-05A 13G00501 03/09/95	OLD-13-07A 13G00701 04/06/95
Volatile Organics (µg/ℓ)									
cis-1,2-Dichloroethene	--	70 ⁵	70	61 n	29 J	30 J	5.6	6	38 J
Trichloroethene	--	3 ⁵	5	1.6 c	16 J	17 J	3 J	3	52
Tetrachloroethene	--	3 ⁵	5	1.1 c	250	270	16	7	680
General Chemistry (mg/ℓ)									
Total Suspended Solids	ND	ND	ND	ND	NA	NA	--	NA	--
Inorganics (µg/ℓ)									
Aluminum	4,067	200 ³	ND	37,000 n	--	--	51 B	1,040	89.9 B
Arsenic	5.0	50 ⁵	50	0.045 c/11 n	--	--	3.7 J	--	2.6 B
Barium	31.4	2,000 ⁵	2,000	2,600 n	2.6 B	3.2 B	2.6 B	10.2 B	3.4 B
Calcium	36,830	ND	ND	1,000,000	60,600	61,100	64,000	36,500	42,300
Copper	5.4	1,000 ³	ND	1,500 n	--	--	--	--	47.9
Iron	1,227	300 ³	ND	11,000 n	34.3 B	33.3 B	78 B	95.2 B	44.7 B
Magnesium	4,560	ND	ND	118,807	1,390 B	1,430 B	1,220 B	1,710 B	2,340 B
Manganese	17.0	50 ³	ND	840 n	6 B	5.4 B	1.7 B	2.6 B	3.1 B
Mercury	0.12	2 ⁵	2	11 n	--	0.14 B	--	--	--
Potassium	5,400	ND	ND	297,016	1,140 B	841 B	873 B	627 B	2,570 B
Sodium	18,222	160,000 ⁵	ND	396,022	7,300	7,060	2,320 B	2,060 B	14,700
Vanadium	20.6	49 ⁴	--	260 n	--	--	--	--	6.8 B
Zinc	4.0	5,000 ³	ND	11,000 n	1.7 B	--	--	--	--
See notes at end of table.									

**Table A-6 (Continued)
Summary of Detections in Shallow Groundwater
Analytical Results, Study Area 13**

Remedial Investigation, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Well ID:					OLD-13-01	OLD-13-01	OLD-13-03	OLD-13-05	OLD-13-07
Lab Identifier:	Background ¹ Screening	FDEPG	FEDMCL	RBC ² for Tap Water	13G00101	13G00101D	13G00301	13G00501	13G00701
Collection Date:					03/09/95	03/09/95	04/06/95	03/09/95	04/06/95

¹ Groundwater background screening value is twice the average of detected concentrations for inorganic analytes. For organic compounds, values are the mean of detected concentration, presented for comparison purposes only.

² RBC = Risk-Based Concentration Table, USEPA Region III, May 1996, R.L. Smith. RBC for chromium is based on chromium VI. RBC for lead is not available, value is treatment technology action limit for lead in drinking water distribution system identified in Drinking Water Standards and Health Advisories (USEPA, 1995). For essential nutrients (calcium, magnesium, potassium, and sodium) screening values were derived based on recommended daily allowances.

³ Secondary Standard.

⁴ Systemic Toxicant.

⁵ Primary Standard.

Notes:

mg/l = milligram per liter.

µg/l = microgram per liter.

NA = not analyzed.

ND = not determined.

c = carcinogenic effects.

n = noncarcinogenic effects.

J = estimated value.

- = Analyte/compound was not detected at reporting limit.

MCL = Maximum Contaminant Level.

FDEPG = Florida Department of Environmental Protection, Groundwater Guidance Concentrations, June 1994.

FEDMCL = Federal Maximum Contaminant Levels, Primary Drinking Water Regulations and Health Advisories, February 1996.

B = Reported concentration is between the instrument detection limit and the contract required detection limit.

USEPA = U.S. Environmental Protection Agency.

Bolded/shaded value indicate exceedance of regulatory guidance and background.

Table A-7
Summary of Detections in Deep Groundwater
Analytical Results, Study Area 13

Remedial Investigation, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Well ID:	Background ¹ Screening	FDEPG	FEDMCL	RBC ² for Tap Water	OLD-13-02C 13G00201 04/06/95	OLD-13-04C 13G00401 04/06/95	OLD-13-06C 13G00601 04/06/95	OLD-13-08C 13G00801 04/06/95
Volatile Organics (µg/ℓ)								
Chloroform	2.4	100 ⁵ /6 ⁶	100	0.15 c	0.06 J	-	-	0.1 J
Trichloroethene	-	3 ⁵	5	1.6 c	-	-	-	0.04 J
Tetrachloroethene	-	3 ⁵	5	1.1 c	0.4	-	-	0.2
Xylenes (total)	-	10,000 ⁵ /20 ³	10,000	12,000 n	0.06 J	-	-	-
Semivolatile Organics (µg/ℓ)								
bis(2-Ethylhexyl)phthalate	1	6 ⁵	ND	4.8 c	-	-	1	1
General Chemistry (mg/ℓ)								
Total Suspended Solids	ND	ND	ND	ND	4	-	-	108
Inorganics (µg/ℓ)								
Aluminum	4,067	200 ³	ND	37,000 n	4,380	320	588	17,300
Arsenic	5.0	50 ⁵	50	0.045 c/11 n	27.6	10.3	22.3	18.3
Barium	31.4	2,000 ⁵	2,000	2,600 n	56.6 B	16.5 B	17.3 B	145 B
Beryllium	-	4 ⁵	4	0.016 c	0.32 B	-	0.11 B	0.41 B
Calcium	36,830	ND	ND	1,000,000	7,360	4,970 B	8,530	9,850
Chromium	7.8	100 ⁵	100	180 n	7 B	-	-	20.8
Iron	1,227	300 ³	ND	11,000 n	2,010	1,870	544	1,190
Lead	4.0	15 ⁵	15	15	-	-	-	2.1 B
Magnesium	4,560	ND	ND	118,807	2,560 B	2,550 B	1,750 B	3,160 B
Manganese	17.0	50 ³	ND	840 n	9 B	6.4 B	6.5 B	5.8 B
See notes at end of table.								

**Table A-7 (Continued)
Summary of Detections in Deep Groundwater
Analytical Results, Study Area 13**

Remedial Investigations, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Well ID:	Background ¹ Screening	FDEPG	FEDMCL	RBC ² for Tap Water	OLD-13-02C	OLD-13-04C	OLD-13-06C	OLD-13-08C
Lab Identifier:					13G00201	13G00401	13G00601	13G00801
Collection Date:					04/06/95	04/06/95	04/06/95	04/06/95
Inorganics (µg/l) (Cont.)								
Potassium	5,400	ND	ND	297,016	3,600 B	3,730 B	675 B	2,810 B
Sodium	18,222	160,000 ⁵	ND	396,022	13,700	12,400	12,200	15,400
Vanadium	20.6	49 ⁴	ND	260 n	6.4 B	3 B	-	16.9 B
Zinc	4.0	5,000 ³	ND	11,000 n	6.8 B	8.6 B	4.7 B	7.2 B

¹ Groundwater background screening value is twice the average of detected concentrations for inorganic analytes. For organic compounds, values are the mean of detected concentration, presented for comparison purposes only.

² RBC = Risk-Based Concentration Table, USEPA Region III, May, 1996, R.L. Smith. RBC for chromium is based on chromium VI. RBC for lead is not available, value is treatment technology action limit for lead in drinking water distribution system identified in Drinking Water Standards and Health Advisories (USEPA, 1995). For essential nutrients (calcium, magnesium, potassium, and sodium) screening values were derived based on recommended daily allowances.

³ Secondary Standard.

⁴ Systemic Toxicant.

⁵ Primary Standard.

⁶ Carcinogen.

Notes:

µg/l = microgram per liter.

- = Analyte/compound was not detected at reporting limit.

c = carcinogenic effects.

n = noncarcinogenic effects.

J = estimated value.

MCL = maximum contaminant levels.

FDEPG = Florida Department of Environmental Protection, Groundwater Guidance Concentrations, June 1994.

FEDMCL = Federal Maximum Contaminant Levels, Primary Drinking Water Regulations and Health Advisories, February 1996.

B = Reported concentration is between the instrument detection limit and the contract required detection limit.

mg/l = milligrams per liter.

ND = not detected.

USEPA = U.S. Environmental Protection Agency.

Bolded/shaded value indicate exceedance of regulatory guidance and background.

FINAL

**Table A-8
Site Screening: Temporary Well and TerraProbe™ Sampling Results**

Remedial Investigation, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Sample ID	Depth (feet bls)	PCE ($\mu\text{g}/\ell$)	TCE ($\mu\text{g}/\ell$)	1,1-DCE ($\mu\text{g}/\ell$)	1,2-DCE ($\mu\text{g}/\ell$)	Vinyl Chloride ($\mu\text{g}/\ell$)
TerraProbe™ Samples						
13Q00101FGC	8	1.5	–	–	–	–
13Q00102FGC	18	–	59.3	–	–	–
13Q00103FGC	30	109.6	8.3	–	–	–
13Q00201FGC	8	–	–	–	–	–
13Q00202FGC	18	–	45.8	–	–	–
13Q00203FGC	30	24.1	23.4	–	–	–
13Q00301FGC	8	–	–	–	–	–
13Q00302FGC	18	11.2	–	–	–	–
13Q00303FGC	30	12.0	18.0	–	–	–
13Q00401FGC	8	1.7	–	–	–	–
13Q00402FGC	18	8.8	–	–	–	–
13Q00403FGC	30	167.9	277.6	–	–	–
13Q00501FGC	8	0.3	–	–	–	–
13Q00502FGC	18	50.6	–	–	–	–
13Q00503FGC	30	21.9	1059.7	–	–	–
13Q00601FGC	8	3.0	–	–	–	–
13Q00602FGC	18	17.0	29.0	–	–	–
13Q00603FGC	30	821.1	852.5	–	–	–
13Q00603	8	760	2100	–	51	–
13Q00701FGC	8	250.8	129.9	–	–	–
13Q00701	8	1600	240	–	770	16
13Q00702FGC	18	4325.8	391.1	–	–	–
13Q00702	18	270	18	–	7	–
13Q00703FGC	30	272.0	41.1	–	–	–
13Q00801FGC	8	136.3	5.1	–	–	–
13Q00802FGC	18	468.8	54.2	–	–	–
13Q00803FGC	30	23.4	7.6	–	–	–
13Q00901FGC	8	16.1	1.9	–	–	–
13Q00902FGC	18	0.8	–	–	–	–

See notes at end of table.

Table A-8 (Continued)
Site Screening: Temporary Well and TerraProbe™ Sampling Results

Remedial Investigation, Operable Unit 4
 Former Laundry Facility and DRMO
 Naval Training Center
 Orlando, Florida

Sample ID	Depth (feet bls)	PCE (µg/l)	TCE (µg/l)	1,1-DCE (µg/l)	1,2-DCE (µg/l)	Vinyl Chloride (µg/l)
TerraProbe™ Samples (Cont.)						
13Q00903FGC	30	3.0	—	—	—	—
13Q01001FGC	8	.3	—	—	—	—
13Q01002FGC	18	1346.4	51.0	—	—	—
13Q01002	18	2500	84	—	25	—
13Q01003FGC	30	1333.4	604.5	—	—	—
13Q01003	30	2000	2200	—	39	—
13Q01101FGC	8	—	—	—	—	—
13Q01102FGC	18	863.5	8.6	—	—	—
13Q01103FGC	30	952.0	98.7	—	—	—
13Q01103	30	6400	400	—	270	—
13Q01201FGC	8	4.3	—	—	—	—
13Q01202FGC	18	3.1	—	—	—	—
13Q01203FGC	30	43.2	—	—	—	—
13Q01301FGC	8	37.0	—	—	—	—
13Q01302FGC	18	0.1	0.1	—	—	—
13Q01303FGC	30	1.5	—	—	—	—
13Q01401FGC	8	1321.7	10.3	—	—	—
13Q01402FGC	18	1244.5	379.3	—	—	—
13Q01403FGC	30	73.6	7.2	—	—	—
13Q01501FGC	8	0.8	—	—	—	—
13Q01502FGC	18	4.9	—	—	—	—
13Q01503FGC	30	71.1	5.6	—	—	—
13Q01601FGC	8	1.11	0.3	—	—	—
13Q01602FGC	18	—	—	—	—	—
13Q01603FGC	30	—	—	—	—	—
13Q01701FGC	8	—	—	—	—	—
13Q01702FGC	18	—	—	—	—	—
13Q01703FGC	30	—	—	—	—	—
See notes at end of table						

FINAL

Table A-8 (Continued)
Site Screening: Temporary Well and TerraProbe™ Sampling Results

Remedial Investigation, Operable Unit 4
 Former Laundry Facility and DRMO
 Naval Training Center
 Orlando, Florida

Sample ID	Depth (feet bls)	PCE ($\mu\text{g}/\ell$)	TCE ($\mu\text{g}/\ell$)	1,1-DCE ($\mu\text{g}/\ell$)	1,2-DCE ($\mu\text{g}/\ell$)	Vinyl Chloride ($\mu\text{g}/\ell$)
TerraProbe™ Samples (Cont.)						
13Q01801FGC	8	1.4	--	--	--	--
13Q01802FGC	18	--	--	--	--	--
13Q01803FGC	30	--	--	--	--	--
13Q01901FGC	8	--	--	--	--	--
13Q01902FGC	18	--	--	--	--	--
13Q01903FGC	30	--	--	--	--	--
13Q02001FGC	8	--	--	--	--	--
13Q02002FGC	18	--	--	--	--	--
13Q02101FGC	8	--	--	--	--	--
13Q02102FGC	18	--	--	--	--	--
Temporary Well Samples						
13G00901FGC		--	--	--	--	--
13G00901		--	--	--	--	--
13G01001FGC		--	--	--	--	--
13G01001		--	--	--	--	--
13G01101FGC		--	--	--	--	--
13G01101		--	--	--	--	--
13G01201FGC		--	--	--	--	--
13G01201		--	--	--	--	--
13G01301FGC		--	--	--	--	--
13G01301		--	--	--	--	--
13G01401FGC		--	--	--	--	--
13G01401		--	--	--	--	--
13G01501FGC		--	--	--	--	--
13G01501		--	--	--	--	--
13G01601FGC		--	--	--	--	--
13G01601		--	--	--	--	--
See notes at end of table.						

FINAL

Table A-8 (Continued)
Site Screening: Temporary Well and TerraProbe™ Sampling Results

Remedial Investigation, Operable Unit 4
 Former Laundry Facility and DRMO
 Naval Training Center
 Orlando, Florida

Sample ID	PCE ($\mu\text{g/l}$)	TCE ($\mu\text{g/l}$)	1,1-DCE ($\mu\text{g/l}$)	1,2-DCE ($\mu\text{g/l}$)	Vinyl Chloride ($\mu\text{g/l}$)
Temporary Well Samples (Cont.)					
13G01701FGC	99.8	107.7	--	--	--
13G01701	120	170	--	320	2
13G01801FGC	6.5	4.8	--	--	--
13G01801	23	14	--	34	--
13G01901FGC	--	--	--	--	--
13G01901	--	--	--	--	--
13G01901FGCD	--	--	--	--	--
13G02001FGC	--	--	--	--	--
13G02001	--	--	--	--	--
13G02101FGC	--	--	--	--	--
13G02101	--	--	--	--	--

Notes: "_" = compound not detected above reporting limits.
 SM = service mark.
 ID = identification.
 bls = below land surface.
 PCE = perchloroethylene.
 $\mu\text{g/l}$ = micrograms per liter.
 TCE = trichloroethene.
 DCE = dichloroethene.

The suffix "D" denotes a duplicate sample.
 The suffix "FGC" denotes a field gas chromatograph (GC) analysis.
 The field GC only analyzed for PCE, 1,2-DCE, and TCE.

Table A-9
Summary of Positive Detections in Surface Soil
Analytical Results, Study Area 14

Remedial Investigation, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Lab Identifier: Collection Date: Feet bls:	Background ¹ Screening	SCG ²	RBC ³ for Residential Soil	RBC ³ for Industrial Soil	14B00101 02/25/95 1	14B00201 02/25/95 2	14B00301 02/25/95 2	14B00401 02/25/95 2
Volatile Organics (µg/kg)								
Tetrachloroethene	--	12,000/30 ⁴	12,000 c	110,000 c	--	11	--	1 J
General Chemistry (mg/kg)								
Total Petroleum Hydrocarbons	--	ND	ND	ND	40.2	9.1	5.5	11.2
Semivolatile Organics (µg/kg)								
Pyrene	--	2,200,000	2,300,000 n	61,000,000 n	230 J	--	--	--
Chrysene	--	140,000	88,000 c	780,000 c	200 J	--	--	--
Benzo(b)fluoranthene	--	1,400	880 c	7,800 c	220 J	--	--	--
Benzo(k)fluoranthene	--	14,000	8,800 c	78,000 c	180 J	--	--	--
Benzo(a)anthracene	--	1,400	880 c	7,800 c	110 J	--	--	--
Indeno(1,2,3-cd)pyrene	--	1,400	880 c	7,800 c	140 J	--	--	--
Benzo(g,h,i)perylene	--	14,000	2,300,000 n	61,000,000 n	180 J	--	--	--
Pesticides/PCBs (µg/kg)								
4,4'-DDE	130/39.2	3,000	1,900 c	17,000 c	6.2 J	--	--	5.8
4,4'-DDT	--	3,100	1,900 c	17,000 c	17	--	6.4	16
alpha-Chlordane	--	800	490 c	4,400 c	1.8 J	--	--	--
gamma-Chlordane	--	800	490 c	4,400 c	1.6 NJ	--	--	--
Inorganics (mg/kg)								
Aluminum	2,088	75,000	78,000 n	1,000,000 n	1,730	945	13.1 B	844
Arsenic	1.0	0.8	0.43 c/23 n	3.8 c/610 n	0.62 B	--	--	0.84 B

See notes at end of table.

**Table A-9 (Continued)
Summary of Positive Detections in Surface Soil
Analytical Results, Study Area 14**

Remedial Investigation, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Lab Identifier: Collection Date: Feet bls:	Background ¹ Screening	SCG ²	RBC ³ for Residential Soil	RBC ³ for Industrial Soil	14B00101 02/25/95 1	14B00201 02/25/95 2	14B00301 02/25/95 2	14B00401 02/25/95 2
Inorganics (mg/kg) (Continued)								
Barium	8.7	5,200	5,500 n	140,000 n	5.8 B	1.8 B	0.28 B	2 B
Beryllium	0.09	0.2	0.15 c	1.3 c	0.07 B	--	--	--
Cadmium	0.98	37	39 n	1,000 n	1.7	--	--	--
Calcium	25,295	ND	1,000,000	1,000,000	12,400	2,460	458 B	1,710
Chromium	4.6	290	390 n	10,000 n	16.4	1.3 B	0.63 B	1 B
Copper	4.1	ND	3,100 n	82,000 n	30.2	--	--	--
Iron	712	ND	23,000 n	610,000 n	660	259	--	279
Lead	14.5	500	400	400	40.9	1.1	--	1.1
Magnesium	328	ND	460,468	460,468	175 B	41.6 B	17.1 B	50.7 B
Manganese	8.1	370	1,800 n	47,000 n	14.7	1.3 B	--	1 B
Nickel	4.4	1,500	1,600 n	41,000 n	9.2	--	--	--
Vanadium	3.1	490	550 n	14,000 n	2.5 B	0.58 B	--	0.68 B
Zinc	17.2	23,000	23,000 n	610,000 n	52.9	--	--	5.3
See notes at end of table.								

Table A-9 (Continued)
Summary of Positive Detections in Surface Soil
Analytical Results, Study Area 14

Remedial Investigation, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Lab Identifier:					14B00101	14B00201	14B00301	14B00401
Collection Date:	Background ¹ Screening	SCG ²	RBC ³ for Residential Soil	RBC ³ for Industrial Soil	02/25/95	02/25/95	02/25/95	02/25/95
Feet bls:					1	2	2	2

- ¹ The background screening value is twice the average of detected background concentrations for inorganic analytes. For organic compounds, values are the mean of detected background concentrations, presented for comparison purposes only.
- ² SCG = Soil Cleanup Goals for Florida (Florida Department of Environmental Protection memorandum, September 29, 1995). Arsenic value is as revised in Applicability of Soil Cleanup Goals for Florida (FDEP memorandum, January 19, 1996). Values indicated are from a residential scenario. Chromium values are for chromium VI.
- ³ RBC = Risk-Based Concentration Table, USEPA Region III, May 1996, R.L. Smith. RBC for chromium is based on chromium VI. RBC for lead is not available, value is Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites (OSWER directive 9355-4-12). For essential nutrients (calcium, magnesium, potassium, and sodium) screening values were derived based on recommended daily allowances.
- ⁴ Residential/Leaching SCGs.

Notes: n = noncarcinogenic effects.
c = carcinogenic effects.
 $\mu\text{g}/\text{kg}$ = microgram per kilogram.
 mg/kg = milligram per kilogram.
N = Indicates presumptive evidence of the compound.
ND = not determined.
J = estimated value.
bls = below land surface.
DDE = dichlorodiphenyldichloroethene.
DDT = dichlorodiphenyltrichloroethane.
USEPA = U.S. Environmental Protection Agency.
OSWER = Office of Solid Waste and Emergency Response.
B = reported concentration is between the instrument detection limit and the contract required detection limit.
- = Analyte/compound was not detected at reporting limit.

All inorganic results expressed in mg/kg soil dry weight; organics in $\mu\text{g}/\text{kg}$ soil dry weight.
Bolded/shaded values indicate exceedance of regulatory guidance and background.

**Table A-10
Summary of Positive Detections in Subsurface Soil
Analytical Results, Study Area 14**

Remedial Investigation, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Lab Identifier: Collection Date: Feet bls:	Background ¹ Screening	SCG ²	RBC ³ for Residential Soil	RBC ³ for Industrial Soil	14B00102 02/25/95 10	14B00102D 02/25/95 10	14B00202 03/27/95 10	14B00302 02/28/95 6	14B00402 03/27/95 10
Volatile Organics (µg/kg)									
Acetone	-	NA	7,800,000 n	200,000,000 n	-	-	6 J	33	5 J
Tetrachloroethene	-	30	12,000 c	110,000 c	-	-	-	-	2 J
General Chemistry (mg/kg)									
Total Petroleum Hydrocarbons	-	NA	ND	ND	594	558	-	-	-
Semivolatile Organics (µg/kg)									
Fluoranthene	-	NA	31,000,000 n	82,000,000 n	-	-	-	140 J	-
Pyrene	-	NA	2,300,000 n	61,000,000 n	-	-	-	170 J	-
Chrysene	-	NA	88,000 c	780,000 c	-	-	-	150 J	-
Benzo(b)fluoranthene	-	NA	880 c	7,800 c	-	-	-	170 J	-
Benzo(k)fluoranthene	-	NA	8,800 c	78,000 c	-	-	-	-	-
Benzo(a)anthracene	-	NA	880 c	7,800 c	-	-	-	100 J	-
Benzo(g,h,i)perylene	-	NA	2,300,000 n	61,000,000 n	-	-	-	110 J	-
Pesticides/PCBs (µg/kg)									
4,4'-DDD	-	NA	2,700 c	24,000 c	9.9 J	9.4 J	-	-	-
4,4'-DDE	39.2	NA	1,900 c	17,000 c	5 J	5.1	-	32	-
4,4'-DDT	-	NA	1,900 c	17,000 c	-	-	-	100	-
alpha-BHC	-	NA	100 c	910 c	-	-	-	6.1	-
alpha-Chlordane	-	NA	490 c	4,400 c	-	-	-	4.6	-
gamma-Chlordane	-	NA	490 c	4,400 c	-	-	-	4.4 J	-
General Chemistry (mg/kg)									
Total Petroleum Hydrocarbons	NA	NA	ND	ND	NA	NA	79.4	48.4	24.2
See notes at end of table.									

**Table A-10 (Continued)
Summary of Positive Detections in Subsurface Soil
Analytical Results, Study Area 14**

Remedial Investigation, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Lab Identifier: Collection Date: Feet bls:	Background ¹ Screening	SCG ²	RBC ³ for Residential Soil	RBC ³ for Industrial Soil	14B00102 02/25/95 10	14B00102D 02/25/95 10	14B00202 03/27/95 10	14B00302 02/28/95 6	14B00402 03/27/95 10
Inorganics (mg/kg)									
Aluminum	2,119	NA	78,000 n	1,000,000 n	1,880	2,090	323	741	1,580
Arsenic	1.1	NA	0.43 c /23 n	3.8 c/610 n	2.6 B	1.9 B	-	-	0.17 B
Barium	3.6	NA	5,500	140,000 n	18.6 B	19.9 B	0.49 B	3.9 B	10.1 B
Beryllium	-	NA	0.15 c	1.3 c	0.36 B	0.49 B	-	0.06 B	0.08 B
Calcium	115	NA	1,000,000	1,000,000	2,310	2,440	3,340	25,400 J	566 B
Chromium	3.7	NA	390 n	10,000 n	33	27.2	1.8 B	1.8 B	4.7
Cobalt	1.6	NA	4,700,000 n	120,000,000 n	1 B	0.87 B	-	-	-
Copper	-	NA	3,100 n	82,000 n	39.2	48.4	2.6 B	0.87 J	3.6 B
Iron	264	NA	23,000 n	610,000 n	5,500	7,260	72	216 J	130
Lead	3.9	NA	400	400	6	6.2	0.56 B	5.2 J	4.4
Magnesium	32.8	NA	460,468	460,468	818 B	949 B	31.7 B	183 B	28.3 B
Manganese	2.1	NA	1,800 n	47,000 n	5.2	6.6	1.8 B	5.3	1.8 B
Mercury	-	NA	23 n	610 n	-	-	-	0.03 B	-
Nickel	-	NA	1,600 n	41,000 n	3.1 B	4 B	-	-	-
Potassium	185	NA	297,016	297,016	1,440	1,660	-	-	-
Sodium	-	NA	1,000,000	1,000,000	-	-	116 B	-	159 B
Thallium	-	NA	6.3 n	160 n	-	-	-	-	0.15 B
Vanadium	3.4	NA	550 n	14,000 n	6.9 B	8.1 B	0.68 B	0.56 J	2.6 B
Zinc	5.6	NA	23,000 n	610,000 n	48.4	56.7	-	7.3	-

See notes at end of table.

**Table A-10 (Continued)
Summary of Positive Detections in Subsurface Soil
Analytical Results, Study Area 14**

Remedial Investigation, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Lab Identifier:	Background ¹ Screening	SCG ²	RBC ³ for Residential Soil	RBC ³ for Industrial Soil	14B00102 02/25/95	14B00102D 02/25/95	14B00202 03/27/95	14B00302 02/28/95	14B00402 03/27/95
Collection Date:					10	10	10	6	10
Feet bls:									

¹ Background values are for subsurface soils and surface soils, respectively. The background screening value is twice the average of detected background concentrations for inorganic analytes. For organic compounds, values are the mean of detected background concentrations, presented for comparison purposes only.

² SCG = Soil Cleanup Goals for Florida (Florida Department of Environmental Protection memorandum, September 29, 1995). Arsenic value is as revised in Applicability of Soil Cleanup Goals for Florida (FDEP memorandum, January 19, 1996). Values indicated are for a leaching scenario, and only apply to tetrachloroethene (PCE). PCE is the only organic constituent present in subsurface soil and also present in groundwater above Florida Groundwater Guidance Concentrations.

³ RBC = Risk-Based Concentration Table, USEPA Region III, May 1996, R.L. Smith. RBC for chromium is based on chromium VI. RBC for lead is not available, value is Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites (OSWER directive 9355-4-12). For essential nutrients (calcium, magnesium, potassium, and sodium) screening values were derived based on recommended daily allowances.

- Notes:
- $\mu\text{g}/\text{kg}$ microgram per kilogram.
 - mg/kg = milligram per kilogram.
 - = Analyte/compound was not detected at reporting limit.
 - ND = not determined.
 - NA = not analyzed.
 - n = noncarcinogenic effects.
 - c = carcinogenic effects.
 - J = estimated value.
 - B = reported concentration is between the instrument detection limit and the contract required detection limit.
 - bls = below land surface.
 - PCB = polychlorinated biphenyl.
 - DDD = dichlorodiphenyldichloroethane.
 - DDE = dichlorodiphenyldichloroethene.
 - DDT = dichlorodiphenyltrichloroethane.
 - BHC = benzene hexachloride.
 - USEPA = U.S. Environmental Protection Agency.
 - OSWER = Office of Solid Waste and Emergency Response.

All inorganic results expressed in mg/kg soil dry weight; organics in $\mu\text{g}/\text{kg}$ soil dry weight.
Bolded/shaded values indicate exceedance of regulatory guidance and background.

**Table A-11
Summary of Detections in Groundwater
Analytical Results, Study Area 14**

Remedial Investigation, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Lab Identifier: Collection Data: Feet bls:	Background ¹ Screening	FDEPG	FEDMCL	RBC ² for Tap Water	OLD-14-01A 14G00101 04/06/95	OLD-14-02A 14G00201 04/06/95	OLD-14-03A 14G00301 03/10/95	OLD-14-03A 14G00302 06/08/95	OLD-14-04A 14G00401 04/06/95	OLD-14-04A 14G00401D 04/06/95
Volatile organics (µg/ℓ)										
Methylene chloride	--	5 ⁵	5	0.15 c	--	2 J	--	NA	--	--
Chloroform	2.4	6 ⁶	100	0.15 c	--	0.2 J	--	NA	--	--
Trichloroethene	--	5 ⁵	5	1.6 c	--	--	--	NA	20 J	19 J
Tetrachloroethene	--	5 ⁵	5	1.1 c	--	1.37 J	--	NA	46	46
Semivolatile organics (µg/ℓ)										
bis(2-Ethylhexyl)- phthalate	--	6 ⁵	6	4.8 c	--	--	33 B	--	--	--
Dimethylphthalate	--	70,000 ⁴	ND	370,000 n	--	--	--	--	--	1 J
Phenol	--	--	--	22,000 n	--	--	--	1 J	--	--
Inorganics (µg/ℓ)										
Aluminum	4,067	200 ³	200	37,000 n	105 B	81.6 B	--	NA	143 B	121 B
Antimony	4.1	6 ⁵	6	15 n	--	10.1 B	17.6	NA	10.6 B	10.4 B
Arsenic	5.0	50 ⁵	50	0.045 c/11 n	1.9 B	2 B	--	NA	--	--
Barium	31.4	2,000 ⁵	2,000	2,600 n	11.6 B	4.5 B	5.7 B	NA	5.8 B	5.3 B
Beryllium	--	4 ⁵	4	0.016 c	0.1 B	--	--	NA	0.15 B	--
Calcium	36,830	ND	ND	1,000,000	37,200	28,100	95,500	NA	31,600	31,600
Iron	1,227	300 ³	ND	11,000 n	191	8 B	32.6 B	NA	142	145
Magnesium	4,560	ND	ND	118,807	1,280 B	2,320 B	6,740	NA	2,000 B	2,020 B
Manganese	17.0	50 ³	ND	840 n	7.4 B	3.5 B	9.4 B	NA	6.6 B	6.2 B
Potassium	5,400	ND	--	297,016	1,900 B	922 B	884 B	NA	2,720 B	2,760 B
Selenium	9.7	50 ⁵	50	180 n	--	--	3.2 B	NA	--	--
Silver	--	100 ³	ND	180 n	3.6 B	--	--	NA	--	3.6 B

See notes at end of table.

**Table A-11 (Continued)
Summary of Detections in Groundwater
Analytical Results, Study Area 14**

Remedial Investigation, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Lab Identifier: Collection Date: Feet bls:	Background ¹ Screening	FDEPG	FEDMCL	RBC ² for Tap Water	OLD-14-01A 14G00101 04/06/95	OLD-14-02A 14G00201 04/06/95	OLD-14-03A 14G00301 03/10/95	OLD-14-03A 14G00302 06/08/95	OLD-14-04A 14G00401 04/06/95	OLD-14-04A 14G00401D 04/06/95
Inorganics ($\mu\text{g}/\ell$) (Cont.)										
Sodium	18,222	160,000 ⁵	ND	396,022	1,340 B	7,370	8,300	NA	40,500	41,600
Vanadium	20.6	49 ⁴	ND	260 n	2.8 B	11.6 B	–	NA	7.4 B	5.7 B
Zinc	4	5,000 ³	ND	11,000 n	1.7 B	24.4	1.9 B	NA	2.3 B	1.4 B

¹ Groundwater background screening value is twice the average of detected concentrations for inorganic analytes. For organic compounds, values are the mean of detected concentration, presented for comparison purposes only.

² RBC = Risk-Based Concentration Table, USEPA Region III, May 1996, R.L. Smith. RBC for chromium is based on chromium VI. RBC for lead is not available, value is treatment technology action limit for lead in drinking water distribution system identified in Drinking Water Standards and Health Advisories (USEPA, 1995). For essential nutrients (calcium, magnesium, potassium, and sodium) screening values were derived based on recommended daily allowances.

³ Secondary Standard.

⁴ Systemic Toxicant.

⁵ Primary Standard.

⁶ Carcinogen.

Notes: n = noncarcinogenic effects

c = carcinogenic effects

$\mu\text{g}/\ell$ = micrograms per liter

ND = not determined

NA = not analyzed

J = estimated value

– = Analyte/compound was not detected at reporting limit.

D = Indicates value was determined during a diluted reanalysis.

B = Reported concentration is between the instrument detection limit and the contract required detection limit.

MCL = maximum contaminant level

FDEPG = Florida Department of Environmental Protection, Groundwater Guidance Concentrations, June 1994.

FEDMCL = Federal Maximum Contaminant Levels, Primary Drinking Water Regulations and Health Advisories, February 1996.

Bolded/shaded value indicate exceedance of regulatory guidance and background.

FOCUSED FIELD INVESTIGATION, OU4
SUMMARY TABLE FOR FIELD LABORATORY AND OFFSITE ANALYTICAL RESULTS

Remedial Investigation, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

Sample No.	EASTING	NORTHING	Date sampled	medium	depth(u)	depth(l)	PCE	TCE	C-1,2-DCE	T-1,2-DCE	1,1-DCE	VC	T. CHLOR.	BENZENE	TOLUENE	ETHYLB.	m/p XYL.	O XYL.	BTEX	TOT VOCs
U4D00101F	544389.00	1536611.00	May-96	D			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4D00201F	544580.00	1536844.00	May-96	D			92.0	220.0	110.0	2.1	N/D	0.4	424.5	N/D	N/D	N/D	N/D	N/D	0.0	424.5
U4D00301F	544608.00	1536833.00	May-96	D			1.6	150.0	92.0	1.0	N/D	N/D	244.6	N/D	N/D	N/D	N/D	N/D	0.0	244.6
U4D00401F	544629.00	1536844.00	May-96	D			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4D00402F	544629.00	1536844.00	May-96	D			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4D00501F	544649.00	1536846.00	May-96	D			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4D00502F	544649.00	1536846.00	May-96	D			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4D00601F	544568.00	1536873.00	May-96	D			N/D	27.0	750.0	5.6	N/D	95.0	877.6	N/D	N/D	N/D	N/D	N/D	0.0	877.6
U4D00701F	544532.00	1536892.00	May-96	D			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	11.0	N/D	N/D	N/D	11.0	11.0
U4D00702F	544532.00	1536892.00	May-96	D			N/D	3.7	N/D	N/D	N/D	N/D	3.7	N/D	N/D	N/D	N/D	N/D	0.0	3.7
U4D00801F	544529.00	1536921.00	May-96	D			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4D00802F	544529.00	1536921.00	May-96	D			N/D	1.1	N/D	N/D	N/D	N/D	1.1	N/D	N/D	N/D	N/D	N/D	0.0	1.1
U4D00901F	544544.00	1536944.00	May-96	D			N/D	N/D	2.2	N/D	N/D	N/D	2.2	N/D	1.6	N/D	N/D	N/D	1.6	3.8
U4D00901FD	544544.00	1536944.00	May-96	D			N/D	0.6	N/D	N/D	N/D	N/D	0.6	N/D	N/D	N/D	N/D	N/D	0.0	0.6
U4D01001F	544558.00	1536844.00	May-96	D			94000.0	53000.0	500.0	35.0	N/D	13.0	147548.0	N/D	3.3	N/D	N/D	1.9	5.2	147553.2
U4D01101F	544565.00	1536806.00	May-96	D			N/D	3.6	38.0	N/D	N/D	N/D	1.3	42.9	N/D	N/D	N/D	N/D	1.3	44.2
U4D01102F	544565.00	1536806.00	May-96	D			N/D	3.8	22.0	N/D	N/D	N/D	25.8	N/D	N/D	N/D	N/D	10.0	10.0	35.8
U4D01201F	544526.00	1536790.00	May-96	D			43.0	1400.0	3000.0	28.0	N/D	53.0	4524.0	N/D	2.3	N/D	N/D	N/D	2.3	4526.3
U4D01301F	544510.00	1536753.00	May-96	D			22.0	360.0	700.0	6.8	N/D	N/D	1088.8	N/D	N/D	N/D	N/D	N/D	0.0	1088.8
U4D01302F	544510.00	1536753.00	May-96	D			0.9	79.0	220.0	1.7	N/D	N/D	301.6	N/D	N/D	N/D	N/D	N/D	0.0	301.6
U4D01401F	544475.00	1536728.00	May-96	D			1.8	72.0	53.0	N/D	N/D	N/D	126.8	N/D	N/D	N/D	N/D	N/D	0.0	126.8
U4D01402F	544475.00	1536728.00	May-96	D			N/D	7.8	6.1	N/D	N/D	N/D	13.9	N/D	N/D	N/D	N/D	N/D	0.0	13.9
U4D01501F	544470.00	1536698.00	May-96	D			1.4	56.0	38.0	N/D	N/D	N/D	95.4	N/D	1.4	N/D	N/D	N/D	1.4	96.8
U4D01502F	544470.00	1536698.00	May-96	D			N/D	13.0	10.0	N/D	N/D	N/D	23.0	N/D	N/D	N/D	N/D	N/D	0.0	23.0
U4D01601F	544457.00	1536689.00	May-96	D			1.0	0.7	N/D	N/D	N/D	N/D	1.7	N/D	N/D	N/D	N/D	N/D	0.0	1.7
U4D01602F	544457.00	1536689.00	May-96	D			0.7	N/D	N/D	N/D	N/D	N/D	0.7	N/D	N/D	N/D	N/D	N/D	0.0	0.7
U4D01701F	544446.00	1536656.00	May-96	D			N/D	N/D	N/D	N/D	N/D	0.5	0.5	N/D	150.0	N/D	N/D	N/D	150.0	150.5
U4D01702F	544446.00	1536656.00	May-96	D			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4D01801F	544428.00	1536627.00	May-96	D			20.0	10.0	7.9	N/D	N/D	N/D	37.9	N/D	550.0	N/D	N/D	N/D	550.0	587.9
U4D01802F	544428.00	1536627.00	May-96	D			N/D	1.3	N/D	N/D	N/D	N/D	0.2	1.5	N/D	N/D	N/D	N/D	0.0	1.5
U4D01802FD	544428.00	1536627.00	May-96	D			0.8	1.2	N/D	N/D	N/D	N/D	2.0	N/D	N/D	N/D	N/D	N/D	0.0	2.0
U4D01901F	544528.00	1536841.00	May-96	D			78.0	800.0	160.0	2.4	N/D	1.5	1041.9	N/D	N/D	N/D	N/D	N/D	0.0	1041.9
U4D02001F	544541.00	1536868.00	May-96	D			N/D	9.0	3.0	N/D	N/D	N/D	12.0	N/D	N/D	N/D	N/D	N/D	0.0	12.0
U4D02101F	544513.00	1536821.00	May-96	D			18.0	410.0	36.0	N/D	1.2	N/D	465.2	N/D	N/D	N/D	N/D	N/D	0.0	465.2
U4D02201F	544499.00	1536794.00	May-96	D			200.0	6.6	N/D	N/D	N/D	N/D	206.6	N/D	N/D	N/D	N/D	N/D	0.0	206.6
U4D02301F	544517.00	1536872.00	May-96	D			N/D	3.9	31.0	N/D	N/D	N/D	34.9	N/D	N/D	N/D	N/D	N/D	0.0	34.9
U4D02401F	544478.00	1536772.00	May-96	D			1400.0	100.0	41.0	N/D	N/D	N/D	1541.0	N/D	N/D	N/D	N/D	N/D	0.0	1541.0
U4D02501F	544463.00	1536747.00	May-96	D			4.4	42.0	20.0	N/D	N/D	N/D	66.4	N/D	N/D	N/D	N/D	N/D	0.0	66.4
U4D02601F	544444.00	1536723.00	May-96	D			N/D	130.0	80.0	N/D	N/D	N/D	210.0	N/D	N/D	N/D	N/D	N/D	0.0	210.0
U4D02601FD	544444.00	1536723.00	May-96	D			N/D	42.0	25.0	N/D	N/D	N/D	67.0	N/D	N/D	N/D	N/D	N/D	0.0	67.0
U4D02701F	544433.00	1536700.00	May-96	D			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4D02801F	544422.00	1536677.00	May-96	D			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0

A-12
 FOCUSED FIELD INVESTIGATION, OU4
 SUMMARY TABLE FOR FIELD LABORATORY AND OFFSITE ANALYTICAL RESULTS

Remedial Investigation, Operable Unit 4
 Study Areas 12, 13, and 14 - Area C
 Naval Training Center
 Orlando, Florida

Sample No.	EASTING	NORTHING	Date sampled	medium	depth(u)	depth(l)	PCE	TCE	C-1,2-DCE	T-1,2-DCE	1,1-DCE	VC	T. CHLOR.	BENZENE	TOLUENE	ETHYLB.	m/p XYL.	O XYL.	BTEX	TOT VOCs
U4D02901F	544413.00	1536654.00	May-96	D			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4D03001F	544491.00	1536897.00	May-96	D			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4D03101F	544505.00	1536849.00	May-96	D			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4D03201F	544492.00	1536822.00	May-96	D			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4D03301F	544428.00	1536844.00	May-96	D			2.0	N/D	N/D	N/D	N/D	N/D	2.0	N/D	N/D	N/D	N/D	N/D	0.0	2.0
U4D03401F	544409.00	1536799.00	May-96	D			8.1	N/D	N/D	N/D	N/D	N/D	8.1	N/D	N/D	N/D	N/D	N/D	0.0	8.1
U4D03501F	544393.00	1536758.00	May-96	D			N/D	15.0	5.7	N/D	N/D	N/D	20.7	N/D	N/D	N/D	N/D	N/D	0.0	20.7
U4D03601F	544380.00	1536705.00	May-96	D			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4D03701F	544358.00	1536664.00	May-96	D			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4D03801F	544361.00	1536841.00	May-96	D			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4D03901F	544338.00	1536795.00	May-96	D			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4D04001F	544441.00	1536888.00	May-96	D			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4D04101F	544337.00	1536745.00	May-96	D			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4D04201F	544382.00	1536632.00	May-96	D			N/D	0.7	N/D	N/D	N/D	N/D	0.7	N/D	N/D	N/D	N/D	N/D	0.0	0.7
U4D04201FD	544382.00	1536632.00	May-96	D			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4D04301F	543989.00	1536792.00	May-96	D			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4D04401F	544384.00	1536877.00	May-96	D			28.0	18.0	N/D	N/D	N/D	N/D	46.0	N/D	N/D	N/D	N/D	N/D	0.0	46.0
U4D04501F	544451.00	1536627.00	May-96	D			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4D04601F	544178.00	1536756.00	May-96	D			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4D04701F	544347.00	1536909.00	May-96	D			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4D04801F	544310.00	1536868.00	May-96	D			N/D	N/D	160.0	1.2	N/D	N/D	161.2	N/D	N/D	N/D	N/D	N/D	0.0	161.2
U4G00101F	544607.72	1536833.15	May-96	G			6.4	3000.0	1600.0	25.0	N/D	N/D	4631.4	N/D	N/D	N/D	N/D	N/D	0.0	4631.4
U4G00102F	544607.72	1536833.15	May-96	G			1.5	450.0	880.0	32.0	N/D	1.0	1364.5	N/D	N/D	N/D	N/D	N/D	0.0	1364.5
U4G00201F	544552.55	1536846.70	May-96	G			590.0	5800.0	530.0	5.0	N/D	N/D	6925.0	N/D	N/D	N/D	N/D	N/D	0.0	6925.0
U4G00202F	544552.55	1536846.70	May-96	G			120.0	1300.0	840.0	25.0	1.1	0.4	2286.5	N/D	N/D	N/D	N/D	N/D	0.0	2286.5
U4G00301F	544560.09	1536800.29	May-96	G			22.0	1400.0	710.0	19.0	N/D	N/D	2151.0	N/D	N/D	N/D	N/D	N/D	0.0	2151.0
U4G00401F	544531.80	1536885.31	May-96	G			3.4	3.3	2.2	N/D	N/D	N/D	8.9	N/D	N/D	N/D	N/D	N/D	0.0	8.9
U4G00501F	544507.63	1536747.31	May-96	G			8.4	330.0	570.0	11.0	N/D	N/D	919.4	N/D	N/D	N/D	N/D	N/D	0.0	919.4
U4G00601F	544464.00	1536834.00	May-96	G			22.0	27.0	2.2	N/D	N/D	N/D	51.2	N/D	N/D	N/D	N/D	N/D	0.0	51.2
U4G00901	544605.89	1536845.69	Jun-96	G	1	11	N/D	500.0	830.0	N/D	N/D	N/D	1330.0	N/D	N/D	N/D	N/D	N/D	0.0	1330.0
U4G00901D	544605.89	1536845.69	Jun-96	G	1	11	N/D	680.0	850.0	N/D	N/D	N/D	1530.0	N/D	N/D	N/D	N/D	N/D	0.0	1530.0
U4G01001	544607.95	1536857.37	Jun-96	G	16	21	N/D	76.0	140.0	N/D	N/D	N/D	216.0	N/D	N/D	N/D	N/D	N/D	0.0	216.0
U4G01101	544600.52	1536850.67	Jun-96	G	57	62	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4G01201	544687.41	1536803.34	Jun-96	G	1.5	11.5	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4G01301	544693.11	1536799.83	Jun-96	G	16	21	N/D	35.0	130.0	N/D	N/D	N/D	165.0	N/D	N/D	N/D	N/D	N/D	0.0	165.0
U4G01401	544695.82	1536807.66	Jun-96	G	57	62	91.0	N/D	N/D	N/D	N/D	N/D	91.0	N/D	N/D	N/D	N/D	N/D	0.0	91.0
U4Q00101F	544606.00	1536854.00	May-96	Q	2	4	1.6	420.0	230.0	0.4	1.0	N/D	653.0	N/D	N/D	N/D	N/D	N/D	0.0	653.0
U4Q00102F	544606.00	1536854.00	May-96	Q	4	6	75.0	990.0	570.0	2.5	N/D	N/D	1637.5	N/D	N/D	N/D	N/D	N/D	0.0	1637.5
U4Q00103F	544606.00	1536854.00	May-96	Q	6	8	N/D	110.0	410.0	N/D	N/D	N/D	520.0	N/D	N/D	N/D	N/D	N/D	0.0	520.0
U4Q00104F	544606.00	1536854.00	May-96	Q	8	10	N/D	93.0	370.0	N/D	N/D	N/D	463.0	N/D	N/D	N/D	N/D	N/D	0.0	463.0
U4Q00105F	544606.00	1536854.00	May-96	Q	10	12	N/D	110.0	830.0	N/D	N/D	N/D	940.0	N/D	N/D	N/D	110.0	18.0	126.0	1066.0
U4Q00106F	544606.00	1536854.00	May-96	Q	24	26	12.0	18.0	N/D	N/D	N/D	N/D	30.0	N/D	N/D	N/D	N/D	N/D	0.0	30.0

FOCUSED FIELD INVESTIGATION, OU4
SUMMARY TABLE FOR FIELD LABORATORY AND OFFSITE ANALYTICAL RESULTS

Remedial Investigation, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

Sample No.	EASTING	NORTHING	Date sampled	medium	depth(u)	depth(l)	PCE	TCE	C-1,2-DCE	T-1,2-DCE	1,1-DCE	VC	T. CHLOR.	BENZENE	TOLUENE	ETHYLB.	m/p XYL.	O XYL.	BTEX	TOT VOCs
U4Q00107F	544606.00	1536854.00	May-96	Q	26	28	8.8	11.0	N/D	N/D	N/D	N/D	19.8	N/D	N/D	N/D	N/D	N/D	0.0	19.8
U4Q00108F	544606.00	1536854.00	May-96	Q	28	30	9.4	3.1	N/D	N/D	N/D	N/D	12.5	N/D	N/D	N/D	N/D	N/D	0.0	12.5
U4Q00109F	544606.00	1536854.00	May-96	Q	30	32	3.5	1.2	N/D	N/D	N/D	N/D	4.7	N/D	N/D	N/D	N/D	N/D	0.0	4.7
U4Q00110F	544606.00	1536854.00	May-96	Q	32	34	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00111F	544606.00	1536854.00	May-96	Q	34	36	1.5	0.5	N/D	N/D	N/D	N/D	2.0	N/D	N/D	N/D	N/D	N/D	0.0	2.0
U4Q00112F	544606.00	1536854.00	May-96	Q	36	38	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00113F	544606.00	1536854.00	May-96	Q	38	40	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00113FD	544606.00	1536854.00	May-96	Q	38	40	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00114F	544606.00	1536854.00	May-96	Q	40	42	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00115F	544606.00	1536854.00	May-96	Q	42	44	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00116F	544606.00	1536854.00	May-96	Q	44	46	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00117F	544606.00	1536854.00	May-96	Q	46	48	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00118F	544606.00	1536854.00	May-96	Q	48	50	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00119F	544606.00	1536854.00	May-96	Q	50	52	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00120F	544606.00	1536854.00	May-96	Q	52	54	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00121F	544606.00	1536854.00	May-96	Q	59	61	N/D	0.9	2.5	N/D	N/D	N/D	3.4	N/D	N/D	N/D	N/D	N/D	0.0	3.4
U4Q00122F	544606.00	1536854.00	May-96	Q	65	67	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00201F	544613.00	1536897.00	May-96	Q	3	5	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00202F	544613.00	1536897.00	May-96	Q	6	8	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00203F	544613.00	1536897.00	May-96	Q	9	11	2.4	1.4	3.2	N/D	N/D	N/D	7.0	N/D	N/D	N/D	N/D	N/D	0.0	7.0
U4Q00204F	544613.00	1536897.00	May-96	Q	22	24	0.8	N/D	N/D	N/D	N/D	N/D	0.8	N/D	N/D	N/D	N/D	N/D	0.0	0.8
U4Q00205F	544613.00	1536897.00	May-96	Q	24	26	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00206F	544613.00	1536897.00	May-96	Q	28	30	0.6	N/D	N/D	N/D	N/D	N/D	0.6	N/D	N/D	N/D	N/D	N/D	0.0	0.6
U4Q00207F	544613.00	1536897.00	May-96	Q	32	34	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00208F	544613.00	1536897.00	May-96	Q	40	42	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00209F	544613.00	1536897.00	May-96	Q	48	50	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00210F	544613.00	1536897.00	May-96	Q	56	58	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00211F	544613.00	1536897.00	May-96	Q	60	62	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00301F	544610.00	1536936.00	May-96	Q	4	6	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00302F	544610.00	1536936.00	May-96	Q	6	8	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00303F	544610.00	1536936.00	May-96	Q	8	10	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00304F	544610.00	1536936.00	May-96	Q	10	12	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00305F	544610.00	1536936.00	May-96	Q	12	14	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00305FD	544610.00	1536936.00	May-96	Q	12	14	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00306F	544610.00	1536936.00	May-96	Q	16	18	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00307F	544610.00	1536936.00	May-96	Q	22	24	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00308F	544610.00	1536936.00	May-96	Q	34	36	10.0	N/D	N/D	N/D	N/D	N/D	10.0	N/D	N/D	N/D	N/D	N/D	0.0	10.0
U4Q00309F	544610.00	1536936.00	May-96	Q	42	44	0.8	N/D	N/D	N/D	N/D	N/D	0.8	N/D	N/D	N/D	N/D	N/D	0.0	0.8
U4Q00309FD	544610.00	1536936.00	May-96	Q	42	44	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00310F	544610.00	1536936.00	May-96	Q	52	54	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00311F	544610.00	1536936.00	May-96	Q	60	62	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00401F	544567.00	1536795.00	May-96	Q	2	4	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0

A-12
 FOCUSED FIELD INVESTIGATION, OU4
 SUMMARY TABLE FOR FIELD LABORATORY AND OFFSITE ANALYTICAL RESULTS

Remedial Investigation, Operable Unit 4
 Study Areas 12, 13, and 14 - Area C
 Naval Training Center
 Orlando, Florida

Sample No.	EASTING	NORTHING	Date sampled	medium	depth(u)	depth(l)	PCE	TCE	C-1,2-DCE	T-1,2-DCE	1,1-DCE	VC	T. CHLOR.	BENZENE	TOLUENE	ETHYLB.	m/p XYL.	O XYL.	BTEX	TOT VOCs
U4Q00402F	544567.00	1536795.00	May-96	Q	4	6	N/D	N/D	5.8	N/D	N/D	N/D	5.8	N/D	N/D	N/D	N/D	N/D	0.0	5.8
U4Q00403F	544567.00	1536795.00	May-96	Q	6	8	1.7	270.0	1100.0	100.0	1.6	3.0	1476.3	N/D	N/D	N/D	N/D	N/D	0.0	1476.3
U4Q00404F	544567.00	1536795.00	May-96	Q	8.5	10.5	8.1	680.0	640.0	19.0	N/D	N/D	1347.1	N/D	N/D	N/D	N/D	N/D	0.0	1347.1
U4Q00405F	544567.00	1536795.00	May-96	Q	15	17	64.0	190.0	4.4	N/D	N/D	N/D	258.4	N/D	N/D	N/D	N/D	N/D	0.0	258.4
U4Q00406F	544567.00	1536795.00	May-96	Q	17	19	97.0	270.0	4.8	N/D	N/D	N/D	371.8	N/D	N/D	N/D	N/D	N/D	0.0	371.8
U4Q00407F	544567.00	1536795.00	May-96	Q	19	21	19.0	160.0	2.2	N/D	N/D	0.1	181.3	N/D	N/D	N/D	N/D	N/D	0.0	181.3
U4Q00407FD	544567.00	1536795.00	May-96	Q	19	21	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00408F	544567.00	1536795.00	May-96	Q	21	23	44.0	310.0	5.0	0.4	N/D	N/D	359.4	0.4	0.4	3.8	N/D	0.7	5.3	364.7
U4Q00409F	544567.00	1536795.00	May-96	Q	23	25	170.0	130.0	3.0	N/D	N/D	N/D	303.0	N/D	N/D	N/D	N/D	N/D	0.0	303.0
U4Q00410F	544567.00	1536795.00	May-96	Q	25	27	180.0	180.0	4.7	N/D	N/D	N/D	364.7	N/D	N/D	N/D	N/D	N/D	0.0	364.7
U4Q00411F	544567.00	1536795.00	May-96	Q	27	29	130.0	56.0	4.2	N/D	N/D	N/D	190.2	N/D	N/D	N/D	N/D	N/D	0.0	190.2
U4Q00412F	544567.00	1536795.00	May-96	Q	29	31	120.0	11.0	N/D	N/D	N/D	N/D	131.0	N/D	N/D	N/D	N/D	N/D	0.0	131.0
U4Q00413F	544567.00	1536795.00	May-96	Q	31	33	120.0	12.0	N/D	N/D	N/D	N/D	132.0	N/D	N/D	N/D	N/D	3.1	3.1	135.1
U4Q00414F	544567.00	1536795.00	May-96	Q	33	35	99.0	1.7	N/D	N/D	N/D	N/D	100.7	N/D	N/D	N/D	N/D	N/D	0.0	100.7
U4Q00415F	544567.00	1536795.00	May-96	Q	35	37	13.0	0.4	N/D	N/D	N/D	N/D	13.4	N/D	N/D	N/D	N/D	N/D	0.0	13.4
U4Q00416F	544567.00	1536795.00	May-96	Q	37	39	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00417F	544567.00	1536795.00	May-96	Q	39	41	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00418F	544567.00	1536795.00	May-96	Q	41	43	0.8	0.8	N/D	N/D	N/D	N/D	1.6	N/D	N/D	N/D	N/D	N/D	0.0	1.6
U4Q00419F	544567.00	1536795.00	May-96	Q	43	45	2.8	0.9	N/D	N/D	N/D	N/D	3.7	N/D	N/D	N/D	N/D	N/D	0.0	3.7
U4Q00420F	544567.00	1536795.00	May-96	Q	45	47	4.9	1.0	N/D	N/D	N/D	N/D	5.9	N/D	N/D	N/D	N/D	N/D	0.0	5.9
U4Q00421F	544567.00	1536795.00	May-96	Q	47	49	1.0	N/D	N/D	N/D	N/D	N/D	1.0	N/D	N/D	N/D	N/D	N/D	0.0	1.0
U4Q00422F	544567.00	1536795.00	May-96	Q	49	51	0.9	N/D	N/D	N/D	N/D	N/D	0.9	N/D	N/D	N/D	N/D	N/D	0.0	0.9
U4Q00423F	544567.00	1536795.00	May-96	Q	51	53	0.8	N/D	N/D	N/D	N/D	N/D	0.8	N/D	N/D	N/D	N/D	N/D	0.0	0.8
U4Q00424F	544567.00	1536795.00	May-96	Q	53	55	4.4	N/D	N/D	N/D	N/D	N/D	4.4	N/D	N/D	N/D	N/D	N/D	0.0	4.4
U4Q00425F	544567.00	1536795.00	May-96	Q	55	57	220.0	9.9	N/D	N/D	N/D	N/D	229.9	N/D	N/D	N/D	N/D	N/D	0.0	229.9
U4Q00426F	544567.00	1536795.00	May-96	Q	57	59	4.3	1.0	N/D	N/D	N/D	N/D	5.3	N/D	N/D	N/D	N/D	N/D	0.0	5.3
U4Q00501F	544570.00	1536750.00	May-96	Q	4	6	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00502F	544570.00	1536750.00	May-96	Q	6	8	N/D	7.1	3.5	N/D	N/D	N/D	10.6	N/D	N/D	N/D	N/D	N/D	0.0	10.6
U4Q00503F	544570.00	1536750.00	May-96	Q	20	22	950.0	23.0	6.7	N/D	N/D	N/D	979.7	N/D	N/D	N/D	N/D	N/D	0.0	979.7
U4Q00504F	544570.00	1536750.00	May-96	Q	24	26	300.0	5.0	1.6	N/D	N/D	N/D	306.6	N/D	N/D	N/D	N/D	N/D	0.0	306.6
U4Q00505F	544570.00	1536750.00	May-96	Q	28	30	300.0	3.0	1.2	N/D	N/D	N/D	304.2	N/D	N/D	N/D	N/D	N/D	0.0	304.2
U4Q00506F	544570.00	1536750.00	May-96	Q	32	34	48.0	3.1	N/D	N/D	N/D	N/D	51.1	N/D	N/D	N/D	N/D	N/D	0.0	51.1
U4Q00506FD	544570.00	1536750.00	May-96	Q	32	34	50.0	2.5	N/D	N/D	N/D	0.1	52.6	N/D	N/D	N/D	N/D	N/D	0.0	52.6
U4Q00507F	544570.00	1536750.00	May-96	Q	36	38	0.4	N/D	N/D	N/D	N/D	N/D	0.4	N/D	N/D	N/D	N/D	N/D	0.0	0.4
U4Q00508F	544570.00	1536750.00	May-96	Q	42	44	0.4	N/D	N/D	N/D	N/D	N/D	0.4	N/D	N/D	N/D	N/D	N/D	0.0	0.4
U4Q00509F	544570.00	1536750.00	May-96	Q	48	50	1.7	1.2	N/D	N/D	N/D	N/D	2.9	N/D	N/D	N/D	N/D	N/D	0.0	2.9
U4Q00510F	544570.00	1536750.00	May-96	Q	58	60	0.5	N/D	N/D	N/D	N/D	N/D	0.5	N/D	N/D	N/D	N/D	N/D	0.0	0.5
U4Q00601F	544562.00	1536704.00	May-96	Q	4	6	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00602F	544562.00	1536704.00	May-96	Q	6	8	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00603F	544562.00	1536704.00	May-96	Q	9	11	1.5	9.0	5.4	N/D	N/D	N/D	15.9	N/D	N/D	N/D	N/D	N/D	0.0	15.9
U4Q00604F	544562.00	1536704.00	May-96	Q	11	13	2.4	71.0	54.0	1.2	N/D	N/D	128.6	N/D	N/D	N/D	N/D	N/D	0.0	128.6
U4Q00605F	544562.00	1536704.00	May-96	Q	22	24	2.0	10.0	1.9	N/D	N/D	N/D	13.9	N/D	N/D	N/D	N/D	N/D	0.0	13.9

FOCUSED FIELD INVESTIGATION, OU4
SUMMARY TABLE FOR FIELD LABORATORY AND OFFSITE ANALYTICAL RESULTS

Remedial Investigation, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

Sample No.	EASTING	NORTHING	Date sampled	medium	depth(u)	depth(l)	PCE	TCE	C-1,2-DCE	T-1,2-DCE	1,1-DCE	VC	T. CHLOR.	BENZENE	TOLUENE	ETHYLB.	m/p XYL.	O XYL.	BTEX	TOT VOCs
U4Q00606F	544562.00	1536704.00	May-96	Q	28	28	3.7	13.0	3.0	N/D	N/D	N/D	19.7	N/D	N/D	N/D	N/D	N/D	0.0	19.7
U4Q00607F	544562.00	1536704.00	May-96	Q	30	32	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00701F	544524.00	1536677.00	May-96	Q	4	6	3.2	26.0	3.8	N/D	N/D	N/D	33.0	N/D	N/D	N/D	N/D	N/D	0.0	33.0
U4Q00702F	544524.00	1536677.00	May-96	Q	6	8	12.0	14.0	2.0	N/D	N/D	N/D	28.0	N/D	N/D	N/D	N/D	N/D	0.0	28.0
U4Q00703F	544524.00	1536677.00	May-96	Q	18	20	24.0	28.0	14.0	N/D	N/D	N/D	66.0	N/D	N/D	N/D	N/D	N/D	0.0	66.0
U4Q00801F	544506.00	1536617.00	May-96	Q	4	6	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00802F	544506.00	1536617.00	May-96	Q	6	8	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00803F	544506.00	1536617.00	May-96	Q	18	20	15.0	7.0	3.2	N/D	N/D	N/D	25.2	N/D	N/D	N/D	N/D	N/D	0.0	25.2
U4Q00804F	544506.00	1536617.00	May-96	Q	24	26	7.0	13.0	2.7	N/D	N/D	N/D	22.7	N/D	N/D	N/D	N/D	N/D	0.0	22.7
U4Q00805F	544506.00	1536617.00	May-96	Q	30	32	N/D	16.0	N/D	N/D	N/D	N/D	16.0	N/D	N/D	N/D	N/D	N/D	0.0	16.0
U4Q00806F	544506.00	1536617.00	May-96	Q	38	40	11.0	15.0	N/D	N/D	N/D	N/D	26.0	N/D	N/D	N/D	N/D	N/D	0.0	26.0
U4Q00807F	544506.00	1536617.00	May-96	Q	46	48	N/D	0.6	N/D	N/D	N/D	N/D	0.6	N/D	N/D	N/D	N/D	N/D	0.0	0.6
U4Q00808F	544506.00	1536617.00	May-96	Q	50	52	5.2	18.0	N/D	N/D	N/D	0.3	23.5	N/D	N/D	N/D	N/D	N/D	0.0	23.5
U4Q00809F	544506.00	1536617.00	May-96	Q	54	56	0.5	0.5	N/D	N/D	N/D	N/D	1.0	N/D	N/D	N/D	N/D	N/D	0.0	1.0
U4Q00901F	544480.00	1536573.00	May-96	Q	4	6	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00902F	544480.00	1536573.00	May-96	Q	7	9	2.8	3.4	1.5	N/D	N/D	N/D	7.7	N/D	N/D	N/D	N/D	N/D	0.0	7.7
U4Q00903F	544506.00	1536567.00	May-96	Q	16	18	9.6	12.0	N/D	N/D	N/D	N/D	21.6	N/D	N/D	N/D	N/D	N/D	0.0	21.6
U4Q00903FD	544506.00	1536567.00	May-96	Q	16	18	8.3	8.9	N/D	N/D	N/D	N/D	17.2	N/D	N/D	N/D	N/D	N/D	0.0	17.2
U4Q00904F	544506.00	1536567.00	May-96	Q	20	22	10.0	2.4	N/D	N/D	N/D	N/D	12.4	N/D	N/D	N/D	N/D	N/D	0.0	12.4
U4Q00904FD	544506.00	1536567.00	May-96	Q	20	22	10.0	4.4	N/D	N/D	N/D	N/D	14.4	N/D	N/D	N/D	N/D	N/D	0.0	14.4
U4Q00905F	544506.00	1536567.00	May-96	Q	24	26	N/D	5.5	N/D	N/D	N/D	0.3	5.8	N/D	N/D	N/D	N/D	N/D	0.0	5.8
U4Q00905FD	544506.00	1536567.00	May-96	Q	24	26	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00906F	544506.00	1536567.00	May-96	Q	28	30	7.8	10.0	N/D	N/D	N/D	N/D	17.8	N/D	N/D	N/D	N/D	N/D	0.0	17.8
U4Q00906FD	544506.00	1536567.00	May-96	Q	28	30	1.9	2.6	N/D	N/D	N/D	N/D	4.5	N/D	N/D	N/D	N/D	N/D	0.0	4.5
U4Q00907F	544506.00	1536567.00	May-96	Q	34	36	N/D	1.0	N/D	N/D	N/D	N/D	1.0	N/D	N/D	N/D	N/D	N/D	0.0	1.0
U4Q00908F	544506.00	1536567.00	May-96	Q	42	44	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00909F	544506.00	1536567.00	May-96	Q	48	50	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q00910F	544506.00	1536567.00	May-96	Q	52	54	0.5	0.8	N/D	N/D	N/D	N/D	1.3	N/D	N/D	N/D	N/D	N/D	0.0	1.3
U4Q01001F	544689.00	1536820.00	May-96	Q	4	6	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q01002F	544689.00	1536820.00	May-96	Q	6	8	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q01003F	544689.00	1536820.00	May-96	Q	8	10	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q01004F	544689.00	1536820.00	May-96	Q	10	12	N/D	4.8	12.0	N/D	N/D	N/D	16.8	N/D	N/D	N/D	N/D	N/D	0.0	16.8
U4Q01005F	544689.00	1536820.00	May-96	Q	12	14	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q01006F	544689.00	1536820.00	May-96	Q	14	16	N/D	84.0	800.0	69.0	0.9	5.0	958.9	N/D	N/D	N/D	N/D	N/D	0.0	958.9
U4Q01007F	544689.00	1536820.00	May-96	Q	22	24	17.0	780.0	800.0	20.0	N/D	8.3	1625.3	N/D	N/D	N/D	N/D	N/D	0.0	1625.3
U4Q01008F	544689.00	1536820.00	May-96	Q	24	26	21.0	960.0	790.0	20.0	N/D	3.0	1794.0	N/D	N/D	N/D	N/D	N/D	0.0	1794.0
U4Q01009F	544689.00	1536820.00	May-96	Q	26	28	1500.0	41.0	550.0	16.0	N/D	0.9	2107.9	N/D	N/D	N/D	N/D	N/D	0.0	2107.9
U4Q01010F	544689.00	1536820.00	May-96	Q	28	30	43.0	2000.0	100.0	14.0	1.0	2.1	2160.1	N/D	N/D	N/D	N/D	N/D	0.0	2160.1
U4Q01011F	544689.00	1536820.00	May-96	Q	30	32	2800.0	3800.0	65.0	10.0	4.0	N/D	6479.0	N/D	N/D	N/D	N/D	N/D	0.0	6479.0
U4Q01012F	544689.00	1536820.00	May-96	Q	32	34	290.0	3200.0	150.0	16.0	7.2	2.7	3665.9	N/D	N/D	N/D	N/D	N/D	0.0	3665.9
U4Q01013F	544689.00	1536820.00	May-96	Q	34	36	240.0	1500.0	54.0	3.8	N/D	0.9	1798.7	N/D	N/D	N/D	N/D	N/D	0.0	1798.7
U4Q01014F	544689.00	1536820.00	May-96	Q	38	40	45.0	190.0	3.9	N/D	N/D	N/D	238.9	N/D	N/D	N/D	N/D	N/D	0.0	238.9

A-12
 FOCUSED FIELD INVESTIGATION, OU4
 SUMMARY TABLE FOR FIELD LABORATORY AND OFFSITE ANALYTICAL RESULTS

Remedial Investigation, Operable Unit 4
 Study Areas 12, 13, and 14 - Area C
 Naval Training Center
 Orlando, Florida

Sample No.	EASTING	NORTHING	Date sampled	medium	depth(u)	depth(l)	PCE	TCE	C-1,2-DCE	T-1,2-DCE	1,1-DCE	VC	T. CHLOR.	BENZENE	TOLUENE	ETHYLB.	m/p XYL.	O XYL.	BTEX	TOT VOCs
U4Q01015F	544689.00	1536820.00	May-96	Q	42	44	3.4	15.0	N/D	N/D	N/D	N/D	18.4	N/D	N/D	N/D	N/D	N/D	0.0	18.4
U4Q01016F	544689.00	1536820.00	May-96	Q	46	48	3.4	14.0	1.8	N/D	N/D	N/D	19.2	N/D	N/D	N/D	N/D	N/D	0.0	19.2
U4Q01017F	544689.00	1536820.00	May-96	Q	48	50	1.2	32.0	1.8	N/D	N/D	N/D	35.0	N/D	N/D	N/D	N/D	N/D	0.0	35.0
U4Q01018F	544689.00	1536820.00	May-96	Q	50	52	17.0	39.0	N/D	N/D	N/D	N/D	56.0	N/D	N/D	N/D	N/D	N/D	0.0	56.0
U4Q01019F	544689.00	1536820.00	May-96	Q	52	54	4.0	33.0	N/D	N/D	N/D	N/D	37.0	N/D	N/D	N/D	N/D	N/D	0.0	37.0
U4Q01020F	544689.00	1536820.00	May-96	Q	54	56	4.9	45.0	2.7	N/D	N/D	N/D	52.6	N/D	N/D	N/D	N/D	N/D	0.0	52.6
U4Q01021F	544689.00	1536820.00	May-96	Q	56	58	7.2	60.0	71.0	1.0	N/D	N/D	139.2	N/D	N/D	N/D	N/D	N/D	0.0	139.2
U4Q01022F	544689.00	1536820.00	May-96	Q	58	60	9.1	18.0	N/D	N/D	N/D	N/D	27.1	N/D	N/D	N/D	N/D	N/D	0.0	27.1
U4Q01023F	544689.00	1536820.00	May-96	Q	60	62	1.3	8.4	N/D	N/D	N/D	N/D	9.7	N/D	N/D	N/D	N/D	N/D	0.0	9.7
U4Q01024F	544689.00	1536820.00	May-96	Q	64	66	4.6	24.0	3.0	N/D	N/D	N/D	31.6	N/D	N/D	N/D	N/D	N/D	0.0	31.6
U4Q01101F	544698.00	1536885.00	May-96	Q	4	6	65.0	12.0	75.0	0.5	N/D	N/D	152.5	N/D	N/D	N/D	N/D	N/D	0.0	152.5
U4Q01102F	544842.00	1536861.00	May-96	Q	6	8	7.7	5.4	110.0	0.5	N/D	N/D	123.6	N/D	N/D	N/D	N/D	N/D	0.0	123.6
U4Q01103F	544842.00	1536861.00	May-96	Q	8	10	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q01104F	544842.00	1536861.00	May-96	Q	10	12	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q01105F	544842.00	1536861.00	May-96	Q	12	14	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q01106F	544842.00	1536861.00	May-96	Q	14	16	N/D	N/D	3.4	N/D	N/D	N/D	3.4	N/D	N/D	N/D	N/D	N/D	0.0	3.4
U4Q01107F	544842.00	1536861.00	May-96	Q	22	24	1.0	9.8	69.0	N/D	N/D	N/D	79.8	N/D	N/D	N/D	N/D	N/D	0.0	79.8
U4Q01108F	544842.00	1536861.00	May-96	Q	26	28	N/D	1.9	N/D	N/D	N/D	N/D	1.9	N/D	N/D	N/D	N/D	N/D	0.0	1.9
U4Q01109F	544842.00	1536861.00	May-96	Q	30	32	6.4	4.6	1.8	N/D	N/D	N/D	12.8	N/D	N/D	N/D	N/D	N/D	0.0	12.8
U4Q01110F	544842.00	1536861.00	May-96	Q	34	36	1.6	N/D	N/D	N/D	N/D	N/D	1.6	N/D	N/D	N/D	N/D	N/D	0.0	1.6
U4Q01111F	544842.00	1536861.00	May-96	Q	38	40	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q01112F	544842.00	1536861.00	May-96	Q	44	46	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q01113F	544842.00	1536861.00	May-96	Q	50	52	1.4	N/D	N/D	N/D	N/D	N/D	1.4	N/D	N/D	N/D	N/D	N/D	0.0	1.4
U4Q01114F	544842.00	1536861.00	May-96	Q	54	56	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q01115F	544842.00	1536861.00	May-96	Q	58	60	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q01115FD	544842.00	1536861.00	May-96	Q	58	60	0.6	N/D	N/D	N/D	N/D	N/D	0.6	N/D	N/D	N/D	N/D	N/D	0.0	0.6
U4Q01116F	544842.00	1536861.00	May-96	Q	62	64	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q01201F	544499.00	1536511.00	May-96	Q	4	6	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q01201FD	544499.00	1536511.00	May-96	Q	4	6	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q01202F	544499.00	1536511.00	May-96	Q	6	8	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q01202FD	544499.00	1536511.00	May-96	Q	6	8	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q01203F	544499.00	1536511.00	May-96	Q	8	10	N/D	0.4	N/D	N/D	N/D	N/D	0.4	N/D	N/D	N/D	N/D	N/D	0.0	0.4
U4Q01204F	544499.00	1536511.00	May-96	Q	18	20	0.8	0.5	N/D	N/D	N/D	N/D	1.3	N/D	N/D	N/D	N/D	N/D	0.0	1.3
U4Q01205F	544499.00	1536511.00	May-96	Q	22	24	6.2	1.3	N/D	N/D	N/D	N/D	7.5	N/D	N/D	N/D	N/D	N/D	0.0	7.5
U4Q01205FD	544499.00	1536511.00	May-96	Q	22	24	6.2	5.7	N/D	N/D	N/D	N/D	11.9	N/D	N/D	N/D	N/D	N/D	0.0	11.9
U4Q01206F	544499.00	1536511.00	May-96	Q	26	28	N/D	4.2	N/D	N/D	N/D	0.3	4.5	N/D	N/D	N/D	N/D	N/D	0.0	4.5
U4Q01206FD	544499.00	1536511.00	May-96	Q	26	28	0.4	2.4	N/D	N/D	N/D	N/D	2.8	N/D	N/D	N/D	N/D	N/D	0.0	2.8
U4Q01207F	544499.00	1536511.00	May-96	Q	32	34	N/D	5.5	N/D	N/D	N/D	N/D	5.5	N/D	N/D	N/D	N/D	N/D	0.0	5.5
U4Q01207FD	544499.00	1536511.00	May-96	Q	32	34	7.3	8.5	N/D	N/D	N/D	N/D	15.8	N/D	N/D	N/D	N/D	N/D	0.0	15.8
U4Q01208F	544499.00	1536511.00	May-96	Q	38	40	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q01209F	544499.00	1536511.00	May-96	Q	46	48	N/D	0.7	N/D	N/D	N/D	N/D	0.7	N/D	N/D	N/D	N/D	N/D	0.0	0.7
U4Q01210F	544499.00	1536511.00	May-96	Q	50	52	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0

FOCUSED FIELD INVESTIGATION, OU4
SUMMARY TABLE FOR FIELD LABORATORY AND OFFSITE ANALYTICAL RESULTS

Remedial Investigation, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

Sample No.	EASTING	NORTHING	Date sampled	medium	depth(u)	depth(l)	PCE	TCE	C-1,2-DCE	T-1,2-DCE	1,1-DCE	VC	T. CHLOR.	BENZENE	TOLUENE	ETHYLB.	m/p XYL.	O XYL.	BTEX	TOT VOCs
U4Q01211F	544499.00	1536511.00	May-96	Q	54	56	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q01212F	544499.00	1536511.00	May-96	Q	58	60	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q01301F	544564.00	1536666.00	May-96	Q	24	26	1.0	1.2	N/D	N/D	N/D	N/D	2.2	N/D	N/D	N/D	N/D	N/D	0.0	2.2
U4Q01302F	544564.00	1536666.00	May-96	Q	30	32	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q01303F	544564.00	1536666.00	May-96	Q	36	38	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q01304F	544564.00	1536666.00	May-96	Q	42	44	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q01305F	544564.00	1536666.00	May-96	Q	48	50	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4Q01306F	544564.00	1536666.00	May-96	Q	54	56	0.4	0.5	N/D	N/D	N/D	N/D	0.9	N/D	N/D	N/D	N/D	N/D	0.0	0.9
U4Q01307F	544564.00	1536666.00	May-96	Q	58	60	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4S00101F	544807.00	1536940.00	May-96	S	0	1	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4S00201F	544781.00	1536823.00	May-96	S	0	1	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4S00301F	544520.00	1536668.00	May-96	S	0	1	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4S00401F	544566.00	1536719.00	May-96	S	0	1	N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4W00101F	544389.00	1536611.00	May-96	W			N/D	N/D	N/D	N/D	N/D	0.1	0.1	N/D	N/D	N/D	N/D	N/D	0.0	0.1
U4W00201F	544580.00	1536844.00	May-96	W			63.0	150.0	230.0	13.0	1.1	12.0	469.1	N/D	N/D	N/D	N/D	N/D	0.0	469.1
U4W00301F	544608.00	1536833.00	May-96	W			N/D	76.0	180.0	10.0	1.1	62.0	329.1	N/D	N/D	N/D	N/D	N/D	0.0	329.1
U4W00601F	544568.00	1536873.00	May-96	W			N/D	23.0	100.0	0.7	N/D	65.0	188.7	N/D	N/D	N/D	N/D	N/D	0.0	188.7
U4W00701F	544532.00	1536892.00	May-96	W			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	0.6	N/D	N/D	N/D	0.6	0.6
U4W00801F	544529.00	1536921.00	May-96	W			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4W00901F	544544.00	1536944.00	May-96	W			N/D	N/D	2.3	N/D	N/D	0.5	2.8	N/D	N/D	N/D	N/D	N/D	0.0	2.8
U4W00901FD	544544.00	1536944.00	May-96	W			N/D	N/D	2.3	N/D	N/D	0.6	2.9	N/D	N/D	N/D	N/D	N/D	0.0	2.9
U4W01001F	544558.00	1536844.00	May-96	W			150.0	920.0	1200.0	46.0	6.4	280.0	2602.4	N/D	0.5	N/D	N/D	N/D	0.5	2602.9
U4W01101F	544565.00	1536806.00	May-96	W			N/D	25.0	94.0	1.2	1.0	12.0	133.2	N/D	1.0	N/D	N/D	N/D	1.0	134.2
U4W01201F	544526.00	1536790.00	May-96	W			N/D	5.6	180.0	0.7	0.9	83.0	270.2	N/D	7.2	N/D	N/D	N/D	7.2	277.4
U4W01301F	544510.00	1536753.00	May-96	W			0.6	97.0	500.0	6.8	1.0	23.0	628.4	N/D	N/D	N/D	N/D	N/D	0.0	628.4
U4W01401F	544475.00	1536728.00	May-96	W			2.8	33.0	42.0	N/D	N/D	5.8	83.6	N/D	N/D	N/D	N/D	N/D	0.0	83.6
U4W01501F	544470.00	1536698.00	May-96	W			N/D	26.0	74.0	0.7	N/D	0.6	101.3	N/D	N/D	N/D	N/D	N/D	0.0	101.3
U4W01601F	544457.00	1536689.00	May-96	W			1.6	5.1	N/D	N/D	N/D	N/D	6.7	N/D	N/D	N/D	N/D	N/D	0.0	6.7
U4W01701F	544446.00	1536656.00	May-96	W			N/D	0.9	N/D	N/D	N/D	N/D	0.9	N/D	6.0	N/D	N/D	N/D	6.0	6.9
U4W01801F	544428.00	1536627.00	May-96	W			N/D	0.5	N/D	N/D	N/D	N/D	0.5	N/D	17.0	N/D	N/D	N/D	17.0	17.5
U4W01801FD	544428.00	1536627.00	May-96	W			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	30.0	N/D	N/D	N/D	30.0	30.0
U4W01901F	544528.00	1536841.00	May-96	W			N/D	N/D	34.0	N/D	N/D	13.0	47.0	N/D	N/D	N/D	N/D	N/D	0.0	47.0
U4W02001F	544541.00	1536868.00	May-96	W			N/D	N/D	15.0	N/D	N/D	7.6	22.6	N/D	N/D	N/D	N/D	N/D	0.0	22.6
U4W02101F	544513.00	1536821.00	May-96	W			0.6	3.7	29.0	N/D	N/D	6.8	40.1	N/D	N/D	N/D	N/D	N/D	0.0	40.1
U4W02201F	544499.00	1536794.00	May-96	W			0.9	2.1	6.1	N/D	N/D	N/D	9.1	N/D	N/D	N/D	N/D	N/D	0.0	9.1
U4W02301F	544517.00	1536872.00	May-96	W			N/D	N/D	27.0	N/D	N/D	8.8	35.6	N/D	N/D	N/D	N/D	N/D	0.0	35.6
U4W02401F	544478.00	1536772.00	May-96	W			4.7	2.0	4.3	N/D	N/D	N/D	11.0	N/D	N/D	N/D	N/D	N/D	0.0	11.0
U4W02501F	544463.00	1536747.00	May-96	W			N/D	16.0	26.0	N/D	N/D	N/D	42.0	N/D	N/D	N/D	N/D	N/D	0.0	42.0
U4W02601F	544444.00	1536723.00	May-96	W			N/D	9.9	23.0	N/D	N/D	N/D	32.9	N/D	N/D	N/D	N/D	N/D	0.0	32.9
U4W02601FD	544444.00	1536723.00	May-96	W			N/D	9.8	23.0	N/D	N/D	N/D	32.8	N/D	N/D	N/D	N/D	N/D	0.0	32.8
U4W02701F	544433.00	1536700.00	May-96	W			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4W02801F	544422.00	1536677.00	May-96	W			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0

A-12
 FOCUSED FIELD INVESTIGATION, OU4
 SUMMARY TABLE FOR FIELD LABORATORY AND OFFSITE ANALYTICAL RESULTS

Remedial Investigation, Operable Unit 4
 Study Areas 12, 13, and 14 - Area C
 Naval Training Center
 Orlando, Florida

Sample No.	EASTING	NORTHING	Date sampled	medium	depth(u)	depth(l)	PCE	TCE	C-1,2-DCE	T-1,2-DCE	1,1-DCE	VC	T. CHLOR.	BENZENE	TOLUENE	ETHYLB.	m/p XYL.	O XYL.	BTEX	TOT VOCs
U4W02901F	544413.00	1536654.00	May-96	W			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4W03001F	544491.00	1536897.00	May-96	W			N/D	N/D	2.8	N/D	N/D	0.3	3.1	N/D	N/D	N/D	N/D	N/D	0.0	3.1
U4W03101F	544505.00	1536849.00	May-96	W			0.4	N/D	N/D	N/D	N/D	1.5	1.9	N/D	N/D	N/D	N/D	N/D	0.0	1.9
U4W03201F	544492.00	1536822.00	May-96	W			N/D	1.0	13.0	N/D	N/D	8.5	22.5	N/D	N/D	N/D	N/D	N/D	0.0	22.5
U4W03301F	544428.00	1536844.00	May-96	W			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4W03301FD	544428.00	1536844.00	May-96	W			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4W03401F	544409.00	1536799.00	May-96	W			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4W03501F	544393.00	1536758.00	May-96	W			N/D	0.7	N/D	N/D	N/D	N/D	0.7	N/D	N/D	N/D	N/D	N/D	0.0	0.7
U4W03502F	544393.00	1536758.00	May-96	W			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4W03601F	544380.00	1536705.00	May-96	W			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4W03602F	544380.00	1536705.00	May-96	W			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4W03701F	544358.00	1536884.00	May-96	W			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4W03702F	544358.00	1536884.00	May-96	W			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	0.4	N/D	N/D	N/D	0.4	0.4
U4W03801F	544361.00	1536841.00	May-96	W			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4W03802F	544361.00	1536841.00	May-96	W			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4W03901F	544338.00	1536795.00	May-96	W			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4W03902F	544338.00	1536795.00	May-96	W			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4W04001F	544441.00	1536888.00	May-96	W			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4W04002F	544441.00	1536888.00	May-96	W			N/D	N/D	7.8	N/D	N/D	3.5	11.3	N/D	0.9	N/D	N/D	N/D	0.9	12.2
U4W04101F	544337.00	1536745.00	May-96	W			N/D	0.5	3.1	N/D	N/D	0.8	4.4	N/D	N/D	N/D	N/D	N/D	0.0	4.4
U4W04102F	544337.00	1536745.00	May-96	W			N/D	N/D	2.7	N/D	N/D	0.4	3.1	N/D	N/D	N/D	N/D	N/D	0.0	3.1
U4W04102FD	544337.00	1536745.00	May-96	W			N/D	0.5	3.0	N/D	N/D	0.5	4.0	N/D	N/D	N/D	N/D	N/D	0.0	4.0
U4W04201F	544382.00	1536632.00	May-96	W			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4W04301F	543989.00	1536792.00	May-96	W			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4W04302F	543989.00	1536792.00	May-96	W			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4W04401F	544384.00	1536877.00	May-96	W			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4W04402F	544384.00	1536877.00	May-96	W			N/D	N/D	4.7	N/D	N/D	1.3	6.0	N/D	N/D	N/D	N/D	N/D	0.0	6.0
U4W04501F	544451.00	1536627.00	May-96	W			1.1	N/D	N/D	N/D	N/D	N/D	1.1	N/D	N/D	N/D	N/D	N/D	0.0	1.1
U4W04502F	544451.00	1536627.00	May-96	W			N/D	N/D	1.6	N/D	N/D	0.3	1.9	N/D	N/D	N/D	N/D	N/D	0.0	1.9
U4W04601F	544178.00	1536756.00	May-96	W			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4W04602F	544178.00	1536756.00	May-96	W			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4W04701F	544347.00	1536909.00	May-96	W			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4W04702F	544347.00	1536909.00	May-96	W			N/D	N/D	3.3	N/D	N/D	0.6	3.9	N/D	N/D	N/D	N/D	N/D	0.0	3.9
U4W04801F	544310.00	1536866.00	May-96	W			N/D	N/D	N/D	N/D	N/D	N/D	0.0	N/D	N/D	N/D	N/D	N/D	0.0	0.0
U4W04802F	544310.00	1536866.00	May-96	W			N/D	N/D	5.6	N/D	N/D	1.3	6.9	N/D	N/D	N/D	N/D	N/D	0.0	6.9

Notes: D = duplicate sample.
 N/D = Non-detect.
 N/A = Not analyzed.

Table A-13
Summary of Subsurface Soil Results for Onsite Analysis

Remedial Investigation, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Sample ID	Depth (feet)	Zone	PCE	TCE	m/p-Xylene	o-Xylene	Sample ID	Depth (feet)	Zone	PCE	TCE	m/p-Xylene	o-Xylene
U4P01401F	0-4	V	82	<2	<4	<2	U4P01702F	4-8	V	10	<2	<4	<2
U4P01401FD	0-4	V	133	<2	<4	<2	U4P01703F	8-12	V	6	<2	<4	<2
U4P01402F	4-8	V	12	<2	<4	<2	U4P01704F	12-16	S	<2	<2	<4	<2
U4P01402FD	4-8	V	15	<2	<4	<2	U4P01705F	16-20	S	<2	<2	<4	<2
U4P01403F	10-12	V	4	<2	<4	<2	U4P01706F	20-24	S	<2	<2	<4	<2
U4P01404F	14-16	S	<2	<2	<4	<2	U4P01707F	26-28	S	<2	<2	<4	<4
U4P01405F	18-20	S	<2	<2	<4	<2	U4P01801F	0-4	V	4	<2	<4	<2
U4P01406F	21-23	S	<2	2	<4	<2	U4P01802F	4-8	V	<2	<2	<4	<2
U4P01501F	0-4	V	52	<2	<4	<2	U4P01803	8-12	V	<2	<2	<4	<2
U4P01502F	4-8	V	15	<2	<4	<2	U4P02001F	0-4	V	250E	<2	<4	<2
U4P01503F	8-12	V	12	<2	<4	<2	U4P02001FD	0-4	V	260E	<2	<4	<2
U4P01504F	14-16	S	15	<2	<4	<2	U4P02002F	4-8	V	40	<2	<4	<2
U4P01505F	18-20	S	<2	3	<4	<2	U4P02003F	8-12	V	20	<2	<4	<2
U4P01601F	0-4	V	158E	3	<4	<2	U4P02004F	14-16	S	<2	<2	<4	<2
U4P01602F	4-8	V	8	<2	<4	<2	U4P02005F	18-20	S	4	<2	<4	<2
U4P01603F	8-12	V	5	<2	<4	<2	U4P02006F	22-24	S	5	<2	<4	<2
U4P01604F	12-16	S	<2	<2	<4	<2	U4P02007F	26-28	S	<2	<2	<4	<2
U4P01605F	16-20	S	<2	<2	<4	<2	U4P02301F	0-4	V	<2	<2	<4	<2
U4P01606F	20-24	S	<2	<2	<4	<2	U4P02302F	4-8	V	<2	<2	<4	<2
U4P01607F	24-28	S	<2	<2	<4	<2	U4P02303F	8-12	S	<2	<2	<4	<2
U4P01701F	0-4	V	100	<2	<4	<2	U4P02304F	14-16	S	<2	<2	<4	<2

See notes at end of table.

**Table A-13 (Continued)
Summary of Subsurface Soil Results for Onsite Analysis**

Remedial Investigation, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Sample ID	Depth (feet)	Zone	PCE	TCE	m/p-Xylene	o-Xylene	Sample ID	Depth (feet)	Zone	PCE	TCE	m/p-Xylene	o-Xylene
U4P02305F	18-20	S	<2	<2	<4	<2	U4P02502F	4-8	V	6	<2	<4	<2
U4P02306F	22-24	S	<2	<2	<4	<2	U4P02503F	8-12	S	<2	<2	<4	<2
U4P02401F	0-4	V	15	<2	<4	<2	U4P02504F	14-16	S	<2	<2	<4	<2
U4P02401FD	0-4	V	15	<2	<4	<2	U4P02505F	18-20	S	<2	<2	<4	<2
U4P02402F	4-8	V	<2	<2	<4	<2	U4P02506F	22-24	S	<2	<2	<4	<2
U4P02403F	8-12	S	<2	<2	<4	<2	U4P02507F	26-28	S	<2	<2	<4	<2
U4P02404F	14-16	S	<2	<2	<4	<2	U4P02601F	0-4	V	<2	<2	9	<2
U4P02405F	18-20	S	<2	<2	<4	<2	U4P02602F	4-8	V	<2	<2	<4	<2
U4P02406F	22-24	S	<2	<2	<4	<2	U4P02603F	8-12	S	<2	<2	<4	4
U4P02407F	26-28	S	<2	<2	<4	<2	U4P02604F	22-24	S	<2	<2	<4	<2
U4P02501F	0-4	V	60	<2	<4	<2	U4P02605F	26-28	S	<2	<2	<4	<2

Notes: All results reported as micrograms per kilogram ($\mu\text{g}/\text{kg}$) soil dry weight.

ID = identification.
PCE = Tetrachloroethene.
TCE = Trichloroethene.
F = field.
D = duplicate sample.
V = vadose.
S = saturated.
E = estimated

FINAL

Table A-14
Summary of Subsurface Soil Results for Offsite Analytical

Remedial Investigation, Operable Unit 4
 Former Laundry Facility and DRMO
 Naval Training Center
 Orlando, Florida

Sample ID	Depth (ft)	Zone	PCE	TCE
U4P01504	14-16	S	430	7.6
U4P01505	18-20	S	7.6	27
U4P01505D	18-20	S	26	27
U4P01604	12-16	S	<6	<6
U4P01901	0-4	V	41	<5.2
U4P01902	4-8	V	22	<5.1
U4P01903	8-12	V	<6.0	<6.0
U4P01904	14-16	S	<6.2	<6.2
U4P01905	18-19	S	<6.1	<6.1
U4P02004	14-16	S	<6.1	<6.1
U4P02101	0-4	V	31	<5.1
U4P02102	4-8	V	20	<5.2
U4P02103	8-12	V	<6.0	<6.0
U4P02104	15-17	S	<6.4	<6.4
U4P02301	0-4	V	<5.1	<5.1
U4P02301D	0-4	V	<5.1	<5.1
U4P02501	0-4	V	17	<5.2
U4P02501D	0-4	V	21	<5.4
U4P02602	4-8	V	<5.9	<5.9

Notes: All results reported as micrograms per kilogram ($\mu\text{g}/\text{kg}$) (ppb).
 ID = identification.
 ft = feet.
 PCE = Tetrachloroethene.
 TCE = Trichloroethene.
 D = duplicate sample.
 V = vadose.
 S = saturated.

Table A-15
Summary of TerraProbe™ Groundwater Results for Onsite Analysis

Remedial Investigation, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Sample No.	Depth (feet)	PCE	TCE	cis-DCE	trans-DCE	Sample No.	Depth (feet)	PCE	TCE	cis-DCE	trans-DCE
U4Q01401F	11-13	440E	230E	45	<2	U4Q02005F	28-30	600E	4	20	<2
U4Q01402F	16-18	50	400E	250E	6	U4Q02101F	13-15	25	<2	10	<2
U4Q01402FD	16-18	20	440E	240E	5	U4Q02102F	16-18	8	<2	6	<2
U4Q01403F	20-22	45	500E	200E	7	U4Q02102FD	16-18	9	<2	6	<2
U4Q01404F	24-26	30	200E	300E	15	U4Q02301F	12-14	<2	<2	<2	<2
U4Q01501F	12-14	800E	200E	8	<2	U4Q02302F	16-18	<2	<2	<2	<2
U4Q01502F	16-18	550E	640E	50	5	U4Q02303F	20-22	10	<2	<2	<2
U4Q01503F	20-22	3362E	1000E	30	5	U4Q02401F	12-14	<2	<2	20	<2
U4Q01601F	12-14	270E	15	2	<2	U4Q02402F	16-18	7	5	70	4
U4Q01602F	16-18	60	4	<2	<2	U4Q02403F	20-22	50	170E	450E	30
U4Q01603F	20-22	120E	<2	3	<2	U4Q02403FD	20-22	40	90	700E	30
U4Q01604F	24-26	50	<2	<2	<2	U4Q02404F	24-26	150E	<2	200E	8
U4Q01605F	28-30	600E	<2	<2	<2	U4Q02405F	28-30	<2	<2	<2	<2
U4Q01701F	12-14	5	<2	7	<2	U4Q02501F	12-14	<2	<2	<2	<2
U4Q01702F	16-18	10	<2	4	<2	U4Q02502F	16-18	<2	<2	<2	<2
U4Q01703F	20-22	12	<2	<2	<2	U4Q02503F	20-22	<2	<2	3	<2
U4Q01704F	24-26	11	<2	<2	<2	U4Q02504F	24-26	98	13	112E	6
U4Q01705F	28-30	17	<2	<2	<2	U4Q02505F	28-30	6	<2	<2	3
U4Q01705FD	28-30	10	<2	<2	<2	U4Q02601F	12-14	320E	<2	<2	<2
U4Q01801F	12-14	7	<2	5	<2	U4Q02602F	16-18	84	<2	11	<2
U4Q02001F	12-14	400E	260E	140E	3	U4Q02602FD	16-18	66	<2	11	<2
U4Q02002F	16-18	1,00E	25	60	<2	U4Q02603F	20-22	110E	2	14	<2
U4Q02003F	20-22	2,350E	100	65	<2	U4Q02604F	24-26	2,100	30	40	<2
U4Q02003FD	20-22	2,370E	105E	60	<2	U4Q02605F	28-30	1,100E	100	3	<2
U4Q02004F	24-26	2000E	20	30	<2	U4Q02701F	12-14	<2	<2	<2	6

See notes at end of table.

Table A-15 (Continued)
Summary of TerraProbe™ Groundwater Results for Onsite Analysis

Remedial Investigation, Operable Unit 4
Former Laundry Facility and DRMO
Naval Training Center
Orlando, Florida

Sample No.	Depth (feet)	PCE	TCE	cis-DCE	trans-DCE	Sample No.	Depth (feet)	PCE	TCE	cis-DCE	trans-DCE
U4Q02702F	16-18	5	<2	<2	2	U4Q02801F	12-14	<2	<2	11	2
U4Q02703F	20-22	4	<2	<2	5	U4Q02802F	18-20	3	<2	12	<2
U4Q02704F	24-26	<2	<2	<2	3	U4Q02803F	24-26	3	<2	3	<2
U4Q02705F	28-30	2	<2	<2	<2	U4Q02804F	30-32	5	<2	<2	2

Notes: All results reported as micrograms per liter ($\mu\text{g}/\text{l}$)

PCE = tetrachloroethene.
TCE = trichloroethene.
cis-DCE = cis-dichloroethene.
trans-DCE = trans-dichloroethene.
< = less than.
E = estimated.

Table A-16
Summary of Groundwater Results for Offsite Analytical

Remedial Investigation, Operable Unit 4
 Former Laundry Facility and DRMO
 Naval Training Center
 Orlando, Florida

Sample ID	Depth (ft)	PCE	TCE	cis-DCE
U4Q01501	12-14	14000	440	<300
U4Q01502	16-18	6100	11000	<250
U4Q01502D	16-18	8600	15000	<300
U4Q01601	12-14	38	3.9	3
U4Q01901	12-14	5.4	0.24	<0.5
U4Q01902	16-18	2.4	0.12	<0.5
U4Q02101	13-15	1.4	0.58	1.1
U4Q02102	16-18	1.1	0.22	0.9
U4Q02403	20-22	33	90	880
U4Q02403D	20-22	30	86	830
U4Q02505	28-30	<0.5	<0.5	0.99
U4Q02704	24-26	<0.5	<0.5	0.13

Notes: ft = feet
 ID = identification
 D = Duplicate
 PCE = Tetrachloroethene
 TCE = Trichloroethene
 cis-DCE = cis-1,2-Dichloroethene

FINAL

Table A-17
Summary of Groundwater Analysis from Monitoring Wells and MicroWells

Remedial Investigation, Operable Unit 4
 Former Laundry Facility and DRMO
 Naval Training Center
 Orlando, Florida

Well ID	Date	Sample ID	PCE	TCE	cis-DCE
OLD-13-01A	3/9/95	13G00101	250	16 J	29 J
	3/24/97	13G00102	46	14	30
OLD-13-02C	4/6/95	13G00201	<.5	<.5	<.5
	3/24/97	13G00202	14	<.5	<.5
OLD-13-03A	4/6/95	13G00301	16	3 J	5.6
	3/24/97	13G00302	9.3	5.2	7.3
OLD-13-04C	4/6/95	13G00401	<.5	<.5	<.5
	3/24/97	13G00402	.13	<.5	<.5
OLD-13-05A	3/9/95	13G00501	7	3	6
	3/24/97	13G00502	1.5	.21	<.5
OLD-13-06C	4/6/95	13G00601	<.5	<.5	<.5
	3/24/97	13G00602	<.5	<.5	<.5
OLD-13-07A	4/6/95	13G00701	680	52	38 J
	3/25/97	13G00702	28,000	<620	<620
OLD-13-08C	4/6/95	13G00801	.2	<.5	.1 J
	3/25/97	13G00802	.18	<.5	<.5
OLD-13-18B	3/25/97	U4G01801	420	2.7	10
OLD-13-19B	3/25/97	U4G01901	9.3	2.3	.31
OLD-13-20B	3/25/97	U4G02001	6,900	910	<150

Notes: J = estimated value.
 ID = identification.
 PCE = tetrachloroethene.
 TCE = trichloroethene.
 DCE = dichloroethene.
 < = less than.

All results reported as micrograms per liter ($\mu\text{g}/\ell$).

APPENDIX B

APPENDIX B
PREVIOUS INVESTIGATION FIGURES

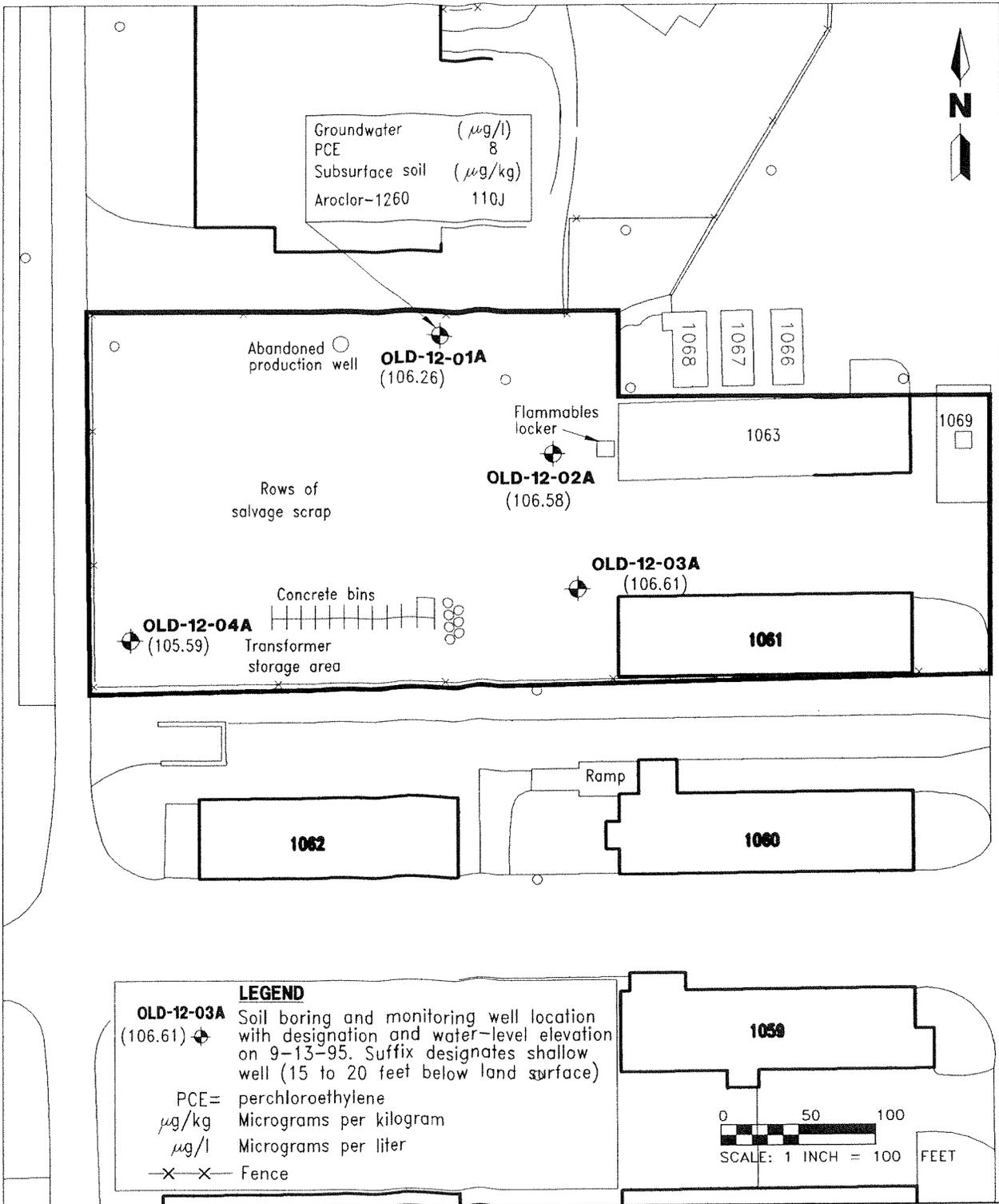
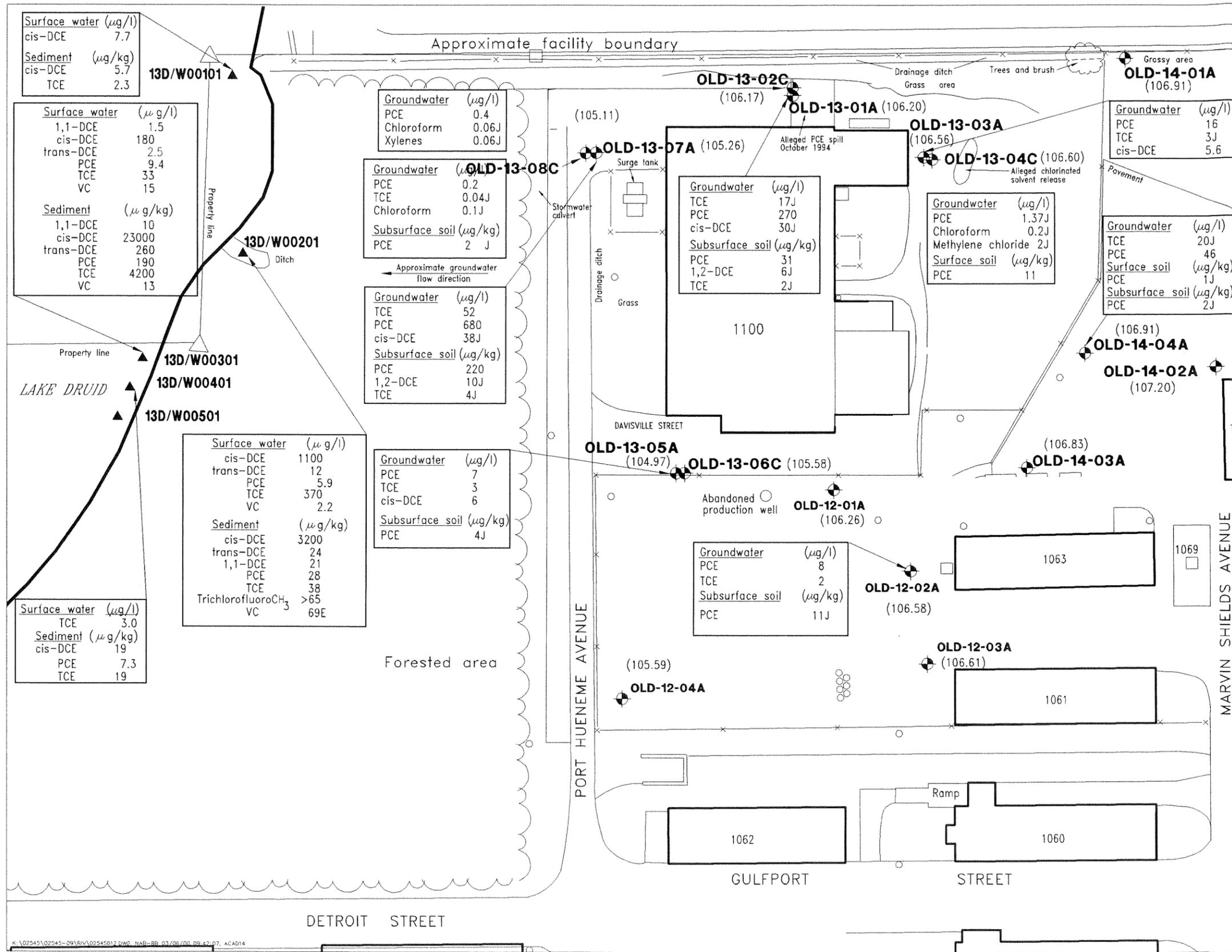


FIGURE B-1
SOIL BORING AND MONITORING WELL LOCATIONS
STUDY AREA 12



REMEDIAL INVESTIGATION
OPERABLE UNIT 4

NAVAL TRAINING CENTER
ORLANDO, FLORIDA



LEGEND

OLD-14-01A
 (106.91) Water-level elevation on 9/13/95

A Suffix designates shallow (15 to 20 feet) below land surface (bls) well

C Suffix designates deep (60 feet) bls well

PCE perchloroethylene
 TCE trichloroethene
 DCE dichloroethene
 VC vinyl chloride
 J estimated value
 $\mu\text{g/l}$ micrograms per liter
 $\mu\text{g/kg}$ micrograms per kilogram

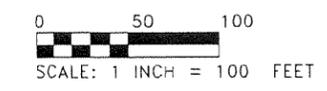
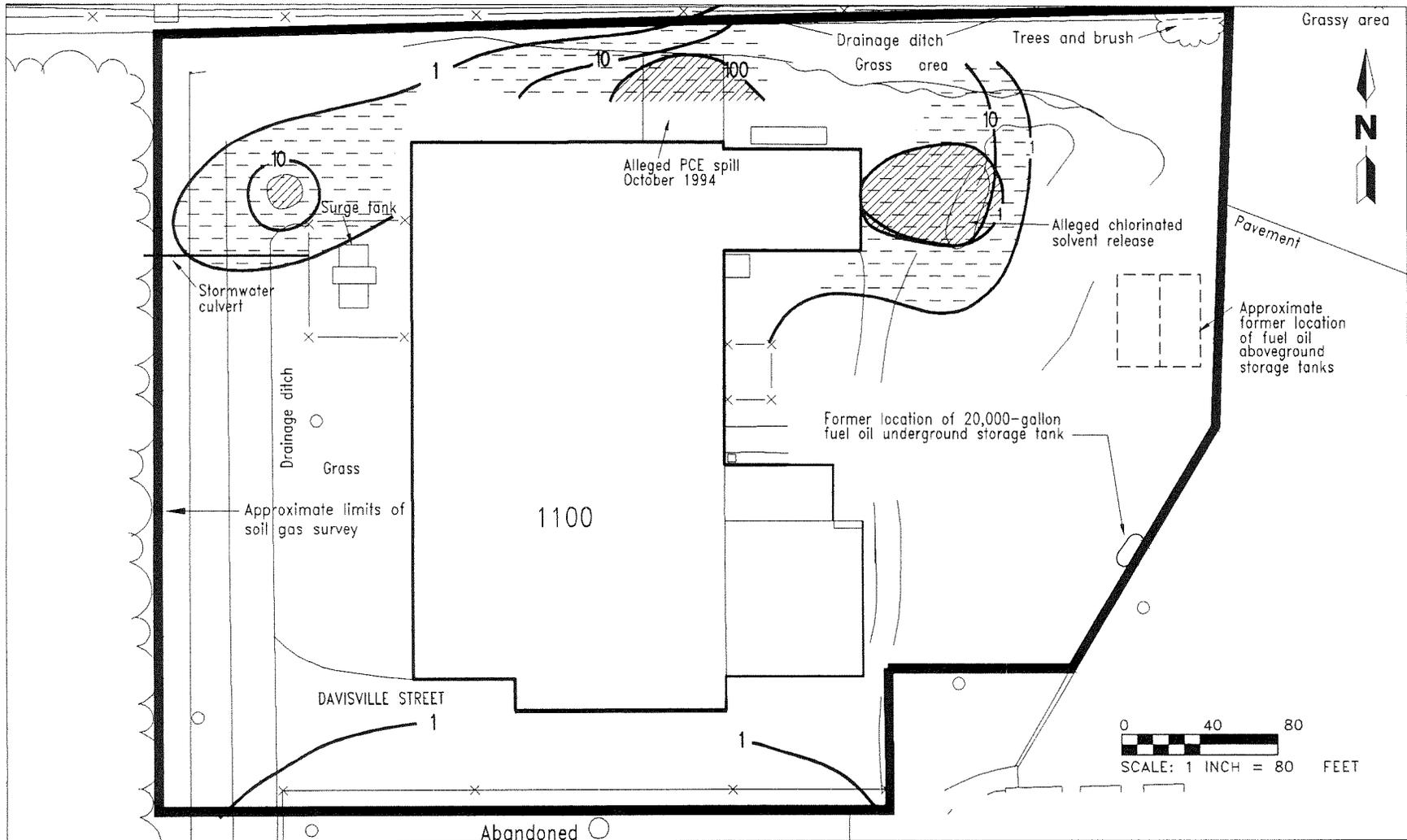


FIGURE B-2
VOLATILE ORGANIC DETECTIONS
AREA C, SITE SCREENING

REMEDIAL INVESTIGATION
OPERABLE UNIT 4

NAVAL TRAINING CENTER
ORLANDO, FLORIDA



LEGEND

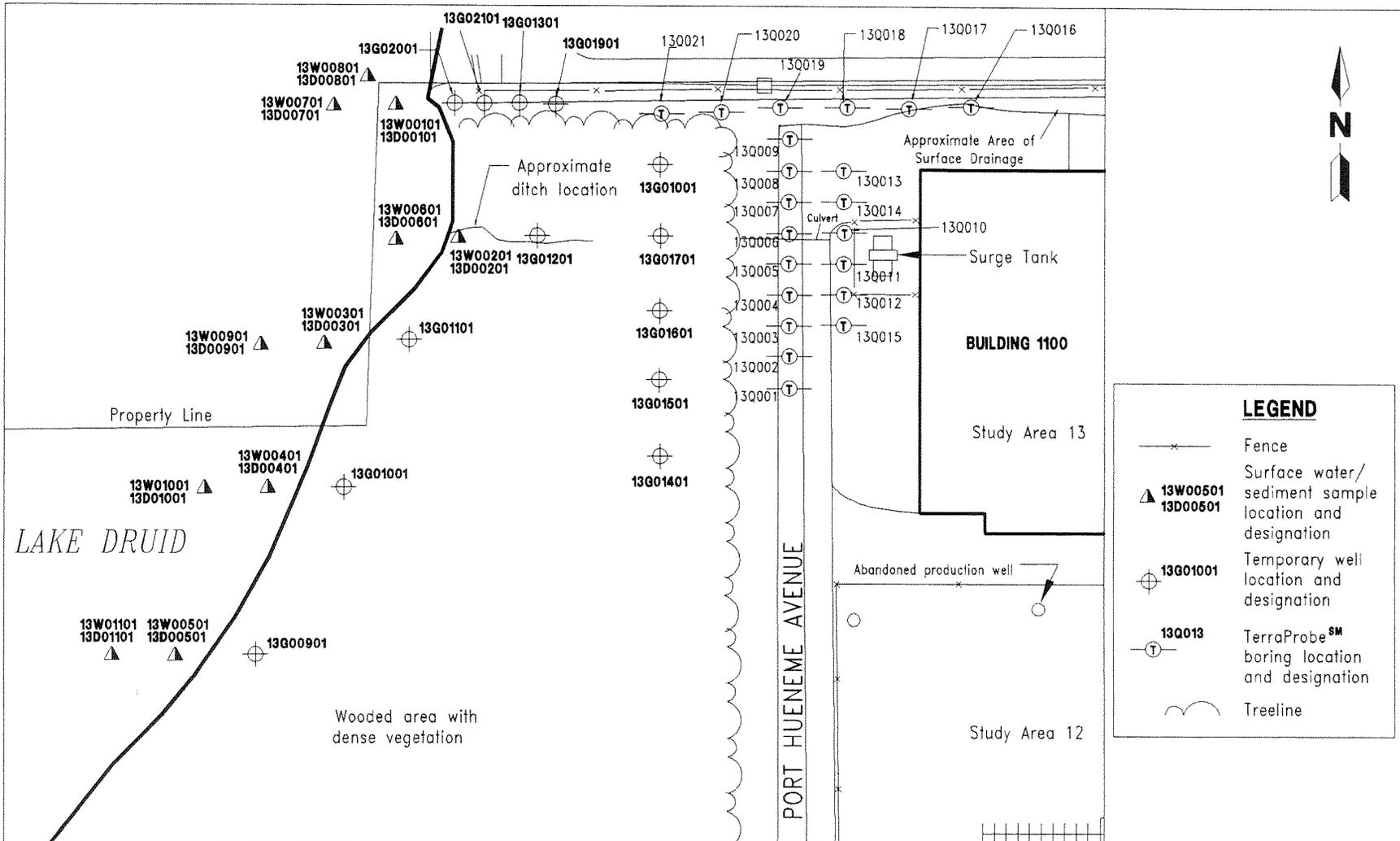
	Perchloroethylene (PCE)
	Trichloroethene
	Micrograms per liter of chlorinated solvents
	Fence

**FIGURE B-3
SOIL GAS SURVEY RESULTS
STUDY AREA 13**



**REMEDIAL INVESTIGATION
OPERABLE UNIT 4**

**NAVAL TRAINING CENTER
ORLANDO, FLORIDA**

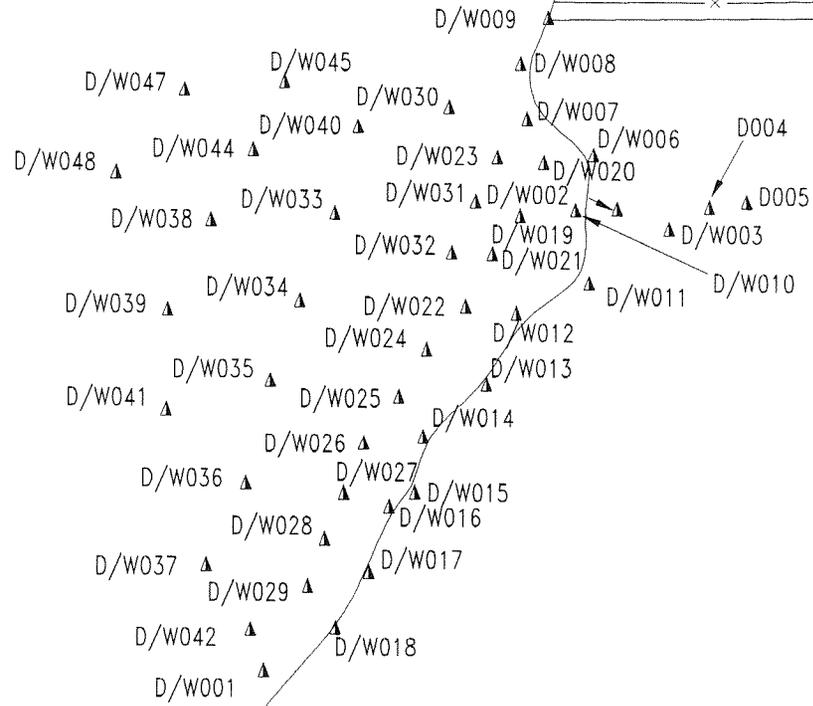




*LAKE
DRUID*

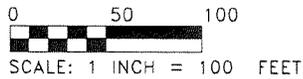
▲ D/W043

▲ D/W046



LEGEND

- ▲ D/W001 Sediment/surface water sample locations and designation
- x— Fence



**FIGURE B-5
SURFACE WATER AND SEDIMENT
SAMPLING LOCATIONS**



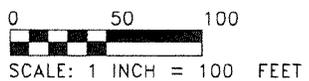
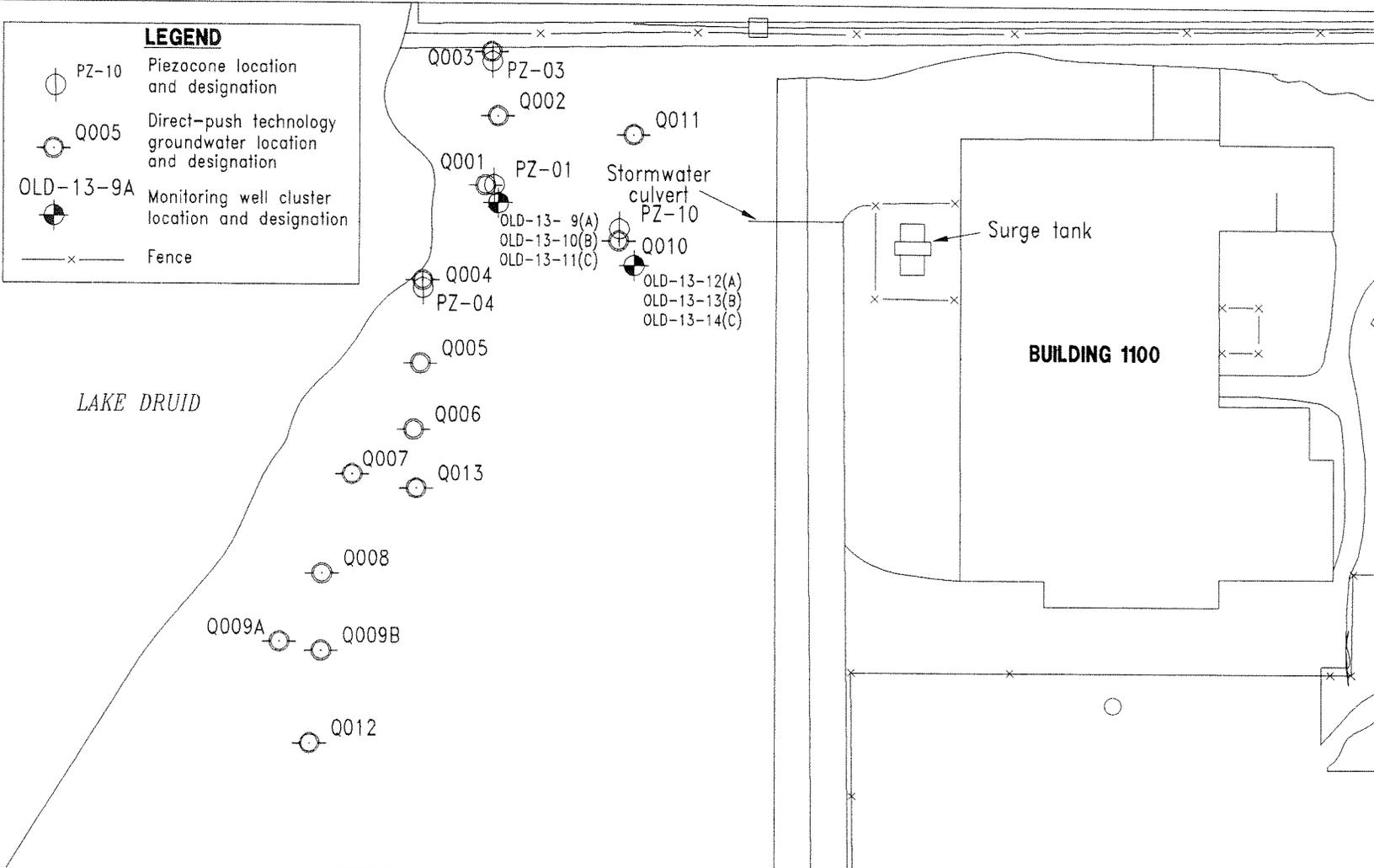
**REMEDIAL INVESTIGATION
OPERABLE UNIT 4**

**NAVAL TRAINING CENTER
ORLANDO, FLORIDA**



LEGEND

-  PZ-10 Piezocone location and designation
-  Q005 Direct-push technology groundwater location and designation
-  OLD-13-9A Monitoring well cluster location and designation
-  Fence

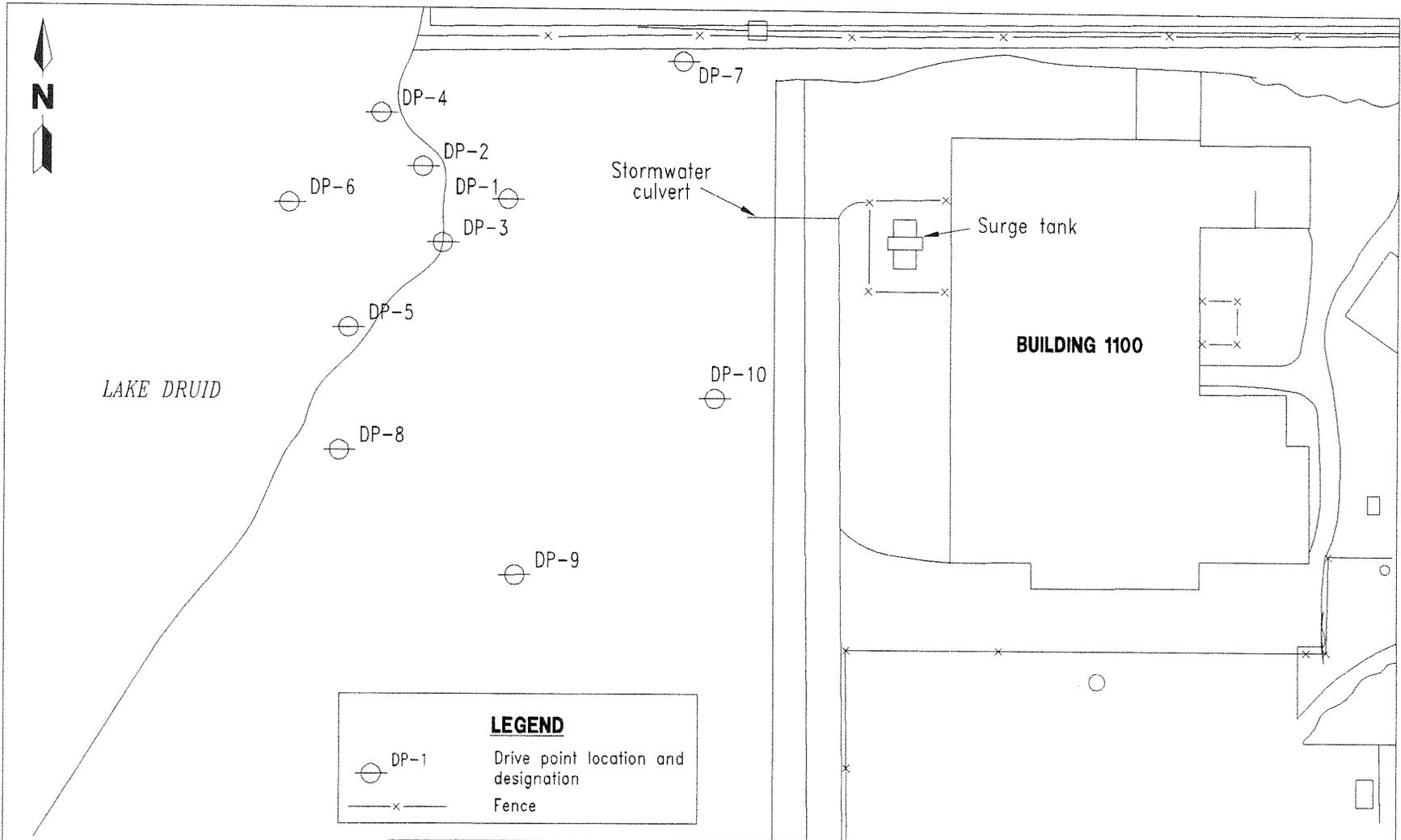


**FIGURE B-6
DIRECT-PUSH TECHNOLOGY
SAMPLING (STRATIGRAPHY AND
GROUNDWATER) LOCATIONS**



**REMEDIAL INVESTIGATION
OPERABLE UNIT 4**

**NAVAL TRAINING CENTER
ORLANDO, FLORIDA**



LEGEND

○ DP-1 Drive point location and designation

—x— Fence

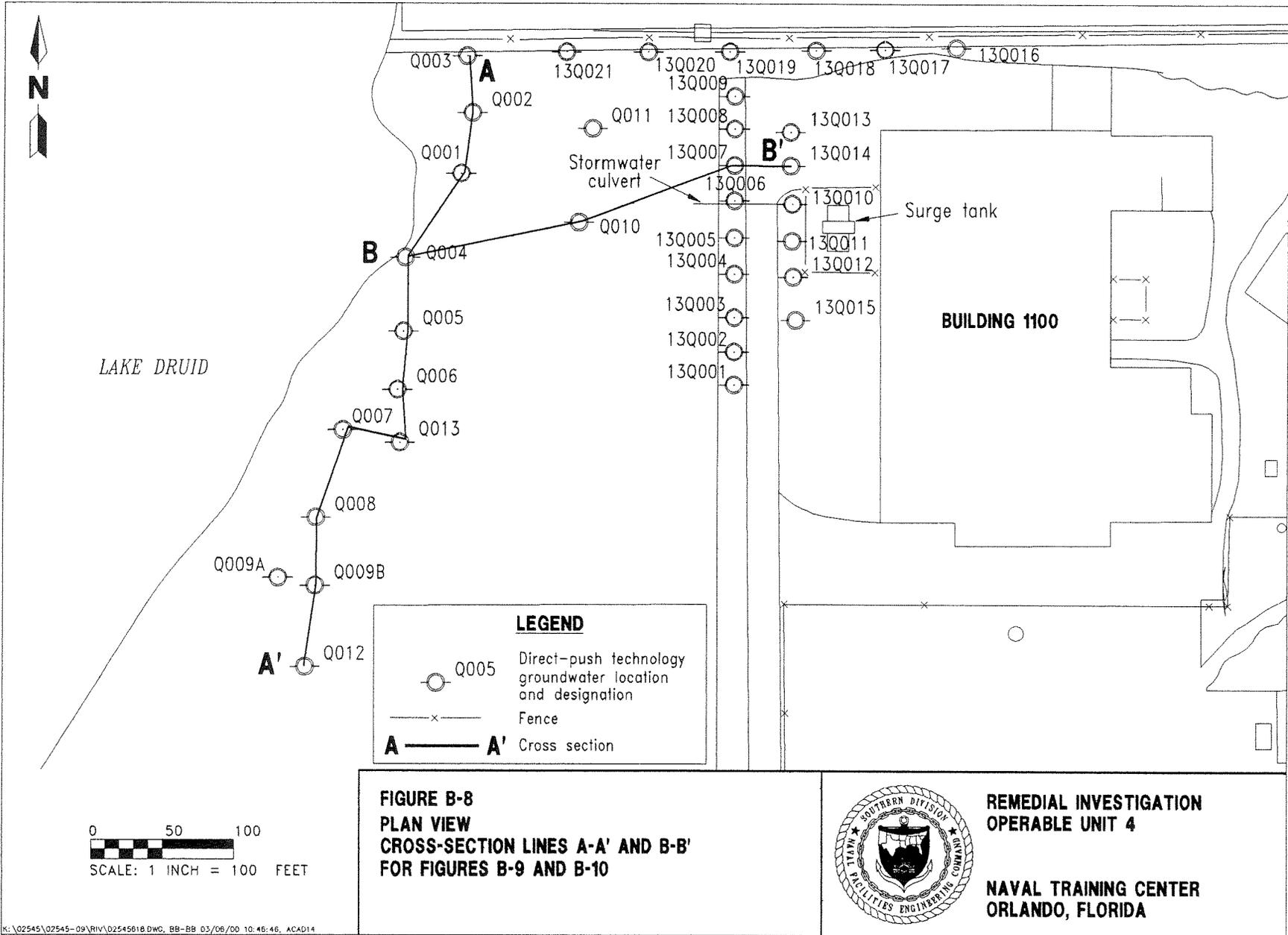
0 50 100
 SCALE: 1 INCH = 100 FEET

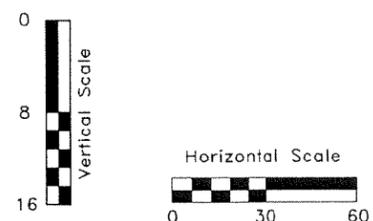
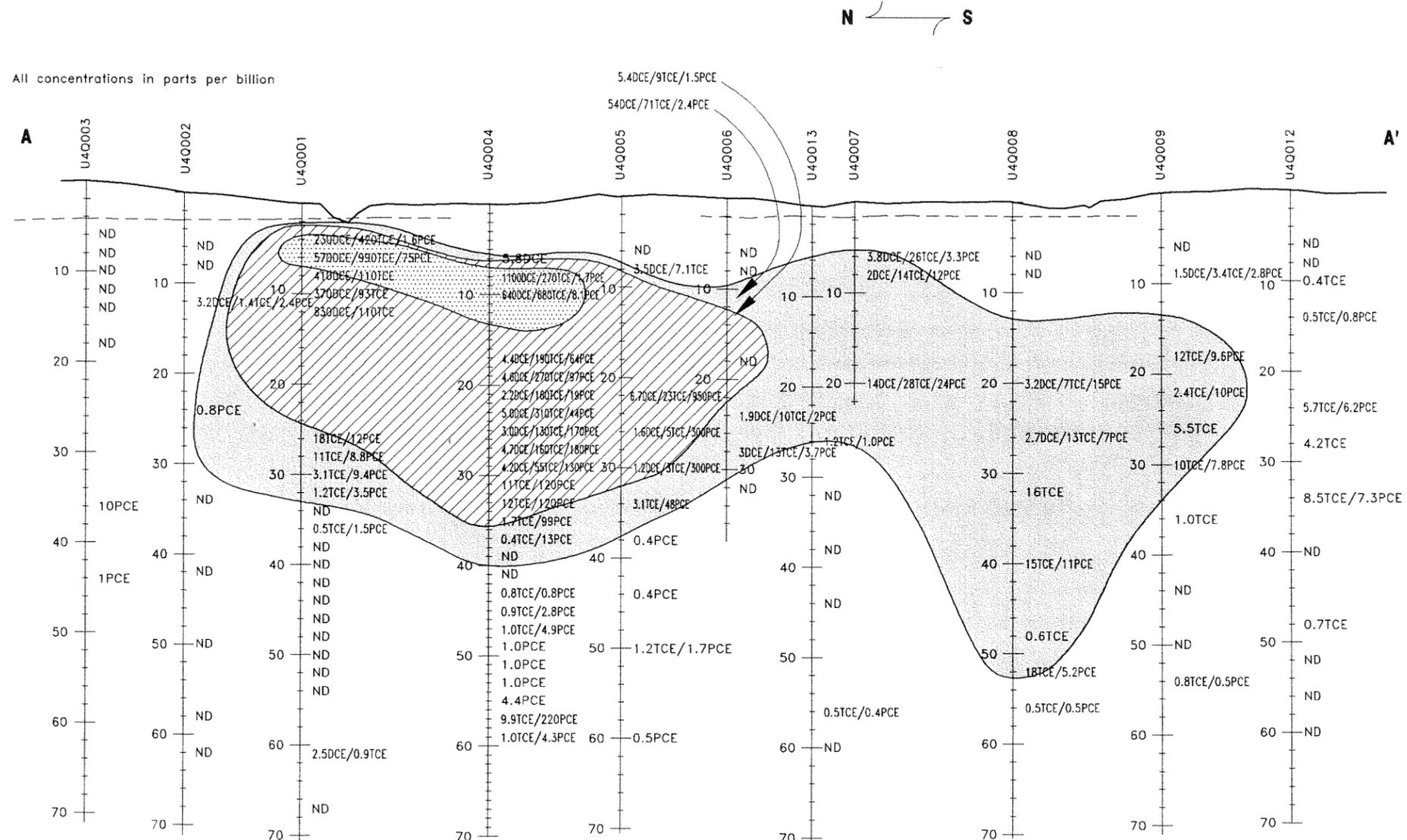
**FIGURE B-7
 DRIVE POINT WELL LOCATION MAP**



**REMEDIAL INVESTIGATION
 OPERABLE UNIT 4**

**NAVAL TRAINING CENTER
 ORLANDO, FLORIDA**





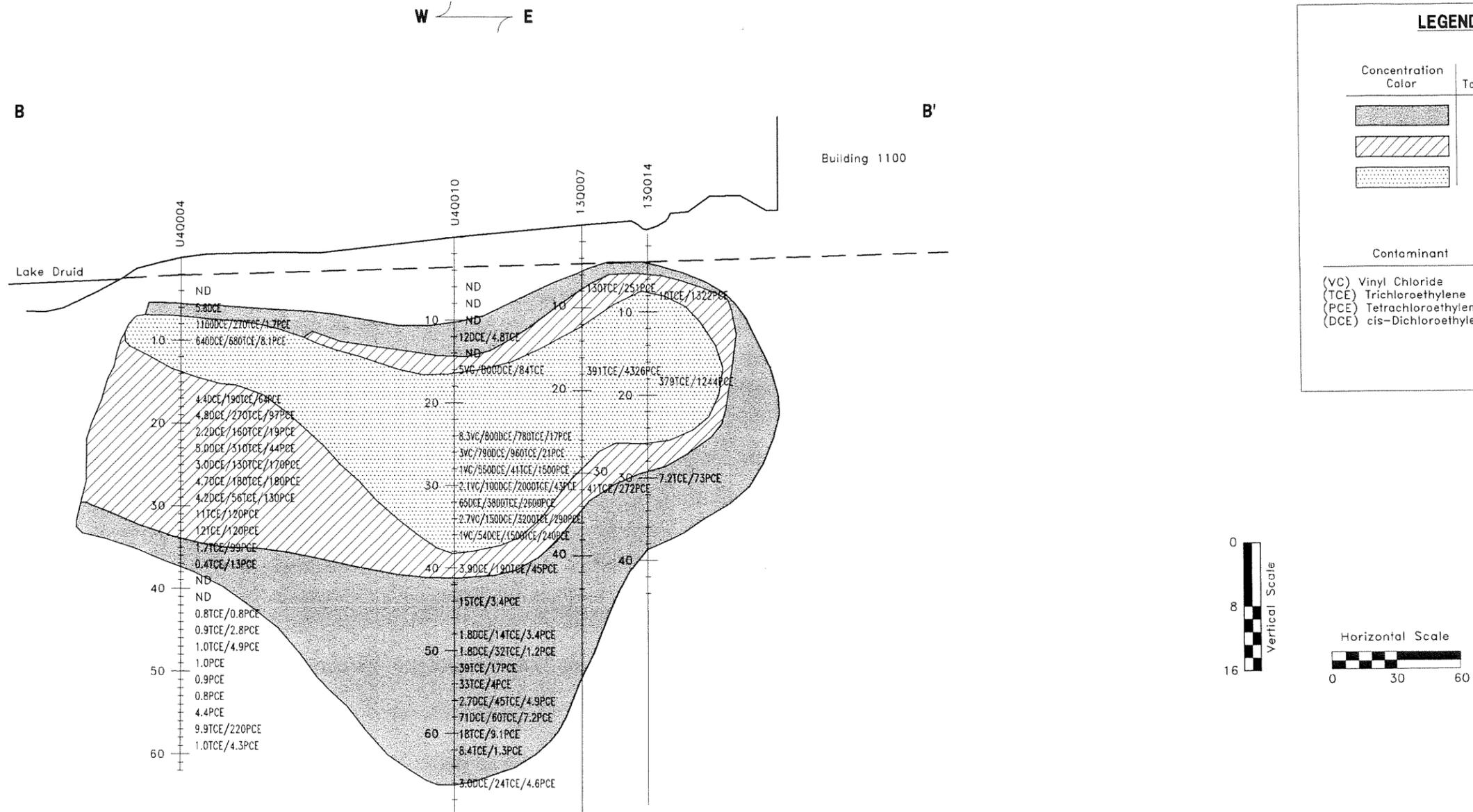
NOTE:
VOC=volatile organic compound

FIGURE B-9
NORTH-SOUTH CROSS SECTION A-A'
SHOWING GROUNDWATER VOC
CONCENTRATIONS

REMEDIAL INVESTIGATION
OPERABLE UNIT 4

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

All concentrations in parts per billion



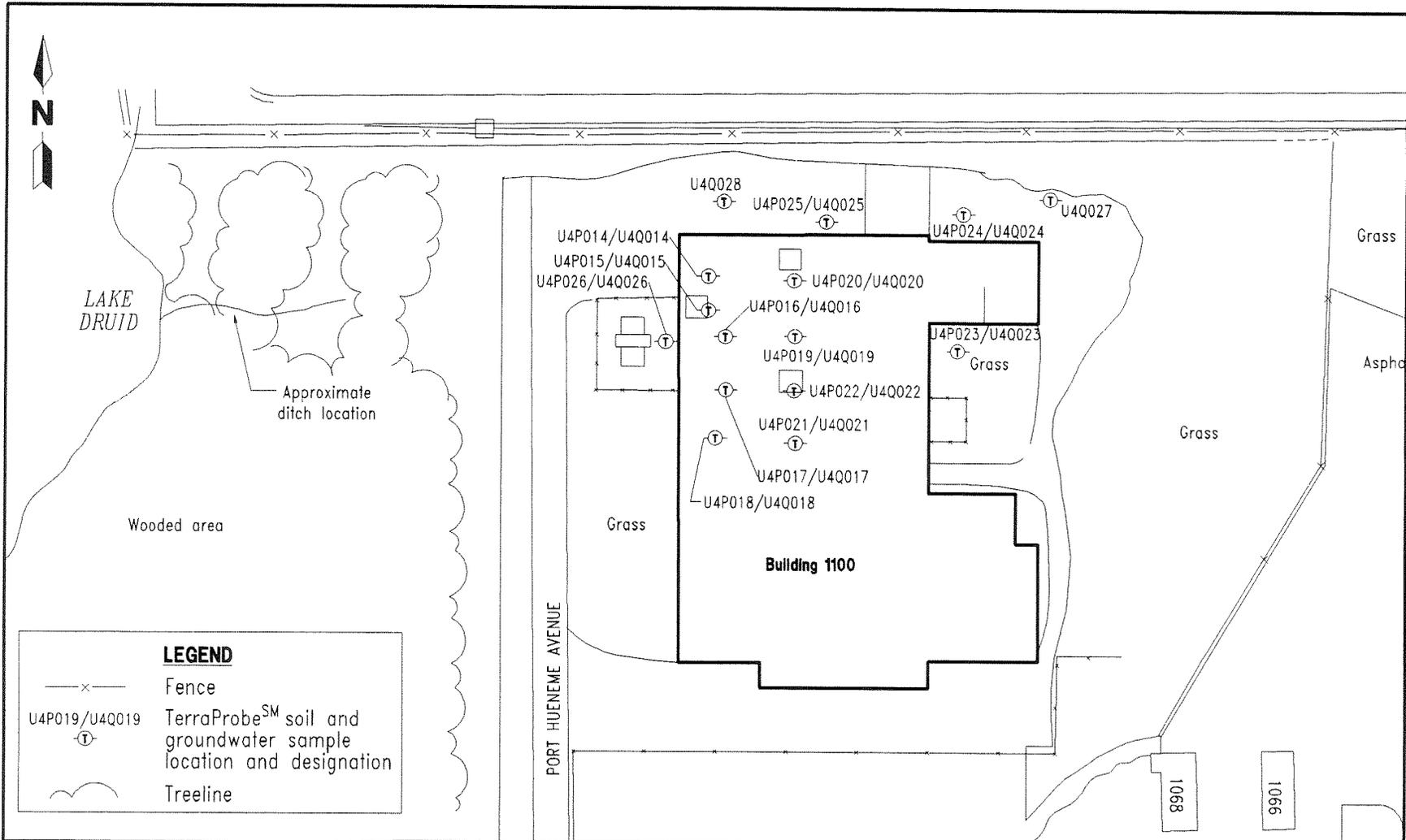
NOTE:
VOC=volatile organic compound

FIGURE B-10
EAST-WEST CROSS SECTION B-B'
SHOWING GROUNDWATER VOC
CONCENTRATIONS



REMEDIAL INVESTIGATION
OPERABLE UNIT 4

NAVAL TRAINING CENTER
ORLANDO, FLORIDA



APPENDIX C

LABORATORY POSITIVE DETECTION TABLES

Table C-1. Summary of Surface Soil Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID			12B00101	12B00201	12B00301	12B00401	12B00401D	13B00501	14B00101	14B00201	14B00301	14B00401
Sample Location			12B001	12B002	12B003	12B004	12B004	13B005	14B001	14B002	14B003	14B004
Sample Depth (feet)			0-1	0-1	0-1	0-1	0-1	1-2	0-1	1-2	1-2	1-2
Sampling Date			2/25/95	2/25/95	2/25/95	2/25/95	2/25/95	2/26/95	2/25/95	2/25/95	2/25/95	2/25/95
	Background Screening	Florida Soil Cleanup Target Level - Residential										
Volatile Organic Compounds ug/kg												
1,1,2,2-Tetrachloroethane	NA	700	--	--	--	--	--	--	--	--	--	--
2-Hexanone	NA	5,100/1,400 ¹	--	--	--	--	--	--	--	--	--	--
Acetone	NA	780,000	--	--	--	--	16	42	--	--	--	--
Methylene Chloride	NA	16,000	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene	NA	8,900/30 ¹	--	--	--	--	--	4 J	--	11	--	1 J
Toluene	NA	380,000	--	--	--	--	--	--	--	--	--	--
Xylene (total)	NA	5,900,000	--	--	--	--	--	--	--	--	--	--
Semivolatile Organic Compounds ug/kg												
Acenaphthene	NA	1,900,000	--	--	--	--	--	--	--	--	--	--
Acenaphthylene	NA	1,100,000	--	--	--	--	--	--	--	--	--	--
Anthracene	NA	18,000,000	--	--	--	--	--	--	--	--	--	--
Benzo(a)anthracene	NA	1,400	--	--	--	--	--	--	110 J	--	--	--
Benzo(a)pyrene	NA	100	--	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	NA	1,400	--	--	--	--	--	--	220 J	--	--	--
Benzo(g,h,i)perylene	NA	2,300,000	--	--	--	--	--	--	180 J	--	--	--
Benzo(k)fluoranthene	NA	15,000	--	--	--	--	--	--	180 J	--	--	--
Butylbenzylphthalate	NA	15,000,000	--	--	--	--	--	--	--	--	--	--
Carbazole	NA	53,000	--	--	--	--	--	--	--	--	--	--
Chrysene	NA	140,000	--	--	--	--	--	--	200 J	--	--	--
Dibenz(a,h)anthracene	NA	100	--	--	--	--	--	--	--	--	--	--
Fluoranthene	NA	2,900,000	--	--	--	--	--	--	--	--	--	--
Fluorene	NA	2,200,000	--	--	--	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	NA	1,500	--	--	--	--	--	--	140 J	--	--	--
Phenanthrene	NA	2,000,000	--	--	--	--	--	--	--	--	--	--
Pyrene	NA	2,200,000	--	--	--	--	--	--	230 J	--	--	--
bis(2-Ethylhexyl)phthalate	NA	76,000	--	--	--	--	--	--	--	--	--	--
Pesticides/PCBs ug/kg												
4,4'-DDD	NA	4,600	--	--	--	--	--	--	--	--	--	--
4,4'-DDE	NA	3,300	--	--	--	--	--	--	6.2 J	--	--	5.8
4,4'-DDT	NA	3,300	--	--	--	--	--	--	17	--	6.4	16

Appendix C
Table C-1. Summary of Surface Soil Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID			12B00101	12B00201	12B00301	12B00401	12B00401D	13B00501	14B00101	14B00201	14B00301	14B00401
Sample Location			12B001	12B002	12B003	12B004	12B004	13B005	14B001	14B002	14B003	14B004
Sample Depth (feet)			0-1	0-1	0-1	0-1	0-1	1-2	0-1	1-2	1-2	1-2
Sampling Date			2/25/95	2/25/95	2/25/95	2/25/95	2/25/95	2/26/95	2/25/95	2/25/95	2/25/95	2/25/95
	Background Screening	Florida Soil Cleanup Target Level - Residential										
Aldrin	NA	70	--	--	--	--	--	--	--	--	--	--
Aroclor-1254	NA	500	--	--	--	--	--	--	--	--	--	--
Aroclor-1260	NA	500	--	--	--	--	--	--	--	--	--	--
Dieldrin	NA	70	--	--	--	--	--	--	--	--	--	--
Endosulfan I	NA	410,000 ⁵	--	--	--	--	--	--	--	--	--	--
Endosulfan II	NA	410,000 ⁵	--	--	--	--	--	--	--	--	--	--
Endosulfan sulfate	NA	410,000 ⁵	--	--	--	--	--	--	--	--	--	--
Endrin	NA	21,000	--	--	--	--	--	--	--	--	--	--
Endrin aldehyde	NA	21,000 ⁴	--	--	--	--	--	--	--	--	--	--
Endrin ketone	NA	21,000 ⁴	--	--	--	--	--	--	--	--	--	--
Heptachlor	NA	200	--	--	--	--	--	--	--	--	--	--
Heptachlor epoxide	NA	100	--	--	--	--	--	--	--	--	--	--
Methoxychlor	NA	370,000	--	--	--	--	--	--	--	--	--	--
alpha-BHC	NA	200	--	--	--	--	--	--	--	--	--	--
alpha-Chlordane	NA	3,100 ³	--	--	--	--	--	--	1.8 J	--	--	--
beta-BHC	NA	600	--	--	--	--	--	--	--	--	--	--
delta-BHC	NA	22,000	--	--	--	--	--	--	--	--	--	--
gamma-BHC (Lindane)	NA	700	--	--	--	--	--	--	--	--	--	--
gamma-Chlordane	NA	3,100 ³	--	--	--	--	--	--	1.6 NJ	--	--	--
Inorganics mg/kg												
Aluminum	2,088	72,000	0.0599	0.0088 B	0.0168 B	1.02	0.806	2.18	1.73	0.945	0.0131 B	0.844
Arsenic	1.0	0.8	--	--	0.38 U	0.56 B	--	0.72 B	0.62 B	--	--	0.84 B
Barium	8.7	110/1,600 ¹	1.5 B	0.3 B	0.25 B	3.9 B	3.6 B	5.7 B	5.8 B	1.8 B	0.28 B	2 B
Beryllium	0.09	120	--	--	0.04 U	--	--	0.13 B	0.07 B	--	--	--
Cadmium	0.98	75	--	--	0.63 U	--	--	--	1.7	--	--	--
Calcium	25,295	NA	994 B	1,410	215 B	3,610	3,400	346 J	12,400	2,460	458 B	1,710
Chromium	4.6	210 ² /38 ¹	0.71 B	--	0.84 B	3.1	1.1 B	8.6	16.4	1.3 B	0.63 B	1 B
Cobalt	--	4,700	--	--	--	--	--	--	--	--	--	--
Copper	4.1	110	--	--	--	0.49 B	--	3.4 J	30.2	--	--	--
Iron	712.0	23,000	19.8 B	14.4 B	--	373	322	36 J	660	259	--	279
Lead	14.5	400	0.46 B	--	0.37 B	1.6	2	8.4 J	40.9	1.1	--	1.1

Table C-1. Summary of Surface Soil Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID			12B00101	12B00201	12B00301	12B00401	12B00401D	13B00501	14B00101	14B00201	14B00301	14B00401
Sample Location			12B001	12B002	12B003	12B004	12B004	13B005	14B001	14B002	14B003	14B004
Sample Depth (feet)			0-1	0-1	0-1	0-1	0-1	1-2	0-1	1-2	1-2	1-2
Sampling Date			2/25/95	2/25/95	2/25/95	2/25/95	2/25/95	2/26/95	2/25/95	2/25/95	2/25/95	2/25/95
	Background Screening	Florida Soil Cleanup Target Level - Residential										
Magnesium	328	NA	23 B	13.9 B	8.2 B	65.2 B	59.9 B	15.7 B	175 B	41.6 B	17.1 B	50.7 B
Manganese	8.1	1,600	0.68 B	0.52 B	0.53 B	2.7 B	2.2 B	1.6 B	14.7	1.3 B	--	1 B
Mercury	0.07	3.4/2.1 ¹	--	--	--	--	--	0.07	--	--	--	--
Nickel	4.4	110/130 ¹	--	--	--	2.8 B	--	3.1 B	9.2	--	--	--
Selenium	0.95	390/5 ¹	--	--	--	--	--	--	--	--	--	--
Silver	1.8	390	--	--	--	--	--	--	--	--	--	--
Vanadium	3.1	15/980 ¹	--	--	--	0.96 B	0.94 B	1.3 J	2.5 B	0.58 B	--	0.68 B
Zinc	17.2	23,000	0.97 B	--	--	1 B	0.96 B	0.36 B	52.9	--	--	5.3
Total Petroleum Hydrocarbons	NA	NA	--	--	--	--	--	17.6	--	--	--	--

Notes:

¹ Where particular compounds were detected in both soil and groundwater, Florida leachability soil cleanup target levels were used. The first number shown indicates the residential direct exposure level, and the second number indicates the leachability level.

² Hexavalent Chromium goals used

³ Chlordane goals used

⁴ Endrin goals used

⁵ Endosulfan goals used

⁶ This surface soil sample location was subsequently excavated as part of an Interim Remedial Action (IRA). Italicized concentrations indicate that the value shown has been superseded by post-IRA confirmatory sample data.

-- = Analyte not detected above M.D.L.

NA = Not Applicable or Not Analyzed

Appendix C
Table C-1. Summary of Surface Soil Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID			U4S00501	U4S00501D	U4S00601	99SPORT0178-9	99SPORT0178-10	99SPORT0178-11	99SPORT0178-12
Sample Location			U4S005	U4S005	U4S006 ¹	Area of U4S006	Area of U4S006	Area of U4S006	Area of U4S006
Sample Depth (feet)			0-1	0-1	0-1	0-1	0-1	0-1	0-1
Sampling Date			10/28/97	10/28/97	10/28/97	5/11/99	5/11/99	5/11/99	5/11/99
	Background Screening	Florida Soil Cleanup Target Level - Residential							
Volatile Organic Compounds ug/kg									
1,1,2,2-Tetrachloroethane	NA	700	--	--	--	NA	NA	NA	NA
2-Hexanone	NA	5,100/1,400 ¹	--	--	--	NA	NA	NA	NA
Acetone	NA	780,000	--	--	--	NA	NA	NA	NA
Methylene Chloride	NA	16,000	--	68	--	NA	NA	NA	NA
Tetrachloroethene	NA	8,900/30 ¹	--	--	--	NA	NA	NA	NA
Toluene	NA	380,000	--	2 J	--	NA	NA	NA	NA
Xylene (total)	NA	5,900,000	--	--	--	NA	NA	NA	NA
Semivolatile Organic Compounds ug/kg									
Acenaphthene	NA	1,900,000	--	--	79 J	--	--	--	--
Acenaphthylene	NA	1,100,000	--	--	290 J	--	--	--	--
Anthracene	NA	18,000,000	--	--	160 J	--	--	--	--
Benzo(a)anthracene	NA	1,400	--	--	1,300	129 J	74.6 J	--	--
Benzo(a)pyrene	NA	100	61 J	53 J	1,500	203 J	95.2 J	--	--
Benzo(b)fluoranthene	NA	1,400	77 J	92 J	3,200 J	205 J	--	--	--
Benzo(g,h,i)perylene	NA	2,300,000	--	--	990	142 J	--	--	--
Benzo(k)fluoranthene	NA	15,000	--	--	3,200 J	233 J	--	--	--
Butylbenzylphthalate	NA	15,000,000	--	--	200 J	NA	NA	NA	NA
Carbazole	NA	53,000	--	--	200 J	NA	NA	NA	NA
Chrysene	NA	140,000	63 J	76 J	2,500	313 J	123 J	--	--
Dibenz(a,h)anthracene	NA	100	--	--	230 J	--	--	--	--
Fluoranthene	NA	2,900,000	100 J	92 J	3,500	442	196 J	--	--
Fluorene	NA	2,200,000	--	--	110 J	--	--	--	--
Indeno(1,2,3-cd)pyrene	NA	1,500	--	--	890	107 J	--	--	--
Phenanthrene	NA	2,000,000	--	--	2,500	273 J	98.4 J	--	--
Pyrene	NA	2,200,000	99 J	94 J	3,900 D	521	187 J	--	--
bis(2-Ethylhexyl)phthalate	NA	76,000	140 J	84 J	720	NA	NA	NA	NA
Pesticides/PCBs ug/kg									
4,4'-DDD	NA	4,600	4.4 J	--	--	NA	NA	NA	NA
4,4'-DDE	NA	3,300	7.7 J	8.9 J	60 J	NA	NA	NA	NA
4,4'-DDT	NA	3,300	1.4 J	--	--	NA	NA	NA	NA

Table C-1. Summary of Surface Soil Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID			U4S00501	U4S00501D	U4S00601	99SPORT0178-9	99SPORT0178-10	99SPORT0178-11	99SPORT0178-12
Sample Location			U4S005	U4S005	U4S006 ¹	Area of U4S006	Area of U4S006	Area of U4S006	Area of U4S006
Sample Depth (feet)			0-1	0-1	0-1	0-1	0-1	0-1	0-1
Sampling Date			10/28/97	10/28/97	10/28/97	5/11/99	5/11/99	5/11/99	5/11/99
	Background Screening	Florida Soil Cleanup Target Level - Residential							
Aldrin	NA	70	--	--	11 J	NA	NA	NA	NA
Aroclor-1254	NA	500	--	130 J	1,500 DJ	--	--	--	--
Aroclor-1260	NA	500	--	--	--	--	--	--	--
Dieldrin	NA	70	--	--	28 J	NA	NA	NA	NA
Endosulfan I	NA	410,000 ⁵	--	--	--	NA	NA	NA	NA
Endosulfan II	NA	410,000 ⁵	--	--	29	NA	NA	NA	NA
Endosulfan sulfate	NA	410,000 ⁵	--	1.2 J	5.8 J	NA	NA	NA	NA
Endrin	NA	21,000	--	--	24 J	NA	NA	NA	NA
Endrin aldehyde	NA	21,000 ⁴	--	--	56 J	NA	NA	NA	NA
Endrin ketone	NA	21,000 ⁴	--	--	50	NA	NA	NA	NA
Heptachlor	NA	200	--	--	23 J	NA	NA	NA	NA
Heptachlor epoxide	NA	100	--	--	11 J	NA	NA	NA	NA
Methoxychlor	NA	370,000	--	--	--	NA	NA	NA	NA
alpha-BHC	NA	200	--	--	--	NA	NA	NA	NA
alpha-Chlordane	NA	3,100 ³	--	--	56 DJ	NA	NA	NA	NA
beta-BHC	NA	600	--	--	30 J	NA	NA	NA	NA
delta-BHC	NA	22,000	--	--	2.1 J	NA	NA	NA	NA
gamma-BHC (Lindane)	NA	700	--	--	0.9 J	NA	NA	NA	NA
gamma-Chlordane	NA	3,100 ³	--	--	--	NA	NA	NA	NA
Inorganics mg/kg									
Aluminum	2,088	72,000	5,100	6,260	9,740	NA	NA	NA	NA
Arsenic	1.0	0.8	--	--	2.4 J	0.444 J	0.563	--	--
Barium	8.7	110/1,600 ¹	13.8 J	22.3 J	51.6 J	NA	NA	NA	NA
Beryllium	0.09	120	--	--	0.37 J	NA	NA	NA	NA
Cadmium	0.98	75	--	--	1.9 J	NA	NA	NA	NA
Calcium	25,295	NA	3,970	6,920	18,600	NA	NA	NA	NA
Chromium	4.6	210 ² /38 ¹	9.8 J	13.3 J	45.2 J	NA	NA	NA	NA
Cobalt	--	4,700	--	--	0.69 J	NA	NA	NA	NA
Copper	4.1	110	5.1 J	7.7	36.6	NA	NA	NA	NA
Iron	712.0	23,000	273	452	1,790	NA	NA	NA	NA
Lead	14.5	400	11.3	20.3	78	NA	NA	NA	NA

Appendix C
Table C-1. Summary of Surface Soil Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID			U4S00501	U4S00501D	U4S00601	99SPORT0178-9	99SPORT0178-10	99SPORT0178-11	99SPORT0178-12
Sample Location			U4S005	U4S005	U4S006 ¹	Area of U4S006	Area of U4S006	Area of U4S006	Area of U4S006
Sample Depth (feet)			0-1	0-1	0-1	0-1	0-1	0-1	0-1
Sampling Date			10/28/97	10/28/97	10/28/97	5/11/99	5/11/99	5/11/99	5/11/99
	Background Screening	Florida Soil Cleanup Target Level - Residential							
Magnesium	328	NA	--	--	--	NA	NA	NA	NA
Manganese	8.1	1,600	6.6 J	9 J	45.2 J	NA	NA	NA	NA
Mercury	0.07	3.4/2.1 ¹	0.22 J	0.27 J	2.2 J	NA	NA	NA	NA
Nickel	4.4	110/130 ¹	1.9 J	2.8 J	6.7 J	NA	NA	NA	NA
Selenium	0.95	390/5 ¹	--	--	1.3 J	NA	NA	NA	NA
Silver	1.8	390	--	--	1.4 J	NA	NA	NA	NA
Vanadium	3.1	15/980 ¹	2.6 J	3.1 J	6.6 J	NA	NA	NA	NA
Zinc	17.2	23,000	--	30.2 J	225 J	NA	NA	NA	NA
Total Petroleum Hydrocarbons	NA	NA	--	--	--	NA	NA	NA	NA

Notes:

¹ Where particular compounds were detected in both soil and groundwater, Florida leachability soil cleanup target levels were used. The first number shown indicates the residential direct exposure level, and the second number indicates the leachability level.

² Hexavalent Chromium goals used

³ Chlordane goals used

⁴ Endrin goals used

⁵ Endosulfan goals used

⁶ This surface soil sample location was subsequently excavated as part of an Interim Remedial Action (IRA). Italicized concentrations indicate that the value shown has been superseded by post-IRA confirmatory sample data.

-- = Analyte not detected above M.D.L.

NA = Not Applicable or Not Analyzed

Table C-1. Summary of Surface Soil Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID			Conf. sample average	U4S00701	U4S00801	U4S00901	U4S01001	U4S01101	99SPORT0178-1	99SPORT0178-2
Sample Location			Area of U4S006	U4S007	U4S008	U4S009	U4S010	U4S011 ¹	Area of U4S011	Area of U4S011
Sample Depth (feet)			0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1
Sampling Date			Average	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97	5/11/99	5/11/99
	Background Screening	Florida Soil Cleanup Target Level - Residential								
Volatile Organic Compounds ug/kg										
1,1,2,2-Tetrachloroethane	NA	700	NA	--	1 J	--	--	--	NA	NA
2-Hexanone	NA	5,100/1,400 ¹	NA	--	8 J	--	--	--	NA	NA
Acetone	NA	780,000	NA	13 J	--	--	--	--	NA	NA
Methylene Chloride	NA	16,000	NA	--	--	--	--	--	NA	NA
Tetrachloroethene	NA	8,900/30 ¹	NA	61	110	--	58	2 J	NA	NA
Toluene	NA	380,000	NA	--	2 J	--	1 J	--	NA	NA
Xylene (total)	NA	5,900,000	NA	--	1 J	--	--	--	NA	NA
Semivolatile Organic Compounds ug/kg										
Acenaphthene	NA	1,900,000	--	--	--	--	--	--	NA	NA
Acenaphthylene	NA	1,100,000	--	--	--	--	--	--	NA	NA
Anthracene	NA	18,000,000	--	--	--	--	--	--	NA	NA
Benzo(a)anthracene	NA	1,400	67.4 J	--	--	260 J	--	140 J	NA	NA
Benzo(a)pyrene	NA	100	92.7 J	--	--	330 J	--	120 J	NA	NA
Benzo(b)fluoranthene	NA	1,400	104.6 J	--	--	630	--	180 J	NA	NA
Benzo(g,h,i)perylene	NA	2,300,000	65.3 J	--	--	220 J	--	73 J	NA	NA
Benzo(k)fluoranthene	NA	15,000	107.9 J	--	--	230 J	--	72 J	NA	NA
Butylbenzylphthalate	NA	15,000,000	NA	--	--	--	--	--	NA	NA
Carbazole	NA	53,000	NA	--	--	58 J	--	--	NA	NA
Chrysene	NA	140,000	122.2 J	--	--	460	--	140 J	NA	NA
Dibenz(a,h)anthracene	NA	100	--	--	--	--	--	--	NA	NA
Fluoranthene	NA	2,900,000	176.0 J	--	--	550	--	250 J	NA	NA
Fluorene	NA	2,200,000	--	--	--	--	--	--	NA	NA
Indeno(1,2,3-cd)pyrene	NA	1,500	56.6 J	--	--	200 J	--	70 J	NA	NA
Phenanthrene	NA	2,000,000	107.7 J	--	--	240 J	--	130 J	NA	NA
Pyrene	NA	2,200,000	195.2 J	--	--	580	--	220 J	NA	NA
bis(2-Ethylhexyl)phthalate	NA	76,000	NA	--	--	110 J	--	--	NA	NA
Pesticides/PCBs ug/kg										
4,4'-DDD	NA	4,600	NA	--	--	15 J	--	--	NA	NA
4,4'-DDE	NA	3,300	NA	--	--	24	--	--	NA	NA
4,4'-DDT	NA	3,300	NA	--	--	23 J	--	0.14 J	NA	NA

Appendix C
Table C-1. Summary of Surface Soil Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID			Conf. sample average	U4S00701	U4S00801	U4S00901	U4S01001	U4S01101	99SPORT0178-1	99SPORT0178-2
Sample Location			Area of U4S006	U4S007	U4S008	U4S009	U4S010	U4S011 ¹	Area of U4S011	Area of U4S011
Sample Depth (feet)			0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1
Sampling Date			Average	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97	5/11/99	5/11/99
	Background Screening	Florida Soil Cleanup Target Level - Residential								
Aldrin	NA	70	NA	--	--	1.9 U	--	--	NA	NA
Aroclor-1254	NA	500	--	--	--	210	--	--	NA	NA
Aroclor-1260	NA	500	--	--	--	--	--	--	NA	NA
Dieldrin	NA	70	NA	--	--	--	--	--	NA	NA
Endosulfan I	NA	410,000 ⁵	NA	--	--	1.4 J	--	--	NA	NA
Endosulfan II	NA	410,000 ⁵	NA	0.31 J	--	2.6 J	--	--	NA	NA
Endosulfan sulfate	NA	410,000 ⁵	NA	--	--	--	--	--	NA	NA
Endrin	NA	21,000	NA	--	--	--	--	--	NA	NA
Endrin aldehyde	NA	21,000 ⁴	NA	--	--	--	--	--	NA	NA
Endrin ketone	NA	21,000 ⁴	NA	--	--	--	--	--	NA	NA
Heptachlor	NA	200	NA	--	--	3.1 J	--	--	NA	NA
Heptachlor epoxide	NA	100	NA	--	--	1.1 J	--	--	NA	NA
Methoxychlor	NA	370,000	NA	--	44	--	--	--	NA	NA
alpha-BHC	NA	200	NA	--	--	--	--	--	NA	NA
alpha-Chlordane	NA	3,100 ³	NA	--	--	1.9 J	--	--	NA	NA
beta-BHC	NA	600	NA	--	--	--	--	--	NA	NA
delta-BHC	NA	22,000	NA	--	--	0.76 J	--	--	NA	NA
gamma-BHC (Lindane)	NA	700	NA	--	--	--	--	--	NA	NA
gamma-Chlordane	NA	3,100 ³	NA	--	--	--	--	0.76 J	NA	NA
Inorganics mg/kg										
Aluminum	2,088	72,000	NA	904	443	2,130	889	2,890	NA	NA
Arsenic	1.0	0.8	0.3595 J	--	--	--	--	11.2	--	0.740
Barium	8.7	110/1,600 ¹	NA	--	2.4 J	36 J	--	167	NA	NA
Beryllium	0.09	120	NA	--	--	--	--	1.1 J	NA	NA
Cadmium	0.98	75	NA	--	--	0.84 J	--	--	NA	NA
Calcium	25,295	NA	NA	2,650	1,700	8,260	2,020	75,100	NA	NA
Chromium	4.6	210 ² /38 ¹	NA	0.83 J	0.73 J	5.7 J	0.71 J	11.4 J	NA	NA
Cobalt	--	4,700	NA	--	--	0.55 J	--	3.4 J	NA	NA
Copper	4.1	110	NA	1.1 J	0.98 J	9.8	--	27.4	NA	NA
Iron	712.0	23,000	NA	365	161	1,270	159	6,400	NA	NA
Lead	14.5	400	NA	1.7	1.8	35.1	1.3	11.3	NA	NA

Table C-1. Summary of Surface Soil Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID			Conf. sample average	U4S00701	U4S00801	U4S00901	U4S01001	U4S01101	99SPORT0178-1	99SPORT0178-2
Sample Location			Area of U4S006	U4S007	U4S008	U4S009	U4S010	U4S011 ¹	Area of U4S011	Area of U4S011
Sample Depth (feet)			0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1
Sampling Date			Average	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97	5/11/99	5/11/99
	Background Screening	Florida Soil Cleanup Target Level - Residential								
Magnesium	328	NA	NA	--	--	--	--	--	NA	NA
Manganese	8.1	1,600	NA	2.9 J	1.7 J	29.9 J	1.5 J	21.1 J	NA	NA
Mercury	0.07	3.4/2.1 ¹	NA	--	--	0.14 J	--	--	NA	NA
Nickel	4.4	110/130 ¹	NA	0.33 J	0.27 J	2.6 J	0.34 J	9.2	NA	NA
Selenium	0.95	390/5 ¹	NA	--	--	--	--	--	NA	NA
Silver	1.8	390	NA	--	--	1.8 J	--	31.3	NA	NA
Vanadium	3.1	15/980 ¹	NA	0.81 J	0.66 J	4.2 J	0.62 J	17.7	NA	NA
Zinc	17.2	23,000	NA	--	--	66.2 J	--	26.6 J	NA	NA
Total Petroleum Hydrocarbons	NA	NA	NA	--	--	--	--	--	NA	NA

Notes:

- ¹ Where particular compounds were detected in both soil and groundwater, Florida leachability soil cleanup target levels were used. The first number shown indicates the residential direct exposure level, and the second number indicates the leachability level.
 - ² Hexavalent Chromium goals used
 - ³ Chlordane goals used
 - ⁴ Endrin goals used
 - ⁵ Endosulfan goals used
 - ⁶ This surface soil sample location was subsequently excavated as part of an Interim Remedial Action (IRA). Italicized concentrations indicate that the value shown has been superseded by post-IRA confirmatory sample data.
- = Analyte not detected above M.D.L. NA = Not Applicable or Not Analyzed

Appendix C
Table C-1. Summary of Surface Soil Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID			99SPORT0178-3	99SPORT0178-4	Conf. sample average	U4S01201	U4S01201D	U4S01301	U4S01401	U4S01501
Sample Location			Area of U4S011	Area of U4S011	Area of U4S011	U4S012	U4S012	U4S013	U4S014	U4S015 ¹
Sample Depth (feet)			0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1
Sampling Date			5/11/99	5/11/99	Average	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97
	Background Screening	Florida Soil Cleanup Target Level - Residential								
Volatile Organic Compounds ug/kg										
1,1,2,2-Tetrachloroethane	NA	700	NA	NA	NA	--	--	--	--	--
2-Hexanone	NA	5,100/1,400 ¹	NA	NA	NA	--	--	--	--	--
Acetone	NA	780,000	NA	NA	NA	--	--	--	--	--
Methylene Chloride	NA	16,000	NA	NA	NA	--	--	44	--	--
Tetrachloroethene	NA	8,900/30 ¹	NA	NA	NA	--	--	--	--	--
Toluene	NA	380,000	NA	NA	NA	2 J	--	--	--	1 J
Xylene (total)	NA	5,900,000	NA	NA	NA	--	--	--	--	--
Semivolatile Organic Compounds ug/kg										
Acenaphthene	NA	1,900,000	NA	NA	NA	--	--	--	--	--
Acenaphthylene	NA	1,100,000	NA	NA	NA	--	--	--	--	430
Anthracene	NA	18,000,000	NA	NA	NA	--	--	--	--	200 J
Benzo(a)anthracene	NA	1,400	NA	NA	NA	55 J	130 J	--	--	1,200
Benzo(a)pyrene	NA	100	NA	NA	NA	78 J	120 J	--	--	1,600
Benzo(b)fluoranthene	NA	1,400	NA	NA	NA	170 J	180 J	--	49 J	2,100
Benzo(g,h,i)perylene	NA	2,300,000	NA	NA	NA	65 J	77 J	--	--	750
Benzo(k)fluoranthene	NA	15,000	NA	NA	NA	160 J	67 J	--	--	600
Butylbenzylphthalate	NA	15,000,000	NA	NA	NA	--	--	--	--	--
Carbazole	NA	53,000	NA	NA	NA	--	--	--	--	--
Chrysene	NA	140,000	NA	NA	NA	120 J	190 J	--	48 J	1,700
Dibenz(a,h)anthracene	NA	100	NA	NA	NA	--	--	--	--	200 J
Fluoranthene	NA	2,900,000	NA	NA	NA	140 J	250 J	--	53 J	2,500 J
Fluorene	NA	2,200,000	NA	NA	NA	--	--	--	--	42 J
Indeno(1,2,3-cd)pyrene	NA	1,500	NA	NA	NA	58 J	61 J	--	--	570
Phenanthrene	NA	2,000,000	NA	NA	NA	68 J	95 J	--	--	330 J
Pyrene	NA	2,200,000	NA	NA	NA	170 J	270 J	--	63 J	3,500 D
bis(2-Ethylhexyl)phthalate	NA	76,000	NA	NA	NA	--	--	--	38 J	340 U
Pesticides/PCBs ug/kg										
4,4'-DDD	NA	4,600	NA	NA	NA	0.78 J	0.24 J	2 J	2.8 J	6.4 J
4,4'-DDE	NA	3,300	NA	NA	NA	--	--	--	2.1 J	--
4,4'-DDT	NA	3,300	NA	NA	NA	--	--	--	0.52 J	1.7 J

Table C-1. Summary of Surface Soil Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID			99SPORT0178-3	99SPORT0178-4	Conf. sample average	U4S01201	U4S01201D	U4S01301	U4S01401	U4S01501
Sample Location			Area of U4S011	Area of U4S011	Area of U4S011	U4S012	U4S012	U4S013	U4S014	U4S015 ¹
Sample Depth (feet)			0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1
Sampling Date			5/11/99	5/11/99	Average	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97
	Background Screening	Florida Soil Cleanup Target Level - Residential								
Aldrin	NA	70	NA	NA	NA	--	--	--	--	--
Aroclor-1254	NA	500	NA	NA	NA	--	--	--	--	--
Aroclor-1260	NA	500	NA	NA	NA	33 J	--	--	--	--
Dieldrin	NA	70	NA	NA	NA	--	--	--	--	--
Endosulfan I	NA	410,000 ⁵	NA	NA	NA	--	--	0.99 J	--	--
Endosulfan II	NA	410,000 ⁵	NA	NA	NA	--	1 J	--	0.85 J	--
Endosulfan sulfate	NA	410,000 ⁵	NA	NA	NA	0.16 J	--	--	--	--
Endrin	NA	21,000	NA	NA	NA	--	--	--	--	--
Endrin aldehyde	NA	21,000 ⁴	NA	NA	NA	--	--	--	--	--
Endrin ketone	NA	21,000 ⁴	NA	NA	NA	--	--	--	--	--
Heptachlor	NA	200	NA	NA	NA	--	--	--	--	--
Heptachlor epoxide	NA	100	NA	NA	NA	0.25 J	0.48 J	--	--	0.4 J
Methoxychlor	NA	370,000	NA	NA	NA	--	--	--	--	1,800 D
alpha-BHC	NA	200	NA	NA	NA	--	--	0.32 J	--	--
alpha-Chlordane	NA	3,100 ³	NA	NA	NA	--	1.8 J	--	--	--
beta-BHC	NA	600	NA	NA	NA	--	--	--	--	--
delta-BHC	NA	22,000	NA	NA	NA	--	--	--	--	--
gamma-BHC (Lindane)	NA	700	NA	NA	NA	--	--	0.25 J	--	--
gamma-Chlordane	NA	3,100 ³	NA	NA	NA	--	1.9 J	--	0.96 J	2.4 J
Inorganics mg/kg										
Aluminum	2,088	72,000	NA	NA	NA	842	631	3,130	176	252
Arsenic	1.0	0.8	0.521	--	0.422	--	--	--	--	--
Barium	8.7	110/1,600 ¹	NA	NA	NA	4.6 J	3.3 J	3.7 J	2.9 J	2.9 J
Beryllium	0.09	120	NA	NA	NA	--	--	--	--	--
Cadmium	0.98	75	NA	NA	NA	--	--	--	--	--
Calcium	25,295	NA	NA	NA	NA	1,410	--	--	--	20,800
Chromium	4.6	210 ² /38 ¹	NA	NA	NA	1.5 J	1.1 J	1.7 J	0.59 J	2.7 J
Cobalt	--	4,700	NA	NA	NA	--	--	--	--	--
Copper	4.1	110	NA	NA	NA	1.6 J	1.4 J	2.3 J	1.5 J	0.95 J
Iron	712.0	23,000	NA	NA	NA	258	182	209	95.7	155
Lead	14.5	400	NA	NA	NA	6.5	5.2	9.8	9.2	9.5

Appendix C
Table C-1. Summary of Surface Soil Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID			99SPORT0178-3	99SPORT0178-4	Conf. sample average	U4S01201	U4S01201D	U4S01301	U4S01401	U4S01501
Sample Location			Area of U4S011	Area of U4S011	Area of U4S011	U4S012	U4S012	U4S013	U4S014	U4S015 ¹
Sample Depth (feet)			0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1
Sampling Date			5/11/99	5/11/99	Average	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97
	Background Screening	Florida Soil Cleanup Target Level - Residential								
Magnesium	328	NA	NA	NA	NA	--	--	--	--	--
Manganese	8.1	1,600	NA	NA	NA	10 J	4.5 J	1.1 J	1.2 J	5.6 J
Mercury	0.07	3.4/2.1 ¹	NA	NA	NA	--	--	--	--	--
Nickel	4.4	110/130 ¹	NA	NA	NA	0.52 J	0.32 J	1.2 J	0.38 J	0.34 J
Selenium	0.95	390/5 ¹	NA	NA	NA	--	--	--	--	--
Silver	1.8	390	NA	NA	NA	--	--	--	--	--
Vanadium	3.1	15/980 ¹	NA	NA	NA	0.92 J	0.7 J	2.4 J	0.87 J	1.5 J
Zinc	17.2	23,000	NA	NA	NA	--	--	--	--	--
Total Petroleum Hydrocarbons	NA	NA	NA	NA	NA	--	--	--	--	--

Notes:

- ¹ Where particular compounds were detected in both soil and groundwater, Florida leachability soil cleanup target levels were used. The first number shown indicates the residential direct exposure level, and the second number indicates the leachability level.
- ² Hexavalent Chromium goals used ³ Chlordane goals used
- ⁴ Endrin goals used ⁶ Endosulfan goals used
- ⁵ This surface soil sample location was subsequently excavated as part of an Interim Remedial Action (IRA). Italicized concentrations indicate that the value shown has been superseded by post-IRA confirmatory sample data.
- = Analyte not detected above M.D.L. NA = Not Applicable or Not Analyzed

Table C-1. Summary of Surface Soil Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID			99SPORT0178-5	99SPORT0178-6	99SPORT0178-7	99SPORT0178-8	Conf. sample average
Sample Location			U4S015	U4S015	U4S015	U4S015	U4S015
Sample Depth (feet)			0-1	0-1	0-1	0-1	0-1
Sampling Date			5/11/99	5/11/99	5/11/99	5/11/99	Average
	Background Screening	Florida Soil Cleanup Target Level - Residential					
Volatile Organic Compounds ug/kg							
1,1,2,2-Tetrachloroethane	NA	700	NA	NA	NA	NA	NA
2-Hexanone	NA	5,100/1,400 ¹	NA	NA	NA	NA	NA
Acetone	NA	780,000	NA	NA	NA	NA	NA
Methylene Chloride	NA	16,000	NA	NA	NA	NA	NA
Tetrachloroethene	NA	8,900/30 ¹	NA	NA	NA	NA	NA
Toluene	NA	380,000	NA	NA	NA	NA	NA
Xylene (total)	NA	5,900,000	NA	NA	NA	NA	NA
Semivolatile Organic Compounds ug/kg							
Acenaphthene	NA	1,900,000	--	--	--	--	--
Acenaphthylene	NA	1,100,000	--	--	--	--	--
Anthracene	NA	18,000,000	--	--	--	--	--
Benzo(a)anthracene	NA	1,400	--	--	--	--	--
Benzo(a)pyrene	NA	100	--	--	--	--	--
Benzo(b)fluoranthene	NA	1,400	--	--	--	--	--
Benzo(g,h,i)perylene	NA	2,300,000	--	--	--	--	--
Benzo(k)fluoranthene	NA	15,000	--	--	--	--	--
Butylbenzylphthalate	NA	15,000,000	NA	NA	NA	NA	NA
Carbazole	NA	53,000	NA	NA	NA	NA	NA
Chrysene	NA	140,000	--	--	--	--	--
Dibenz(a,h)anthracene	NA	100	--	--	--	--	--
Fluoranthene	NA	2,900,000	--	--	--	--	--
Fluorene	NA	2,200,000	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	NA	1,500	--	--	--	--	--
Phenanthrene	NA	2,000,000	--	--	--	--	--
Pyrene	NA	2,200,000	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	NA	76,000	NA	NA	NA	NA	NA
Pesticides/PCBs ug/kg							
4,4'-DDD	NA	4,600	NA	NA	NA	NA	NA
4,4'-DDE	NA	3,300	NA	NA	NA	NA	NA
4,4'-DDT	NA	3,300	NA	NA	NA	NA	NA

Appendix C
Table C-1. Summary of Surface Soil Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID			99SPORT0178-5	99SPORT0178-6	99SPORT0178-7	99SPORT0178-8	Conf. sample average
Sample Location			U4S015	U4S015	U4S015	U4S015	U4S015
Sample Depth (feet)			0-1	0-1	0-1	0-1	0-1
Sampling Date			5/11/99	5/11/99	5/11/99	5/11/99	Average
	Background Screening	Florida Soil Cleanup Target Level - Residential					
Aldrin	NA	70	NA	NA	NA	NA	NA
Aroclor-1254	NA	500	NA	NA	NA	NA	NA
Aroclor-1260	NA	500	NA	NA	NA	NA	NA
Dieldrin	NA	70	NA	NA	NA	NA	NA
Endosulfan I	NA	410,000 ⁵	NA	NA	NA	NA	NA
Endosulfan II	NA	410,000 ⁵	NA	NA	NA	NA	NA
Endosulfan sulfate	NA	410,000 ⁵	NA	NA	NA	NA	NA
Endrin	NA	21,000	NA	NA	NA	NA	NA
Endrin aldehyde	NA	21,000 ⁴	NA	NA	NA	NA	NA
Endrin ketone	NA	21,000 ⁴	NA	NA	NA	NA	NA
Heptachlor	NA	200	NA	NA	NA	NA	NA
Heptachlor epoxide	NA	100	NA	NA	NA	NA	NA
Methoxychlor	NA	370,000	NA	NA	NA	NA	NA
alpha-BHC	NA	200	NA	NA	NA	NA	NA
alpha-Chlordane	NA	3,100 ³	NA	NA	NA	NA	NA
beta-BHC	NA	600	NA	NA	NA	NA	NA
delta-BHC	NA	22,000	NA	NA	NA	NA	NA
gamma-BHC (Lindane)	NA	700	NA	NA	NA	NA	NA
gamma-Chlordane	NA	3,100 ³	NA	NA	NA	NA	NA
Inorganics mg/kg							
Aluminum	2,088	72,000	NA	NA	NA	NA	NA
Arsenic	1.0	0.8	NA	NA	NA	NA	NA
Barium	8.7	110/1,600 ¹	NA	NA	NA	NA	NA
Beryllium	0.09	120	NA	NA	NA	NA	NA
Cadmium	0.98	75	NA	NA	NA	NA	NA
Calcium	25,295	NA	NA	NA	NA	NA	NA
Chromium	4.6	210 ² /38 ¹	NA	NA	NA	NA	NA
Cobalt	--	4,700	NA	NA	NA	NA	NA
Copper	4.1	110	NA	NA	NA	NA	NA
Iron	712.0	23,000	NA	NA	NA	NA	NA
Lead	14.5	400	NA	NA	NA	NA	NA

Table C-1. Summary of Surface Soil Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID			99SPORT0178-5	99SPORT0178-6	99SPORT0178-7	99SPORT0178-8	Conf. sample average
Sample Location			U4S015	U4S015	U4S015	U4S015	U4S015
Sample Depth (feet)			0-1	0-1	0-1	0-1	0-1
Sampling Date			5/11/99	5/11/99	5/11/99	5/11/99	Average
	Background Screening	Florida Soil Cleanup Target Level - Residential					
Magnesium	328	NA	NA	NA	NA	NA	NA
Manganese	8.1	1,600	NA	NA	NA	NA	NA
Mercury	0.07	3.4/2.1 ¹	NA	NA	NA	NA	NA
Nickel	4.4	110/130 ¹	NA	NA	NA	NA	NA
Selenium	0.95	390/5 ¹	NA	NA	NA	NA	NA
Silver	1.8	390	NA	NA	NA	NA	NA
Vanadium	3.1	15/980 ¹	NA	NA	NA	NA	NA
Zinc	17.2	23,000	NA	NA	NA	NA	NA
Total Petroleum Hydrocarbons	NA	NA	NA	NA	NA	NA	NA

Notes:

¹ Where particular compounds were detected in both soil and groundwater, Florida leachability soil cleanup target levels were used. The first number shown indicates the residential direct exposure level, and the second number indicates the leachability level.

² Hexavalent Chromium goals used

³ Chlordane goals used

⁴ Endrin goals used

⁵ Endosulfan goals used

⁶ This surface soil sample location was subsequently excavated as part of an Interim Remedial Action (IRA). Italicized concentrations indicate that the value shown has been superseded by post-IRA confirmatory sample data.

-- = Analyte not detected above M.D.L.

NA = Not Applicable or Not Analyzed

APPENDIX D

COMPLETE LABORATORY ANALYTICAL RESULTS

Table D-1. Summary of Surface Soil Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	12B00101	12B00201	12B00301	12B00401	12B00401D	13B00501	14B00101	14B00201	14B00301	14B00401	U4S00501	U4S00501D
Sampling Date	2/25/95	2/25/95	2/25/95	2/25/95	2/25/95	2/26/95	2/25/95	2/25/95	2/25/95	2/25/95	10/28/97	10/28/97
Volatile Organic Compounds ug/kg												
1,1,1-Trichloroethane	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
1,1,2,2-Tetrachloroethane	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
1,1,2-Trichloroethane	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
1,1-Dichloroethane	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
1,1-Dichloroethene	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
1,2-Dichloroethane	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
1,2-Dichloroethene (total)	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
1,2-Dichloropropane	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
2-Butanone	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
2-Hexanone	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
4-Methyl-2-pentanone	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
Acetone	14 U	15 U	10 U	10 U	16	42	11 U	12 U	10 U	12 U	17 U	14 U
Benzene	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
Bromodichloromethane	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
Bromoform	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
Bromomethane	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
Carbon disulfide	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
Carbon tetrachloride	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
Chlorobenzene	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
Chloroethane	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
Chloroform	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
Chloromethane	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
Dibromochloromethane	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
Ethylbenzene	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
Methylene chloride	10 U	12 U	11 U	10 U	10 U	10 U	17 U	68				
Styrene	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
Tetrachloroethene	10 U	4 J	11 U	11	10 U	1 J	17 U	14 U				
Toluene	10 U	12 U	11 U	10 U	10 U	10 U	17 U	2 J				
Trichloroethene	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
Vinyl chloride	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
Xylene (total)	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
cis-1,3-Dichloropropene	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
trans-1,3-Dichloropropene	10 U	12 U	11 U	10 U	10 U	10 U	17 U	14 U				
Semivolatile Organic Compounds ug/kg												
1,2,4-Trichlorobenzene	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
1,2-Dichlorobenzene	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
1,3-Dichlorobenzene	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
1,4-Dichlorobenzene	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
2,2'-oxybis(1-Chloropropane)	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				

Appendix D
Table D-1. Summary of Surface Soil Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID	12B00101	12B00201	12B00301	12B00401	12B00401D	13B00501	14B00101	14B00201	14B00301	14B00401	U4S00501	U4S00501D
Sampling Date	2/25/95	2/25/95	2/25/95	2/25/95	2/25/95	2/26/95	2/25/95	2/25/95	2/25/95	2/25/95	10/28/97	10/28/97
2,4,5-Trichlorophenol	860 U	850 U	860 U	860 U	860 U	1,000 U	890 U	860 U	850 U	870 U	1,400 U	1,200 U
2,4,6-Trichlorophenol	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
2,4-Dichlorophenol	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
2,4-Dimethylphenol	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
2,4-Dinitrophenol	860 U	850 U	860 U	860 U	860 U	1,000 U	890 U	860 U	850 U	870 U	1,400 U	1,200 U
2,4-Dinitrotoluene	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
2,6-Dinitrotoluene	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
2-Chloronaphthalene	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
2-Chlorophenol	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
2-Methylnaphthalene	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
2-Methylphenol	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
2-Nitroaniline	860 U	850 U	860 U	860 U	860 U	1,000 U	890 U	860 U	850 U	870 U	1,400 U	1,200 U
2-Nitrophenol	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
3,3'-Dichlorobenzidine	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
3-Nitroaniline	860 U	850 U	860 U	860 U	860 U	1,000 U	890 U	860 U	850 U	870 U	1,400 U	1,200 U
4,6-Dinitro-2-methylphenol	860 U	850 U	860 U	860 U	860 U	1,000 U	890 U	860 U	850 U	870 U	1,400 U	1,200 U
4-Bromophenyl-phenylether	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
4-Chloro-3-methylphenol	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
4-Chloroaniline	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
4-Chlorophenyl-phenylether	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
4-Methylphenol	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
4-Nitroaniline	860 U	850 U	860 U	860 U	860 U	1,000 U	890 U	860 U	850 U	870 U	1,400 U	1,200 U
4-Nitrophenol	860 U	850 U	860 U	860 U	860 U	1,000 U	890 U	860 U	850 U	870 U	1,400 U	1,200 U
Acenaphthene	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
Acenaphthylene	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
Anthracene	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
Benzo(a)anthracene	340 U	410 U	110 J	340 U	340 U	350 U	550 U	460 U				
Benzo(a)pyrene	340 U	410 U	350 U	340 U	340 U	350 U	61 J	53 J				
Benzo(b)fluoranthene	340 U	410 U	220 J	340 U	340 U	350 U	77 J	92 J				
Benzo(g,h,i)perylene	340 U	410 U	180 J	340 U	340 U	350 U	550 U	460 U				
Benzo(k)fluoranthene	340 U	410 U	180 J	340 U	340 U	350 U	550 U	460 U				
Butylbenzylphthalate	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
Carbazole	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
Chrysene	340 U	410 U	200 J	340 U	340 U	350 U	63 J	76 J				
Di-n-butylphthalate	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
Di-n-octylphthalate	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
Dibenz(a,h)anthracene	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
Dibenzofuran	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
Diethylphthalate	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
Dimethylphthalate	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
Fluoranthene	340 U	410 U	350 U	340 U	340 U	350 U	100 J	92 J				

Appendix D

Table D-1. Summary of Surface Soil Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID	12B00101	12B00201	12B00301	12B00401	12B00401D	13B00501	14B00101	14B00201	14B00301	14B00401	U4S00501	U4S00501D
Sampling Date	2/25/95	2/25/95	2/25/95	2/25/95	2/25/95	2/26/95	2/25/95	2/25/95	2/25/95	2/25/95	10/28/97	10/28/97
Fluorene	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
Hexachlorobenzene	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
Hexachlorobutadiene	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 UJ				
Hexachlorocyclopentadiene	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 UJ				
Hexachloroethane	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
Indeno(1,2,3-cd)pyrene	340 U	410 U	140 J	340 U	340 U	350 U	550 U	460 U				
Isophorone	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
N-Nitroso-di-n-propylamine	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
N-Nitrosodiphenylamine (1)	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 UJ				
Naphthalene	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
Nitrobenzene	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
Pentachlorophenol	340 U	410 U	350 U	340 U	340 U	350 U	1,400 UJ	1,200 UJ				
Phenanthrene	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
Phenol	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
Pyrene	340 U	410 U	230 J	340 U	340 U	350 U	99 J	94 J				
bis(2-Chloroethoxy)methane	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
bis(2-Chloroethyl)ether	340 U	410 U	350 U	340 U	340 U	350 U	550 U	460 U				
bis(2-Ethylhexyl)phthalate	340 U	410 U	350 U	340 U	340 U	350 U	140 J	84 J				
Pesticides/PCBs ug/kg												
4,4'-DDD	3.4 U	3.4 U	3.4 U	3.4 U	17 U	4 U	7 U	3.4 U	3.4 U	3.4 U	4.4 J	4.6 U
4,4'-DDE	3.4 U	3.4 U	3.4 U	3.4 U	17 U	4 U	6.2 J	3.4 U	3.4 U	5.8	7.7 J	8.9 J
4,4'-DDT	3.4 U	3.4 U	3.4 U	3.4 U	17 U	4 U	17	3.4 U	6.4	16	1.4 J	4.6 U
Aldrin	1.8 U	1.8 U	1.8 U	1.8 U	8.8 U	2 U	1.8 U	1.8 U	1.7 U	1.8 U	2.9 U	2.4 U
Aroclor-1016	34 U	34 U	34 U	34 U	170 U	40 U	35 U	34 U	34 U	34 U	56 U	46 U
Aroclor-1221	70 U	69 U	69 U	69 U	350 U	81 U	72 U	69 U	68 U	70 U	110 U	94 U
Aroclor-1232	34 U	34 U	34 U	34 U	170 U	40 U	35 U	34 U	34 U	34 U	56 U	46 U
Aroclor-1242	34 U	34 U	34 U	34 U	170 U	40 U	35 U	34 U	34 U	34 U	56 U	46 U
Aroclor-1248	34 U	34 U	34 U	34 U	170 U	40 U	35 U	34 U	34 U	34 U	56 U	46 U
Aroclor-1254	34 U	34 U	34 U	34 U	170 U	40 U	70 U	34 U	34 U	34 U	56 U	130 J
Aroclor-1260	34 U	34 U	34 U	34 U	170 U	40 U	70 U	34 U	34 U	34 U	56 U	46 U
Dieldrin	3.4 U	3.4 U	3.4 U	3.4 U	17 U	4 U	7 U	3.4 U	3.4 U	3.4 U	5.6 U	4.6 U
Endosulfan I	1.8 U	1.8 U	1.8 U	1.8 U	8.8 U	2 U	1.8 U	1.8 U	1.7 U	1.8 U	2.9 U	2.4 U
Endosulfan II	3.4 U	3.4 U	3.4 U	3.4 U	17 U	4 U	7 U	3.4 U	3.4 U	3.4 U	5.6 U	4.6 U
Endosulfan sulfate	3.4 U	3.4 U	3.4 U	3.4 U	17 U	4 U	7 U	3.4 U	3.4 U	3.4 U	5.6 U	1.2 J
Endrin	3.4 U	3.4 U	3.4 U	3.4 U	17 U	4 U	7 U	3.4 U	3.4 U	3.4 U	5.6 U	4.6 U
Endrin aldehyde	3.4 U	3.4 U	3.4 U	3.4 U	17 U	4 U	7 U	3.4 U	3.4 U	3.4 U	5.6 U	4.6 U
Endrin ketone	3.4 U	3.4 U	3.4 U	3.4 U	17 U	4 U	7 U	3.4 U	3.4 U	3.4 U	5.6 U	4.6 U
Heptachlor	1.8 U	1.8 U	1.8 U	1.8 U	8.8 U	2 U	1.8 U	1.8 U	1.7 U	1.8 U	2.9 U	2.4 U
Heptachlor epoxide	1.8 U	1.8 U	1.8 U	1.8 U	8.8 U	2 U	1.8 U	1.8 U	1.7 U	1.8 U	2.9 U	2.4 U
Methoxychlor	18 U	18 U	18 U	18 U	88 U	20 U	36 U	18 U	17 U	18 U	29 U	24 U
Toxaphene	180 U	180 U	180 U	180 U	880 U	200 U	360 U	180 U	170 U	180 U	290 U	240 U

Appendix D
Table D-1. Summary of Surface Soil Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID	12B00101	12B00201	12B00301	12B00401	12B00401D	13B00501	14B00101	14B00201	14B00301	14B00401	U4S00501	U4S00501D
Sampling Date	2/25/95	2/25/95	2/25/95	2/25/95	2/25/95	2/26/95	2/25/95	2/25/95	2/25/95	2/25/95	10/28/97	10/28/97
alpha-BHC	1.8 U	1.8 U	1.8 U	1.8 U	8.8 U	2 U	1.8 U	1.8 U	1.7 U	1.8 U	2.9 U	2.4 U
alpha-Chlordane	1.8 U	1.8 U	1.8 U	1.8 U	8.8 U	2 U	1.8 J	1.8 U	1.7 U	1.8 U	2.9 U	2.4 U
beta-BHC	1.8 U	1.8 U	1.8 U	1.8 U	8.8 U	2 U	1.8 U	1.8 U	1.7 U	1.8 U	2.9 U	2.4 U
delta-BHC	1.8 U	1.8 U	1.8 U	1.8 U	8.8 U	2 U	1.8 U	1.8 U	1.7 U	1.8 U	2.9 U	2.4 U
gamma-BHC (Lindane)	1.8 U	1.8 U	1.8 U	1.8 U	8.8 U	2 U	1.8 U	1.8 U	1.7 U	1.8 U	2.9 U	2.4 U
gamma-Chlordane	1.8 U	1.8 U	1.8 U	1.8 U	8.8 U	2 U	1.6 NJ	1.8 U	1.7 U	1.8 U	2.9 U	2.4 U
Inorganics mg/kg												
Aluminum	0.0599	0.0088 B	0.0168 B	1.02	0.806	2.18	1.73	0.945	0.0131 B	0.844	5,100	6,260
Antimony	4.6 U	4.5 U	4.6 U	4.6 U	4.6 U	5.4 U	4.8 U	4.7 U	4.5 U	4.7 U	0.95 UJ	0.8 UJ
Arsenic	0.39 U	0.39 UJ	0.38 U	0.56 B	0.39 U	0.72 B	0.62 B	0.39 U	0.38 U	0.84 B	1.9 U	1.6 U
Barium	1.5 B	0.3 B	0.25 B	3.9 B	3.6 B	5.7 B	5.8 B	1.8 B	0.28 B	2 B	13.8 J	22.3 J
Beryllium	0.04 U	0.13 B	0.07 B	0.04 U	0.04 U	0.04 U	0.12 U	0.19 U				
Cadmium	0.62 U	0.61 U	0.63 U	0.63 U	0.63 U	0.74 U	1.7	0.64 U	0.61 U	0.64 U	0.1 U	0.11 U
Calcium	994 B	1,410	215 B	3,610	3,400	346 J	12,400	2,460	458 B	1,710	3,970	6,920
Chromium	0.71 B	0.5 U	0.84 B	3.1	1.1 B	8.6	16.4	1.3 B	0.63 B	1 B	9.8 J	13.3 J
Cobalt	0.4 U	0.4 U	0.41 U	0.41 U	0.4 U	0.48 U	0.43 U	0.41 U	0.39 U	0.41 U	0.23 U	0.19 U
Copper	0.44 U	0.44 U	0.45 U	0.49 B	0.44 U	3.4 J	30.2	0.45 U	0.43 U	0.46 U	5.1 J	7.7
Iron	19.8 B	14.4 B	10.4 UJ	373	322	36 J	660	259	12.1 U	279	273	452
Lead	0.46 B	0.31 U	0.37 B	1.6	2	8.4 J	40.9	1.1	0.3 U	1.1	11.3	20.3
Magnesium	23 B	13.9 B	8.2 B	65.2 B	59.9 B	15.7 B	175 B	41.6 B	17.1 B	50.7 B	250 U	411 U
Manganese	0.68 B	0.52 B	0.53 B	2.7 B	2.2 B	1.6 B	14.7	1.3 B	0.26 U	1 B	6.6 J	9 J
Mercury	0.02 U	0.03 U	0.02 UJ	0.03 UJ	0.04 UJ	0.07	0.05 UJ	0.03 U	0.04 U	0.03 U	0.22 J	0.27 J
Nickel	1.9 U	1.9 U	2 U	2.8 B	1.9 U	3.1 B	9.2	2 U	1.9 U	2 U	1.9 J	2.8 J
Potassium	94.9 U	93.2 U	96.1 U	96.1 U	95.2 U	113 U	100 U	97 U	92.5 U	97.6 U	49.5 U	53.6 U
Selenium	0.47 U	0.47 U	0.46 U	0.47 U	0.47 U	0.55 U	0.49 U	0.47 U	0.45 U	0.47 U	1.4 U	1.2 U
Silver	0.54 U	0.53 U	0.55 U	0.55 U	0.55 U	0.65 U	0.57 U	0.56 U	0.53 U	0.56 U	0.26 U	0.22 U
Sodium	4.5 U	4.4 U	4.6 U	6.7 U	5.5 U	5.9 U	6.3 U	13.2 U	4.4 U	7.7 U	220 U	178 U
Thallium	0.37 U	0.43 U	0.39 U	0.37 U	0.36 U	0.38 U	1.6 U	1.4 U				
Vanadium	0.42 U	0.42 U	0.43 U	0.96 B	0.94 B	1.3 J	2.5 B	0.58 B	0.41 U	0.68 B	2.6 J	3.1 J
Zinc	0.97 B	0.24 U	0.24 U	1 B	0.96 B	0.36 B	52.9	0.32 U	0.24 U	5.3	15 U	30.2 J
Total Petroleum Hydrocarbons	--	--	--	--	--	17.6	--	--	--	--	--	--

Table D-1. Summary of Surface Soil Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4S00601	U4S00701	U4S00801	U4S00901	U4S01001	U4S01101	U4S01201	U4S01201D	U4S01301	U4S01401	U4S01501
Sampling Date	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97
Volatile Organic Compounds ug/kg											
1,1,1-Trichloroethane	14 U	10 U	10 U	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
1,1,2,2-Tetrachloroethane	14 U	10 U	1 J	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
1,1,2-Trichloroethane	14 U	10 U	10 U	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
1,1-Dichloroethane	14 U	10 U	10 U	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
1,1-Dichloroethene	14 U	10 U	10 U	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
1,2-Dichloroethane	14 U	10 U	10 U	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
1,2-Dichloroethene (total)	14 U	10 U	10 U	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
1,2-Dichloropropane	14 U	10 U	10 U	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
2-Butanone	14 U	10 U	10 U	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
2-Hexanone	14 U	10 U	8 J	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
4-Methyl-2-pentanone	14 U	10 U	10 U	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
Acetone	14 U	13 J	10 U	11 UJ	10 U	11 U	11 U	11 U	14 U	11 U	10 J
Benzene	14 U	10 U	10 U	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
Bromodichloromethane	14 U	10 U	10 U	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
Bromoform	14 U	10 U	10 U	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
Bromomethane	14 U	10 U	10 U	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
Carbon disulfide	14 U	10 U	10 U	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
Carbon tetrachloride	14 U	10 U	10 U	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
Chlorobenzene	14 U	10 U	10 U	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
Chloroethane	14 U	10 U	10 U	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
Chloroform	14 U	10 U	10 U	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
Chloromethane	14 U	10 U	10 U	11 U	10 U	11 U	11 U	11 U	14 U	11 UJ	10 U
Dibromochloromethane	14 U	10 U	10 U	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
Ethylbenzene	14 U	10 U	10 U	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
Methylene chloride	25 U	16 U	10 U	11 U	15 U	21 U	23 U	20 U	44	11 U	11 U
Styrene	14 U	10 U	10 U	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
Tetrachloroethene	14 U	61	110	11 U	58	2 J	11 U	11 U	14 U	11 U	10 U
Toluene	14 U	10 U	2 J	11 U	1 J	11 U	2 J	11 U	14 U	11 U	1 J
Trichloroethene	14 U	10 U	10 U	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
Vinyl chloride	14 U	10 U	10 U	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
Xylene (total)	14 U	10 U	1 J	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
cis-1,3-Dichloropropene	14 U	10 U	10 U	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
trans-1,3-Dichloropropene	14 U	10 U	10 U	11 U	10 U	11 U	11 U	11 U	14 U	11 U	10 U
Semivolatile Organic Compounds ug/kg											
1,2,4-Trichlorobenzene	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
1,2-Dichlorobenzene	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
1,3-Dichlorobenzene	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
1,4-Dichlorobenzene	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
2,2'-oxybis(1-Chloropropane)	480 U	340 U	340 U	360 U	340 UJ	370 U	360 U	350 UJ	470 U	370 UJ	340 UJ

Appendix D

Table D-1. Summary of Surface Soil Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4S00601	U4S00701	U4S00801	U4S00901	U4S01001	U4S01101	U4S01201	U4S01201D	U4S01301	U4S01401	U4S01501
Sampling Date	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97
2,4,5-Trichlorophenol	1,200 U	850 U	860 U	910 U	840 U	930 U	900 U	880 U	1,200 U	920 U	850 U
2,4,6-Trichlorophenol	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
2,4-Dichlorophenol	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
2,4-Dimethylphenol	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
2,4-Dinitrophenol	1,200 U	850 U	860 U	910 U	840 U	930 U	900 U	880 U	1,200 U	920 U	850 U
2,4-Dinitrotoluene	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
2,6-Dinitrotoluene	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
2-Chloronaphthalene	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
2-Chlorophenol	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
2-Methylnaphthalene	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
2-Methylphenol	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
2-Nitroaniline	1,200 UJ	850 U	860 U	910 U	840 U	930 U	900 U	880 U	1,200 U	920 U	850 U
2-Nitrophenol	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
3,3'-Dichlorobenzidine	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
3-Nitroaniline	1,200 U	850 UJ	860 UJ	910 U	840 U	930 UJ	900 UJ	880 U	1,200 UJ	920 U	850 U
4,6-Dinitro-2-methylphenol	1,200 U	850 U	860 U	910 U	840 U	930 U	900 U	880 U	1,200 U	920 U	850 U
4-Bromophenyl-phenylether	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
4-Chloro-3-methylphenol	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
4-Chloroaniline	480 UJ	340 UJ	340 UJ	360 UJ	340 U	370 UJ	360 UJ	350 U	470 UJ	370 U	340 U
4-Chlorophenyl-phenylether	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
4-Methylphenol	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
4-Nitroaniline	1,200 U	850 U	860 U	910 U	840 U	930 U	900 U	880 U	1,200 U	920 U	850 U
4-Nitrophenol	1,200 U	850 U	860 U	910 U	840 UJ	930 U	900 U	880 UJ	1,200 U	920 UJ	850 UJ
Acenaphthene	79 J	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
Acenaphthylene	290 J	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	430
Anthracene	160 J	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	200 J
Benzo(a)anthracene	1,300	340 U	340 U	260 J	340 U	140 J	55 J	130 J	470 U	370 U	1,200
Benzo(a)pyrene	1,500	340 U	340 U	330 J	340 U	120 J	78 J	120 J	470 U	370 U	1,600
Benzo(b)fluoranthene	3,200 J	340 U	340 U	630	340 U	180 J	170 J	180 J	470 U	49 J	2,100
Benzo(g,h,i)perylene	990	340 U	340 U	220 J	340 U	73 J	65 J	77 J	470 U	370 U	750
Benzo(k)fluoranthene	3,200 J	340 U	340 U	230 J	340 U	72 J	160 J	67 J	470 U	370 U	600
Butylbenzylphthalate	200 J	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
Carbazole	200 J	340 U	340 U	58 J	340 U	370 U	360 U	350 U	470 U	370 U	340 U
Chrysene	2,500	340 U	340 U	460	340 U	140 J	120 J	190 J	470 U	48 J	1,700
Di-n-butylphthalate	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
Di-n-octylphthalate	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
Dibenz(a,h)anthracene	230 J	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	200 J
Dibenzofuran	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
Diethylphthalate	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
Dimethylphthalate	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
Fluoranthene	3,500	340 U	340 U	550	340 UJ	250 J	140 J	250 J	470 U	53 J	2,500 J

Appendix D

Table D-1. Summary of Surface Soil Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4S00601	U4S00701	U4S00801	U4S00901	U4S01001	U4S01101	U4S01201	U4S01201D	U4S01301	U4S01401	U4S01501
Sampling Date	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97
Fluorene	110 J	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	42 J
Hexachlorobenzene	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
Hexachlorobutadiene	480 U	340 U	340 U	360 U	340 UJ	370 U	360 U	350 UJ	470 U	370 UJ	340 UJ
Hexachlorocyclopentadiene	480 U	340 U	340 U	360 U	340 UJ	370 U	360 U	350 UJ	470 U	370 UJ	340 UJ
Hexachloroethane	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
Indeno(1,2,3-cd)pyrene	890	340 U	340 U	200 J	340 U	70 J	58 J	61 J	470 U	370 U	570
Isophorone	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
N-Nitroso-di-n-propylamine	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
N-Nitrosodiphenylamine (1)	480 U	340 U	340 U	360 U	340 UJ	370 U	360 U	350 UJ	470 U	370 UJ	340 UJ
Naphthalene	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
Nitrobenzene	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
Pentachlorophenol	1,200 U	850 U	860 U	910 U	840 UJ	930 U	900 U	880 UJ	1,200 U	920 UJ	850 UJ
Phenanthrene	2,500	340 U	340 U	240 J	340 U	130 J	68 J	95 J	470 U	370 U	330 J
Phenol	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
Pyrene	3,900 D	340 U	340 U	580	340 U	220 J	170 J	270 J	470 U	63 J	3,500 D
bis(2-Chloroethoxy)methane	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
bis(2-Chloroethyl)ether	480 U	340 U	340 U	360 U	340 U	370 U	360 U	350 U	470 U	370 U	340 U
bis(2-Ethylhexyl)phthalate	720	340 U	340 U	110 J	340 U	370 U	360 U	350 U	470 U	38 J	340 U
Pesticides/PCBs ug/kg											
4,4'-DDD	4.8 U	3.4 U	3.4 U	15 J	3.4 U	3.7 U	0.78 J	0.24 J	2 J	2.8 J	6.4 J
4,4'-DDE	60 J	3.4 U	3.4 U	24	3.4 U	3.7 U	3.6 U	3.5 U	4.7 U	2.1 J	17 U
4,4'-DDT	4.8 U	3.4 U	3.4 U	23 J	3.4 U	0.14 J	3.6 U	3.5 U	4.7 U	0.52 J	1.7 J
Aldrin	11 J	1.7 U	1.8 U	1.9 U	1.7 U	1.9 U	1.8 U	1.8 U	2.4 U	1.9 U	8.6 U
Aroclor-1016	48 U	34 U	34 U	36 U	34 U	37 U	36 U	35 U	47 U	37 U	170 U
Aroclor-1221	97 U	69 U	69 U	74 U	69 U	75 U	72 U	71 U	96 U	74 U	340 U
Aroclor-1232	48 U	34 U	34 U	36 U	34 U	37 U	36 U	35 U	47 U	37 U	170 U
Aroclor-1242	48 U	34 U	34 U	36 U	34 U	37 U	36 U	35 U	47 U	37 U	170 U
Aroclor-1248	48 U	34 U	34 U	36 U	34 U	37 U	36 U	35 U	47 U	37 U	170 U
Aroclor-1254	1,500 DJ	34 U	34 U	210	34 U	37 U	36 U	35 U	47 U	37 U	170 U
Aroclor-1260	48 U	34 U	34 U	36 U	34 U	37 U	33 J	35 U	47 U	37 U	170 U
Dieldrin	28 J	3.4 U	3.4 U	3.6 U	3.4 U	3.7 U	3.6 U	3.5 U	4.7 U	3.7 U	17 U
Endosulfan I	2.4 U	1.7 U	1.8 U	1.4 J	1.7 U	1.9 U	1.8 U	1.8 U	0.99 J	1.9 U	8.6 U
Endosulfan II	29	0.31 J	3.4 U	2.6 J	3.4 U	3.7 U	3.6 U	1 J	4.7 U	0.85 J	17 U
Endosulfan sulfate	5.8 J	3.4 U	3.4 U	3.6 U	3.4 U	3.7 U	0.16 J	3.5 U	4.7 U	3.7 U	17 U
Endrin	24 J	3.4 U	3.4 U	3.6 U	3.4 U	3.7 U	3.6 U	3.5 U	4.7 U	3.7 U	17 U
Endrin aldehyde	56 J	3.4 U	3.4 U	3.6 U	3.4 U	3.7 U	3.6 U	3.5 U	4.7 U	3.7 U	17 U
Endrin ketone	50	3.4 U	3.4 U	3.6 U	3.4 U	3.7 U	3.6 U	3.5 U	4.7 U	3.7 U	17 U
Heptachlor	23 J	1.7 U	1.8 U	3.1 J	1.7 U	1.9 U	1.8 U	1.8 U	2.4 U	1.9 U	8.6 U
Heptachlor epoxide	11 J	1.7 U	1.8 U	1.1 J	1.7 U	1.9 U	0.25 J	0.48 J	2.4 U	1.9 U	0.4 J
Methoxychlor	24 U	17 U	44	19 U	17 U	19 U	18 U	18 U	24 U	19 U	1,800 D
Toxaphene	240 U	170 U	180 U	190 U	170 U	190 U	180 U	180 U	240 U	190 U	860 U

Appendix D
Table D-1. Summary of Surface Soil Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4S00601	U4S00701	U4S00801	U4S00901	U4S01001	U4S01101	U4S01201	U4S01201D	U4S01301	U4S01401	U4S01501
Sampling Date	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97	10/28/97
alpha-BHC	2.4 U	1.7 U	1.8 U	1.9 U	1.7 U	1.9 U	1.8 U	1.8 U	0.32 J	1.9 U	8.6 U
alpha-Chlordane	56 DJ	1.7 U	1.8 U	1.9 J	1.7 U	1.9 U	1.8 U	1.8 J	2.4 U	1.9 U	8.6 U
beta-BHC	30 J	1.7 U	1.8 U	1.9 U	1.7 U	1.9 U	1.8 U	1.8 U	2.4 U	1.9 U	8.6 U
delta-BHC	2.1 J	1.7 U	1.8 U	0.76 J	1.7 U	1.9 U	1.8 U	1.8 U	2.4 U	1.9 U	8.6 U
gamma-BHC (Lindane)	0.9 J	1.7 U	1.8 U	1.9 U	1.7 U	1.9 U	1.8 U	1.8 U	0.25 J	1.9 U	8.6 U
gamma-Chlordane	2.4 U	1.7 U	1.8 U	1.9 U	1.7 U	0.76 J	1.8 U	1.9 J	2.4 U	0.96 J	2.4 J
Inorganics mg/kg											
Aluminum	9,740	904	443	2,130	889	2,890	842	631	3,130	176	252
Antimony	0.91 UJ	0.57 UJ	0.6 UJ	0.63 UJ	0.58 UJ	0.64 UJ	0.62 UJ	0.57 UJ	0.83 UJ	0.63 UJ	0.58 UJ
Arsenic	2.4 J	1.2 U	1.2 U	1.3 U	1.2 U	11.2	1.3 U	1.2 U	1.7 U	1.3 U	1.2 U
Barium	51.6 J	2 U	2.4 J	36 J	1.5 U	167	4.6 J	3.3 J	3.7 J	2.9 J	2.9 J
Beryllium	0.37 J	0.02 U	0.02 U	0.11 U	0.02 U	1.1 J	0.02 U	0.02 U	0.08 U	0.02 U	0.02 U
Cadmium	1.9 J	0.06 U	0.06 U	0.84 J	0.06 U	0.07 U	0.06 U	0.06 U	0.09 U	0.07 U	0.06 U
Calcium	18,600	2,650	1,700	8,260	2,020	75,100	1,410	1,230 U	733 U	472 U	20,800
Chromium	45.2 J	0.83 J	0.73 J	5.7 J	0.71 J	11.4 J	1.5 J	1.1 J	1.7 J	0.59 J	2.7 J
Cobalt	0.69 J	0.14 U	0.14 U	0.55 J	0.14 U	3.4 J	0.15 U	0.14 U	0.2 U	0.15 U	0.14 U
Copper	36.6	1.1 J	0.98 J	9.8	0.75 U	27.4	1.6 J	1.4 J	2.3 J	1.5 J	0.95 J
Iron	1,790	365	161	1,270	159	6,400	258	182	209	95.7	155
Lead	78	1.7	1.8	35.1	1.3	11.3	6.5	5.2	9.8	9.2	9.5
Magnesium	792 U	76.3 U	28.8 U	329 U	37.8 U	1,130 U	75.6 U	57.6 U	44.5 U	49.4 U	164 U
Manganese	45.2 J	2.9 J	1.7 J	29.9 J	1.5 J	21.1 J	10 J	4.5 J	1.1 J	1.2 J	5.6 J
Mercury	2.2 J	0.04 U	0.05 U	0.14 J	0.05 U	0.05 U	0.05 U	0.05 U	0.07 U	0.05 U	0.05 U
Nickel	6.7 J	0.33 J	0.27 J	2.6 J	0.34 J	9.2	0.52 J	0.32 J	1.2 J	0.38 J	0.34 J
Potassium	117 U	22.1 U	25.8 U	98.8 U	15.5 U	786 U	30.2 U	21.6 U	28.9 U	20.5 U	28 U
Selenium	1.3 J	0.87 U	0.91 U	0.96 U	0.88 U	0.97 U	0.95 U	0.87 U	1.3 U	0.96 U	0.88 U
Silver	1.4 J	0.16 U	0.17 U	1.8 J	0.16 U	31.3	0.17 U	0.16 U	0.23 U	0.17 U	0.16 U
Sodium	171 U	105 U	155 U	144 U	120 U	238 U	146 U	121 U	197 U	153 U	144 U
Thallium	1.4 U	0.99 U	1 U	1.1 U	1 U	1.1 U	1.1 U	0.99 U	1.4 U	1.1 U	1 U
Vanadium	6.6 J	0.81 J	0.66 J	4.2 J	0.62 J	17.7	0.92 J	0.7 J	2.4 J	0.87 J	1.5 J
Zinc	225 J	2.5 U	2.5 U	66.2 J	0.98 U	26.6 J	6.4 U	4.3 U	2.4 U	3.3 U	3.1 U
Total Petroleum Hydrocarbons	--	--	--	--	--	--	--	--	--	--	--

Table D-2. Summary of Subsurface Soil Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	12B00102	12B00202	12B00302	12B00402	13B00101	13B00401	13B00801	13B00901	13B01001	13B01101
Depth	6-8	6-8	6-8	6-8	6-8	6-8	6-8	6-8	6-8	4-6
Well ID	OLD-12-01A	OLD-12-02A	OLD-12-03A	OLD-12-04A	OLD-13-01A	OLD-14-04C	NA	OLD-13-09A	NA	OLD-13-11C
Sampling Date	2/27/95	2/27/95	2/28/95	2/25/95	2/26/95	3/31/95	3/30/95	2/25/95	2/25/95	2/25/95
Total Organic Carbon	--	--	--	--	--	--	--	--	--	--
Volatile Organic Compounds ug/kg										
1,1,1-Trichloroethane	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U
1,1,2,2-Tetrachloroethane	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U
1,1,2-Trichloroethane	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U
1,1-Dichloroethane	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U
1,1-Dichloroethene	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U
1,2-Dichloroethane	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U
1,2-Dichloroethene (total)	11 U	11 U	11 U	11 U	6 J	11 U	12 U	12 U	12 U	12 U
1,2-Dichloropropane	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U
2-Butanone	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	4 J
2-Hexanone	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U
4-Methyl-2-pentanone	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U
Acetone	16	32	49	19 U	130	11 U	12 U	58 U	68	58 U
Benzene	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U
Bromodichloromethane	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U
Bromoform	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U
Bromomethane	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U
Carbon disulfide	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U
Carbon tetrachloride	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U
Chlorobenzene	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U
Chloroethane	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U
Chloroform	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U
Chloromethane	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U
Dibromochloromethane	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U
Ethylbenzene	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U
Methylene chloride	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U
Styrene	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U
Tetrachloroethene	11 J	11 U	11 U	11 U	31	11 U	2 J	12 U	12 U	12 U
Toluene	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U
Trichloroethene	11 U	11 U	11 U	11 U	2 J	11 U	12 U	12 U	12 U	12 U
Vinyl chloride	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U
Xylene (total)	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U
cis-1,3-Dichloropropene	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U
trans-1,3-Dichloropropene	11 U	11 U	11 U	11 U	13 U	11 U	12 U	12 U	12 U	12 U

Appendix D
Table D-2. Summary of Subsurface Soil Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID	12B00102	12B00202	12B00302	12B00402	13B00101	13B00401	13B00801	13B00901	13B01001	13B01101
Depth	6-8	6-8	6-8	6-8	6-8	6-8	6-8	6-8	6-8	4-6
Well ID	OLD-12-01A	OLD-12-02A	OLD-12-03A	OLD-12-04A	OLD-13-01A	OLD-14-04C	NA	OLD-13-09A	NA	OLD-13-11C
Sampling Date	2/27/95	2/27/95	2/28/95	2/25/95	2/26/95	3/31/95	3/30/95	2/25/95	2/25/95	2/25/95
Semivolatile Organic Compounds ug/kg										
1,2,4-Trichlorobenzene	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
1,2-Dichlorobenzene	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
1,3-Dichlorobenzene	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
1,4-Dichlorobenzene	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
2,2'-oxybis(1-Chloropropane)	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
2,4,5-Trichlorophenol	920 U	950 U	900 U	920 U	970 U	880 U	930 U	980 U	1,000 U	980 U
2,4,6-Trichlorophenol	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
2,4-Dichlorophenol	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
2,4-Dimethylphenol	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
2,4-Dinitrophenol	920 U	950 U	900 U	920 U	970 U	880 U	930 U	980 U	1,000 U	980 U
2,4-Dinitrotoluene	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
2,6-Dinitrotoluene	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
2-Chloronaphthalene	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
2-Chlorophenol	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
2-Methylnaphthalene	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
2-Methylphenol	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
2-Nitroaniline	920 U	950 U	900 U	920 U	970 U	880 U	930 U	980 U	1,000 U	980 U
2-Nitrophenol	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
3,3'-Dichlorobenzidine	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
3-Nitroaniline	920 U	950 U	900 U	920 U	970 U	880 U	930 U	980 U	1,000 U	980 U
4,6-Dinitro-2-methylphenol	920 U	950 U	900 U	920 U	970 U	880 U	930 U	980 U	1,000 U	980 U
4-Bromophenyl-phenylether	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
4-Chloro-3-methylphenol	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
4-Chloroaniline	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
4-Chlorophenyl-phenylether	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
4-Methylphenol	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
4-Nitroaniline	920 U	950 U	900 U	920 U	970 U	880 U	930 U	980 U	1,000 U	980 U
4-Nitrophenol	920 U	950 U	900 U	920 U	970 U	880 U	930 U	980 U	1,000 U	980 U
Acenaphthene	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Acenaphthylene	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Anthracene	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Benzo(a)anthracene	110 J	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Benzo(a)pyrene	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Benzo(b)fluoranthene	160 J	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Benzo(g,h,i)perylene	120 J	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Benzo(k)fluoranthene	130 J	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Butylbenzylphthalate	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Carbazole	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Chrysene	160 J	380 U	110 J	370 U	390 U	360 U	380 U	390 U	410 U	390 U

Table D-2. Summary of Subsurface Soil Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	12B00102	12B00202	12B00302	12B00402	13B00101	13B00401	13B00801	13B00901	13B01001	13B01101
Depth	6-8	6-8	6-8	6-8	6-8	6-8	6-8	6-8	6-8	4-6
Well ID	OLD-12-01A	OLD-12-02A	OLD-12-03A	OLD-12-04A	OLD-13-01A	OLD-14-04C	NA	OLD-13-09A	NA	OLD-13-11C
Sampling Date	2/27/95	2/27/95	2/28/95	2/25/95	2/26/95	3/31/95	3/30/95	2/25/95	2/25/95	2/25/95
Di-n-butylphthalate	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Di-n-octylphthalate	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Dibenz(a,h)anthracene	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Dibenzofuran	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Diethylphthalate	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Dimethylphthalate	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Fluoranthene	260 J	380 U	110 J	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Fluorene	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Hexachlorobenzene	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Hexachlorobutadiene	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Hexachlorocyclopentadiene	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Hexachloroethane	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Indeno(1,2,3-cd)pyrene	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Isophorone	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
N-Nitroso-di-n-propylamine	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
N-Nitrosodiphenylamine (1)	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Naphthalene	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Nitrobenzene	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Pentachlorophenol	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Phenanthrene	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Phenol	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Pyrene	200 J	380 U	110 J	370 U	390 U	360 U	380 U	390 U	410 U	390 U
bis(2-Chloroethoxy)methane	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
bis(2-Chloroethyl)ether	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
bis(2-Ethylhexyl)phthalate	370 U	380 U	360 U	370 U	390 U	360 U	380 U	390 U	410 U	390 U
Pesticides/PCBs ug/kg										
4,4'-DDD	7.4 U	3.7 U	3.5 U	3.6 U	4 U	3.6 U	3.8 U	4 U	3.9 U	2.6 J
4,4'-DDE	5.2 J	3.7 U	3.5 U	3.6 U	4 U	3.6 U	3.8 U	4 U	3.9 U	2.8 J
4,4'-DDT	23 J	3.7 U	3.5 U	3.6 U	4 U	3.6 U	3.8 U	4 U	3.9 U	3.8 U
Aldrin	3.8 U	1.9 U	1.8 U	1.8 U	2 U	1.9 U	2 U	2 U	2 U	2 U
Aroclor-1016	74 U	37 U	35 U	36 U	40 U	36 U	38 U	40 U	39 U	38 U
Aroclor-1221	150 U	75 U	72 U	73 U	81 U	74 U	78 U	81 U	80 U	78 U
Aroclor-1232	74 U	37 U	35 U	36 U	40 U	36 U	38 U	40 U	39 U	38 U
Aroclor-1242	74 U	37 U	35 U	36 U	40 U	36 U	38 U	40 U	39 U	38 U
Aroclor-1248	74 U	37 U	35 U	36 U	40 U	36 U	38 U	40 U	39 U	38 U
Aroclor-1254	74 U	37 U	35 U	36 U	40 U	36 U	38 U	40 U	39 U	38 U
Aroclor-1260	110	37 U	35 U	36 U	40 U	36 U	38 U	40 U	39 U	38 U
Dieldrin	7.4 U	3.7 U	3.5 U	3.6 U	4 U	3.6 U	3.8 U	4 U	3.9 U	3.8 U
Endosulfan I	3.8 U	1.9 U	1.8 U	1.8 U	2 U	1.9 U	2 U	2 U	2 U	2 U
Endosulfan II	7.4 U	3.7 U	3.5 U	3.6 U	4 U	3.6 U	3.8 U	4 U	3.9 U	3.8 U

Appendix D
Table D-2. Summary of Subsurface Soil Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID	12B00102	12B00202	12B00302	12B00402	13B00101	13B00401	13B00801	13B00901	13B01001	13B01101
Depth	6-8	6-8	6-8	6-8	6-8	6-8	6-8	6-8	6-8	4-6
Well ID	OLD-12-01A	OLD-12-02A	OLD-12-03A	OLD-12-04A	OLD-13-01A	OLD-14-04C	NA	OLD-13-09A	NA	OLD-13-11C
Sampling Date	2/27/95	2/27/95	2/28/95	2/25/95	2/26/95	3/31/95	3/30/95	2/25/95	2/25/95	2/25/95
Endosulfan sulfate	7.4 U	3.7 U	3.5 U	3.6 U	4 U	3.6 U	3.8 U	4 U	3.9 U	3.8 U
Endrin	7.4 U	3.7 U	3.5 U	3.6 U	4 U	3.6 U	3.8 U	4 U	3.9 U	3.8 U
Endrin aldehyde	7.4 U	3.7 U	3.5 U	3.6 U	4 U	3.6 U	3.8 U	4 U	3.9 U	3.8 U
Endrin ketone	7.4 U	3.7 U	3.5 U	3.6 U	4 U	3.6 U	3.8 U	4 U	3.9 U	3.8 U
Heptachlor	3.8 U	1.9 U	1.8 U	1.8 U	2 U	1.9 U	2 U	2 U	2 U	2 U
Heptachlor epoxide	3.8 U	1.9 U	1.8 U	1.8 U	2 U	1.9 U	2 U	2 U	2 U	2 U
Methoxychlor	38 U	19 U	18 U	18 U	20 U	19 U	20 U	20 U	20 U	20 U
Toxaphene	380 U	190 U	180 U	180 U	200 U	190 U	200 U	200 U	200 U	200 U
alpha-BHC	3.8 U	1.9 U	1.8 U	1.8 U	2 U	1.9 U	2 U	2 U	2 U	2 U
alpha-Chlordane	3.8 U	1.9 U	1.8 U	1.8 U	2 U	1.9 U	2 U	2 U	2 U	2 U
beta-BHC	3.8 U	1.9 U	1.8 U	1.8 U	2 U	1.9 U	2 U	2 U	2 U	2 U
delta-BHC	3.8 U	1.9 U	1.8 U	1.8 U	2 U	1.9 U	2 U	2 U	2 U	2 U
gamma-BHC (Lindane)	3.8 U	1.9 U	1.8 U	1.8 U	2 U	1.9 U	2 U	2 U	2 U	2 U
gamma-Chlordane	3.8 U	1.9 U	1.8 U	1.8 U	2 U	1.9 U	2 U	2 U	2 U	2 U
Inorganics mg/kg										
Aluminum	0.665	0.31	0.39	0.75	0.196	503	1,430	0.339	0.29	0.455
Antimony	5 U	5.1 U	4.8 U	4.8 U	5.4 U	2 U	2.1 U	5.5 U	5.6 U	5.3 U
Arsenic	0.6 B	0.43 U	0.67 J	0.42 U	0.78 B	0.15 U	0.16 U	1.2 J	0.48 B	0.62 B
Barium	6.3 B	0.34 U	1.3 U	2.1 B	0.47 U	0.4 B	1.6 B	0.73 B	0.71 B	2.7 B
Beryllium	0.11 B	0.05 U	0.04 U	0.04 U	0.28 B	0.04 U	0.05 U	0.05 U	0.05 U	0.05 U
Cadmium	0.72 B	0.7 U	0.66 U	0.66 U	0.74 U	0.29 U	0.3 U	0.75 U	0.77 U	0.72 U
Calcium	46,700 J	147 J	25,900 J	1,190	72.4 J	110 B	132 B	591 B	162 B	288 B
Chromium	2.2 B	0.62 B	0.82 B	1.7 B	0.97 B	1.1 B	1.6 B	1.3 B	1.8 B	4.1
Cobalt	0.44 U	0.45 U	0.43 U	0.43 U	0.48 U	0.67 U	0.63 U	0.48 U	0.49 U	0.47 U
Copper	0.49 UJ	0.5 UJ	0.47 UJ	0.47 U	0.53 U	0.79 U	0.87 U	0.53 U	0.54 U	2.8 B
Iron	208 J	5.7 J	143 J	52.1	17.9 J	96.8	280	58.9	53.7	183
Lead	14.5 J	1.2 J	3 J	1.7	0.43 J	0.35 B	0.7	0.64 B	0.44 B	1.7
Magnesium	659 B	6.2 B	192 B	16.5 B	5.9 U	13.4 B	38.6 B	18.7 B	16.4 B	31.9 B
Manganese	23.9	0.24 U	4.5	0.8 B	0.52 U	0.78 B	0.8 B	0.42 B	0.38 B	0.92 B
Mercury	0.05	0.06	0.05	0.03 UJ	0.04 B	0.03 U	0.03 U	0.03 UJ	0.04 UJ	0.04 UJ
Nickel	2.3 B	2.2 U	2 U	2.1 U	2.3 U	1.1 U	1.2 U	2.3 U	2.4 U	2.2 U
Potassium	104 U	106 U	100 U	101 U	112 U	101 U	107 U	113 U	116 U	110 U
Selenium	0.51 U	0.52 U	0.49 U	0.5 U	0.55 U	0.13 U	0.14 U	0.54 U	0.57 U	0.54 U
Silver	0.6 U	0.61 U	0.58 U	0.58 U	0.65 U	0.5 U	0.54 U	0.65 U	0.67 U	0.63 U
Sodium	46 B	5.1 U	12.1 U	4.8 U	6.2 U	96.8 B	163 B	5.4 U	5.5 U	5.2 U
Thallium	0.4 U	0.41 U	0.39 U	0.4 U	0.43 U	0.13 UJ	0.14 UJ	0.43 U	0.45 U	0.42 U
Vanadium	1.1 J	0.47 UJ	2 J	0.46 B	0.5 UJ	0.53 B	1.6 B	0.51 U	0.52 U	0.5 B
Zinc	44.4	0.27 U	0.96 B	0.26 U	0.34 B	1.1 U	1.3 U	1 B	0.47 U	4.5 B
Total Petroleum Hydrocarbons	209.7	11.7	21.7	--	8.2	16.8	15.6	--	--	--

Table D-2. Summary of Subsurface Soil Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	13B01201	13B01301	U4B02101	U4B02102	U4B02201	U4B02202	U4B02301	U4B02302	U4B02501
Depth	6-8	6-8	18-20	30-32	18-20	30-32	8-10	30-32	8-10
Well ID	OLD-13-12A	NA	OLD-13-21B	OLD-13-21B	OLD-13-22B	OLD-13-22B	OLD-13-23B	OLD-13-23B	OLD-13-25B
Sampling Date	2/25/95	2/25/95	11/14/97	11/14/97	11/21/97	11/21/97	11/13/97	11/13/97	11/18/97
Total Organic Carbon	--	--	14,000	3,300	24,000	4,900	16,000	8,100	4,200
Volatile Organic Compounds ug/kg									
1,1,1-Trichloroethane	11 U	12 U	--	--	--	--	--	--	--
1,1,2,2-Tetrachloroethane	11 U	12 U	--	--	--	--	--	--	--
1,1,2-Trichloroethane	11 U	12 U	--	--	--	--	--	--	--
1,1-Dichloroethane	11 U	12 U	--	--	--	--	--	--	--
1,1-Dichloroethene	11 U	12 U	--	--	--	--	--	--	--
1,2-Dichloroethane	11 U	12 U	--	--	--	--	--	--	--
1,2-Dichloroethene (total)	11 U	12 U	--	--	--	--	--	--	--
1,2-Dichloropropane	11 U	12 U	--	--	--	--	--	--	--
2-Butanone	11 U	12 U	--	--	--	--	--	--	--
2-Hexanone	11 U	12 U	--	--	--	--	--	--	--
4-Methyl-2-pentanone	11 U	12 U	--	--	--	--	--	--	--
Acetone	51 U	8 J	--	--	--	--	--	--	--
Benzene	11 U	12 U	--	--	--	--	--	--	--
Bromodichloromethane	11 U	12 U	--	--	--	--	--	--	--
Bromoform	11 U	12 U	--	--	--	--	--	--	--
Bromomethane	11 U	12 U	--	--	--	--	--	--	--
Carbon disulfide	11 U	12 U	--	--	--	--	--	--	--
Carbon tetrachloride	11 U	12 U	--	--	--	--	--	--	--
Chlorobenzene	11 U	12 U	--	--	--	--	--	--	--
Chloroethane	11 U	12 U	--	--	--	--	--	--	--
Chloroform	11 U	12 U	--	--	--	--	--	--	--
Chloromethane	11 U	12 U	--	--	--	--	--	--	--
Dibromochloromethane	11 U	12 U	--	--	--	--	--	--	--
Ethylbenzene	11 U	12 U	--	--	--	--	--	--	--
Methylene chloride	11 U	12 U	--	--	--	--	--	--	--
Styrene	11 U	12 U	--	--	--	--	--	--	--
Tetrachloroethene	11 U	12 U	--	--	--	--	--	--	--
Toluene	11 U	12 U	--	--	--	--	--	--	--
Trichloroethene	11 U	12 U	--	--	--	--	--	--	--
Vinyl chloride	11 U	12 U	--	--	--	--	--	--	--
Xylene (total)	11 U	12 U	--	--	--	--	--	--	--
cis-1,3-Dichloropropene	11 U	12 U	--	--	--	--	--	--	--
trans-1,3-Dichloropropene	11 U	12 U	--	--	--	--	--	--	--

Appendix D

Table D-2. Summary of Subsurface Soil Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID	13B01201	13B01301	U4B02101	U4B02102	U4B02201	U4B02202	U4B02301	U4B02302	U4B02501
Depth	6-8	6-8	18-20	30-32	18-20	30-32	8-10	30-32	8-10
Well ID	OLD-13-12A	NA	OLD-13-21B	OLD-13-21B	OLD-13-22B	OLD-13-22B	OLD-13-23B	OLD-13-23B	OLD-13-25B
Sampling Date	2/25/95	2/25/95	11/14/97	11/14/97	11/21/97	11/21/97	11/13/97	11/13/97	11/18/97
Semivolatile Organic Compounds ug/kg									
1,2,4-Trichlorobenzene	380 U	410 U	--	--	--	--	--	--	--
1,2-Dichlorobenzene	380 U	410 U	--	--	--	--	--	--	--
1,3-Dichlorobenzene	380 U	410 U	--	--	--	--	--	--	--
1,4-Dichlorobenzene	380 U	410 U	--	--	--	--	--	--	--
2,2'-oxybis(1-Chloropropane)	380 U	410 U	--	--	--	--	--	--	--
2,4,5-Trichlorophenol	950 U	1,000 U	--	--	--	--	--	--	--
2,4,6-Trichlorophenol	380 U	410 U	--	--	--	--	--	--	--
2,4-Dichlorophenol	380 U	410 U	--	--	--	--	--	--	--
2,4-Dimethylphenol	380 U	410 U	--	--	--	--	--	--	--
2,4-Dinitrophenol	950 U	1,000 U	--	--	--	--	--	--	--
2,4-Dinitrotoluene	380 U	410 U	--	--	--	--	--	--	--
2,6-Dinitrotoluene	380 U	410 U	--	--	--	--	--	--	--
2-Chloronaphthalene	380 U	410 U	--	--	--	--	--	--	--
2-Chlorophenol	380 U	410 U	--	--	--	--	--	--	--
2-Methylnaphthalene	380 U	410 U	--	--	--	--	--	--	--
2-Methylphenol	380 U	410 U	--	--	--	--	--	--	--
2-Nitroaniline	950 U	1,000 U	--	--	--	--	--	--	--
2-Nitrophenol	380 U	410 U	--	--	--	--	--	--	--
3,3'-Dichlorobenzidine	380 U	410 U	--	--	--	--	--	--	--
3-Nitroaniline	950 U	1,000 U	--	--	--	--	--	--	--
4,6-Dinitro-2-methylphenol	950 U	1,000 U	--	--	--	--	--	--	--
4-Bromophenyl-phenylether	380 U	410 U	--	--	--	--	--	--	--
4-Chloro-3-methylphenol	380 U	410 U	--	--	--	--	--	--	--
4-Chloroaniline	380 U	410 U	--	--	--	--	--	--	--
4-Chlorophenyl-phenylether	380 U	410 U	--	--	--	--	--	--	--
4-Methylphenol	380 U	410 U	--	--	--	--	--	--	--
4-Nitroaniline	950 U	1,000 U	--	--	--	--	--	--	--
4-Nitrophenol	950 U	1,000 U	--	--	--	--	--	--	--
Acenaphthene	380 U	410 U	--	--	--	--	--	--	--
Acenaphthylene	380 U	410 U	--	--	--	--	--	--	--
Anthracene	380 U	410 U	--	--	--	--	--	--	--
Benzo(a)anthracene	380 U	410 U	--	--	--	--	--	--	--
Benzo(a)pyrene	380 U	410 U	--	--	--	--	--	--	--
Benzo(b)fluoranthene	380 U	410 U	--	--	--	--	--	--	--
Benzo(g,h,i)perylene	380 U	410 U	--	--	--	--	--	--	--
Benzo(k)fluoranthene	380 U	410 U	--	--	--	--	--	--	--
Butylbenzylphthalate	380 U	410 U	--	--	--	--	--	--	--
Carbazole	380 U	410 U	--	--	--	--	--	--	--
Chrysene	380 U	410 U	--	--	--	--	--	--	--

Table D-2. Summary of Subsurface Soil Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	13B01201	13B01301	U4B02101	U4B02102	U4B02201	U4B02202	U4B02301	U4B02302	U4B02501
Depth	6-8	6-8	18-20	30-32	18-20	30-32	8-10	30-32	8-10
Well ID	OLD-13-12A	NA	OLD-13-21B	OLD-13-21B	OLD-13-22B	OLD-13-22B	OLD-13-23B	OLD-13-23B	OLD-13-25B
Sampling Date	2/25/95	2/25/95	11/14/97	11/14/97	11/21/97	11/21/97	11/13/97	11/13/97	11/18/97
Di-n-butylphthalate	380 U	410 U	--	--	--	--	--	--	--
Di-n-octylphthalate	380 U	410 U	--	--	--	--	--	--	--
Dibenz(a,h)anthracene	380 U	410 U	--	--	--	--	--	--	--
Dibenzofuran	380 U	410 U	--	--	--	--	--	--	--
Diethylphthalate	380 U	410 U	--	--	--	--	--	--	--
Dimethylphthalate	380 U	410 U	--	--	--	--	--	--	--
Fluoranthene	380 U	410 U	--	--	--	--	--	--	--
Fluorene	380 U	410 U	--	--	--	--	--	--	--
Hexachlorobenzene	380 U	410 U	--	--	--	--	--	--	--
Hexachlorobutadiene	380 U	410 U	--	--	--	--	--	--	--
Hexachlorocyclopentadiene	380 U	410 U	--	--	--	--	--	--	--
Hexachloroethane	380 U	410 U	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	380 U	410 U	--	--	--	--	--	--	--
Isophorone	380 U	410 U	--	--	--	--	--	--	--
N-Nitroso-di-n-propylamine	380 U	410 U	--	--	--	--	--	--	--
N-Nitrosodiphenylamine (1)	380 U	410 U	--	--	--	--	--	--	--
Naphthalene	380 U	410 U	--	--	--	--	--	--	--
Nitrobenzene	380 U	410 U	--	--	--	--	--	--	--
Pentachlorophenol	380 U	410 U	--	--	--	--	--	--	--
Phenanthrene	380 U	410 U	--	--	--	--	--	--	--
Phenol	380 U	410 U	--	--	--	--	--	--	--
Pyrene	380 U	410 U	--	--	--	--	--	--	--
bis(2-Chloroethoxy)methane	380 U	410 U	--	--	--	--	--	--	--
bis(2-Chloroethyl)ether	380 U	410 U	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	380 U	410 U	--	--	--	--	--	--	--
Pesticides/PCBs ug/kg									
4,4'-DDD	3.8 U	4 U	--	--	--	--	--	--	--
4,4'-DDE	3.8 U	4 U	--	--	--	--	--	--	--
4,4'-DDT	3.8 U	4 U	--	--	--	--	--	--	--
Aldrin	2 U	2 U	--	--	--	--	--	--	--
Aroclor-1016	38 U	40 U	--	--	--	--	--	--	--
Aroclor-1221	77 U	81 U	--	--	--	--	--	--	--
Aroclor-1232	38 U	40 U	--	--	--	--	--	--	--
Aroclor-1242	38 U	40 U	--	--	--	--	--	--	--
Aroclor-1248	38 U	40 U	--	--	--	--	--	--	--
Aroclor-1254	38 U	40 U	--	--	--	--	--	--	--
Aroclor-1260	38 U	40 U	--	--	--	--	--	--	--
Dieldrin	3.8 U	4 U	--	--	--	--	--	--	--
Endosulfan I	2 U	2 U	--	--	--	--	--	--	--
Endosulfan II	3.8 U	4 U	--	--	--	--	--	--	--

Appendix D
Table D-2. Summary of Subsurface Soil Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID	13B01201	13B01301	U4B02101	U4B02102	U4B02201	U4B02202	U4B02301	U4B02302	U4B02501
Depth	6-8	6-8	18-20	30-32	18-20	30-32	8-10	30-32	8-10
Well ID	OLD-13-12A	NA	OLD-13-21B	OLD-13-21B	OLD-13-22B	OLD-13-22B	OLD-13-23B	OLD-13-23B	OLD-13-25B
Sampling Date	2/25/95	2/25/95	11/14/97	11/14/97	11/21/97	11/21/97	11/13/97	11/13/97	11/18/97
Endosulfan sulfate	3.8 U	4 U	--	--	--	--	--	--	--
Endrin	3.8 U	4 U	--	--	--	--	--	--	--
Endrin aldehyde	3.8 U	4 U	--	--	--	--	--	--	--
Endrin ketone	3.8 U	4 U	--	--	--	--	--	--	--
Heptachlor	2 U	2 U	--	--	--	--	--	--	--
Heptachlor epoxide	2 U	2 U	--	--	--	--	--	--	--
Methoxychlor	20 U	20 U	--	--	--	--	--	--	--
Toxaphene	200 U	200 U	--	--	--	--	--	--	--
alpha-BHC	2 U	2 U	--	--	--	--	--	--	--
alpha-Chlordane	2 U	2 U	--	--	--	--	--	--	--
beta-BHC	2 U	2 U	--	--	--	--	--	--	--
delta-BHC	2 U	2 U	--	--	--	--	--	--	--
gamma-BHC (Lindane)	2 U	2 U	--	--	--	--	--	--	--
gamma-Chlordane	2 U	2 U	--	--	--	--	--	--	--
Inorganics mg/kg									
Aluminum	0.703	1.03	--	--	--	--	--	--	--
Antimony	5.2 U	5.5 U	--	--	--	--	--	--	--
Arsenic	0.75 B	1.3 J	--	--	--	--	--	--	--
Barium	1.8 B	2.7 B	--	--	--	--	--	--	--
Beryllium	0.05 U	0.05 U	--	--	--	--	--	--	--
Cadmium	0.7 U	0.76 U	--	--	--	--	--	--	--
Calcium	1,070 B	394 B	--	--	--	--	--	--	--
Chromium	1.3 B	3.3	--	--	--	--	--	--	--
Cobalt	0.45 U	0.49 U	--	--	--	--	--	--	--
Copper	0.75 B	1.3 B	--	--	--	--	--	--	--
Iron	68.4	118	--	--	--	--	--	--	--
Lead	1.5	2.4	--	--	--	--	--	--	--
Magnesium	27.4 B	33.8 B	--	--	--	--	--	--	--
Manganese	1.1 B	1.3 B	--	--	--	--	--	--	--
Mercury	0.03 UJ	0.04 UJ	--	--	--	--	--	--	--
Nickel	2.2 U	2.3 U	--	--	--	--	--	--	--
Potassium	107 U	115 U	--	--	--	--	--	--	--
Selenium	0.53 U	0.55 U	--	--	--	--	--	--	--
Silver	0.61 U	0.66 U	--	--	--	--	--	--	--
Sodium	5.1 U	5.4 U	--	--	--	--	--	--	--
Thallium	0.42 U	0.44 U	--	--	--	--	--	--	--
Vanadium	0.79 B	0.96 B	--	--	--	--	--	--	--
Zinc	1.3 B	2.6 B	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons	--	--	--	--	--	--	--	--	--

Table D-2. Summary of Subsurface Soil Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4B02502	U4B03001	U4B03001D	U4B03002	U4B03003	U4B03003D	U4B03004	U4B03301	U4B03302
Depth	21-23	8-10	8-10	20-22	38-40	38-40	52-54	8-10	20-22
Well ID	OLD-13-25B	OLD-13-35C	OLD-13-35C	OLD-13-35C	OLD-13-35C	OLD-13-35C	OLD-13-35C	OLD-13-38C	OLD-13-38C
Sampling Date	11/18/97	12/17/97	12/17/97	12/17/97	12/17/97	12/17/97	12/17/97	12/13/97	12/13/97
Total Organic Carbon	2,400	16,000 >	16,000 >	1,790 J	1,180	2,530	1,530	15,040	3,970
Volatle Organic Compounds ug/kg									
1,1,1-Trichloroethane	--	14 U	14 U	13 U	12 U	12 U	13 U	12 U	12 U
1,1,2,2-Tetrachloroethane	--	14 U	14 U	13 U	12 U	12 U	13 U	12 U	12 U
1,1,2-Trichloroethane	--	14 U	14 U	13 U	12 U	12 U	13 U	12 U	12 U
1,1-Dichloroethane	--	14 U	14 U	13 U	12 U	12 U	13 U	12 U	12 U
1,1-Dichloroethene	--	14 U	14 U	13 U	12 U	12 U	13 U	12 U	12 U
1,2-Dichloroethane	--	14 U	14 U	13 U	12 U	12 U	13 U	12 U	12 U
1,2-Dichloroethene (total)	--	14 U	14 U	13 U	12 U	12 U	13 U	12 U	12 U
1,2-Dichloropropane	--	14 U	14 U	13 U	12 U	12 U	13 U	12 U	12 U
2-Butanone	--	14 UJ	14 U	13 UJ	12 UJ	12 U	13 UJ	12 UJ	12 UJ
2-Hexanone	--	14 UJ	14 UJ	13 UJ	12 UJ	12 UJ	13 UJ	12 U	12 U
4-Methyl-2-pentanone	--	14 U	14 U	13 U	12 U	12 U	13 U	12 U	12 U
Acetone	--	14 U	14 U	13 U	12 U	12 U	13 U	12 UJ	12 UJ
Benzene	--	14 U	14 U	13 U	12 U	12 U	13 U	12 U	12 U
Bromodichloromethane	--	14 U	14 U	13 U	12 U	12 U	13 U	12 U	12 U
Bromoform	--	14 U	14 U	13 U	12 U	12 U	13 U	12 U	12 U
Bromomethane	--	14 U	14 U	13 U	12 U	12 U	13 U	12 U	12 U
Carbon disulfide	--	14 UJ	14 UJ	13 UJ	12 UJ	12 UJ	13 UJ	12 UJ	12 UJ
Carbon tetrachloride	--	14 U	14 U	13 U	12 U	12 U	13 U	12 U	12 U
Chlorobenzene	--	14 U	14 U	13 U	12 U	12 U	13 U	12 U	12 U
Chloroethane	--	14 U	14 U	13 U	12 U	12 U	13 U	12 U	12 U
Chloroform	--	14 U	14 U	13 U	12 U	12 U	13 U	12 U	12 U
Chloromethane	--	14 UJ	14 UJ	13 UJ	12 UJ	12 UJ	13 UJ	12 U	12 U
Dibromochloromethane	--	14 U	14 U	13 U	12 U	12 U	13 U	12 U	12 U
Ethylbenzene	--	14 U	14 U	13 U	12 U	12 U	13 U	12 U	12 U
Methylene chloride	--	14 UJ	14 UJ	13 UJ	12 UJ	12 UJ	13 UJ	12 U	12 U
Styrene	--	14 U	14 U	13 U	12 U	12 U	13 U	12 U	12 U
Tetrachloroethene	--	14 U	14 U	13 U	12 U	12 U	13 U	12 U	12 U
Toluene	--	14 U	14 U	13 U	12 U	12 U	13 U	12 U	12 U
Trichloroethene	--	14 U	14 U	13 U	12 U	12 U	13 U	12 U	12 U
Vinyl chloride	--	14 UJ	14 UJ	13 UJ	12 UJ	12 UJ	13 UJ	12 U	12 U
Xylene (total)	--	14 U	14 U	13 U	12 U	12 U	13 U	12 U	12 U
cis-1,3-Dichloropropene	--	14 U	14 U	13 U	12 U	12 U	13 U	12 U	12 U
trans-1,3-Dichloropropene	--	14 U	14 U	13 U	12 U	12 U	13 U	12 U	12 U

Appendix D
Table D-2. Summary of Subsurface Soil Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID	U4B02502	U4B03001	U4B03001D	U4B03002	U4B03003	U4B03003D	U4B03004	U4B03301	U4B03302
Depth	21-23	8-10	8-10	20-22	38-40	38-40	52-54	8-10	20-22
Well ID	OLD-13-25B	OLD-13-35C	OLD-13-35C	OLD-13-35C	OLD-13-35C	OLD-13-35C	OLD-13-35C	OLD-13-38C	OLD-13-38C
Sampling Date	11/18/97	12/17/97	12/17/97	12/17/97	12/17/97	12/17/97	12/17/97	12/13/97	12/13/97
Semivolatile Organic Compounds ug/kg									
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--	--
1,2-Dichlorobenzene	--	--	--	--	--	--	--	--	--
1,3-Dichlorobenzene	--	--	--	--	--	--	--	--	--
1,4-Dichlorobenzene	--	--	--	--	--	--	--	--	--
2,2'-oxybis(1-Chloropropane)	--	--	--	--	--	--	--	--	--
2,4,5-Trichlorophenol	--	--	--	--	--	--	--	--	--
2,4,6-Trichlorophenol	--	--	--	--	--	--	--	--	--
2,4-Dichlorophenol	--	--	--	--	--	--	--	--	--
2,4-Dimethylphenol	--	--	--	--	--	--	--	--	--
2,4-Dinitrophenol	--	--	--	--	--	--	--	--	--
2,4-Dinitrotoluene	--	--	--	--	--	--	--	--	--
2,6-Dinitrotoluene	--	--	--	--	--	--	--	--	--
2-Chloronaphthalene	--	--	--	--	--	--	--	--	--
2-Chlorophenol	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	--	--	--	--	--	--	--	--	--
2-Methylphenol	--	--	--	--	--	--	--	--	--
2-Nitroaniline	--	--	--	--	--	--	--	--	--
2-Nitrophenol	--	--	--	--	--	--	--	--	--
3,3'-Dichlorobenzidine	--	--	--	--	--	--	--	--	--
3-Nitroaniline	--	--	--	--	--	--	--	--	--
4,6-Dinitro-2-methylphenol	--	--	--	--	--	--	--	--	--
4-Bromophenyl-phenylether	--	--	--	--	--	--	--	--	--
4-Chloro-3-methylphenol	--	--	--	--	--	--	--	--	--
4-Chloroaniline	--	--	--	--	--	--	--	--	--
4-Chlorophenyl-phenylether	--	--	--	--	--	--	--	--	--
4-Methylphenol	--	--	--	--	--	--	--	--	--
4-Nitroaniline	--	--	--	--	--	--	--	--	--
4-Nitrophenol	--	--	--	--	--	--	--	--	--
Acenaphthene	--	--	--	--	--	--	--	--	--
Acenaphthylene	--	--	--	--	--	--	--	--	--
Anthracene	--	--	--	--	--	--	--	--	--
Benzo(a)anthracene	--	--	--	--	--	--	--	--	--
Benzo(a)pyrene	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	--	--	--	--	--	--	--	--	--
Benzo(g,h,i)perylene	--	--	--	--	--	--	--	--	--
Benzo(k)fluoranthene	--	--	--	--	--	--	--	--	--
Butylbenzylphthalate	--	--	--	--	--	--	--	--	--
Carbazole	--	--	--	--	--	--	--	--	--
Chrysene	--	--	--	--	--	--	--	--	--

Table D-2. Summary of Subsurface Soil Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4B02502	U4B03001	U4B03001D	U4B03002	U4B03003	U4B03003D	U4B03004	U4B03301	U4B03302
Depth	21-23	8-10	8-10	20-22	38-40	38-40	52-54	8-10	20-22
Well ID	OLD-13-25B	OLD-13-35C	OLD-13-35C	OLD-13-35C	OLD-13-35C	OLD-13-35C	OLD-13-35C	OLD-13-38C	OLD-13-38C
Sampling Date	11/18/97	12/17/97	12/17/97	12/17/97	12/17/97	12/17/97	12/17/97	12/13/97	12/13/97
Di-n-butylphthalate	--	--	--	--	--	--	--	--	--
Di-n-octylphthalate	--	--	--	--	--	--	--	--	--
Dibenz(a,h)anthracene	--	--	--	--	--	--	--	--	--
Dibenzofuran	--	--	--	--	--	--	--	--	--
Diethylphthalate	--	--	--	--	--	--	--	--	--
Dimethylphthalate	--	--	--	--	--	--	--	--	--
Fluoranthene	--	--	--	--	--	--	--	--	--
Fluorene	--	--	--	--	--	--	--	--	--
Hexachlorobenzene	--	--	--	--	--	--	--	--	--
Hexachlorobutadiene	--	--	--	--	--	--	--	--	--
Hexachlorocyclopentadiene	--	--	--	--	--	--	--	--	--
Hexachloroethane	--	--	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	--	--	--	--	--	--	--	--	--
Isophorone	--	--	--	--	--	--	--	--	--
N-Nitroso-di-n-propylamine	--	--	--	--	--	--	--	--	--
N-Nitrosodiphenylamine (1)	--	--	--	--	--	--	--	--	--
Naphthalene	--	--	--	--	--	--	--	--	--
Nitrobenzene	--	--	--	--	--	--	--	--	--
Pentachlorophenol	--	--	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--	--	--
Phenol	--	--	--	--	--	--	--	--	--
Pyrene	--	--	--	--	--	--	--	--	--
bis(2-Chloroethoxy)methane	--	--	--	--	--	--	--	--	--
bis(2-Chloroethyl)ether	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	--	--	--
Pesticides/PCBs ug/kg									
4,4'-DDD	--	--	--	--	--	--	--	--	--
4,4'-DDE	--	--	--	--	--	--	--	--	--
4,4'-DDT	--	--	--	--	--	--	--	--	--
Aldrin	--	--	--	--	--	--	--	--	--
Aroclor-1016	--	--	--	--	--	--	--	--	--
Aroclor-1221	--	--	--	--	--	--	--	--	--
Aroclor-1232	--	--	--	--	--	--	--	--	--
Aroclor-1242	--	--	--	--	--	--	--	--	--
Aroclor-1248	--	--	--	--	--	--	--	--	--
Aroclor-1254	--	--	--	--	--	--	--	--	--
Aroclor-1260	--	--	--	--	--	--	--	--	--
Dieldrin	--	--	--	--	--	--	--	--	--
Endosulfan I	--	--	--	--	--	--	--	--	--
Endosulfan II	--	--	--	--	--	--	--	--	--

Appendix D
Table D-2. Summary of Subsurface Soil Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID	U4B02502	U4B03001	U4B03001D	U4B03002	U4B03003	U4B03003D	U4B03004	U4B03301	U4B03302
Depth	21-23	8-10	8-10	20-22	38-40	38-40	52-54	8-10	20-22
Well ID	OLD-13-25B	OLD-13-35C	OLD-13-35C	OLD-13-35C	OLD-13-35C	OLD-13-35C	OLD-13-35C	OLD-13-38C	OLD-13-38C
Sampling Date	11/18/97	12/17/97	12/17/97	12/17/97	12/17/97	12/17/97	12/17/97	12/13/97	12/13/97
Endosulfan sulfate	--	--	--	--	--	--	--	--	--
Endrin	--	--	--	--	--	--	--	--	--
Endrin aldehyde	--	--	--	--	--	--	--	--	--
Endrin ketone	--	--	--	--	--	--	--	--	--
Heptachlor	--	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	--	--	--	--
Methoxychlor	--	--	--	--	--	--	--	--	--
Toxaphene	--	--	--	--	--	--	--	--	--
alpha-BHC	--	--	--	--	--	--	--	--	--
alpha-Chlordane	--	--	--	--	--	--	--	--	--
beta-BHC	--	--	--	--	--	--	--	--	--
delta-BHC	--	--	--	--	--	--	--	--	--
gamma-BHC (Lindane)	--	--	--	--	--	--	--	--	--
gamma-Chlordane	--	--	--	--	--	--	--	--	--
Inorganics mg/kg									
Aluminum	--	18,800	15,800	2,590	2,110	1,790	2,170	370	2,670
Antimony	--	0.51 U	0.52 U	0.48 U	0.5 U	0.48 U	0.5 U	0.48 U	0.46 U
Arsenic	--	0.97 J	0.57 U	0.53 U	0.55 U	0.53 U	1.5 J	0.52 U	0.5 U
Barium	--	135	85.9	54.5	28.3 J	25 J	35.7 J	4.6 J	33.3 J
Beryllium	--	0.19 U	0.15 U	0.09 U	0.19 U	0.17 U	0.52 J	0.02 U	0.06 U
Cadmium	--	0.13 U	0.13 U	0.12 U	0.13 U	0.12 U	0.12 U	0.12 U	0.11 U
Calcium	--	608 U	272 U	386 U	328 U	305 U	3,020	156 U	213 U
Chromium	--	20.9 J	18.5 J	3 J	3.3 J	2.8 J	3.7 J	1.2 J	3.1 J
Cobalt	--	0.36 J	0.41 J	0.12 U	0.13 U	0.12 U	0.78 J	0.12 U	0.11 U
Copper	--	2.1 J	2.6 J	0.67 U	1 J	0.72 U	0.86 J	0.93 J	0.92 J
Iron	--	493 J	513 J	45.1 J	79.7 J	55.6 J	1,050 J	15.5 U	47.3 J
Lead	--	6.1 J	7 J	1.6 U	1.4 U	1.6 U	2.3 J	3.7 J	2 U
Magnesium	--	89.7 U	82.6 U	27.1 U	23.9 U	21.7 U	39.5 U	15.9 U	23.4 U
Manganese	--	1.3 J	2 J	0.45 J	0.47 J	0.53 J	2.1 J	0.38 U	0.28 J
Mercury	--	0.06 U	0.24	0.05 U	0.05 U	0.04 U	0.06 U	0.04 UJ	0.05 UJ
Nickel	--	0.72 J	0.74 J	0.26 U	0.28 U	0.27 U	1.9 J	0.26 U	0.25 U
Potassium	--	66.9 U	63 U	18.3 U	27.7 U	12.2 U	16.8 U	8.6 U	15.4 U
Selenium	--	1 U	1.2 J	0.96 U	1 U	0.96 U	1 U	0.95 U	0.91 U
Silver	--	0.18 U	0.18 U	0.17 U	0.18 U	0.17 U	0.17 U	0.17 U	0.16 U
Sodium	--	111 U	120 U	114 U	165 U	117 U	108 U	73.4 U	173 U
Thallium	--	0.94 U	0.96 U	0.89 U	0.93 U	0.89 U	0.92 U	0.88 U	0.85 U
Vanadium	--	7.2 J	5.9 J	1.2 J	2.7 J	2.2 J	2.7 J	1.2 J	1.2 J
Zinc	--	7.8 U	4.3 U	4 U	4.2 U	6.7 U	4.2 U	4 U	3.8 U
Total Petroleum Hydrocarbons	--	--	--	--	--	--	--	--	--

Table D-2. Summary of Subsurface Soil Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4B03303	U4B03304	U4B03501	U4B03502	U4B03601	U4B03602
Depth	38-40	56-58	15-17	23-25	12-14	25-27
Well ID	OLD-13-38C	OLD-13-38C	OLD-13-40B	OLD-13-40B	OLD-13-41B	OLD-13-41B
Sampling Date	12/13/97	12/13/97	12/15/97	12/15/97	12/14/97	12/15/97
Total Organic Carbon	1,530	4,480	560	5,220	553	8,070
Volatile Organic Compounds ug/kg						
1,1,1-Trichloroethane	12 U					
1,1,2,2-Tetrachloroethane	12 U					
1,1,2-Trichloroethane	12 U					
1,1-Dichloroethane	12 U					
1,1-Dichloroethene	12 U					
1,2-Dichloroethane	12 U					
1,2-Dichloroethene (total)	12 U					
1,2-Dichloropropane	12 U					
2-Butanone	12 UJ	12 UJ	12 UJ	12 U	12 UJ	12 UJ
2-Hexanone	12 U	12 U	12 U	12 U	12 UJ	12 U
4-Methyl-2-pentanone	12 U					
Acetone	12 UJ					
Benzene	12 U					
Bromodichloromethane	12 U					
Bromoform	12 U					
Bromomethane	12 U					
Carbon disulfide	12 UJ					
Carbon tetrachloride	12 U					
Chlorobenzene	12 U					
Chloroethane	12 U					
Chloroform	12 U					
Chloromethane	12 U	12 U	12 U	12 U	12 UJ	12 U
Dibromochloromethane	12 U					
Ethylbenzene	12 U					
Methylene chloride	12 U	12 U	15 U	13 U	12 U	12 U
Styrene	12 U					
Tetrachloroethene	12 U	12 U	12 U	12 U	49	3 J
Toluene	12 U					
Trichloroethene	12 U	1 J				
Vinyl chloride	12 U	12 U	12 U	12 U	12 UJ	12 U
Xylene (total)	12 U					
cis-1,3-Dichloropropene	12 U					
trans-1,3-Dichloropropene	12 U					

Appendix D

Table D-2. Summary of Subsurface Soil Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID	U4B03303	U4B03304	U4B03501	U4B03502	U4B03601	U4B03602
Depth	38-40	56-58	15-17	23-25	12-14	25-27
Well ID	OLD-13-38C	OLD-13-38C	OLD-13-40B	OLD-13-40B	OLD-13-41B	OLD-13-41B
Sampling Date	12/13/97	12/13/97	12/15/97	12/15/97	12/14/97	12/15/97
Semivolatile Organic Compounds ug/kg						
1,2,4-Trichlorobenzene	--	--	--	--	--	--
1,2-Dichlorobenzene	--	--	--	--	--	--
1,3-Dichlorobenzene	--	--	--	--	--	--
1,4-Dichlorobenzene	--	--	--	--	--	--
2,2'-oxybis(1-Chloropropane)	--	--	--	--	--	--
2,4,5-Trichlorophenol	--	--	--	--	--	--
2,4,6-Trichlorophenol	--	--	--	--	--	--
2,4-Dichlorophenol	--	--	--	--	--	--
2,4-Dimethylphenol	--	--	--	--	--	--
2,4-Dinitrophenol	--	--	--	--	--	--
2,4-Dinitrotoluene	--	--	--	--	--	--
2,6-Dinitrotoluene	--	--	--	--	--	--
2-Chloronaphthalene	--	--	--	--	--	--
2-Chlorophenol	--	--	--	--	--	--
2-Methylnaphthalene	--	--	--	--	--	--
2-Methylphenol	--	--	--	--	--	--
2-Nitroaniline	--	--	--	--	--	--
2-Nitrophenol	--	--	--	--	--	--
3,3'-Dichlorobenzidine	--	--	--	--	--	--
3-Nitroaniline	--	--	--	--	--	--
4,6-Dinitro-2-methylphenol	--	--	--	--	--	--
4-Bromophenyl-phenylether	--	--	--	--	--	--
4-Chloro-3-methylphenol	--	--	--	--	--	--
4-Chloroaniline	--	--	--	--	--	--
4-Chlorophenyl-phenylether	--	--	--	--	--	--
4-Methylphenol	--	--	--	--	--	--
4-Nitroaniline	--	--	--	--	--	--
4-Nitrophenol	--	--	--	--	--	--
Acenaphthene	--	--	--	--	--	--
Acenaphthylene	--	--	--	--	--	--
Anthracene	--	--	--	--	--	--
Benzo(a)anthracene	--	--	--	--	--	--
Benzo(a)pyrene	--	--	--	--	--	--
Benzo(b)fluoranthene	--	--	--	--	--	--
Benzo(g,h,i)perylene	--	--	--	--	--	--
Benzo(k)fluoranthene	--	--	--	--	--	--
Butylbenzylphthalate	--	--	--	--	--	--
Carbazole	--	--	--	--	--	--
Chrysene	--	--	--	--	--	--

Table D-2. Summary of Subsurface Soil Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4B03303	U4B03304	U4B03501	U4B03502	U4B03601	U4B03602
Depth	38-40	56-58	15-17	23-25	12-14	25-27
Well ID	OLD-13-38C	OLD-13-38C	OLD-13-40B	OLD-13-40B	OLD-13-41B	OLD-13-41B
Sampling Date	12/13/97	12/13/97	12/15/97	12/15/97	12/14/97	12/15/97
Di-n-butylphthalate	--	--	--	--	--	--
Di-n-octylphthalate	--	--	--	--	--	--
Dibenz(a,h)anthracene	--	--	--	--	--	--
Dibenzofuran	--	--	--	--	--	--
Diethylphthalate	--	--	--	--	--	--
Dimethylphthalate	--	--	--	--	--	--
Fluoranthene	--	--	--	--	--	--
Fluorene	--	--	--	--	--	--
Hexachlorobenzene	--	--	--	--	--	--
Hexachlorobutadiene	--	--	--	--	--	--
Hexachlorocyclopentadiene	--	--	--	--	--	--
Hexachloroethane	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	--	--	--	--	--	--
Isophorone	--	--	--	--	--	--
N-Nitroso-di-n-propylamine	--	--	--	--	--	--
N-Nitrosodiphenylamine (1)	--	--	--	--	--	--
Naphthalene	--	--	--	--	--	--
Nitrobenzene	--	--	--	--	--	--
Pentachlorophenol	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--
Phenol	--	--	--	--	--	--
Pyrene	--	--	--	--	--	--
bis(2-Chloroethoxy)methane	--	--	--	--	--	--
bis(2-Chloroethyl)ether	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--
Pesticides/PCBs ug/kg						
4,4'-DDD	--	--	--	--	--	--
4,4'-DDE	--	--	--	--	--	--
4,4'-DDT	--	--	--	--	--	--
Aldrin	--	--	--	--	--	--
Aroclor-1016	--	--	--	--	--	--
Aroclor-1221	--	--	--	--	--	--
Aroclor-1232	--	--	--	--	--	--
Aroclor-1242	--	--	--	--	--	--
Aroclor-1248	--	--	--	--	--	--
Aroclor-1254	--	--	--	--	--	--
Aroclor-1260	--	--	--	--	--	--
Dieldrin	--	--	--	--	--	--
Endosulfan I	--	--	--	--	--	--
Endosulfan II	--	--	--	--	--	--

Appendix D
Table D-2. Summary of Subsurface Soil Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID	U4B03303	U4B03304	U4B03501	U4B03502	U4B03601	U4B03602
Depth	38-40	56-58	15-17	23-25	12-14	25-27
Well ID	OLD-13-38C	OLD-13-38C	OLD-13-40B	OLD-13-40B	OLD-13-41B	OLD-13-41B
Sampling Date	12/13/97	12/13/97	12/15/97	12/15/97	12/14/97	12/15/97
Endosulfan sulfate	--	--	--	--	--	--
Endrin	--	--	--	--	--	--
Endrin aldehyde	--	--	--	--	--	--
Endrin ketone	--	--	--	--	--	--
Heptachlor	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	--
Methoxychlor	--	--	--	--	--	--
Toxaphene	--	--	--	--	--	--
alpha-BHC	--	--	--	--	--	--
alpha-Chlordane	--	--	--	--	--	--
beta-BHC	--	--	--	--	--	--
delta-BHC	--	--	--	--	--	--
gamma-BHC (Lindane)	--	--	--	--	--	--
gamma-Chlordane	--	--	--	--	--	--
Inorganics mg/kg						
Aluminum	1,170	5,080	40.1 J	4,930	118	1,380
Antimony	0.44 U	0.46 U	0.48 U	0.46 U	0.45 U	0.46 U
Arsenic	0.49 U	4.7	0.53 U	0.51 U	0.5 U	0.51 U
Barium	20.9 J	32 J	0.27 U	92.4	0.3 U	20.5 J
Beryllium	0.06 U	0.6 J	0.02 U	0.22 J	0.03 U	0.04 U
Cadmium	0.11 U	0.4 J	0.12 U	0.12 U	0.11 U	0.12 U
Calcium	146 U	21,200	97.9 U	410 U	65.4 U	162 U
Chromium	2.2 J	10.6 J	0.87 J	6.1 J	0.38 J	2 J
Cobalt	0.11 U	1.1 J	0.12 U	0.12 U	0.11 U	0.12 U
Copper	0.51 U	3.1 J	0.51 U	1.1 J	0.47 U	0.83 J
Iron	63.3 J	4,700 J	143 J	177 J	9.7 U	60.5 J
Lead	1.2 U	4.2 J	0.53 U	4.8 J	0.57 U	1.6 U
Magnesium	14.3 U	215 U	14.6 U	45.9 U	14.8 U	20.6 U
Manganese	0.75 J	14.8	1.3 J	0.31 J	0.23 U	0.42 J
Mercury	0.05 UJ	0.06 UJ	0.05 UJ	0.07 J	0.05 U	0.05 U
Nickel	0.24 U	3.5 J	0.26 U	0.57 J	0.25 U	0.25 U
Potassium	14.3 U	104 U	8.7 U	26.2 U	8.1 U	12.3 U
Selenium	0.88 U	0.92 U	0.96 U	0.92 U	0.9 U	0.92 U
Silver	0.15 U	0.16 U	0.17 U	0.16 U	0.16 U	0.16 U
Sodium	147 U	124 U	118 U	131 U	113 U	140 U
Thallium	0.82 U	0.85 U	0.89 U	0.85 U	0.84 U	0.85 U
Vanadium	1.1 J	13.8	0.28 J	2.6 J	0.73 J	1.1 J
Zinc	3.7 U	9 U	4 U	3.9 U	3.8 U	3.9 U
Total Petroleum Hydrocarbons	--	--	--	--	--	--

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	12G00102	12G00202	12G00302	12G00402	13G00103	13G00203	13G00303	13G00403	14G00102	14G00203
Well ID	OLD-12-01A	OLD-12-02A	OLD-12-03A	OLD-12-04A	OLD-13-01A	OLD-13-02C	OLD-13-03A	OLD-13-04C	OLD-14-01A	OLD-14-02A
Sampling Date	2/10/98	2/10/98	2/10/98	2/10/98	2/12/98	2/12/98	2/11/98	2/11/98	2/10/98	2/10/98
Volatile Organic Compounds ug/L										
1,1,1,2-Tetrachloroethane	--	--	--	--	--	--	--	--	--	--
1,1,1-Trichloroethane	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Tetrachloroethane	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloropropene	--	--	--	--	--	--	--	--	--	--
1,2,3-Trichloropropane	--	--	--	--	--	--	--	--	--	--
1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--	--
1,2-Dichloroethane	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--	--
1,3-Dichloropropane	--	--	--	--	--	--	--	--	--	--
2,2-Dichloropropane	--	--	--	--	--	--	--	--	--	--
2-Chlorotoluene	--	--	--	--	--	--	--	--	--	--
2-Hexanone	5 U	5 U	--	5 U	31 U	5 U	5 U	5 U	--	--
4-Chlorotoluene	--	--	--	--	--	--	--	--	--	--
4-Methyl-2-pentanone	5 U	5 U	5 U	5 U	31 U	5 U	5 U	5 U	5 U	5 U
Benzene	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
Bromobenzene	--	--	--	--	--	--	--	--	--	--
Bromochloromethane	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
Bromodichloromethane	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
Bromoform	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
Bromomethane	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
Carbon disulfide	1 U	1 U	1 U	1 U	6 UJ	1 UJ	1 U	1 U	1 U	1 U
Carbon tetrachloride	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
Chloroethane	1 U	1 UJ	1 U	1 U	6 UJ	1 UJ	1 U	1 U	1 U	1 U
Chloroform	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
Chloromethane	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
Dibromochloromethane	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
Dibromomethane	--	--	--	--	--	--	--	--	--	--
Dichlorodifluoromethane	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
Isopropylbenzene	--	--	--	--	--	--	--	--	--	--

Appendix D
Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	12G00102	12G00202	12G00302	12G00402	13G00103	13G00203	13G00303	13G00403	14G00102	14G00203
Well ID	OLD-12-01A	OLD-12-02A	OLD-12-03A	OLD-12-04A	OLD-13-01A	OLD-13-02C	OLD-13-03A	OLD-13-04C	OLD-14-01A	OLD-14-02A
Sampling Date	2/10/98	2/10/98	2/10/98	2/10/98	2/12/98	2/12/98	2/11/98	2/11/98	2/10/98	2/10/98
Methyl-tert-butyl ether	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
Methylene chloride	2 U	2 U	2 U	2 U	12 U	2 U	2 U	2 U	2 U	2 U
Styrene	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
Tetrachloroethene	2	1 U	1 U	1 U	120	3	16	1 U	1 U	2
Toluene	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	1 U	1 U	1 U	1 U	7	1 U	2	1 U	1 U	1 U
Trichlorofluoromethane	--	--	--	--	--	--	--	--	--	--
Vinyl chloride	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
Xylene (total)	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	1 U	1 U	1 U	1 U	6	1 U	4	1 U	1 U	1 U
cis-1,3-Dichloropropene	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
n-Butylbenzene	--	--	--	--	--	--	--	--	--	--
n-Propylbenzene	--	--	--	--	--	--	--	--	--	--
sec-Butylbenzene	--	--	--	--	--	--	--	--	--	--
t-Butylbenzene	--	--	--	--	--	--	--	--	--	--
trans-1,2-Dichloroethene	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
trans-1,3-Dichloropropene	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
Semivolatile Organic Compounds ug/L										
1,2,3-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--
1,2,4-Trichlorobenzene	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
1,2-Dibromoethane	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
1,3-Dichlorobenzene	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
1,4-Dichlorobenzene	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
2,2'-oxybis(1-Chloropropane)	--	--	--	--	--	--	--	--	--	--
2,4,5-Trichlorophenol	--	--	--	--	--	--	--	--	--	--
2,4,6-Trichlorophenol	--	--	--	--	--	--	--	--	--	--
2,4-Dichlorophenol	--	--	--	--	--	--	--	--	--	--
2,4-Dimethylphenol	--	--	--	--	--	--	--	--	--	--
2,4-Dinitrophenol	--	--	--	--	--	--	--	--	--	--
2,4-Dinitrotoluene	--	--	--	--	--	--	--	--	--	--
2,6-Dinitrotoluene	--	--	--	--	--	--	--	--	--	--
2-Chloronaphthalene	--	--	--	--	--	--	--	--	--	--
2-Chlorophenol	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	--	--	--	--	--	--	--	--	--	--
2-Methylphenol	--	--	--	--	--	--	--	--	--	--

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	12G00102	12G00202	12G00302	12G00402	13G00103	13G00203	13G00303	13G00403	14G00102	14G00203
Well ID	OLD-12-01A	OLD-12-02A	OLD-12-03A	OLD-12-04A	OLD-13-01A	OLD-13-02C	OLD-13-03A	OLD-13-04C	OLD-14-01A	OLD-14-02A
Sampling Date	2/10/98	2/10/98	2/10/98	2/10/98	2/12/98	2/12/98	2/11/98	2/11/98	2/10/98	2/10/98
2-Nitroaniline	--	--	--	--	--	--	--	--	--	--
2-Nitrophenol	--	--	--	--	--	--	--	--	--	--
3,3'-Dichlorobenzidine	--	--	--	--	--	--	--	--	--	--
3-Nitroaniline	--	--	--	--	--	--	--	--	--	--
4,6-Dinitro-2-methylphenol	--	--	--	--	--	--	--	--	--	--
4-Bromophenyl-phenylether	--	--	--	--	--	--	--	--	--	--
4-Chloro-3-methylphenol	--	--	--	--	--	--	--	--	--	--
4-Chloroaniline	--	--	--	--	--	--	--	--	--	--
4-Chlorophenyl-phenylether	--	--	--	--	--	--	--	--	--	--
4-Methylphenol	--	--	--	--	--	--	--	--	--	--
4-Nitroaniline	--	--	--	--	--	--	--	--	--	--
4-Nitrophenol	--	--	--	--	--	--	--	--	--	--
Acenaphthene	--	--	--	--	--	--	--	--	--	--
Acenaphthylene	--	--	--	--	--	--	--	--	--	--
Anthracene	--	--	--	--	--	--	--	--	--	--
Benzo(a)anthracene	--	--	--	--	--	--	--	--	--	--
Benzo(a)pyrene	--	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	--	--	--	--	--	--	--	--	--	--
Benzo(g,h,i)perylene	--	--	--	--	--	--	--	--	--	--
Benzo(k)fluoranthene	--	--	--	--	--	--	--	--	--	--
Butylbenzylphthalate	--	--	--	--	--	--	--	--	--	--
Carbazole	--	--	--	--	--	--	--	--	--	--
Chrysene	--	--	--	--	--	--	--	--	--	--
Di-n-butylphthalate	--	--	--	--	--	--	--	--	--	--
Di-n-octylphthalate	--	--	--	--	--	--	--	--	--	--
Dibenz(a,h)anthracene	--	--	--	--	--	--	--	--	--	--
Dibenzofuran	--	--	--	--	--	--	--	--	--	--
Diethylphthalate	--	--	--	--	--	--	--	--	--	--
Dimethylphthalate	--	--	--	--	--	--	--	--	--	--
Fluoranthene	--	--	--	--	--	--	--	--	--	--
Fluorene	--	--	--	--	--	--	--	--	--	--
Hexachlorobenzene	--	--	--	--	--	--	--	--	--	--
Hexachlorobutadiene	--	--	--	--	--	--	--	--	--	--
Hexachlorocyclopentadiene	--	--	--	--	--	--	--	--	--	--
Hexachloroethane	--	--	--	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	--	--	--	--	--	--	--	--	--	--

Appendix D
Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	12G00102	12G00202	12G00302	12G00402	13G00103	13G00203	13G00303	13G00403	14G00102	14G00203
Well ID	OLD-12-01A	OLD-12-02A	OLD-12-03A	OLD-12-04A	OLD-13-01A	OLD-13-02C	OLD-13-03A	OLD-13-04C	OLD-14-01A	OLD-14-02A
Sampling Date	2/10/98	2/10/98	2/10/98	2/10/98	2/12/98	2/12/98	2/11/98	2/11/98	2/10/98	2/10/98
Isophorone	--	--	--	--	--	--	--	--	--	--
N-Nitroso-di-n-propylamine	--	--	--	--	--	--	--	--	--	--
N-Nitrosodiphenylamine (1)	--	--	--	--	--	--	--	--	--	--
Naphthalene	--	--	--	--	--	--	--	--	--	--
Nitrobenzene	--	--	--	--	--	--	--	--	--	--
Pentachlorophenol	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--	--	--	--
Phenol	--	--	--	--	--	--	--	--	--	--
Pyrene	--	--	--	--	--	--	--	--	--	--
bis(2-Chloroethoxy)methane	--	--	--	--	--	--	--	--	--	--
bis(2-Chloroethyl)ether	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	--	--	--	--
p-Isopropyltoluene	--	--	--	--	--	--	--	--	--	--
Pesticides/PCBs ug/L										
1,2-Dibromo-3-chloropropane	1 U	1 U	1 U	1 U	6 U	1 U	1 U	1 U	1 U	1 U
4,4'-DDD	--	--	--	--	--	--	--	--	--	--
4,4'-DDE	--	--	--	--	--	--	--	--	--	--
4,4'-DDT	--	--	--	--	--	--	--	--	--	--
Aldrin	--	--	--	--	--	--	--	--	--	--
Aroclor-1016	--	--	--	--	--	--	--	--	--	--
Aroclor-1221	--	--	--	--	--	--	--	--	--	--
Aroclor-1232	--	--	--	--	--	--	--	--	--	--
Aroclor-1242	--	--	--	--	--	--	--	--	--	--
Aroclor-1248	--	--	--	--	--	--	--	--	--	--
Aroclor-1254	--	--	--	--	--	--	--	--	--	--
Aroclor-1260	--	--	--	--	--	--	--	--	--	--
Dieldrin	--	--	--	--	--	--	--	--	--	--
Endosulfan I	--	--	--	--	--	--	--	--	--	--
Endosulfan II	--	--	--	--	--	--	--	--	--	--
Endosulfan sulfate	--	--	--	--	--	--	--	--	--	--
Endrin	--	--	--	--	--	--	--	--	--	--
Endrin aldehyde	--	--	--	--	--	--	--	--	--	--
Endrin ketone	--	--	--	--	--	--	--	--	--	--
Heptachlor	--	--	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	--	--	--	--	--
Methoxychlor	--	--	--	--	--	--	--	--	--	--

Appendix D

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID	12G00102	12G00202	12G00302	12G00402	13G00103	13G00203	13G00303	13G00403	14G00102	14G00203
Well ID	OLD-12-01A	OLD-12-02A	OLD-12-03A	OLD-12-04A	OLD-13-01A	OLD-13-02C	OLD-13-03A	OLD-13-04C	OLD-14-01A	OLD-14-02A
Sampling Date	2/10/98	2/10/98	2/10/98	2/10/98	2/12/98	2/12/98	2/11/98	2/11/98	2/10/98	2/10/98
Toxaphene	--	--	--	--	--	--	--	--	--	--
alpha-BHC	--	--	--	--	--	--	--	--	--	--
alpha-Chlordane	--	--	--	--	--	--	--	--	--	--
beta-BHC	--	--	--	--	--	--	--	--	--	--
delta-BHC	--	--	--	--	--	--	--	--	--	--
gamma-BHC (Lindane)	--	--	--	--	--	--	--	--	--	--
gamma-Chlordane	--	--	--	--	--	--	--	--	--	--
Inorganics ug/L										
Aluminum	1,490	1,340	697	404	488	748	92.1 U	328	144 J	98.3 U
Antimony	3.6 J	3.3 U	2.5 U	4 U	3.4 U	2.5 U	2.6 U	2.5 U	2.5 U	4.7 J
Arsenic	3.1 U									
Barium	16.6 J	5.2 J	9 J	4.2 J	4.1 J	13.7 J	2.9 J	11.5 J	15.8 J	1.7 J
Beryllium	0.53 U	0.34 U	0.3 U	0.61 U	0.57 U	0.66 U	0.62 U	0.65 U	0.3 U	0.3 U
Cadmium	0.3 U									
Calcium	60,000 U	19,200 U	19,300 U	23,000 U	37,400 U	4,780 U	64,700 U	11,700 U	34,700 U	45,100 U
Chromium	3.5 J	3.6	1 J	1.3 J	1.5 J	1.9 J	0.9 U	1.1 J	0.9 U	0.9 U
Cobalt	0.8 U									
Copper	0.7 U	1.9 U	0.7 U	1.1 U	0.7 U					
Iron	58.2 J	33.7 J	15.7 U	23.7 J	35.3 J	1,180	15.7 U	1,210	1,100	15.7 U
Lead	3.5 U	2.2 U	1.6 U	1.9 U	3.4 U	1.6 U	1.6 U	2.1 U	1.6 U	1.6 U
Magnesium	6,090 U	1,850 U	4,020 U	1,000 U	735 U	3,310 U	2,070 U	2,620 U	1,180 U	1,520 U
Manganese	1.1 U	0.77 U	20.4 U	0.99 U	0.53 U	2.6 U	0.24 U	4.5 U	5.5 U	0.28 U
Mercury	0.1 U									
Nickel	1.6 J	1.2 U	1.3 J	1.2 U						
Potassium	1,530 U	2,480 U	10,700	627 U	205 U	1,710 U	639 U	3,270 U	1,040 U	840 U
Selenium	3.6 U									
Silver	0.7 U									
Sodium	20,900 U	3,160 U	1,120,000	3,270 U	1,640 U	13,300 U	4,000 U	14,600 U	2,920 U	8,900 U
Thallium	4.2 U									
Vanadium	--	7.4 J	2.6 J	--	--	--	--	--	2.2 J	6.5 J
Zinc	1 U	1 U	1 U	1 U	1 U	1 U	1 U	4.3 U	4.2 U	1 U

Appendix D
Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	14G00203D	14G00304	14G00403	14G00501	14G00601	14G00701	14G00801	13G00706	13G00708	13G00709
Well ID	OLD-14-02A	OLD-14-03A	OLD-14-04A	OLD-14-05A	OLD-14-06A	OLD-14-07A	OLD-14-08A	OLD-13-07A	OLD-13-07A	OLD-13-07A
Sampling Date	2/10/98	2/09/98	2/10/98	2/10/98	2/10/98	2/09/98	2/10/98	1/27/98	2/12/98	2/20/98
Volatile Organic Compounds ug/L										
1,1,1,2-Tetrachloroethane	--	--	--	--	--	--	--	1,000 U	--	1,000 U
1,1,1-Trichloroethane	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
1,1,2,2-Tetrachloroethane	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
1,1,2-Trichloroethane	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
1,1-Dichloroethane	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
1,1-Dichloroethene	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
1,1-Dichloropropene	--	--	--	--	--	--	--	1,000 U	--	1,000 U
1,2,3-Trichloropropane	--	--	--	--	--	--	--	1,000 U	--	1,000 U
1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	1,000 U	--	1,000 U
1,2-Dichloroethane	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
1,2-Dichloropropane	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	1,000 U	--	1,000 U
1,3-Dichloropropane	--	--	--	--	--	--	--	1,000 U	--	1,000 U
2,2-Dichloropropane	--	--	--	--	--	--	--	1,000 U	--	1,000 U
2-Chlorotoluene	--	--	--	--	--	--	--	1,000 U	--	1,000 U
2-Hexanone	5 U	5 U	8 U	5 U	--	5 U	5 U	--	12,000 U	--
4-Chlorotoluene	--	--	--	--	--	--	--	1,000 U	--	1,000 U
4-Methyl-2-pentanone	5 U	5 U	8 U	5 U	5 U	5 U	5 U	--	12,000 U	--
Benzene	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
Bromobenzene	--	--	--	--	--	--	--	1,000 U	--	1,000 U
Bromochloromethane	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
Bromodichloromethane	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
Bromoform	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
Bromomethane	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
Carbon disulfide	1 U	1 U	2 U	1 U	1 U	1 U	1 U	--	2,500 U	--
Carbon tetrachloride	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
Chlorobenzene	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
Chloroethane	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
Chloroform	1 U	1 U	2 U	1 U	4	1 U	1 U	1,000 U	2,500 U	1,000 U
Chloromethane	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
Dibromochloromethane	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
Dibromomethane	--	--	--	--	--	--	--	1,000 U	--	1,000 U
Dichlorodifluoromethane	--	--	--	--	--	--	--	1,000 U	--	1,000 U
Ethylbenzene	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
Isopropylbenzene	--	--	--	--	--	--	--	1,000 U	--	1,000 U

Appendix D

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	14G00203D	14G00304	14G00403	14G00501	14G00601	14G00701	14G00801	13G00706	13G00708	13G00709
Well ID	OLD-14-02A	OLD-14-03A	OLD-14-04A	OLD-14-05A	OLD-14-06A	OLD-14-07A	OLD-14-08A	OLD-13-07A	OLD-13-07A	OLD-13-07A
Sampling Date	2/10/98	2/09/98	2/10/98	2/10/98	2/10/98	2/09/98	2/10/98	1/27/98	2/12/98	2/20/98
Methyl-tert-butyl ether	1 U	1 U	2 U	1 U	1 U	1 U	1 U	--	2,500 U	--
Methylene chloride	2 U	2 U	3 U	2 U	2 U	2 U	2 U	5,000 U	5,000 U	5,000 U
Styrene	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
Tetrachloroethene	2	1 U	28	1	1 U	1 U	1 U	34,000	34,000	33,000
Toluene	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
Trichloroethene	1 U	1 U	2	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
Trichlorofluoromethane	--	--	--	--	--	--	--	1,000 U	--	1,000 U
Vinyl chloride	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
Xylene (total)	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
cis-1,2-Dichloroethene	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
cis-1,3-Dichloropropene	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
n-Butylbenzene	--	--	--	--	--	--	--	1,000 U	--	1,000 U
n-Propylbenzene	--	--	--	--	--	--	--	1,000 U	--	1,000 U
sec-Butylbenzene	--	--	--	--	--	--	--	1,000 U	--	1,000 U
t-Butylbenzene	--	--	--	--	--	--	--	1,000 U	--	1,000 U
trans-1,2-Dichloroethene	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
trans-1,3-Dichloropropene	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
Semivolatile Organic Compounds ug/L										
1,2,3-Trichlorobenzene	--	--	--	--	--	--	--	1,000 U	--	1,000 U
1,2,4-Trichlorobenzene	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	10 U	1,000 U
1,2-Dibromoethane	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
1,2-Dichlorobenzene	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	10 U	1,000 U
1,3-Dichlorobenzene	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	10 U	1,000 U
1,4-Dichlorobenzene	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	10 U	1,000 U
2,2'-oxybis(1-Chloropropane)	--	--	--	--	--	10 U	--	--	10 U	--
2,4,5-Trichlorophenol	--	--	--	--	--	25 U	--	--	25 U	--
2,4,6-Trichlorophenol	--	--	--	--	--	10 U	--	--	10 U	--
2,4-Dichlorophenol	--	--	--	--	--	10 U	--	--	10 U	--
2,4-Dimethylphenol	--	--	--	--	--	10 U	--	--	10 U	--
2,4-Dinitrophenol	--	--	--	--	--	25 UJ	--	--	25 UJ	--
2,4-Dinitrotoluene	--	--	--	--	--	10 U	--	--	10 U	--
2,6-Dinitrotoluene	--	--	--	--	--	10 UJ	--	--	10 U	--
2-Chloronaphthalene	--	--	--	--	--	10 U	--	--	10 U	--
2-Chlorophenol	--	--	--	--	--	10 U	--	--	10 U	--
2-Methylnaphthalene	--	--	--	--	--	10 U	--	--	10 U	--
2-Methylphenol	--	--	--	--	--	10 U	--	--	10 U	--

Appendix D
Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID	14G00203D	14G00304	14G00403	14G00501	14G00601	14G00701	14G00801	13G00708	13G00708	13G00709
Well ID	OLD-14-02A	OLD-14-03A	OLD-14-04A	OLD-14-05A	OLD-14-06A	OLD-14-07A	OLD-14-08A	OLD-13-07A	OLD-13-07A	OLD-13-07A
Sampling Date	2/10/98	2/09/98	2/10/98	2/10/98	2/10/98	2/09/98	2/10/98	1/27/98	2/12/98	2/20/98
2-Nitroaniline	--	--	--	--	--	25 U	--	--	25 U	--
2-Nitrophenol	--	--	--	--	--	10 U	--	--	10 U	--
3,3'-Dichlorobenzidine	--	--	--	--	--	10 U	--	--	10 U	--
3-Nitroaniline	--	--	--	--	--	25 U	--	--	25 U	--
4,6-Dinitro-2-methylphenol	--	--	--	--	--	25 UJ	--	--	25 UJ	--
4-Bromophenyl-phenylether	--	--	--	--	--	10 U	--	--	10 U	--
4-Chloro-3-methylphenol	--	--	--	--	--	10 U	--	--	10 U	--
4-Chloroaniline	--	--	--	--	--	10 U	--	--	10 U	--
4-Chlorophenyl-phenylether	--	--	--	--	--	10 U	--	--	10 U	--
4-Methylphenol	--	--	--	--	--	10 U	--	--	10 U	--
4-Nitroaniline	--	--	--	--	--	25 U	--	--	25 U	--
4-Nitrophenol	--	--	--	--	--	25 U	--	--	25 UJ	--
Acenaphthene	--	--	--	--	--	10 U	--	--	10 U	--
Acenaphthylene	--	--	--	--	--	10 U	--	--	10 U	--
Anthracene	--	--	--	--	--	10 U	--	--	10 U	--
Benzo(a)anthracene	--	--	--	--	--	10 U	--	--	10 U	--
Benzo(a)pyrene	--	--	--	--	--	10 U	--	--	10 U	--
Benzo(b)fluoranthene	--	--	--	--	--	10 U	--	--	10 U	--
Benzo(g,h,i)perylene	--	--	--	--	--	10 U	--	--	10 U	--
Benzo(k)fluoranthene	--	--	--	--	--	10 U	--	--	10 U	--
Butylbenzylphthalate	--	--	--	--	--	10 U	--	--	10 U	--
Carbazole	--	--	--	--	--	10 U	--	--	10 U	--
Chrysene	--	--	--	--	--	10 U	--	--	10 U	--
Di-n-butylphthalate	--	--	--	--	--	10 U	--	--	10 U	--
Di-n-octylphthalate	--	--	--	--	--	10 U	--	--	10 UJ	--
Dibenz(a,h)anthracene	--	--	--	--	--	10 U	--	--	10 U	--
Dibenzofuran	--	--	--	--	--	10 U	--	--	10 U	--
Diethylphthalate	--	--	--	--	--	10 U	--	--	10 U	--
Dimethylphthalate	--	--	--	--	--	10 U	--	--	10 U	--
Fluoranthene	--	--	--	--	--	10 U	--	--	10 U	--
Fluorene	--	--	--	--	--	10 U	--	--	10 U	--
Hexachlorobenzene	--	--	--	--	--	10 U	--	--	10 UJ	--
Hexachlorobutadiene	--	--	--	--	--	10 U	--	1,000 U	10 UJ	1,000 U
Hexachlorocyclopentadiene	--	--	--	--	--	10 U	--	--	10 U	--
Hexachloroethane	--	--	--	--	--	10 U	--	--	10 U	--
Indeno(1,2,3-cd)pyrene	--	--	--	--	--	10 U	--	--	10 U	--

Appendix D

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	14G00203D	14G00304	14G00403	14G00501	14G00601	14G00701	14G00801	13G00706	13G00708	13G00709
Well ID	OLD-14-02A	OLD-14-03A	OLD-14-04A	OLD-14-05A	OLD-14-06A	OLD-14-07A	OLD-14-08A	OLD-13-07A	OLD-13-07A	OLD-13-07A
Sampling Date	2/10/98	2/09/98	2/10/98	2/10/98	2/10/98	2/09/98	2/10/98	1/27/98	2/12/98	2/20/98
Isophorone	--	--	--	--	--	10 U	--	--	10 U	--
N-Nitroso-di-n-propylamine	--	--	--	--	--	10 U	--	--	10 U	--
N-Nitrosodiphenylamine (1)	--	--	--	--	--	10 U	--	--	10 U	--
Naphthalene	--	--	--	--	--	10 U	--	1,000 U	10 U	1,000 U
Nitrobenzene	--	--	--	--	--	10 U	--	--	10 U	--
Pentachlorophenol	--	--	--	--	--	25 U	--	--	25 U	--
Phenanthrene	--	--	--	--	--	10 U	--	--	10 U	--
Phenol	--	--	--	--	--	10 U	--	--	10 U	--
Pyrene	--	--	--	--	--	10 U	--	--	10 U	--
bis(2-Chloroethoxy)methane	--	--	--	--	--	10 U	--	--	10 U	--
bis(2-Chloroethyl)ether	--	--	--	--	--	10 U	--	--	10 U	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	10 U	--	--	10 U	--
p-Isopropyltoluene	--	--	--	--	--	--	--	1,000 U	--	1,000 U
Pesticides/PCBs ug/L										
1,2-Dibromo-3-chloropropane	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1,000 U	2,500 U	1,000 U
4,4'-DDD	--	--	--	--	--	0.1 U	--	--	0.1 U	--
4,4'-DDE	--	--	--	--	--	0.1 U	--	--	0.1 U	--
4,4'-DDT	--	--	--	--	--	0.1 U	--	--	0.1 U	--
Aldrin	--	--	--	--	--	0.05 U	--	--	0.05 U	--
Aroclor-1016	--	--	--	--	--	1 U	--	--	1 U	--
Aroclor-1221	--	--	--	--	--	2 U	--	--	2 U	--
Aroclor-1232	--	--	--	--	--	1 U	--	--	1 U	--
Aroclor-1242	--	--	--	--	--	1 U	--	--	1 U	--
Aroclor-1248	--	--	--	--	--	1 U	--	--	1 U	--
Aroclor-1254	--	--	--	--	--	1 U	--	--	1 U	--
Aroclor-1260	--	--	--	--	--	1 U	--	--	1 U	--
Dieldrin	--	--	--	--	--	0.1 U	--	--	0.1 U	--
Endosulfan I	--	--	--	--	--	0.05 U	--	--	0.05 U	--
Endosulfan II	--	--	--	--	--	0.1 U	--	--	0.1 U	--
Endosulfan sulfate	--	--	--	--	--	0.1 U	--	--	0.1 U	--
Endrin	--	--	--	--	--	0.1 U	--	--	0.1 U	--
Endrin aldehyde	--	--	--	--	--	0.1 U	--	--	0.1 U	--
Endrin ketone	--	--	--	--	--	0.1 U	--	--	0.1 U	--
Heptachlor	--	--	--	--	--	0.05 U	--	--	0.05 U	--
Heptachlor epoxide	--	--	--	--	--	0.05 U	--	--	0.05 U	--
Methoxychlor	--	--	--	--	--	0.5 U	--	--	0.5 U	--

Appendix D

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	14G00203D	14G00304	14G00403	14G00501	14G00601	14G00701	14G00801	13G00706	13G00708	13G00709
Well ID	OLD-14-02A	OLD-14-03A	OLD-14-04A	OLD-14-05A	OLD-14-06A	OLD-14-07A	OLD-14-08A	OLD-13-07A	OLD-13-07A	OLD-13-07A
Sampling Date	2/10/98	2/09/98	2/10/98	2/10/98	2/10/98	2/09/98	2/10/98	1/27/98	2/12/98	2/20/98
Toxaphene	--	--	--	--	--	5 U	--	--	5 U	--
alpha-BHC	--	--	--	--	--	0.05 U	--	--	0.05 U	--
alpha-Chlordane	--	--	--	--	--	0.05 U	--	--	0.05 U	--
beta-BHC	--	--	--	--	--	0.05 U	--	--	0.05 U	--
delta-BHC	--	--	--	--	--	0.05 U	--	--	0.05 U	--
gamma-BHC (Lindane)	--	--	--	--	--	0.05 U	--	--	0.05 U	--
gamma-Chlordane	--	--	--	--	--	0.05 U	--	--	0.05 U	--
Inorganics ug/L										
Aluminum	106 U	200 J	210	103 U	85.8 U	217	413	--	131 J	--
Antimony	5.6 J	20.7 J	12.7 J	7.1 J	3.1 J	15.7 J	2.5 U	--	2.6 U	--
Arsenic	3.1 U	--	3.1 U	--						
Barium	2.3 J	2.9 J	2.7 J	2.8 J	1.4 J	5.2 J	3 J	--	1.7 J	--
Beryllium	0.3 U	0.31 U	0.3 U	--	0.3 U	--				
Cadmium	0.3 U	--	0.3 U	--						
Calcium	46,900 U	53,000 U	18,100 U	37,700 U	49,400 U	46,300 U	43,900 U	--	25,100 U	--
Chromium	1 J	1 J	1.1 J	0.9 U	0.9 U	1.4 J	1.6 J	--	1.4	--
Cobalt	0.8 U	--	0.8 U	--						
Copper	0.7 U	0.7 U	0.7 U	0.82 U	0.7 U	1.8 U	2.4 U	--	0.7 U	--
Iron	15.7 U	15.7 U	44.5 J	15.7 U	15.7 U	53.4 J	65.2 J	100 U	16.7 J	100 U
Lead	1.6 U	--	1.6 U	--						
Magnesium	1,550 U	4,670 U	1,360 U	1,690 U	8,450 U	1,290 U	3,750 U	--	1,700 U	--
Manganese	0.32 U	1.5 U	0.67 U	1.9 U	0.74 U	0.96 U	2.1 U	15 U	0.84 U	15 U
Mercury	0.1 U	--	0.1 U	--						
Nickel	1.2 U	--	2.3 J	--						
Potassium	867 U	1,420 U	1,250 U	834 U	1,050 U	380 U	691 U	--	1,550 U	--
Selenium	3.6 U	--	3.6 U	--						
Silver	0.7 U	--	0.7 U	--						
Sodium	9,240 U	6,560 U	15,600 U	5,270 U	26,300 U	2,060 U	1,440 U	--	9,500 U	--
Thallium	4.2 U	--	4.2 U	--						
Vanadium	6.8 J	10.7 J	11.2 J	8.4 J	7.9 J	6.2 J	1.9 J	--	23 J	--
Zinc	1 U	1 U	3.2 U	18.3 U	1 U	3.9 U	54.6 U	--	1 U	--

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	13G00710	U4G00707	U4G007XX	U4G00903	U4G00904	U4G00905	U4G00906	U4G00907	U4G009XX
Well ID	OLD-13-07A	OLD-13-07A	OLD-13-07A	OLD-13-09A	OLD-13-09A	OLD-13-09A	OLD-13-09A	OLD-13-09A	OLD-13-09A
Sampling Date	3/12/98	2/05/98	00/00/00	1/28/98	2/04/98	2/19/98	3/12/98	3/17/98	00/00/00
Volatile Organic Compounds ug/L									
1,1,1,2-Tetrachloroethane	500 U	500 U	750 U	50 U	50 U	50 U	20 U	--	42.5 U
1,1,1-Trichloroethane	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
1,1,2-Tetrachloroethane	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
1,1,2-Trichloroethane	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
1,1-Dichloroethane	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
1,1-Dichloroethene	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
1,1-Dichloropropene	500 U	500 U	750 U	50 U	50 U	50 U	20 U	--	42.5 U
1,2,3-Trichloropropane	500 U	500 U	750 U	50 U	50 U	50 U	20 U	--	42.5 U
1,2,4-Trimethylbenzene	500 U	500 U	750 U	50 U	50 U	50 U	20 U	--	42.5 U
1,2-Dichloroethane	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
1,2-Dichloropropane	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
1,3,5-Trimethylbenzene	500 U	500 U	750 U	50 U	50 U	50 U	20 U	--	42.5 U
1,3-Dichloropropane	500 U	500 U	750 U	50 U	50 U	50 U	20 U	--	42.5 U
2,2-Dichloropropane	500 U	500 U	750 U	50 U	50 U	50 U	20 U	--	42.5 U
2-Chlorotoluene	500 U	500 U	750 U	50 U	50 U	50 U	20 U	--	42.5 U
2-Hexanone	--	--	12,000 U	--	--	--	--	5 UR	--
4-Chlorotoluene	500 U	500 U	750 U	50 U	50 U	50 U	20 U	--	42.5 U
4-Methyl-2-pentanone	--	--	12,000 U	--	--	--	--	5 U	5 U
Benzene	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
Bromobenzene	500 U	500 U	750 U	50 U	50 U	50 U	20 U	--	42.5 U
Bromochloromethane	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
Bromodichloromethane	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
Bromoform	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
Bromomethane	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
Carbon disulfide	--	--	2,500 U	--	--	--	--	1 U	1 U
Carbon tetrachloride	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
Chlorobenzene	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
Chloroethane	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
Chloroform	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
Chloromethane	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
Dibromochloromethane	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
Dibromomethane	500 U	500 U	750 U	50 U	50 U	50 U	20 U	--	42.5 U
Dichlorodifluoromethane	500 U	500 U	750 U	50 U	50 U	50 U	20 U	--	42.5 U
Ethylbenzene	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
Isopropylbenzene	500 U	500 U	750 U	50 U	50 U	50 U	20 U	--	42.5 U

Appendix D
Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	13G00710	U4G00707	U4G007XX	U4G00903	U4G00904	U4G00905	U4G00906	U4G00907	U4G009XX
Well ID	OLD-13-07A	OLD-13-07A	OLD-13-07A	OLD-13-09A	OLD-13-09A	OLD-13-09A	OLD-13-09A	OLD-13-09A	OLD-13-09A
Sampling Date	3/12/98	2/05/98	00/00/00	1/28/98	2/04/98	2/19/98	3/12/98	3/17/98	00/00/00
Methyl-tert-butyl ether	--	--	2,500 U	--	--	--	--	--	--
Methylene chloride	2,500 U	2,500 U	4,000 U	250 U	250 U	250 U	100 U	2 U	170.4 U
Styrene	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
Tetrachloroethene	18,000	30,000	29,800	50 U	50 U	50 U	270	12 U	71.4 J
Toluene	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
Trichloroethene	500 U	500 U	1,100 U	370	550	530	590	20	412
Trichlorofluoromethane	500 U	500 U	750 U	50 U	50 U	50 U	20 U	--	42.5 U
Vinyl chloride	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
Xylene (total)	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
cis-1,2-Dichloroethene	500 U	500 U	1,100 U	1,600	1,500	1,700	1,300	18	1,223.6
cis-1,3-Dichloropropene	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
n-Butylbenzene	500 U	500 U	750 U	50 U	50 U	50 U	20 U	--	42.5 U
n-Propylbenzene	500 U	500 U	750 U	50 U	50 U	50 U	20 U	--	42.5 U
sec-Butylbenzene	500 U	500 U	750 U	50 U	50 U	50 U	20 U	--	42.5 U
t-Butylbenzene	500 U	500 U	750 U	50 U	50 U	50 U	20 U	--	42.5 U
trans-1,2-Dichloroethene	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
trans-1,3-Dichloropropene	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
Semivolatile Organic Compounds ug/L									
1,2,3-Trichlorobenzene	500 U	500 U	750 U	50 U	50 U	50 U	20 U	--	42.5 U
1,2,4-Trichlorobenzene	500 U	500 U	602 U	50 U	50 U	50 U	20 U	1 U	34.2 U
1,2-Dibromoethane	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
1,2-Dichlorobenzene	500 U	500 U	602 U	50 U	50 U	50 U	20 U	1 U	34.2 U
1,3-Dichlorobenzene	500 U	500 U	602 U	50 U	50 U	50 U	20 U	1 U	34.2 U
1,4-Dichlorobenzene	500 U	500 U	602 U	50 U	50 U	50 U	20 U	1 U	34.2 U
2,2'-oxybis(1-Chloropropane)	--	--	10 U	--	--	--	--	10 U	10 U
2,4,5-Trichlorophenol	--	--	25 U	--	--	--	--	25 U	25 U
2,4,6-Trichlorophenol	--	--	10 U	--	--	--	--	10 U	10 U
2,4-Dichlorophenol	--	--	10 U	--	--	--	--	10 U	10 U
2,4-Dimethylphenol	--	--	10 U	--	--	--	--	10 U	10 U
2,4-Dinitrophenol	--	--	25 UJ	--	--	--	--	25 UJ	25 UJ
2,4-Dinitrotoluene	--	--	10 U	--	--	--	--	10 U	10 U
2,6-Dinitrotoluene	--	--	10 U	--	--	--	--	10 U	10 U
2-Chloronaphthalene	--	--	10 U	--	--	--	--	10 U	10 U
2-Chlorophenol	--	--	10 U	--	--	--	--	10 U	10 U
2-Methylnaphthalene	--	--	10 U	--	--	--	--	10 U	10 U
2-Methylphenol	--	--	10 U	--	--	--	--	10 U	10 U

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	13G00710	U4G00707	U4G007XX	U4G00903	U4G00904	U4G00905	U4G00906	U4G00907	U4G009XX
Well ID	OLD-13-07A	OLD-13-07A	OLD-13-07A	OLD-13-09A	OLD-13-09A	OLD-13-09A	OLD-13-09A	OLD-13-09A	OLD-13-09A
Sampling Date	3/12/98	2/05/98	00/00/00	1/28/98	2/04/98	2/19/98	3/12/98	3/17/98	00/00/00
2-Nitroaniline	--	--	25 U	--	--	--	--	25 U	25 U
2-Nitrophenol	--	--	10 U	--	--	--	--	10 U	10 U
3,3'-Dichlorobenzidine	--	--	10 U	--	--	--	--	10 UJ	10 UJ
3-Nitroaniline	--	--	25 U	--	--	--	--	25 U	25 U
4,6-Dinitro-2-methylphenol	--	--	25 UJ	--	--	--	--	25 U	25 U
4-Bromophenyl-phenylether	--	--	10 U	--	--	--	--	10 U	10 U
4-Chloro-3-methylphenol	--	--	10 U	--	--	--	--	10 U	10 U
4-Chloroaniline	--	--	10 U	--	--	--	--	10 U	10 U
4-Chlorophenyl-phenylether	--	--	10 U	--	--	--	--	10 U	10 U
4-Methylphenol	--	--	10 U	--	--	--	--	10 U	10 U
4-Nitroaniline	--	--	25 U	--	--	--	--	25 U	25 U
4-Nitrophenol	--	--	25 UJ	--	--	--	--	25 U	25 U
Acenaphthene	--	--	10 U	--	--	--	--	10 U	10 U
Acenaphthylene	--	--	10 U	--	--	--	--	10 U	10 U
Anthracene	--	--	10 U	--	--	--	--	10 U	10 U
Benzo(a)anthracene	--	--	10 U	--	--	--	--	10 U	10 U
Benzo(a)pyrene	--	--	10 U	--	--	--	--	10 U	10 U
Benzo(b)fluoranthene	--	--	10 U	--	--	--	--	10 U	10 U
Benzo(g,h,i)perylene	--	--	10 U	--	--	--	--	10 U	10 U
Benzo(k)fluoranthene	--	--	10 U	--	--	--	--	10 U	10 U
Butylbenzylphthalate	--	--	10 U	--	--	--	--	10 U	10 U
Carbazole	--	--	10 U	--	--	--	--	10 U	10 U
Chrysene	--	--	10 U	--	--	--	--	10 U	10 U
Di-n-butylphthalate	--	--	10 U	--	--	--	--	10 U	10 U
Di-n-octylphthalate	--	--	10 UJ	--	--	--	--	10 U	10 U
Dibenz(a,h)anthracene	--	--	10 U	--	--	--	--	10 U	10 U
Dibenzofuran	--	--	10 U	--	--	--	--	10 U	10 U
Diethylphthalate	--	--	10 U	--	--	--	--	10 U	10 U
Dimethylphthalate	--	--	10 U	--	--	--	--	10 U	10 U
Fluoranthene	--	--	10 U	--	--	--	--	10 U	10 U
Fluorene	--	--	10 U	--	--	--	--	10 U	10 U
Hexachlorobenzene	--	--	10 UJ	--	--	--	--	10 U	10 U
Hexachlorobutadiene	500 U	500 U	602 UJ	50 U	50 U	50 U	20 U	10 U	36 U
Hexachlorocyclopentadiene	--	--	10 U	--	--	--	--	10 U	10 U
Hexachloroethane	--	--	10 U	--	--	--	--	10 U	10 U
Indeno(1,2,3-cd)pyrene	--	--	10 U	--	--	--	--	10 U	10 U

Appendix D
Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID	13G00710	U4G00707	U4G007XX	U4G00903	U4G00904	U4G00905	U4G00906	U4G00907	U4G009XX
Well ID	OLD-13-07A	OLD-13-07A	OLD-13-07A	OLD-13-09A	OLD-13-09A	OLD-13-09A	OLD-13-09A	OLD-13-09A	OLD-13-09A
Sampling Date	3/12/98	2/05/98	00/00/00	1/28/98	2/04/98	2/19/98	3/12/98	3/17/98	00/00/00
Isophorone	--	--	10 U	--	--	--	--	10 U	10 U
N-Nitroso-di-n-propylamine	--	--	10 U	--	--	--	--	10 U	10 U
N-Nitrosodiphenylamine (1)	--	--	10 U	--	--	--	--	10 U	10 U
Naphthalene	500 U	500 U	602 U	50 U	50 U	50 U	20 U	10 U	36 U
Nitrobenzene	--	--	10 U	--	--	--	--	10 U	10 U
Pentachlorophenol	--	--	25 U	--	--	--	--	25 U	25 U
Phenanthrene	--	--	10 U	--	--	--	--	10 U	10 U
Phenol	--	--	10 U	--	--	--	--	10 U	10 U
Pyrene	--	--	10 U	--	--	--	--	10 U	10 U
bis(2-Chloroethoxy)methane	--	--	10 U	--	--	--	--	10 U	10 U
bis(2-Chloroethyl)ether	--	--	10 U	--	--	--	--	10 U	10 U
bis(2-Ethylhexyl)phthalate	--	--	10 U	--	--	--	--	10 U	10 U
p-Isopropyltoluene	500 U	500 U	750 U	50 U	50 U	50 U	20 U	--	42.5 U
Pesticides/PCBs ug/L									
1,2-Dibromo-3-chloropropane	500 U	500 U	1,100 U	50 U	50 U	50 U	20 U	1 U	34.2 U
4,4'-DDD	--	--	0.1 U	--	--	--	--	0.095 U	0.095 U
4,4'-DDE	--	--	0.1 U	--	--	--	--	0.095 U	0.095 U
4,4'-DDT	--	--	0.1 U	--	--	--	--	0.095 U	0.095 U
Aldrin	--	--	0.05 U	--	--	--	--	0.048 U	0.048 U
Aroclor-1016	--	--	1 U	--	--	--	--	0.95 U	0.95 U
Aroclor-1221	--	--	2 U	--	--	--	--	1.9 U	1.9 U
Aroclor-1232	--	--	1 U	--	--	--	--	0.95 U	0.95 U
Aroclor-1242	--	--	1 U	--	--	--	--	0.95 U	0.95 U
Aroclor-1248	--	--	1 U	--	--	--	--	0.95 U	0.95 U
Aroclor-1254	--	--	1 U	--	--	--	--	0.95 U	0.95 U
Aroclor-1260	--	--	1 U	--	--	--	--	0.95 U	0.95 U
Dieldrin	--	--	0.1 U	--	--	--	--	0.095 U	0.095 U
Endosulfan I	--	--	0.05 U	--	--	--	--	0.048 U	0.048 U
Endosulfan II	--	--	0.1 U	--	--	--	--	0.095 U	0.095 U
Endosulfan sulfate	--	--	0.1 U	--	--	--	--	0.095 U	0.095 U
Endrin	--	--	0.1 U	--	--	--	--	0.095 U	0.095 U
Endrin aldehyde	--	--	0.1 U	--	--	--	--	0.095 U	0.095 U
Endrin ketone	--	--	0.1 U	--	--	--	--	0.095 U	0.095 U
Heptachlor	--	--	0.05 U	--	--	--	--	0.048 U	0.048 U
Heptachlor epoxide	--	--	0.05 U	--	--	--	--	0.048 U	0.048 U
Methoxychlor	--	--	0.5 U	--	--	--	--	0.48 U	0.48 U

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	13G00710	U4G00707	U4G007XX	U4G00903	U4G00904	U4G00905	U4G00906	U4G00907	U4G009XX
Well ID	OLD-13-07A	OLD-13-07A	OLD-13-07A	OLD-13-09A	OLD-13-09A	OLD-13-09A	OLD-13-09A	OLD-13-09A	OLD-13-09A
Sampling Date	3/12/98	2/05/98	00/00/00	1/28/98	2/04/98	2/19/98	3/12/98	3/17/98	00/00/00
Toxaphene	--	--	5 U	--	--	--	--	4.8 U	4.8 U
alpha-BHC	--	--	0.05 U	--	--	--	--	0.048 U	0.048 U
alpha-Chlordane	--	--	0.05 U	--	--	--	--	0.048 U	0.048 U
beta-BHC	--	--	0.05 U	--	--	--	--	0.048 U	0.048 U
delta-BHC	--	--	0.05 U	--	--	--	--	0.048 U	0.048 U
gamma-BHC (Lindane)	--	--	0.05 U	--	--	--	--	0.048 U	0.048 U
gamma-Chlordane	--	--	0.05 U	--	--	--	--	0.048 U	0.048 U
Inorganics ug/L									
Aluminum	--	--	131 J	--	--	--	--	117 J	117 J
Antimony	--	--	2.6 U	--	--	--	--	3 U	3 U
Arsenic	--	--	3.1 U	--	--	--	--	3.1 U	3.1 U
Barium	--	--	1.7 J	--	--	--	--	7.4 J	7.4 J
Beryllium	--	--	0.3 U	--	--	--	--	0.3 U	0.3 U
Cadmium	--	--	0.3 U	--	--	--	--	0.3 U	0.3 U
Calcium	--	--	25,100 U	--	--	--	--	3,350 J	3,350 J
Chromium	--	--	1.4	--	--	--	--	0.95 J	0.95 J
Cobalt	--	--	0.8 U	--	--	--	--	0.8 U	0.8 U
Copper	--	--	0.7 U	--	--	--	--	0.7 U	0.7 U
Iron	100 U	250 U	83.34 J	100 U	100 U	100 U	100 U	57.2 J	51.44 J
Lead	--	--	1.6 U	--	--	--	--	1.6 U	1.6 U
Magnesium	--	--	1,700 U	--	--	--	--	1,340 J	1,340 J
Manganese	15 U	15 U	12.168 U	15 U	15 U	15 U	15 U	0.43 U	12.086 U
Mercury	--	--	0.1 U	--	--	--	--	0.1 U	0.1 U
Nickel	--	--	2.3 J	--	--	--	--	1.3 J	1.3 J
Potassium	--	--	1,550 U	--	--	--	--	1,900 J	1,900 J
Selenium	--	--	3.6 U	--	--	--	--	3.6 UJ	3.6 UJ
Silver	--	--	0.7 U	--	--	--	--	0.7 U	0.7 U
Sodium	--	--	9,500 U	--	--	--	--	13,000	13,000
Thallium	--	--	4.2 U	--	--	--	--	4.2 U	4.2 U
Vanadium	--	--	23 J	--	--	--	--	1.5 J	1.5 J
Zinc	--	--	1 U	--	--	--	--	1 U	1 U

Appendix D
Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID	U4G01103	U4G01203	U4G01204	U4G01205	U4G01206	U4G012XX	U4G01502	U4G01503	U4G01504
Well ID	OLD-13-11C	OLD-13-12A	OLD-13-12A	OLD-13-12A	OLD-13-12A	OLD-13-12A	OLD-13-15A	OLD-13-15A	OLD-13-15A
Sampling Date	2/12/98	1/28/98	2/04/98	2/19/98	3/12/98	00/00/00	1/27/98	2/05/98	2/20/98
Volatile Organic Compounds ug/L									
1,1,1,2-Tetrachloroethane	--	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
1,1,1-Trichloroethane	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
1,1,2,2-Tetrachloroethane	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
1,1,2-Trichloroethane	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
1,1-Dichloroethane	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
1,1-Dichloroethene	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
1,1-Dichloropropene	--	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
1,2,3-Trichloropropane	--	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
1,2,4-Trimethylbenzene	--	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
1,2-Dichloroethane	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
1,2-Dichloropropane	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
1,3,5-Trimethylbenzene	--	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
1,3-Dichloropropane	--	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
2,2-Dichloropropane	--	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
2-Chlorotoluene	--	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
2-Hexanone	5 U	--	--	--	--	--	--	--	--
4-Chlorotoluene	--	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
4-Methyl-2-pentanone	5 U	--	--	--	--	--	--	--	--
Benzene	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
Bromobenzene	--	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
Bromochloromethane	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
Bromodichloromethane	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
Bromoform	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
Bromomethane	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
Carbon disulfide	1 U	--	--	--	--	--	--	--	--
Carbon tetrachloride	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
Chlorobenzene	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
Chloroethane	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
Chloroform	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
Chloromethane	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
Dibromochloromethane	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
Dibromomethane	--	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
Dichlorodifluoromethane	--	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
Ethylbenzene	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
Isopropylbenzene	--	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U

Appendix D

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID	U4G01103	U4G01203	U4G01204	U4G01205	U4G01206	U4G012XX	U4G01502	U4G01503	U4G01504
Well ID	OLD-13-11C	OLD-13-12A	OLD-13-12A	OLD-13-12A	OLD-13-12A	OLD-13-12A	OLD-13-15A	OLD-13-15A	OLD-13-15A
Sampling Date	2/12/98	1/28/98	2/04/98	2/19/98	3/12/98	00/00/00	1/27/98	2/05/98	2/20/98
Methyl-tert-butyl ether	1 U	--	--	--	--	--	--	--	--
Methylene chloride	2 U	5 U	5 U	12 U	10 U	8 U	25 U	12 U	5 U
Styrene	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
Tetrachloroethene	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
Toluene	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
Trichloroethene	1 U	1 U	1 U	5.1	26	8.025	5 U	2.5 U	1 U
Trichlorofluoromethane	--	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
Vinyl chloride	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
Xylene (total)	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
cis-1,2-Dichloroethene	1 U	11	31	52	90	46	5 U	2.5 U	1 U
cis-1,3-Dichloropropene	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
n-Butylbenzene	--	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
n-Propylbenzene	--	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
sec-Butylbenzene	--	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
t-Butylbenzene	--	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
trans-1,2-Dichloroethene	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
trans-1,3-Dichloropropene	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
Semivolatile Organic Compounds ug/L									
1,2,3-Trichlorobenzene	--	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
1,2,4-Trichlorobenzene	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
1,2-Dibromoethane	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
1,2-Dichlorobenzene	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
1,3-Dichlorobenzene	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
1,4-Dichlorobenzene	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
2,2'-oxybis(1-Chloropropane)	--	--	--	--	--	--	--	--	--
2,4,5-Trichlorophenol	--	--	--	--	--	--	--	--	--
2,4,6-Trichlorophenol	--	--	--	--	--	--	--	--	--
2,4-Dichlorophenol	--	--	--	--	--	--	--	--	--
2,4-Dimethylphenol	--	--	--	--	--	--	--	--	--
2,4-Dinitrophenol	--	--	--	--	--	--	--	--	--
2,4-Dinitrotoluene	--	--	--	--	--	--	--	--	--
2,6-Dinitrotoluene	--	--	--	--	--	--	--	--	--
2-Chloronaphthalene	--	--	--	--	--	--	--	--	--
2-Chlorophenol	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	--	--	--	--	--	--	--	--	--
2-Methylphenol	--	--	--	--	--	--	--	--	--

Appendix D
Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4G01103	U4G01203	U4G01204	U4G01205	U4G01206	U4G012XX	U4G01502	U4G01503	U4G01504
Well ID	OLD-13-11C	OLD-13-12A	OLD-13-12A	OLD-13-12A	OLD-13-12A	OLD-13-12A	OLD-13-15A	OLD-13-15A	OLD-13-15A
Sampling Date	2/12/98	1/28/98	2/04/98	2/19/98	3/12/98	00/00/00	1/27/98	2/05/98	2/20/98
2-Nitroaniline	--	--	--	--	--	--	--	--	--
2-Nitrophenol	--	--	--	--	--	--	--	--	--
3,3'-Dichlorobenzidine	--	--	--	--	--	--	--	--	--
3-Nitroaniline	--	--	--	--	--	--	--	--	--
4,6-Dinitro-2-methylphenol	--	--	--	--	--	--	--	--	--
4-Bromophenyl-phenylether	--	--	--	--	--	--	--	--	--
4-Chloro-3-methylphenol	--	--	--	--	--	--	--	--	--
4-Chloroaniline	--	--	--	--	--	--	--	--	--
4-Chlorophenyl-phenylether	--	--	--	--	--	--	--	--	--
4-Methylphenol	--	--	--	--	--	--	--	--	--
4-Nitroaniline	--	--	--	--	--	--	--	--	--
4-Nitrophenol	--	--	--	--	--	--	--	--	--
Acenaphthene	--	--	--	--	--	--	--	--	--
Acenaphthylene	--	--	--	--	--	--	--	--	--
Anthracene	--	--	--	--	--	--	--	--	--
Benzo(a)anthracene	--	--	--	--	--	--	--	--	--
Benzo(a)pyrene	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	--	--	--	--	--	--	--	--	--
Benzo(g,h,i)perylene	--	--	--	--	--	--	--	--	--
Benzo(k)fluoranthene	--	--	--	--	--	--	--	--	--
Butylbenzylphthalate	--	--	--	--	--	--	--	--	--
Carbazole	--	--	--	--	--	--	--	--	--
Chrysene	--	--	--	--	--	--	--	--	--
Di-n-butylphthalate	--	--	--	--	--	--	--	--	--
Di-n-octylphthalate	--	--	--	--	--	--	--	--	--
Dibenz(a,h)anthracene	--	--	--	--	--	--	--	--	--
Dibenzofuran	--	--	--	--	--	--	--	--	--
Diethylphthalate	--	--	--	--	--	--	--	--	--
Dimethylphthalate	--	--	--	--	--	--	--	--	--
Fluoranthene	--	--	--	--	--	--	--	--	--
Fluorene	--	--	--	--	--	--	--	--	--
Hexachlorobenzene	--	--	--	--	--	--	--	--	--
Hexachlorobutadiene	--	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
Hexachlorocyclopentadiene	--	--	--	--	--	--	--	--	--
Hexachloroethane	--	--	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	--	--	--	--	--	--	--	--	--

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4G01103	U4G01203	U4G01204	U4G01205	U4G01206	U4G012XX	U4G01502	U4G01503	U4G01504
Well ID	OLD-13-11C	OLD-13-12A	OLD-13-12A	OLD-13-12A	OLD-13-12A	OLD-13-12A	OLD-13-15A	OLD-13-15A	OLD-13-15A
Sampling Date	2/12/98	1/28/98	2/04/98	2/19/98	3/12/98	00/00/00	1/27/98	2/05/98	2/20/98
Isophorone	--	--	--	--	--	--	--	--	--
N-Nitroso-di-n-propylamine	--	--	--	--	--	--	--	--	--
N-Nitrosodiphenylamine (1)	--	--	--	--	--	--	--	--	--
Naphthalene	--	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
Nitrobenzene	--	--	--	--	--	--	--	--	--
Pentachlorophenol	--	--	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--	--	--
Phenol	--	--	--	--	--	--	--	--	--
Pyrene	--	--	--	--	--	--	--	--	--
bis(2-Chloroethoxy)methane	--	--	--	--	--	--	--	--	--
bis(2-Chloroethyl)ether	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	--	--	--
p-Isopropyltoluene	--	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
Pesticides/PCBs ug/L									
1,2-Dibromo-3-chloropropane	1 U	1 U	1 U	2.5 U	2 U	1.625 U	5 U	2.5 U	1 U
4,4'-DDD	--	--	--	--	--	--	--	--	--
4,4'-DDE	--	--	--	--	--	--	--	--	--
4,4'-DDT	--	--	--	--	--	--	--	--	--
Aldrin	--	--	--	--	--	--	--	--	--
Aroclor-1016	--	--	--	--	--	--	--	--	--
Aroclor-1221	--	--	--	--	--	--	--	--	--
Aroclor-1232	--	--	--	--	--	--	--	--	--
Aroclor-1242	--	--	--	--	--	--	--	--	--
Aroclor-1248	--	--	--	--	--	--	--	--	--
Aroclor-1254	--	--	--	--	--	--	--	--	--
Aroclor-1260	--	--	--	--	--	--	--	--	--
Dieldrin	--	--	--	--	--	--	--	--	--
Endosulfan I	--	--	--	--	--	--	--	--	--
Endosulfan II	--	--	--	--	--	--	--	--	--
Endosulfan sulfate	--	--	--	--	--	--	--	--	--
Endrin	--	--	--	--	--	--	--	--	--
Endrin aldehyde	--	--	--	--	--	--	--	--	--
Endrin ketone	--	--	--	--	--	--	--	--	--
Heptachlor	--	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	--	--	--	--
Methoxychlor	--	--	--	--	--	--	--	--	--

Appendix D
Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4G01103	U4G01203	U4G01204	U4G01205	U4G01206	U4G012XX	U4G01502	U4G01503	U4G01504
Well ID	OLD-13-11C	OLD-13-12A	OLD-13-12A	OLD-13-12A	OLD-13-12A	OLD-13-12A	OLD-13-15A	OLD-13-15A	OLD-13-15A
Sampling Date	2/12/98	1/28/98	2/04/98	2/19/98	3/12/98	00/00/00	1/27/98	2/05/98	2/20/98
Toxaphene	--	--	--	--	--	--	--	--	--
alpha-BHC	--	--	--	--	--	--	--	--	--
alpha-Chlordane	--	--	--	--	--	--	--	--	--
beta-BHC	--	--	--	--	--	--	--	--	--
delta-BHC	--	--	--	--	--	--	--	--	--
gamma-BHC (Lindane)	--	--	--	--	--	--	--	--	--
gamma-Chlordane	--	--	--	--	--	--	--	--	--
Inorganics ug/L									
Aluminum	1,400	--	--	--	--	--	--	--	--
Antimony	2.5 U	--	--	--	--	--	--	--	--
Arsenic	3.1 U	--	--	--	--	--	--	--	--
Barium	14.3 J	--	--	--	--	--	--	--	--
Beryllium	0.31 U	--	--	--	--	--	--	--	--
Cadmium	0.3 U	--	--	--	--	--	--	--	--
Calcium	56,000 U	--	--	--	--	--	--	--	--
Chromium	1.8 J	--	--	--	--	--	--	--	--
Cobalt	0.8 U	--	--	--	--	--	--	--	--
Copper	5.1 J	--	--	--	--	--	--	--	--
Iron	106	100 U							
Lead	1.6 U	--	--	--	--	--	--	--	--
Magnesium	1,370 U	--	--	--	--	--	--	--	--
Manganese	2.9 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U
Mercury	0.1 U	--	--	--	--	--	--	--	--
Nickel	6.5 J	--	--	--	--	--	--	--	--
Potassium	2,350 U	--	--	--	--	--	--	--	--
Selenium	3.6 U	--	--	--	--	--	--	--	--
Silver	0.7 U	--	--	--	--	--	--	--	--
Sodium	23,700 U	--	--	--	--	--	--	--	--
Thallium	4.2 U	--	--	--	--	--	--	--	--
Vanadium	4.4 J	--	--	--	--	--	--	--	--
Zinc	4.1 U	--	--	--	--	--	--	--	--

Appendix D

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4G01505	U4G015XX	U4G01902	U4G02003	U4G02102	U4G02103	U4G02104	U4G02105	U4G021XX
Well ID	OLD-13-15A	OLD-13-15A	OLD-13-19B	OLD-13-20B	OLD-13-21B	OLD-13-21B	OLD-13-21B	OLD-13-21B	OLD-13-21B
Sampling Date	3/12/98	00/00/00	2/12/98	2/12/98	1/27/98	2/05/98	2/20/98	3/12/98	00/00/00
Volatile Organic Compounds ug/L									
1,1,1,2-Tetrachloroethane	1 U	2.375 U	--	--	20 U	20 U	50 U	20 U	27.5 U
1,1,1-Trichloroethane	1 U	2.375 U	1 U	28 U	20 U	20 U	50 U	20 U	27.5 U
1,1,2,2-Tetrachloroethane	1 U	2.375 U	1 U	28 U	20 U	20 U	50 U	20 U	27.5 U
1,1,2-Trichloroethane	1 U	2.375 U	1 U	28 U	20 U	20 U	50 U	20 U	27.5 U
1,1-Dichloroethane	1 U	2.375 U	1 U	28 U	20 U	20 U	50 U	20 U	27.5 U
1,1-Dichloroethene	1 U	2.375 U	1 U	28 U	20 U	20 U	50 U	20 U	27.5 U
1,1-Dichloropropene	1 U	2.375 U	--	--	20 U	20 U	50 U	20 U	27.5 U
1,2,3-Trichloropropane	1 U	2.375 U	--	--	20 U	20 U	50 U	20 U	27.5 U
1,2,4-Trimethylbenzene	1 U	2.375 U	--	--	20 U	20 U	50 U	20 U	27.5 U
1,2-Dichloroethane	1 U	2.375 U	1 U	28 U	20 U	20 U	50 U	20 U	27.5 U
1,2-Dichloropropane	1 U	2.375 U	1 U	28 U	20 U	20 U	50 U	20 U	27.5 U
1,3,5-Trimethylbenzene	1 U	2.375 U	--	--	20 U	20 U	50 U	20 U	27.5 U
1,3-Dichloropropane	1 U	2.375 U	--	--	20 U	20 U	50 U	20 U	27.5 U
2,2-Dichloropropane	1 U	2.375 U	--	--	20 U	20 U	50 U	20 U	27.5 U
2-Chlorotoluene	1 U	2.375 U	--	--	20 U	20 U	50 U	20 U	27.5 U
2-Hexanone	--	--	5 U	140 U	--	--	--	--	--
4-Chlorotoluene	1 U	2.375 U	--	--	20 U	20 U	50 U	20 U	27.5 U
4-Methyl-2-pentanone	--	--	5 U	140 U	--	--	--	--	--
Benzene	1 U	2.375 U	1 U	28 U	20 U	20 U	50 U	20 U	27.5 U
Bromobenzene	1 U	2.375 U	--	--	20 U	20 U	50 U	20 U	27.5 U
Bromochloromethane	1 U	2.375 U	1 U	28 U	20 U	20 U	50 U	20 U	27.5 U
Bromodichloromethane	1 U	2.375 U	1 U	28 U	20 U	20 U	50 U	20 U	27.5 U
Bromoform	1 U	2.375 U	1 U	28 U	20 U	20 U	50 U	20 U	27.5 U
Bromomethane	1 U	2.375 U	1 U	28 U	20 U	20 U	50 U	20 U	27.5 U
Carbon disulfide	--	--	1 UJ	28 U	--	--	--	--	--
Carbon tetrachloride	1 U	2.375 U	1 U	28 U	20 U	20 U	50 U	20 U	27.5 U
Chlorobenzene	1 U	2.375 U	1 U	28 U	20 U	20 U	50 U	20 U	27.5 U
Chloroethane	1 U	2.375 U	1 UJ	28 U	20 U	20 U	50 U	20 U	27.5 U
Chloroform	1 U	2.375 U	1 U	28 U	20 U	20 U	50 U	20 U	27.5 U
Chloromethane	1 U	2.375 U	1 U	28 U	20 U	20 U	50 U	20 U	27.5 U
Dibromochloromethane	1 U	2.375 U	1 U	28 U	20 U	20 U	50 U	20 U	27.5 U
Dibromomethane	1 U	2.375 U	--	--	20 U	20 U	50 U	20 U	27.5 U
Dichlorodifluoromethane	1 U	2.375 U	--	--	20 U	20 U	50 U	20 U	27.5 U
Ethylbenzene	1 U	2.375 U	1 U	28 U	20 U	20 U	50 U	20 U	27.5 U
Isopropylbenzene	1 U	2.375 U	--	--	20 U	20 U	50 U	20 U	27.5 U

Appendix D
Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID	U4G01505	U4G015XX	U4G01902	U4G02003	U4G02102	U4G02103	U4G02104	U4G02105	U4G021XX
Well ID	OLD-13-15A	OLD-13-16A	OLD-13-19B	OLD-13-20B	OLD-13-21B	OLD-13-21B	OLD-13-21B	OLD-13-21B	OLD-13-21B
Sampling Date	3/12/98	00/00/00	2/12/98	2/12/98	1/27/98	2/05/98	2/20/98	3/12/98	00/00/00
Methyl-tert-butyl ether	--	--	1 U	28 U	--	--	--	--	--
Methylene chloride	5 U	11.75 U	2 U	56 U	100 U	100 U	250 U	100 U	137.5 U
Styrene	1 U	2.375 U	1 U	28 U	20 U	20 U	50 U	20 U	27.5 U
Tetrachloroethene	2.2	25.675 U	3	310	20 U	20 U	50 U	20 U	27.5 U
Toluene	1 U	2.375 U	1 U	28 U	20 U	20 U	50 U	20 U	27.5 U
Trichloroethene	1 U	2.375 U	0.7 J	270	690	530	680	600	625
Trichlorofluoromethane	1 U	2.375 U	--	--	20 U	20 U	50 U	20 U	27.5 U
Vinyl chloride	1 U	2.375 U	1 U	28 U	20 U	20 U	50 U	20 U	27.5 U
Xylene (total)	1 U	2.375 U	1 U	28 U	20 U	20 U	50 U	20 U	27.5 U
cis-1,2-Dichloroethene	1 U	2.375 U	1 U	23 J	990	790	1,000	770	887.5
cis-1,3-Dichloropropene	1 U	2.375 U	1 U	28 U	20 U	20 U	50 U	20 U	27.5 U
n-Butylbenzene	1 U	2.375 U	--	--	20 U	20 U	50 U	20 U	27.5 U
n-Propylbenzene	1 U	2.375 U	--	--	20 U	20 U	50 U	20 U	27.5 U
sec-Butylbenzene	1 U	2.375 U	--	--	20 U	20 U	50 U	20 U	27.5 U
t-Butylbenzene	1 U	2.375 U	--	--	20 U	20 U	50 U	20 U	27.5 U
trans-1,2-Dichloroethene	1 U	2.375 U	1 U	28 U	20 U	20 U	50 U	20 U	27.5 U
trans-1,3-Dichloropropene	1 U	2.375 U	1 U	28 U	20 U	20 U	50 U	20 U	27.5 U
Semivolatle Organic Compounds ug/L									
1,2,3-Trichlorobenzene	1 U	2.375 U	--	--	20 U	20 U	50 U	20 U	27.5 U
1,2,4-Trichlorobenzene	1 U	2.375 U	1 U	10 U	20 U	20 U	50 U	20 U	27.5 U
1,2-Dibromoethane	1 U	2.375 U	1 U	28 U	20 U	20 U	50 U	20 U	27.5 U
1,2-Dichlorobenzene	1 U	2.375 U	1 U	10 U	20 U	20 U	50 U	20 U	27.5 U
1,3-Dichlorobenzene	1 U	2.375 U	1 U	10 U	20 U	20 U	50 U	20 U	27.5 U
1,4-Dichlorobenzene	1 U	2.375 U	1 U	10 U	20 U	20 U	50 U	20 U	27.5 U
2,2'-oxybis(1-Chloropropane)	--	--	--	10 U	--	--	--	--	--
2,4,5-Trichlorophenol	--	--	--	25 U	--	--	--	--	--
2,4,6-Trichlorophenol	--	--	--	10 U	--	--	--	--	--
2,4-Dichlorophenol	--	--	--	10 U	--	--	--	--	--
2,4-Dimethylphenol	--	--	--	10 U	--	--	--	--	--
2,4-Dinitrophenol	--	--	--	25 UJ	--	--	--	--	--
2,4-Dinitrotoluene	--	--	--	10 U	--	--	--	--	--
2,6-Dinitrotoluene	--	--	--	10 U	--	--	--	--	--
2-Chloronaphthalene	--	--	--	10 U	--	--	--	--	--
2-Chlorophenol	--	--	--	10 U	--	--	--	--	--
2-Methylnaphthalene	--	--	--	10 U	--	--	--	--	--
2-Methylphenol	--	--	--	10 U	--	--	--	--	--

Appendix D

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4G01505	U4G015XX	U4G01902	U4G02003	U4G02102	U4G02103	U4G02104	U4G02105	U4G021XX
Well ID	OLD-13-15A	OLD-13-15A	OLD-13-19B	OLD-13-20B	OLD-13-21B	OLD-13-21B	OLD-13-21B	OLD-13-21B	OLD-13-21B
Sampling Date	3/12/98	00/00/00	2/12/98	2/12/98	1/27/98	2/05/98	2/20/98	3/12/98	00/00/00
2-Nitroaniline	--	--	--	25 U	--	--	--	--	--
2-Nitrophenol	--	--	--	10 U	--	--	--	--	--
3,3'-Dichlorobenzidine	--	--	--	10 U	--	--	--	--	--
3-Nitroaniline	--	--	--	25 U	--	--	--	--	--
4,6-Dinitro-2-methylphenol	--	--	--	25 UJ	--	--	--	--	--
4-Bromophenyl-phenylether	--	--	--	10 U	--	--	--	--	--
4-Chloro-3-methylphenol	--	--	--	10 U	--	--	--	--	--
4-Chloroaniline	--	--	--	10 U	--	--	--	--	--
4-Chlorophenyl-phenylether	--	--	--	10 U	--	--	--	--	--
4-Methylphenol	--	--	--	10 U	--	--	--	--	--
4-Nitroaniline	--	--	--	25 U	--	--	--	--	--
4-Nitrophenol	--	--	--	25 UJ	--	--	--	--	--
Acenaphthene	--	--	--	10 U	--	--	--	--	--
Acenaphthylene	--	--	--	10 U	--	--	--	--	--
Anthracene	--	--	--	10 U	--	--	--	--	--
Benzo(a)anthracene	--	--	--	10 U	--	--	--	--	--
Benzo(a)pyrene	--	--	--	10 U	--	--	--	--	--
Benzo(b)fluoranthene	--	--	--	10 U	--	--	--	--	--
Benzo(g,h,i)perylene	--	--	--	10 U	--	--	--	--	--
Benzo(k)fluoranthene	--	--	--	10 U	--	--	--	--	--
Butylbenzylphthalate	--	--	--	10 U	--	--	--	--	--
Carbazole	--	--	--	10 U	--	--	--	--	--
Chrysene	--	--	--	10 U	--	--	--	--	--
Di-n-butylphthalate	--	--	--	10 U	--	--	--	--	--
Di-n-octylphthalate	--	--	--	10 UJ	--	--	--	--	--
Dibenz(a,h)anthracene	--	--	--	10 U	--	--	--	--	--
Dibenzofuran	--	--	--	10 U	--	--	--	--	--
Diethylphthalate	--	--	--	10 U	--	--	--	--	--
Dimethylphthalate	--	--	--	10 U	--	--	--	--	--
Fluoranthene	--	--	--	10 U	--	--	--	--	--
Fluorene	--	--	--	10 U	--	--	--	--	--
Hexachlorobenzene	--	--	--	10 UJ	--	--	--	--	--
Hexachlorobutadiene	1 U	2.375 U	--	10 UJ	20 U	20 U	50 U	20 U	27.5 U
Hexachlorocyclopentadiene	--	--	--	10 U	--	--	--	--	--
Hexachloroethane	--	--	--	10 U	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	--	--	--	10 U	--	--	--	--	--

Appendix D
Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID	U4G01505	U4G015XX	U4G01902	U4G02003	U4G02102	U4G02103	U4G02104	U4G02105	U4G021XX
Well ID	OLD-13-15A	OLD-13-15A	OLD-13-19B	OLD-13-20B	OLD-13-21B	OLD-13-21B	OLD-13-21B	OLD-13-21B	OLD-13-21B
Sampling Date	3/12/98	00/00/00	2/12/98	2/12/98	1/27/98	2/05/98	2/20/98	3/12/98	00/00/00
Isophorone	--	--	--	10 U	--	--	--	--	--
N-Nitroso-di-n-propylamine	--	--	--	10 U	--	--	--	--	--
N-Nitrosodiphenylamine (1)	--	--	--	10 U	--	--	--	--	--
Naphthalene	1 U	2.375 U	--	10 U	20 U	20 U	50 U	20 U	27.5 U
Nitrobenzene	--	--	--	10 U	--	--	--	--	--
Pentachlorophenol	--	--	--	25 U	--	--	--	--	--
Phenanthrene	--	--	--	10 U	--	--	--	--	--
Phenol	--	--	--	10 UJ	--	--	--	--	--
Pyrene	--	--	--	10 U	--	--	--	--	--
bis(2-Chloroethoxy)methane	--	--	--	10 UJ	--	--	--	--	--
bis(2-Chloroethyl)ether	--	--	--	10 U	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	10 UJ	--	--	--	--	--
p-Isopropyltoluene	1 U	2.375 U	--	--	20 U	20 U	50 U	20 U	27.5 U
Pesticides/PCBs ug/L									
1,2-Dibromo-3-chloropropane	1 U	2.375 U	1 U	28 U	20 U	20 U	50 U	20 U	27.5 U
4,4'-DDD	--	--	--	0.1 UJ	--	--	--	--	--
4,4'-DDE	--	--	--	0.1 UJ	--	--	--	--	--
4,4'-DDT	--	--	--	0.1 UJ	--	--	--	--	--
Aldrin	--	--	--	0.05 UJ	--	--	--	--	--
Aroclor-1016	--	--	--	1 UJ	--	--	--	--	--
Aroclor-1221	--	--	--	2 UJ	--	--	--	--	--
Aroclor-1232	--	--	--	1 UJ	--	--	--	--	--
Aroclor-1242	--	--	--	1 UJ	--	--	--	--	--
Aroclor-1248	--	--	--	1 UJ	--	--	--	--	--
Aroclor-1254	--	--	--	1 UJ	--	--	--	--	--
Aroclor-1260	--	--	--	1 UJ	--	--	--	--	--
Dieldrin	--	--	--	0.1 UJ	--	--	--	--	--
Endosulfan I	--	--	--	0.05 UJ	--	--	--	--	--
Endosulfan II	--	--	--	0.1 UJ	--	--	--	--	--
Endosulfan sulfate	--	--	--	0.1 UJ	--	--	--	--	--
Endrin	--	--	--	0.1 UJ	--	--	--	--	--
Endrin aldehyde	--	--	--	0.1 UJ	--	--	--	--	--
Endrin ketone	--	--	--	0.1 UJ	--	--	--	--	--
Heptachlor	--	--	--	0.05 UJ	--	--	--	--	--
Heptachlor epoxide	--	--	--	0.05 UJ	--	--	--	--	--
Methoxychlor	--	--	--	0.5 UJ	--	--	--	--	--

Appendix D

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4G01505	U4G015XX	U4G01902	U4G02003	U4G02102	U4G02103	U4G02104	U4G02105	U4G021XX
Well ID	OLD-13-15A	OLD-13-15A	OLD-13-19B	OLD-13-20B	OLD-13-21B	OLD-13-21B	OLD-13-21B	OLD-13-21B	OLD-13-21B
Sampling Date	3/12/98	00/00/00	2/12/98	2/12/98	1/27/98	2/05/98	2/20/98	3/12/98	00/00/00
Toxaphene	--	--	--	5 UJ	--	--	--	--	--
alpha-BHC	--	--	--	0.05 UJ	--	--	--	--	--
alpha-Chlordane	--	--	--	0.05 UJ	--	--	--	--	--
beta-BHC	--	--	--	0.05 UJ	--	--	--	--	--
delta-BHC	--	--	--	0.05 UJ	--	--	--	--	--
gamma-BHC (Lindane)	--	--	--	0.05 UJ	--	--	--	--	--
gamma-Chlordane	--	--	--	0.05 UJ	--	--	--	--	--
Inorganics ug/L									
Aluminum	--	--	35,500	109 U	--	--	--	--	--
Antimony	--	--	2.5 U	2.5 U	--	--	--	--	--
Arsenic	--	--	3.1 U	3.1 U	--	--	--	--	--
Barium	--	--	289	9.7 J	--	--	--	--	--
Beryllium	--	--	1.2 U	0.3 U	--	--	--	--	--
Cadmium	--	--	0.3 U	0.3 U	--	--	--	--	--
Calcium	--	--	2,840 U	27,100 U	--	--	--	--	--
Chromium	--	--	59.4	0.9 U	--	--	--	--	--
Cobalt	--	--	0.8 U	0.8 U	--	--	--	--	--
Copper	--	--	94.8	0.7 U	--	--	--	--	--
Iron	290 U	110	1,200	448	300	290	300	260	287.5
Lead	--	--	45.2 U	1.6 U	--	--	--	--	--
Magnesium	--	--	145 U	2,130 U	--	--	--	--	--
Manganese	15 U	15 U	31.7 U	9.8 U	--	15 U	15 U	15 U	15 U
Mercury	--	--	3.7	0.1 U	--	--	--	--	--
Nickel	--	--	7.6 J	1.2 U	--	--	--	--	--
Potassium	--	--	3,490 U	1,720 U	--	--	--	--	--
Selenium	--	--	13.1	3.6 U	--	--	--	--	--
Silver	--	--	0.7 U	0.7 U	--	--	--	--	--
Sodium	--	--	41,400 U	7,440 U	--	--	--	--	--
Thallium	--	--	4.2 U	4.2 U	--	--	--	--	--
Vanadium	--	--	--	0.6 U	--	--	--	--	--
Zinc	--	--	30.2 U	1 U	--	--	--	--	--

Appendix D
Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID	U4G02201	U4G02202	U4G02203	U4G02204	U4G02205	U4G02206	U4G022XX	U4G02302	U4G02303
Well ID	OLD-13-22B	OLD-13-23B	OLD-13-23B						
Sampling Date	12/09/97	1/28/98	2/04/98	2/12/98	2/19/98	3/12/98	00/00/00	1/29/98	2/04/98
Volatile Organic Compounds ug/L									
1,1,1,2-Tetrachloroethane	94 UJ	2 U	5 U	--	2.5 U	20 U	24.7 U	200 U	50 U
1,1,1-Trichloroethane	94 UJ	2 U	5 U	8 U	2.5 U	20 U	21.917 U	200 U	50 U
1,1,2,2-Tetrachloroethane	62 UJ	2 U	5 U	8 U	2.5 U	20 U	16.583 U	200 U	50 U
1,1,2-Trichloroethane	94 UJ	2 U	5 U	8 U	2.5 U	20 U	21.917 U	200 U	50 U
1,1-Dichloroethane	62 UJ	2 U	5 U	8 U	2.5 U	20 U	16.583 U	200 U	50 U
1,1-Dichloroethene	94 UJ	2 U	5 U	8 U	2.5 U	20 U	21.917 U	200 U	50 U
1,1-Dichloropropene	120 UJ	2 U	5 U	--	2.5 U	20 U	29.9 U	200 U	50 U
1,2,3-Trichloropropane	120 UJ	2 U	5 U	--	2.5 U	20 U	29.9 U	200 U	50 U
1,2,4-Trimethylbenzene	62 UJ	2 U	5 U	--	2.5 U	20 U	18.3 U	200 U	50 U
1,2-Dichloroethane	94 UJ	2 U	5 U	8 U	2.5 U	20 U	21.917 U	200 U	50 U
1,2-Dichloropropane	94 UJ	2 U	5 U	8 U	2.5 U	20 U	21.917 U	200 U	50 U
1,3,5-Trimethylbenzene	62 UJ	2 U	5 U	--	2.5 U	20 U	18.3 U	200 U	50 U
1,3-Dichloropropane	94 UJ	2 U	5 U	--	2.5 U	20 U	24.7 U	200 U	50 U
2,2-Dichloropropane	62 UJ	2 U	5 U	--	2.5 U	20 U	18.3 U	200 U	50 U
2-Chlorotoluene	62 UJ	2 U	5 U	--	2.5 U	20 U	18.3 U	200 U	50 U
2-Hexanone	--	--	--	42 U	--	--	42 U	--	--
4-Chlorotoluene	62 UJ	2 U	5 U	--	2.5 U	20 U	18.3 U	200 U	50 U
4-Methyl-2-pentanone	--	--	--	42 U	--	--	42 U	--	--
Benzene	94 UJ	2 U	5 U	8 U	2.5 U	20 U	21.917 U	200 U	50 U
Bromobenzene	62 UJ	2 U	5 U	--	2.5 U	20 U	18.3 U	200 U	50 U
Bromochloromethane	120 UJ	2 U	5 U	8 U	2.5 U	20 U	26.25 U	200 U	50 U
Bromodichloromethane	62 UJ	2 U	5 U	8 U	2.5 U	20 U	16.583 U	200 U	50 U
Bromoform	62 UJ	2 U	5 U	8 U	2.5 U	20 U	16.583 U	200 U	50 U
Bromomethane	62 UJ	2 U	5 U	8 U	2.5 U	20 U	16.583 U	200 U	50 U
Carbon disulfide	--	--	--	8 U	--	--	8 U	--	--
Carbon tetrachloride	120 UJ	2 U	5 U	8 U	2.5 U	20 U	26.25 U	200 U	50 U
Chlorobenzene	62 UJ	2 U	5 U	8 U	2.5 U	20 U	16.583 U	200 U	50 U
Chloroethane	62 UJ	2 U	5 U	8 U	2.5 U	20 U	16.583 U	200 U	50 U
Chloroform	94 UJ	2 U	5 U	8 U	2.5 U	20 U	21.917 U	200 U	50 U
Chloromethane	120 UJ	2 U	5 U	8 U	2.5 U	20 U	26.25 U	200 U	50 U
Dibromochloromethane	62 UJ	2 U	5 U	8 U	2.5 U	20 U	16.583 U	200 U	50 U
Dibromomethane	94 UJ	2 U	5 U	--	2.5 U	20 U	24.7 U	200 U	50 U
Dichlorodifluoromethane	120 UJ	2 U	5 U	--	2.5 U	20 U	24.7 U	200 U	50 U
Ethylbenzene	62 UJ	2 U	5 U	8 U	2.5 U	20 U	16.583 U	200 U	50 U
Isopropylbenzene	94 UJ	2 U	5 U	--	2.5 U	20 U	24.7 U	200 U	50 U

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4G02201	U4G02202	U4G02203	U4G02204	U4G02205	U4G02206	U4G022XX	U4G02302	U4G02303
Well ID	OLD-13-22B	OLD-13-23B	OLD-13-23B						
Sampling Date	12/09/97	1/28/98	2/04/98	2/12/98	2/19/98	3/12/98	00/00/00	1/29/98	2/04/98
Methyl-tert-butyl ether	94 UJ	--	--	8 U	--	--	51 U	--	--
Methylene chloride	190 UJ	10 U	25 U	16 U	12 U	100 U	58.83 U	1,000 U	250 U
Styrene	62 U	2 U	5 U	8 U	2.5 U	20 U	16.583 U	200 U	50 U
Tetrachloroethene	94 U	2 U	5 U	8 U	2.5 U	20 U	21.917 U	200 U	50 U
Toluene	94 U	2 U	5 U	8 U	2.5 U	20 U	21.917 U	200 U	50 U
Trichloroethene	690 J	11	21	20	24	360	187.67 J	3,000	12,400
Trichlorofluoromethane	120 UJ	2 U	5 U	--	2.5 U	20 U	29.9 U	200 U	50 U
Vinyl chloride	120 UJ	2 U	5 U	8 U	2.5 U	20 U	26.25 U	200 U	50 U
Xylene (total)	62 UJ	2 U	5 U	8 U	2.5 U	20 U	16.583 U	200 U	50 U
cis-1,2-Dichloroethene	2,000 J	55	90	92	94	1,200	588.5 J	1,300	1,900
cis-1,3-Dichloropropene	62 UJ	2 U	5 U	8 U	2.5 U	20 U	16.583 U	200 U	50 U
n-Butylbenzene	94 UJ	2 U	5 U	--	2.5 U	20 U	24.7 U	200 U	50 U
n-Propylbenzene	94 UJ	2 U	5 U	--	2.5 U	20 U	24.7 U	200 U	50 U
sec-Butylbenzene	94 UJ	2 U	5 U	--	2.5 U	20 U	24.7 U	200 U	50 U
t-Butylbenzene	94 UJ	2 U	5 U	--	2.5 U	20 U	24.7 U	200 U	50 U
trans-1,2-Dichloroethene	94 UJ	2 U	5 U	8 U	2.5 U	20 U	21.917 U	200 U	50 U
trans-1,3-Dichloropropene	94 UJ	2 U	5 U	8 U	2.5 U	20 U	21.917 U	200 U	50 U
Semivolatile Organic Compounds ug/L									
1,2,3-Trichlorobenzene	94 UJ	2 U	5 U	--	2.5 U	20 U	24.7 U	200 U	50 U
1,2,4-Trichlorobenzene	62 UJ	2 U	5 U	8 U	2.5 U	20 U	16.583 U	200 U	50 U
1,2-Dibromoethane	94 UJ	2 U	5 U	8 U	2.5 U	20 U	21.917 U	200 U	50 U
1,2-Dichlorobenzene	62 UJ	2 U	5 U	8 U	2.5 U	20 U	16.583 U	200 U	50 U
1,3-Dichlorobenzene	62 UJ	2 U	5 U	8 U	2.5 U	20 U	16.583 U	200 U	50 U
1,4-Dichlorobenzene	62 UJ	2 U	5 U	8 U	2.5 U	20 U	16.583 U	200 U	50 U
2,2'-oxybis(1-Chloropropane)	--	--	--	10 U	--	--	10 U	--	--
2,4,5-Trichlorophenol	--	--	--	25 U	--	--	25 U	--	--
2,4,6-Trichlorophenol	--	--	--	10 U	--	--	10 U	--	--
2,4-Dichlorophenol	--	--	--	10 U	--	--	10 U	--	--
2,4-Dimethylphenol	--	--	--	10 U	--	--	10 U	--	--
2,4-Dinitrophenol	--	--	--	25 UJ	--	--	25 UJ	--	--
2,4-Dinitrotoluene	--	--	--	10 U	--	--	10 U	--	--
2,6-Dinitrotoluene	--	--	--	10 U	--	--	10 U	--	--
2-Chloronaphthalene	--	--	--	10 U	--	--	10 U	--	--
2-Chlorophenol	--	--	--	10 U	--	--	10 U	--	--
2-Methylnaphthalene	--	--	--	10 U	--	--	10 U	--	--
2-Methylphenol	--	--	--	10 U	--	--	10 U	--	--

Appendix D
Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID	U4G02201	U4G02202	U4G02203	U4G02204	U4G02205	U4G02206	U4G022XX	U4G02302	U4G02303
Well ID	OLD-13-22B	OLD-13-23B	OLD-13-23B						
Sampling Date	12/09/97	1/28/98	2/04/98	2/12/98	2/19/98	3/12/98	00/00/00	1/29/98	2/04/98
2-Nitroaniline	--	--	--	25 U	--	--	25 U	--	--
2-Nitrophenol	--	--	--	10 U	--	--	10 U	--	--
3,3'-Dichlorobenzidine	--	--	--	10 U	--	--	10 U	--	--
3-Nitroaniline	--	--	--	25 U	--	--	25 U	--	--
4,6-Dinitro-2-methylphenol	--	--	--	25 UJ	--	--	25 UJ	--	--
4-Bromophenyl-phenylether	--	--	--	10 U	--	--	10 U	--	--
4-Chloro-3-methylphenol	--	--	--	10 U	--	--	10 U	--	--
4-Chloroaniline	--	--	--	10 U	--	--	10 U	--	--
4-Chlorophenyl-phenylether	--	--	--	10 U	--	--	10 U	--	--
4-Methylphenol	--	--	--	10 U	--	--	10 U	--	--
4-Nitroaniline	--	--	--	25 U	--	--	25 U	--	--
4-Nitrophenol	--	--	--	25 UJ	--	--	25 UJ	--	--
Acenaphthene	--	--	--	10 U	--	--	10 U	--	--
Acenaphthylene	--	--	--	10 U	--	--	10 U	--	--
Anthracene	--	--	--	10 U	--	--	10 U	--	--
Benzo(a)anthracene	--	--	--	10 U	--	--	10 U	--	--
Benzo(a)pyrene	--	--	--	10 U	--	--	10 U	--	--
Benzo(b)fluoranthene	--	--	--	10 U	--	--	10 U	--	--
Benzo(g,h,i)perylene	--	--	--	10 U	--	--	10 U	--	--
Benzo(k)fluoranthene	--	--	--	10 U	--	--	10 U	--	--
Butylbenzylphthalate	--	--	--	10 U	--	--	10 U	--	--
Carbazole	--	--	--	10 U	--	--	10 U	--	--
Chrysene	--	--	--	10 U	--	--	10 U	--	--
Di-n-butylphthalate	--	--	--	10 U	--	--	10 U	--	--
Di-n-octylphthalate	--	--	--	10 UJ	--	--	10 UJ	--	--
Dibenz(a,h)anthracene	--	--	--	10 U	--	--	10 U	--	--
Dibenzofuran	--	--	--	10 U	--	--	10 U	--	--
Diethylphthalate	--	--	--	10 U	--	--	10 U	--	--
Dimethylphthalate	--	--	--	10 U	--	--	10 U	--	--
Fluoranthene	--	--	--	10 U	--	--	10 U	--	--
Fluorene	--	--	--	10 U	--	--	10 U	--	--
Hexachlorobenzene	--	--	--	10 UJ	--	--	10 UJ	--	--
Hexachlorobutadiene	94 UJ	2 U	5 U	10 UJ	2.5 U	20 U	22.25 U	200 U	50 U
Hexachlorocyclopentadiene	--	--	--	10 U	--	--	10 U	--	--
Hexachloroethane	--	--	--	10 U	--	--	10 U	--	--
Indeno(1,2,3-cd)pyrene	--	--	--	10 U	--	--	10 U	--	--

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4G02201	U4G02202	U4G02203	U4G02204	U4G02205	U4G02206	U4G022XX	U4G02302	U4G02303
Well ID	OLD-13-22B	OLD-13-23B	OLD-13-23B						
Sampling Date	12/09/97	1/28/98	2/04/98	2/12/98	2/19/98	3/12/98	00/00/00	1/29/98	2/04/98
Isophorone	--	--	--	10 U	--	--	10 U	--	--
N-Nitroso-di-n-propylamine	--	--	--	10 U	--	--	10 U	--	--
N-Nitrosodiphenylamine (1)	--	--	--	10 U	--	--	10 U	--	--
Naphthalene	94 UJ	2 U	5 U	10 U	2.5 U	20 U	22.25 U	200 U	50 U
Nitrobenzene	--	--	--	10 U	--	--	10 U	--	--
Pentachlorophenol	--	--	--	25 U	--	--	25 U	--	--
Phenanthrene	--	--	--	10 U	--	--	10 U	--	--
Phenol	--	--	--	10 UJ	--	--	10 UJ	--	--
Pyrene	--	--	--	10 U	--	--	10 U	--	--
bis(2-Chloroethoxy)methane	--	--	--	10 UJ	--	--	10 UJ	--	--
bis(2-Chloroethyl)ether	--	--	--	10 U	--	--	10 U	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	10 UJ	--	--	10 UJ	--	--
p-Isopropyltoluene	94 UJ	2 U	5 U	--	2.5 U	20 U	61.75 U	200 U	50 U
Pesticides/PCBs ug/L									
1,2-Dibromo-3-chloropropane	190 UJ	2 U	5 U	8 U	2.5 U	20 U	37.917 U	200 U	50 U
4,4'-DDD	--	--	--	0.1 U	--	--	0.1 U	--	--
4,4'-DDE	--	--	--	0.1 U	--	--	0.1 U	--	--
4,4'-DDT	--	--	--	0.1 U	--	--	0.1 U	--	--
Aldrin	--	--	--	0.05 U	--	--	0.05 U	--	--
Aroclor-1016	--	--	--	1 U	--	--	1 U	--	--
Aroclor-1221	--	--	--	2 U	--	--	2 U	--	--
Aroclor-1232	--	--	--	1 U	--	--	1 U	--	--
Aroclor-1242	--	--	--	1 U	--	--	1 U	--	--
Aroclor-1248	--	--	--	1 U	--	--	1 U	--	--
Aroclor-1254	--	--	--	1 U	--	--	1 U	--	--
Aroclor-1260	--	--	--	1 U	--	--	1 U	--	--
Dieldrin	--	--	--	0.1 U	--	--	0.1 U	--	--
Endosulfan I	--	--	--	0.05 U	--	--	0.05 U	--	--
Endosulfan II	--	--	--	0.1 U	--	--	0.1 U	--	--
Endosulfan sulfate	--	--	--	0.1 U	--	--	0.1 U	--	--
Endrin	--	--	--	0.1 U	--	--	0.1 U	--	--
Endrin aldehyde	--	--	--	0.1 U	--	--	0.1 U	--	--
Endrin ketone	--	--	--	0.1 U	--	--	0.1 U	--	--
Heptachlor	--	--	--	0.05 U	--	--	0.05 U	--	--
Heptachlor epoxide	--	--	--	0.05 U	--	--	0.05 U	--	--
Methoxychlor	--	--	--	0.5 U	--	--	0.5 U	--	--

Appendix D
Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4G02201	U4G02202	U4G02203	U4G02204	U4G02205	U4G02206	U4G022XX	U4G02302	U4G02303
Well ID	OLD-13-22B	OLD-13-23B	OLD-13-23B						
Sampling Date	12/09/97	1/28/98	2/04/98	2/12/98	2/19/98	3/12/98	00/00/00	1/29/98	2/04/98
Toxaphene	--	--	--	5 U	--	--	5 U	--	--
alpha-BHC	--	--	--	0.05 U	--	--	0.05 U	--	--
alpha-Chlordane	--	--	--	0.05 U	--	--	0.05 U	--	--
beta-BHC	--	--	--	0.05 U	--	--	0.05 U	--	--
delta-BHC	--	--	--	0.05 U	--	--	0.05 U	--	--
gamma-BHC (Lindane)	--	--	--	0.05 U	--	--	0.05 U	--	--
gamma-Chlordane	--	--	--	0.05 U	--	--	0.05 U	--	--
Inorganics ug/L									
Aluminum	--	--	--	937	--	--	937	--	--
Antimony	--	--	--	4 U	--	--	4 U	--	--
Arsenic	--	--	--	3.1 U	--	--	3.1 U	--	--
Barium	--	--	--	5.1 J	--	--	5.1 J	--	--
Beryllium	--	--	--	0.33 U	--	--	0.33 U	--	--
Cadmium	--	--	--	0.3 U	--	--	0.3 U	--	--
Calcium	--	--	--	344 U	--	--	344 U	--	--
Chromium	--	--	--	1.6 J	--	--	1.6 J	--	--
Cobalt	--	--	--	0.8 U	--	--	0.8 U	--	--
Copper	--	--	--	0.7 U	--	--	0.7 U	--	--
Iron	--	100 U	100 U	34.6 J	100 U	100 U	46.92 J	310	350
Lead	--	--	--	1.6 U	--	--	1.6 U	--	--
Magnesium	--	--	--	463 U	--	--	463 U	--	--
Manganese	--	15 U	15 U	0.33 U	15 U	15 U	12.066 U	15 U	15 U
Mercury	--	--	--	0.1 U	--	--	0.1 U	--	--
Nickel	--	--	--	1.2 U	--	--	1.2 U	--	--
Potassium	--	--	--	739 U	--	--	739 U	--	--
Selenium	--	--	--	3.6 U	--	--	3.6 U	--	--
Silver	--	--	--	0.7 U	--	--	0.7 U	--	--
Sodium	--	--	--	12,200 U	--	--	12,200 U	--	--
Thallium	--	--	--	4.2 U	--	--	4.2 U	--	--
Vanadium	--	--	--	9.8 J	--	--	9.8 J	--	--
Zinc	--	--	--	1 U	--	--	1 U	--	--

Appendix D

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4G02304	U4G02305	U4G023XX	U4G02401	U4G02402	U4G02403	U4G02404	U4G02405	U4G024XX
Well ID	OLD-13-23B	OLD-13-23B	OLD-13-23B	OLD-13-24A	OLD-13-24A	OLD-13-24A	OLD-13-24A	OLD-13-24A	OLD-13-24A
Sampling Date	2/19/98	3/12/98	00/00/00	12/09/97	1/28/98	2/04/98	2/19/98	3/12/98	00/00/00
Volatile Organic Compounds ug/L									
1,1,1,2-Tetrachloroethane	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
1,1,1-Trichloroethane	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
1,1,2,2-Tetrachloroethane	200 U	50 U	125 U	1 UJ	10 U	1 U	1 U	1 U	2.8 U
1,1,2-Trichloroethane	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
1,1-Dichloroethane	200 U	50 U	125 U	1 UJ	10 U	1 U	1 U	1 U	2.8 U
1,1-Dichloroethene	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
1,1-Dichloropropene	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
1,2,3-Trichloropropane	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
1,2,4-Trimethylbenzene	200 U	50 U	125 U	1 UJ	10 U	1 U	1 U	1 U	2.8 U
1,2-Dichloroethane	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
1,2-Dichloropropane	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
1,3,5-Trimethylbenzene	200 U	50 U	125 U	1 UJ	10 U	1 U	1 U	1 U	2.8 U
1,3-Dichloropropane	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
2,2-Dichloropropane	200 U	50 U	125 U	1 UJ	10 U	1 U	1 U	1 U	2.8 U
2-Chlorotoluene	200 U	50 U	125 U	1 UJ	10 U	1 U	1 U	1 U	2.8 U
2-Hexanone	--	--	--	--	--	--	--	--	--
4-Chlorotoluene	200 U	50 U	125 U	1 UJ	10 U	1 U	1 U	1 U	2.8 U
4-Methyl-2-pentanone	--	--	--	--	--	--	--	--	--
Benzene	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
Bromobenzene	200 U	50 U	125 U	1 UJ	10 U	1 U	1 U	1 U	2.8 U
Bromochloromethane	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
Bromodichloromethane	200 U	50 U	125 U	1 UJ	10 U	1 U	1 U	1 U	2.8 U
Bromoform	200 U	50 U	125 U	1 UJ	10 U	1 U	1 U	1 U	2.8 U
Bromomethane	200 U	50 U	125 U	1 UJ	10 U	1 U	1 U	1 U	2.8 U
Carbon disulfide	--	--	--	--	--	--	--	--	--
Carbon tetrachloride	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
Chlorobenzene	200 U	50 U	125 U	1 UJ	10 U	1 U	1 U	1 U	2.8 U
Chloroethane	200 U	50 U	125 U	1 UJ	10 U	1 U	1 U	1 U	2.8 U
Chloroform	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
Chloromethane	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
Dibromochloromethane	200 U	50 U	125 U	1 UJ	10 U	1 U	1 U	1 U	2.8 U
Dibromomethane	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
Dichlorodifluoromethane	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
Ethylbenzene	200 U	50 U	125 U	1 UJ	10 U	1 U	1 U	1 U	2.8 U
Isopropylbenzene	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U

Appendix D

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4G02304	U4G02305	U4G023XX	U4G02401	U4G02402	U4G02403	U4G02404	U4G02405	U4G024XX
Well ID	OLD-13-23B	OLD-13-23B	OLD-13-23B	OLD-13-24A	OLD-13-24A	OLD-13-24A	OLD-13-24A	OLD-13-24A	OLD-13-24A
Sampling Date	2/19/98	3/12/98	00/00/00	12/09/97	1/28/98	2/04/98	2/19/98	3/12/98	00/00/00
Methyl-tert-butyl ether	--	--	--	2 UJ	--	--	--	--	2 UJ
Methylene chloride	1,000 U	250 U	625 U	4 UJ	50 U	5 U	5 U	5 U	13.8 U
Styrene	200 U	50 U	125 U	1 UJ	10 U	1 U	1 U	1 U	2.8 U
Tetrachloroethene	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
Toluene	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
Trichloroethene	2,500	2,000	2,475	22 J	35	14	11	14	19.2 J
Trichlorofluoromethane	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
Vinyl chloride	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
Xylene (total)	200 U	50 U	125 U	1 UJ	10 U	1 U	1 U	1 U	2.8 U
cis-1,2-Dichloroethene	1,700	1,700	1,650	46 J	96	33	21	22	43.6 J
cis-1,3-Dichloropropene	200 U	50 U	125 U	1 UJ	10 U	1 U	1 U	1 U	2.8 U
n-Butylbenzene	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
n-Propylbenzene	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
sec-Butylbenzene	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
t-Butylbenzene	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
trans-1,2-Dichloroethene	200 U	50 U	125 U	0.7 J	10 U	1 U	1 U	1 U	1.44 J
trans-1,3-Dichloropropene	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
Semivolatile Organic Compounds ug/L									
1,2,3-Trichlorobenzene	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
1,2,4-Trichlorobenzene	200 U	50 U	125 U	1 UJ	10 U	1 U	1 U	1 U	2.8 U
1,2-Dibromoethane	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
1,2-Dichlorobenzene	200 U	50 U	125 U	1 UJ	10 U	1 U	1 U	1 U	2.8 U
1,3-Dichlorobenzene	200 U	50 U	125 U	1 UJ	10 U	1 U	1 U	1 U	2.8 U
1,4-Dichlorobenzene	200 U	50 U	125 U	1 UJ	10 U	1 U	1 U	1 U	2.8 U
2,2'-oxybis(1-Chloropropane)	--	--	--	--	--	--	--	--	--
2,4,5-Trichlorophenol	--	--	--	--	--	--	--	--	--
2,4,6-Trichlorophenol	--	--	--	--	--	--	--	--	--
2,4-Dichlorophenol	--	--	--	--	--	--	--	--	--
2,4-Dimethylphenol	--	--	--	--	--	--	--	--	--
2,4-Dinitrophenol	--	--	--	--	--	--	--	--	--
2,4-Dinitrotoluene	--	--	--	--	--	--	--	--	--
2,6-Dinitrotoluene	--	--	--	--	--	--	--	--	--
2-Chloronaphthalene	--	--	--	--	--	--	--	--	--
2-Chlorophenol	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	--	--	--	--	--	--	--	--	--
2-Methylphenol	--	--	--	--	--	--	--	--	--

Appendix D

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4G02304	U4G02305	U4G023XX	U4G02401	U4G02402	U4G02403	U4G02404	U4G02405	U4G024XX
Well ID	OLD-13-23B	OLD-13-23B	OLD-13-23B	OLD-13-24A	OLD-13-24A	OLD-13-24A	OLD-13-24A	OLD-13-24A	OLD-13-24A
Sampling Date	2/19/98	3/12/98	00/00/00	12/09/97	1/28/98	2/04/98	2/19/98	3/12/98	00/00/00
2-Nitroaniline	--	--	--	--	--	--	--	--	--
2-Nitrophenol	--	--	--	--	--	--	--	--	--
3,3'-Dichlorobenzidine	--	--	--	--	--	--	--	--	--
3-Nitroaniline	--	--	--	--	--	--	--	--	--
4,6-Dinitro-2-methylphenol	--	--	--	--	--	--	--	--	--
4-Bromophenyl-phenylether	--	--	--	--	--	--	--	--	--
4-Chloro-3-methylphenol	--	--	--	--	--	--	--	--	--
4-Chloroaniline	--	--	--	--	--	--	--	--	--
4-Chlorophenyl-phenylether	--	--	--	--	--	--	--	--	--
4-Methylphenol	--	--	--	--	--	--	--	--	--
4-Nitroaniline	--	--	--	--	--	--	--	--	--
4-Nitrophenol	--	--	--	--	--	--	--	--	--
Acenaphthene	--	--	--	--	--	--	--	--	--
Acenaphthylene	--	--	--	--	--	--	--	--	--
Anthracene	--	--	--	--	--	--	--	--	--
Benzo(a)anthracene	--	--	--	--	--	--	--	--	--
Benzo(a)pyrene	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	--	--	--	--	--	--	--	--	--
Benzo(g,h,i)perylene	--	--	--	--	--	--	--	--	--
Benzo(k)fluoranthene	--	--	--	--	--	--	--	--	--
Butylbenzylphthalate	--	--	--	--	--	--	--	--	--
Carbazole	--	--	--	--	--	--	--	--	--
Chrysene	--	--	--	--	--	--	--	--	--
Di-n-butylphthalate	--	--	--	--	--	--	--	--	--
Di-n-octylphthalate	--	--	--	--	--	--	--	--	--
Dibenz(a,h)anthracene	--	--	--	--	--	--	--	--	--
Dibenzofuran	--	--	--	--	--	--	--	--	--
Diethylphthalate	--	--	--	--	--	--	--	--	--
Dimethylphthalate	--	--	--	--	--	--	--	--	--
Fluoranthene	--	--	--	--	--	--	--	--	--
Fluorene	--	--	--	--	--	--	--	--	--
Hexachlorobenzene	--	--	--	--	--	--	--	--	--
Hexachlorobutadiene	200 U	50 U	125 U	2 U	10 U	1 U	1 U	1 U	3 U
Hexachlorocyclopentadiene	--	--	--	--	--	--	--	--	--
Hexachloroethane	--	--	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	--	--	--	--	--	--	--	--	--

Appendix D

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4G02304	U4G02305	U4G023XX	U4G02401	U4G02402	U4G02403	U4G02404	U4G02405	U4G024XX
Well ID	OLD-13-23B	OLD-13-23B	OLD-13-23B	OLD-13-24A	OLD-13-24A	OLD-13-24A	OLD-13-24A	OLD-13-24A	OLD-13-24A
Sampling Date	2/19/98	3/12/98	00/00/00	12/09/97	1/28/98	2/04/98	2/19/98	3/12/98	00/00/00
Isophorone	--	--	--	--	--	--	--	--	--
N-Nitroso-di-n-propylamine	--	--	--	--	--	--	--	--	--
N-Nitrosodiphenylamine (1)	--	--	--	--	--	--	--	--	--
Naphthalene	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
Nitrobenzene	--	--	--	--	--	--	--	--	--
Pentachlorophenol	--	--	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--	--	--
Phenol	--	--	--	--	--	--	--	--	--
Pyrene	--	--	--	--	--	--	--	--	--
bis(2-Chloroethoxy)methane	--	--	--	--	--	--	--	--	--
bis(2-Chloroethyl)ether	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	--	--	--
p-Isopropyltoluene	200 U	50 U	125 U	2 UJ	10 U	1 U	1 U	1 U	3 U
Pesticides/PCBs ug/L									
1,2-Dibromo-3-chloropropane	200 U	50 U	125 U	4 UJ	10 U	1 U	1 U	1 U	3.4 U
4,4'-DDD	--	--	--	--	--	--	--	--	--
4,4'-DDE	--	--	--	--	--	--	--	--	--
4,4'-DDT	--	--	--	--	--	--	--	--	--
Aldrin	--	--	--	--	--	--	--	--	--
Aroclor-1016	--	--	--	--	--	--	--	--	--
Aroclor-1221	--	--	--	--	--	--	--	--	--
Aroclor-1232	--	--	--	--	--	--	--	--	--
Aroclor-1242	--	--	--	--	--	--	--	--	--
Aroclor-1248	--	--	--	--	--	--	--	--	--
Aroclor-1254	--	--	--	--	--	--	--	--	--
Aroclor-1260	--	--	--	--	--	--	--	--	--
Dieldrin	--	--	--	--	--	--	--	--	--
Endosulfan I	--	--	--	--	--	--	--	--	--
Endosulfan II	--	--	--	--	--	--	--	--	--
Endosulfan sulfate	--	--	--	--	--	--	--	--	--
Endrin	--	--	--	--	--	--	--	--	--
Endrin aldehyde	--	--	--	--	--	--	--	--	--
Endrin ketone	--	--	--	--	--	--	--	--	--
Heptachlor	--	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	--	--	--	--
Methoxychlor	--	--	--	--	--	--	--	--	--

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4G02304	U4G02305	U4G023XX	U4G02401	U4G02402	U4G02403	U4G02404	U4G02405	U4G024XX
Well ID	OLD-13-23B	OLD-13-23B	OLD-13-23B	OLD-13-24A	OLD-13-24A	OLD-13-24A	OLD-13-24A	OLD-13-24A	OLD-13-24A
Sampling Date	2/19/98	3/12/98	00/00/00	12/09/97	1/28/98	2/04/98	2/19/98	3/12/98	00/00/00
Toxaphene	--	--	--	--	--	--	--	--	--
alpha-BHC	--	--	--	--	--	--	--	--	--
alpha-Chlordane	--	--	--	--	--	--	--	--	--
beta-BHC	--	--	--	--	--	--	--	--	--
delta-BHC	--	--	--	--	--	--	--	--	--
gamma-BHC (Lindane)	--	--	--	--	--	--	--	--	--
gamma-Chlordane	--	--	--	--	--	--	--	--	--
Inorganics ug/L									
Aluminum	--	--	--	--	--	--	--	--	--
Antimony	--	--	--	--	--	--	--	--	--
Arsenic	--	--	--	--	--	--	--	--	--
Barium	--	--	--	--	--	--	--	--	--
Beryllium	--	--	--	--	--	--	--	--	--
Cadmium	--	--	--	--	--	--	--	--	--
Calcium	--	--	--	--	--	--	--	--	--
Chromium	--	--	--	--	--	--	--	--	--
Cobalt	--	--	--	--	--	--	--	--	--
Copper	--	--	--	--	--	--	--	--	--
Iron	380	620	415	--	240	200	140	180	190
Lead	--	--	--	--	--	--	--	--	--
Magnesium	--	--	--	--	--	--	--	--	--
Manganese	15 U	15 U	15 U	--	15 U				
Mercury	--	--	--	--	--	--	--	--	--
Nickel	--	--	--	--	--	--	--	--	--
Potassium	--	--	--	--	--	--	--	--	--
Selenium	--	--	--	--	--	--	--	--	--
Silver	--	--	--	--	--	--	--	--	--
Sodium	--	--	--	--	--	--	--	--	--
Thallium	--	--	--	--	--	--	--	--	--
Vanadium	--	--	--	--	--	--	--	--	--
Zinc	--	--	--	--	--	--	--	--	--

Appendix D

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID	U4G02502	U4G02503	U4G02504	U4G02505	U4G025XX	U4G02701	U4G03301	U4G03401	U4G03501	U4G03601
Well ID	OLD-13-25B	OLD-13-25B	OLD-13-25B	OLD-13-25B	OLD-13-25B	OLD-13-27A	OLD-13-33A	OLD-13-34B	OLD-13-35C	OLD-13-36A
Sampling Date	1/28/98	2/04/98	2/19/98	3/12/98	00/00/00	2/10/98	2/11/98	2/11/98	2/11/98	2/11/98
Volatile Organic Compounds ug/L										
1,1,1,2-Tetrachloroethane	10 U	10 U	10 U	5 U	8.75 U	--	--	--	--	--
1,1,1-Trichloroethane	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloropropene	10 U	10 U	10 U	5 U	8.75 U	--	--	--	--	--
1,2,3-Trichloropropane	10 U	10 U	10 U	5 U	8.75 U	--	--	--	--	--
1,2,4-Trimethylbenzene	10 U	10 U	10 U	5 U	8.75 U	--	--	--	--	--
1,2-Dichloroethane	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
1,3,5-Trimethylbenzene	10 U	10 U	10 U	5 U	8.75 U	--	--	--	--	--
1,3-Dichloropropane	10 U	10 U	10 U	5 U	8.75 U	--	--	--	--	--
2,2-Dichloropropane	10 U	10 U	10 U	5 U	8.75 U	--	--	--	--	--
2-Chlorotoluene	10 U	10 U	10 U	5 U	8.75 U	--	--	--	--	--
2-Hexanone	--	--	--	--	--	5 U	5 U	5 U	5 U	5 U
4-Chlorotoluene	10 U	10 U	10 U	5 U	8.75 U	--	--	--	--	--
4-Methyl-2-pentanone	--	--	--	--	--	5 U	5 U	5 U	5 U	5 U
Benzene	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
Bromobenzene	10 U	10 U	10 U	5 U	8.75 U	--	--	--	--	--
Bromochloromethane	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
Bromodichloromethane	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
Bromoform	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
Bromomethane	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
Carbon disulfide	--	--	--	--	--	1 U	1 U	1 U	1 U	1 U
Carbon tetrachloride	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
Chloroethane	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
Chloroform	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
Chloromethane	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
Dibromochloromethane	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
Dibromomethane	10 U	10 U	10 U	5 U	8.75 U	--	--	--	--	--
Dichlorodifluoromethane	10 U	10 U	10 U	5 U	8.75 U	--	--	--	--	--
Ethylbenzene	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
Isopropylbenzene	10 U	10 U	10 U	5 U	8.75 U	--	--	--	--	--

Appendix D

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID	U4G02502	U4G02503	U4G02504	U4G02505	U4G025XX	U4G02701	U4G03301	U4G03401	U4G03501	U4G03601
Well ID	OLD-13-25B	OLD-13-25B	OLD-13-25B	OLD-13-25B	OLD-13-25B	OLD-13-27A	OLD-13-33A	OLD-13-34B	OLD-13-35C	OLD-13-36A
Sampling Date	1/28/98	2/04/98	2/19/98	3/12/98	00/00/00	2/10/98	2/11/98	2/11/98	2/11/98	2/11/98
Methyl-tert-butyl ether	--	--	--	--	--	1 U	1 U	1 U	1 U	1 U
Methylene chloride	50 U	50 U	50 U	25 U	43.75 U	2 U	2 U	2 U	2 U	2 U
Styrene	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
Tetrachloroethene	240	180	270	320	252.5	4	1 U	12	1 U	2
Toluene	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	15	21	28	32	24	2	1 U	3	1 U	3
Trichlorofluoromethane	10 U	10 U	10 U	5 U	8.75 U	--	--	--	--	--
Vinyl chloride	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
Xylene (total)	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	10 U	10 U	10 U	16	7.75 U	1 U	1 U	3	1 U	1
cis-1,3-Dichloropropene	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
n-Butylbenzene	10 U	10 U	10 U	5 U	8.75 U	--	--	--	--	--
n-Propylbenzene	10 U	10 U	10 U	5 U	8.75 U	--	--	--	--	--
sec-Butylbenzene	10 U	10 U	10 U	5 U	8.75 U	--	--	--	--	--
t-Butylbenzene	10 U	10 U	10 U	5 U	8.75 U	--	--	--	--	--
trans-1,2-Dichloroethene	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
trans-1,3-Dichloropropene	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
Semivolatile Organic Compounds ug/L										
1,2,3-Trichlorobenzene	10 U	10 U	10 U	5 U	8.75 U	--	--	--	--	--
1,2,4-Trichlorobenzene	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
1,2-Dibromoethane	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
1,3-Dichlorobenzene	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
1,4-Dichlorobenzene	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
2,2'-oxybis(1-Chloropropane)	--	--	--	--	--	10 U	10 UJ	10 UJ	--	10 UJ
2,4,5-Trichlorophenol	--	--	--	--	--	25 U	25 U	25 U	--	25 U
2,4,6-Trichlorophenol	--	--	--	--	--	10 U	10 U	10 U	--	10 U
2,4-Dichlorophenol	--	--	--	--	--	10 U	10 U	10 U	--	10 U
2,4-Dimethylphenol	--	--	--	--	--	10 U	10 U	10 U	--	10 U
2,4-Dinitrophenol	--	--	--	--	--	25 UJ	25 UJ	25 UJ	--	25 U
2,4-Dinitrotoluene	--	--	--	--	--	10 U	10 UJ	10 UJ	--	10 U
2,6-Dinitrotoluene	--	--	--	--	--	10 UJ	10 UJ	10 UJ	--	10 U
2-Chloronaphthalene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
2-Chlorophenol	--	--	--	--	--	10 U	10 U	10 U	--	10 U
2-Methylnaphthalene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
2-Methylphenol	--	--	--	--	--	10 U	10 U	10 U	--	10 U

Appendix D
Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID	U4G02502	U4G02503	U4G02504	U4G02505	U4G025XX	U4G02701	U4G03301	U4G03401	U4G03501	U4G03601
Well ID	OLD-13-25B	OLD-13-25B	OLD-13-25B	OLD-13-25B	OLD-13-25B	OLD-13-27A	OLD-13-33A	OLD-13-34B	OLD-13-35C	OLD-13-36A
Sampling Date	1/28/98	2/04/98	2/19/98	3/12/98	00/00/00	2/10/98	2/11/98	2/11/98	2/11/98	2/11/98
2-Nitroaniline	--	--	--	--	--	25 U	25 U	25 U	--	25 U
2-Nitrophenol	--	--	--	--	--	10 U	10 U	10 U	--	10 U
3,3'-Dichlorobenzidine	--	--	--	--	--	10 U	10 U	10 U	--	10 U
3-Nitroaniline	--	--	--	--	--	25 U	25 U	25 U	--	25 U
4,6-Dinitro-2-methylphenol	--	--	--	--	--	25 UJ	25 U	25 U	--	25 U
4-Bromophenyl-phenylether	--	--	--	--	--	10 U	10 U	10 U	--	10 U
4-Chloro-3-methylphenol	--	--	--	--	--	10 U	10 U	10 U	--	10 U
4-Chloroaniline	--	--	--	--	--	10 U	10 U	10 U	--	10 U
4-Chlorophenyl-phenylether	--	--	--	--	--	10 U	10 U	10 U	--	10 U
4-Methylphenol	--	--	--	--	--	10 U	10 U	10 U	--	10 U
4-Nitroaniline	--	--	--	--	--	25 U	25 U	25 U	--	25 U
4-Nitrophenol	--	--	--	--	--	25 U	25 UJ	25 UJ	--	25 UJ
Acenaphthene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Acenaphthylene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Anthracene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Benzo(a)anthracene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Benzo(a)pyrene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Benzo(b)fluoranthene	--	--	--	--	--	10 U	10 U	10 U	--	10 UJ
Benzo(g,h,i)perylene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Benzo(k)fluoranthene	--	--	--	--	--	10 U	10 U	10 U	--	10 UJ
Butylbenzylphthalate	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Carbazole	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Chrysene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Di-n-butylphthalate	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Di-n-octylphthalate	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Dibenz(a,h)anthracene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Dibenzofuran	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Diethylphthalate	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Dimethylphthalate	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Fluoranthene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Fluorene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Hexachlorobenzene	--	--	--	--	--	10 U	10 UJ	10 UJ	--	10 UJ
Hexachlorobutadiene	10 U	10 U	10 U	5 U	8.75 U	10 U	10 UJ	10 UJ	--	10 UJ
Hexachlorocyclopentadiene	--	--	--	--	--	10 U	10 UJ	10 UJ	--	10 U
Hexachloroethane	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Indeno(1,2,3-cd)pyrene	--	--	--	--	--	10 U	10 U	10 U	--	10 U

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4G02502	U4G02503	U4G02504	U4G02505	U4G025XX	U4G02701	U4G03301	U4G03401	U4G03501	U4G03601
Well ID	OLD-13-25B	OLD-13-25B	OLD-13-25B	OLD-13-25B	OLD-13-25B	OLD-13-27A	OLD-13-33A	OLD-13-34B	OLD-13-35C	OLD-13-36A
Sampling Date	1/28/98	2/04/98	2/19/98	3/12/98	00/00/00	2/10/98	2/11/98	2/11/98	2/11/98	2/11/98
Isophorone	--	--	--	--	--	10 U	10 U	10 U	--	10 U
N-Nitroso-di-n-propylamine	--	--	--	--	--	10 U	10 U	10 U	--	10 U
N-Nitrosodiphenylamine (1)	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Naphthalene	10 U	10 U	10 U	5 U	8.75 U	10 U	10 U	10 U	--	10 U
Nitrobenzene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Pentachlorophenol	--	--	--	--	--	25 U	25 UJ	25 UJ	--	25 U
Phenanthrene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Phenol	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Pyrene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
bis(2-Chloroethoxy)methane	--	--	--	--	--	10 U	10 U	10 U	--	10 U
bis(2-Chloroethyl)ether	--	--	--	--	--	10 U	10 U	10 U	--	10 U
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	10 U	10 U	10 U	--	10 U
p-Isopropyltoluene	10 U	10 U	10 U	5 U	8.75 U	--	--	--	--	--
Pesticides/PCBs ug/L										
1,2-Dibromo-3-chloropropane	10 U	10 U	10 U	5 U	8.75 U	1 U	1 U	1 U	1 U	1 U
4,4'-DDD	--	--	--	--	--	0.098 U	0.098 U	0.1 U	--	0.095 U
4,4'-DDE	--	--	--	--	--	0.098 U	0.098 U	0.1 U	--	0.095 U
4,4'-DDT	--	--	--	--	--	0.098 U	0.098 U	0.1 U	--	0.095 U
Aldrin	--	--	--	--	--	0.049 U	0.049 U	0.051 U	--	0.048 U
Aroclor-1016	--	--	--	--	--	0.98 U	0.98 U	1 U	--	0.95 U
Aroclor-1221	--	--	--	--	--	2 U	2 U	2 U	--	1.9 U
Aroclor-1232	--	--	--	--	--	0.98 U	0.98 U	1 U	--	0.95 U
Aroclor-1242	--	--	--	--	--	0.98 U	0.98 U	1 U	--	0.95 U
Aroclor-1248	--	--	--	--	--	0.98 U	0.98 U	1 U	--	0.95 U
Aroclor-1254	--	--	--	--	--	0.98 U	0.98 U	1 U	--	0.95 U
Aroclor-1260	--	--	--	--	--	0.98 U	0.98 U	1 U	--	0.95 U
Dieldrin	--	--	--	--	--	0.098 U	0.098 U	0.1 U	--	0.095 U
Endosulfan I	--	--	--	--	--	0.049 U	0.049 U	0.051 U	--	0.048 U
Endosulfan II	--	--	--	--	--	0.098 U	0.098 U	0.1 U	--	0.095 U
Endosulfan sulfate	--	--	--	--	--	0.098 U	0.098 U	0.1 U	--	0.095 U
Endrin	--	--	--	--	--	0.098 U	0.098 U	0.1 U	--	0.095 U
Endrin aldehyde	--	--	--	--	--	0.098 U	0.098 U	0.1 U	--	0.095 U
Endrin ketone	--	--	--	--	--	0.098 U	0.098 U	0.1 U	--	0.095 U
Heptachlor	--	--	--	--	--	0.049 U	0.049 U	0.051 U	--	0.048 U
Heptachlor epoxide	--	--	--	--	--	0.049 U	0.049 U	0.051 U	--	0.048 U
Methoxychlor	--	--	--	--	--	0.49 U	0.49 U	0.51 U	--	0.48 U

Appendix D

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4G02502	U4G02503	U4G02504	U4G02505	U4G025XX	U4G02701	U4G03301	U4G03401	U4G03501	U4G03601
Well ID	OLD-13-25B	OLD-13-25B	OLD-13-25B	OLD-13-25B	OLD-13-25B	OLD-13-27A	OLD-13-33A	OLD-13-34B	OLD-13-35C	OLD-13-36A
Sampling Date	1/28/98	2/04/98	2/19/98	3/12/98	00/00/00	2/10/98	2/11/98	2/11/98	2/11/98	2/11/98
Toxaphene	--	--	--	--	--	4.9 U	4.9 U	5.1 U	--	4.8 U
alpha-BHC	--	--	--	--	--	0.049 U	0.049 U	0.051 U	--	0.048 U
alpha-Chlordane	--	--	--	--	--	0.049 U	0.049 U	0.051 U	--	0.048 U
beta-BHC	--	--	--	--	--	0.049 U	0.049 U	0.051 U	--	0.048 U
delta-BHC	--	--	--	--	--	0.049 U	0.049 U	0.051 U	--	0.048 U
gamma-BHC (Lindane)	--	--	--	--	--	0.049 U	0.049 U	0.051 U	--	0.048 U
gamma-Chlordane	--	--	--	--	--	0.049 U	0.049 U	0.051 U	--	0.048 U
Inorganics ug/L										
Aluminum	--	--	--	--	--	99.7 U	1,390	1,590	4,690	2,920
Antimony	--	--	--	--	--	7.2 U	2.5 U	2.5 U	2.5 U	2.5 U
Arsenic	--	--	--	--	--	3.1 U				
Barium	--	--	--	--	--	3.9 J	3.5 J	13.4 J	34.3 J	6.6 J
Beryllium	--	--	--	--	--	0.63 U	0.87 U	0.67 U	1.1 U	0.66 U
Cadmium	--	--	--	--	--	0.3 U				
Calcium	--	--	--	--	--	48,100 U	20,300 U	657 U	4,840 U	16,800 U
Chromium	--	--	--	--	--	0.9 U	2.4 J	2.9 J	2.9 J	7.1 J
Cobalt	--	--	--	--	--	0.8 U				
Copper	--	--	--	--	--	0.7 U				
Iron	180	100 U	140	100 U	105	16.8 J	482	182	2,970	447
Lead	--	--	--	--	--	1.6 U	2.7 U	1.6 U	6 U	3.4 U
Magnesium	--	--	--	--	--	2,920 U	1,440 U	389 U	2,180 U	967 U
Manganese	15 U	3.3 U	2.8 U	0.91 U	112 U	2.7 U				
Mercury	--	--	--	--	--	0.1 U				
Nickel	--	--	--	--	--	1.2 U	1.2 U	1.2 U	2.9 J	1.2 U
Potassium	--	--	--	--	--	1,990 U	337 U	757 U	1,040 U	1,660 U
Selenium	--	--	--	--	--	15.5	3.6 U	3.6 U	3.6 U	3.6 U
Silver	--	--	--	--	--	0.7 U				
Sodium	--	--	--	--	--	7,630 U	7,210 U	11,100 U	23,300 U	15,500 U
Thallium	--	--	--	--	--	4.2 U				
Vanadium	--	--	--	--	--	--	--	--	--	--
Zinc	--	--	--	--	--	1 U	1 U	1 U	10.8 U	1 U

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4G03701	U4G03701D	U4G03801	U4G03901	U4G04001	U4G04101	U4G04101D	U4G04301	U4G04301D
Well ID	OLD-13-37B	OLD-13-37B	OLD-13-38C	OLD-13-39B	OLD-13-40B	OLD-13-41B	OLD-13-41B	OLD-13-43C	OLD-13-43C
Sampling Date	2/11/98	2/11/98	2/11/98	2/10/98	2/12/98	2/12/98	2/12/98	2/12/98	2/12/98
Volatile Organic Compounds ug/L									
1,1,1,2-Tetrachloroethane	--	--	--	--	--	--	--	--	--
1,1,1-Trichloroethane	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
1,1,2,2-Tetrachloroethane	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
1,1,2-Trichloroethane	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
1,1-Dichloroethane	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
1,1-Dichloroethene	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
1,1-Dichloropropene	--	--	--	--	--	--	--	--	--
1,2,3-Trichloropropane	--	--	--	--	--	--	--	--	--
1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--
1,2-Dichloroethane	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
1,2-Dichloropropane	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--
1,3-Dichloropropane	--	--	--	--	--	--	--	--	--
2,2-Dichloropropane	--	--	--	--	--	--	--	--	--
2-Chlorotoluene	--	--	--	--	--	--	--	--	--
2-Hexanone	120 U	120 U	5 U	120 U	5 U	840 U	840 U	5 U	5 U
4-Chlorotoluene	--	--	--	--	--	--	--	--	--
4-Methyl-2-pentanone	120 U	120 U	5 U	120 U	5 U	840 U	840 U	5 U	5 U
Benzene	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
Bromobenzene	--	--	--	--	--	--	--	--	--
Bromochloromethane	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
Bromodichloromethane	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
Bromoform	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
Bromomethane	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
Carbon disulfide	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
Carbon tetrachloride	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
Chlorobenzene	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
Chloroethane	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
Chloroform	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
Chloromethane	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
Dibromochloromethane	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
Dibromomethane	--	--	--	--	--	--	--	--	--
Dichlorodifluoromethane	--	--	--	--	--	--	--	--	--
Ethylbenzene	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
Isopropylbenzene	--	--	--	--	--	--	--	--	--

Appendix D
Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID	U4G03701	U4G03701D	U4G03801	U4G03901	U4G04001	U4G04101	U4G04101D	U4G04301	U4G04301D
Well ID	OLD-13-37B	OLD-13-37B	OLD-13-38C	OLD-13-39B	OLD-13-40B	OLD-13-41B	OLD-13-41B	OLD-13-43C	OLD-13-43C
Sampling Date	2/11/98	2/11/98	2/11/98	2/10/98	2/12/98	2/12/98	2/12/98	2/12/98	2/12/98
Methyl-tert-butyl ether	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
Methylene chloride	50 U	50 U	2 U	50 U	2 U	330 U	330 U	2 U	2 U
Styrene	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
Tetrachloroethene	240	230	1 U	390	2	340	370	1 U	1 U
Toluene	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
Trichloroethene	110	100	1 U	25	0.7 J	1,900	2,100	1 U	1 U
Trichlorofluoromethane	--	--	--	--	--	--	--	--	--
Vinyl chloride	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
Xylene (total)	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
cis-1,2-Dichloroethene	31	27	1 U	25 U	1	550	560	1 U	1 U
cis-1,3-Dichloropropene	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
n-Butylbenzene	--	--	--	--	--	--	--	--	--
n-Propylbenzene	--	--	--	--	--	--	--	--	--
sec-Butylbenzene	--	--	--	--	--	--	--	--	--
t-Butylbenzene	--	--	--	--	--	--	--	--	--
trans-1,2-Dichloroethene	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
trans-1,3-Dichloropropene	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
Semivolatile Organic Compounds ug/L									
1,2,3-Trichlorobenzene	--	--	--	--	--	--	--	--	--
1,2,4-Trichlorobenzene	10 U	10 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
1,2-Dibromoethane	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
1,2-Dichlorobenzene	10 U	10 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
1,3-Dichlorobenzene	10 U	10 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
1,4-Dichlorobenzene	10 U	10 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
2,2'-oxybis(1-Chloropropane)	10 UJ	10 UJ	--	--	--	--	--	--	--
2,4,5-Trichlorophenol	25 U	25 U	--	--	--	--	--	--	--
2,4,6-Trichlorophenol	10 U	10 U	--	--	--	--	--	--	--
2,4-Dichlorophenol	10 U	10 U	--	--	--	--	--	--	--
2,4-Dimethylphenol	10 U	10 U	--	--	--	--	--	--	--
2,4-Dinitrophenol	25 UJ	25 U	--	--	--	--	--	--	--
2,4-Dinitrotoluene	10 UJ	10 U	--	--	--	--	--	--	--
2,6-Dinitrotoluene	10 UJ	10 U	--	--	--	--	--	--	--
2-Chloronaphthalene	10 U	10 U	--	--	--	--	--	--	--
2-Chlorophenol	10 U	10 U	--	--	--	--	--	--	--
2-Methylnaphthalene	10 U	10 U	--	--	--	--	--	--	--
2-Methylphenol	10 U	10 U	--	--	--	--	--	--	--

Appendix D

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4G03701	U4G03701D	U4G03801	U4G03901	U4G04001	U4G04101	U4G04101D	U4G04301	U4G04301D
Well ID	OLD-13-37B	OLD-13-37B	OLD-13-38C	OLD-13-39B	OLD-13-40B	OLD-13-41B	OLD-13-41B	OLD-13-43C	OLD-13-43C
Sampling Date	2/11/98	2/11/98	2/11/98	2/10/98	2/12/98	2/12/98	2/12/98	2/12/98	2/12/98
2-Nitroaniline	25 U	25 U	--	--	--	--	--	--	--
2-Nitrophenol	10 U	10 U	--	--	--	--	--	--	--
3,3'-Dichlorobenzidine	10 U	10 U	--	--	--	--	--	--	--
3-Nitroaniline	25 U	25 U	--	--	--	--	--	--	--
4,6-Dinitro-2-methylphenol	25 U	25 U	--	--	--	--	--	--	--
4-Bromophenyl-phenylether	10 U	10 U	--	--	--	--	--	--	--
4-Chloro-3-methylphenol	10 U	10 U	--	--	--	--	--	--	--
4-Chloroaniline	10 U	10 U	--	--	--	--	--	--	--
4-Chlorophenyl-phenylether	10 U	10 U	--	--	--	--	--	--	--
4-Methylphenol	10 U	10 U	--	--	--	--	--	--	--
4-Nitroaniline	25 U	25 U	--	--	--	--	--	--	--
4-Nitrophenol	25 UJ	25 UJ	--	--	--	--	--	--	--
Acenaphthene	10 U	10 U	--	--	--	--	--	--	--
Acenaphthylene	10 U	10 U	--	--	--	--	--	--	--
Anthracene	10 U	10 U	--	--	--	--	--	--	--
Benzo(a)anthracene	10 U	10 U	--	--	--	--	--	--	--
Benzo(a)pyrene	10 U	10 U	--	--	--	--	--	--	--
Benzo(b)fluoranthene	10 U	10 UJ	--	--	--	--	--	--	--
Benzo(g,h,i)perylene	10 U	10 U	--	--	--	--	--	--	--
Benzo(k)fluoranthene	10 U	10 UJ	--	--	--	--	--	--	--
Butylbenzylphthalate	10 U	10 U	--	--	--	--	--	--	--
Carbazole	10 U	10 U	--	--	--	--	--	--	--
Chrysene	10 U	10 U	--	--	--	--	--	--	--
Di-n-butylphthalate	10 U	10 U	--	--	--	--	--	--	--
Di-n-octylphthalate	10 U	10 U	--	--	--	--	--	--	--
Dibenz(a,h)anthracene	10 U	10 U	--	--	--	--	--	--	--
Dibenzofuran	10 U	10 U	--	--	--	--	--	--	--
Diethylphthalate	10 U	10 U	--	--	--	--	--	--	--
Dimethylphthalate	10 U	10 U	--	--	--	--	--	--	--
Fluoranthene	10 U	10 U	--	--	--	--	--	--	--
Fluorene	10 U	10 U	--	--	--	--	--	--	--
Hexachlorobenzene	10 UJ	10 UJ	--	--	--	--	--	--	--
Hexachlorobutadiene	10 UJ	10 UJ	--	--	--	--	--	--	--
Hexachlorocyclopentadiene	10 UJ	10 U	--	--	--	--	--	--	--
Hexachloroethane	10 U	10 U	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	10 U	10 U	--	--	--	--	--	--	--

Appendix D

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4G03701	U4G03701D	U4G03801	U4G03901	U4G04001	U4G04101	U4G04101D	U4G04301	U4G04301D
Well ID	OLD-13-37B	OLD-13-37B	OLD-13-38C	OLD-13-39B	OLD-13-40B	OLD-13-41B	OLD-13-41B	OLD-13-43C	OLD-13-43C
Sampling Date	2/11/98	2/11/98	2/11/98	2/10/98	2/12/98	2/12/98	2/12/98	2/12/98	2/12/98
Isophorone	10 U	10 U	--	--	--	--	--	--	--
N-Nitroso-di-n-propylamine	10 U	10 U	--	--	--	--	--	--	--
N-Nitrosodiphenylamine (1)	10 U	10 U	--	--	--	--	--	--	--
Naphthalene	10 U	10 U	--	--	--	--	--	--	--
Nitrobenzene	10 U	10 U	--	--	--	--	--	--	--
Pentachlorophenol	25 UJ	25 U	--	--	--	--	--	--	--
Phenanthrene	10 U	10 U	--	--	--	--	--	--	--
Phenol	10 U	10 U	--	--	--	--	--	--	--
Pyrene	10 U	10 U	--	--	--	--	--	--	--
bis(2-Chloroethoxy)methane	10 U	10 U	--	--	--	--	--	--	--
bis(2-Chloroethyl)ether	10 U	10 U	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	10 U	10 U	--	--	--	--	--	--	--
p-Isopropyltoluene	--	--	--	--	--	--	--	--	--
Pesticides/PCBs ug/L									
1,2-Dibromo-3-chloropropane	25 U	25 U	1 U	25 U	1 U	170 U	170 U	1 U	1 U
4,4'-DDD	0.099 U	0.098 U	--	--	--	--	--	--	--
4,4'-DDE	0.099 U	0.098 U	--	--	--	--	--	--	--
4,4'-DDT	0.099 U	0.098 U	--	--	--	--	--	--	--
Aldrin	0.05 U	0.049 U	--	--	--	--	--	--	--
Aroclor-1016	0.99 U	0.98 U	--	--	--	--	--	--	--
Aroclor-1221	2 U	2 U	--	--	--	--	--	--	--
Aroclor-1232	0.99 U	0.98 U	--	--	--	--	--	--	--
Aroclor-1242	0.99 U	0.98 U	--	--	--	--	--	--	--
Aroclor-1248	0.99 U	0.98 U	--	--	--	--	--	--	--
Aroclor-1254	0.99 U	0.98 U	--	--	--	--	--	--	--
Aroclor-1260	0.99 U	0.98 U	--	--	--	--	--	--	--
Dieldrin	0.099 U	0.098 U	--	--	--	--	--	--	--
Endosulfan I	0.05 U	0.049 U	--	--	--	--	--	--	--
Endosulfan II	0.099 U	0.098 U	--	--	--	--	--	--	--
Endosulfan sulfate	0.099 U	0.098 U	--	--	--	--	--	--	--
Endrin	0.099 U	0.098 U	--	--	--	--	--	--	--
Endrin aldehyde	0.099 U	0.098 U	--	--	--	--	--	--	--
Endrin ketone	0.099 U	0.098 U	--	--	--	--	--	--	--
Heptachlor	0.05 U	0.049 U	--	--	--	--	--	--	--
Heptachlor epoxide	0.05 U	0.049 U	--	--	--	--	--	--	--
Methoxychlor	0.5 U	0.49 U	--	--	--	--	--	--	--

Appendix D

Table D-3. Summary of Unfiltered Groundwater Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4G03701	U4G03701D	U4G03801	U4G03901	U4G04001	U4G04101	U4G04101D	U4G04301	U4G04301D
Well ID	OLD-13-37B	OLD-13-37B	OLD-13-38C	OLD-13-39B	OLD-13-40B	OLD-13-41B	OLD-13-41B	OLD-13-43C	OLD-13-43C
Sampling Date	2/11/98	2/11/98	2/11/98	2/10/98	2/12/98	2/12/98	2/12/98	2/12/98	2/12/98
Toxaphene	5 U	4.9 U	--	--	--	--	--	--	--
alpha-BHC	0.05 U	0.049 U	--	--	--	--	--	--	--
alpha-Chlordane	0.05 U	0.049 U	--	--	--	--	--	--	--
beta-BHC	0.05 U	0.049 U	--	--	--	--	--	--	--
delta-BHC	0.05 U	0.049 U	--	--	--	--	--	--	--
gamma-BHC (Lindane)	0.05 U	0.049 U	--	--	--	--	--	--	--
gamma-Chlordane	0.05 U	0.049 U	--	--	--	--	--	--	--
Inorganics ug/L									
Aluminum	14,500	10,900	513	4,040	14,400	2,380	2,570	315	310
Antimony	2.5 U								
Arsenic	3.1 U								
Barium	75 J	55.7 J	29.5 J	58.7 J	153 J	37.1 J	39.1 J	15.6 J	15.7 J
Beryllium	0.85 U	0.78 U	0.67 U	0.77 U	0.97 U	0.36 U	0.32 U	0.31 U	0.3 U
Cadmium	0.3 U								
Calcium	3,170 U	2,830 U	4,490 U	4,580 U	4,490 U	3,480 U	3,870 U	6,690 U	6,890 U
Chromium	25.4	20.4	1.1 J	5.3 J	26.6	3.2 J	3.8 J	1.2 J	1.5 J
Cobalt	0.8 U								
Copper	8.5 U	6.1 U	0.7 U	1.5 U	20.3 U	0.7 U	0.97 U	0.7 U	0.7 U
Iron	3,560	3,140	2,120	1,130	4,920	1,180	1,430	639	687
Lead	13.5 U	9 U	2.7 U	6.6 U	29.8 U	3.2 U	3.1 U	1.6 U	2 U
Magnesium	1,220 U	1,140 U	2,910 U	1,810 U	1,270 U	1,150 U	1,260 U	5,270 U	5,330 U
Manganese	70.1 U	60.3 U	34.2 U	30.9 U	63.1 U	22.5 U	24.6 U	4.7 U	5.1 U
Mercury	0.23	0.3	0.1 U	0.13 J	0.5	0.1 U	0.1 U	0.1 U	0.1 U
Nickel	4.2 J	3.8 J	3 J	2.2 J	5.4 J	1.2 U	1.9 J	1.2 U	1.2 U
Potassium	961 U	923 U	1,960 U	2,310 U	944 U	810 U	920 U	2,140 U	2,180 U
Selenium	4.1 J	3.6 U							
Silver	0.7 U								
Sodium	118,000 U	113,000 U	16,800 U	36,300 U	63,200 U	19,000 U	19,900 U	10,500 U	10,800 U
Thallium	4.2 U								
Vanadium	--	--	--	--	--	3 J	3.3 J	2.6 J	2.4 J
Zinc	1 U	1 U	1 U	1 U	12.6 U	3.8 U	5.8 U	1 U	1.4 U

Appendix D
Table D-4. Summary of Filtered Groundwater
Analytical Results

Remedial Investigation
Operable Unit 4, Study Area 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

SAMP ID	MATRIX	SAMP DATE	CHEM NAME	RESULT	QUAL	UNITS
14H00203	WATER	10-Feb-98	Aluminum	32.3	U	UG/L
14H00203	WATER	10-Feb-98	Antimony	5.8	J	UG/L
14H00203	WATER	10-Feb-98	Arsenic	3.1	U	UG/L
14H00203	WATER	10-Feb-98	Barium	1.5	J	UG/L
14H00203	WATER	10-Feb-98	Beryllium	0.3	U	UG/L
14H00203	WATER	10-Feb-98	Cadmium	0.3	U	UG/L
14H00203	WATER	10-Feb-98	Calcium	46200	U	UG/L
14H00203	WATER	10-Feb-98	Chromium	0.9	U	UG/L
14H00203	WATER	10-Feb-98	Cobalt	0.8	U	UG/L
14H00203	WATER	10-Feb-98	Copper	9.7	J	UG/L
14H00203	WATER	10-Feb-98	Iron	15.7	U	UG/L
14H00203	WATER	10-Feb-98	Lead	1.6	U	UG/L
14H00203	WATER	10-Feb-98	Magnesium	1590	U	UG/L
14H00203	WATER	10-Feb-98	Manganese	0.68	U	UG/L
14H00203	WATER	10-Feb-98	Mercury	0.1	U	UG/L
14H00203	WATER	10-Feb-98	Nickel	1.6	J	UG/L
14H00203	WATER	10-Feb-98	Potassium	887	U	UG/L
14H00203	WATER	10-Feb-98	Selenium	3.6	U	UG/L
14H00203	WATER	10-Feb-98	Silver	0.7	U	UG/L
14H00203	WATER	10-Feb-98	Sodium	9400	U	UG/L
14H00203	WATER	10-Feb-98	Thallium	4.2	U	UG/L
14H00203	WATER	10-Feb-98	Vanadium	7	J	UG/L
14H00203	WATER	10-Feb-98	Zinc	1	U	UG/L
14H00304	WATER	09-Feb-98	Aluminum	86.9	U	UG/L
14H00304	WATER	09-Feb-98	Antimony	21	J	UG/L
14H00304	WATER	09-Feb-98	Arsenic	3.1	U	UG/L
14H00304	WATER	09-Feb-98	Barium	2.5	J	UG/L
14H00304	WATER	09-Feb-98	Beryllium	0.3	U	UG/L
14H00304	WATER	09-Feb-98	Cadmium	0.3	U	UG/L
14H00304	WATER	09-Feb-98	Calcium	51300	U	UG/L
14H00304	WATER	09-Feb-98	Chromium	0.9	U	UG/L
14H00304	WATER	09-Feb-98	Cobalt	0.8	U	UG/L
14H00304	WATER	09-Feb-98	Copper	11.4	J	UG/L
14H00304	WATER	09-Feb-98	Iron	15.7	U	UG/L
14H00304	WATER	09-Feb-98	Lead	1.6	U	UG/L
14H00304	WATER	09-Feb-98	Magnesium	4480	U	UG/L
14H00304	WATER	09-Feb-98	Manganese	1.8	U	UG/L
14H00304	WATER	09-Feb-98	Mercury	0.1	U	UG/L
14H00304	WATER	09-Feb-98	Nickel	1.5	J	UG/L
14H00304	WATER	09-Feb-98	Potassium	1380	U	UG/L
14H00304	WATER	09-Feb-98	Selenium	3.7	J	UG/L
14H00304	WATER	09-Feb-98	Silver	0.7	U	UG/L
14H00304	WATER	09-Feb-98	Sodium	6330	U	UG/L
14H00304	WATER	09-Feb-98	Thallium	4.2	U	UG/L
14H00304	WATER	09-Feb-98	Vanadium	9.8	J	UG/L
14H00304	WATER	09-Feb-98	Zinc	1	U	UG/L
14H00403	WATER	10-Feb-98	Aluminum	34.7	U	UG/L
14H00403	WATER	10-Feb-98	Antimony	12.4	J	UG/L
14H00403	WATER	10-Feb-98	Arsenic	3.1	U	UG/L
14H00403	WATER	10-Feb-98	Barium	1.3	J	UG/L
14H00403	WATER	10-Feb-98	Beryllium	0.3	U	UG/L

Appendix D
Table D-4. Summary of Filtered Groundwater
Analytical Results

Remedial Investigation
Operable Unit 4, Study Area 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

SAMP ID	MATRIX	SAMP DATE	CHEM NAME	RESULT	QUAL	UNITS
14H00403	WATER	10-Feb-98	Cadmium	0.3	U	UG/L
14H00403	WATER	10-Feb-98	Calcium	18200	U	UG/L
14H00403	WATER	10-Feb-98	Chromium	0.9	U	UG/L
14H00403	WATER	10-Feb-98	Cobalt	0.8	U	UG/L
14H00403	WATER	10-Feb-98	Copper	4.1	U	UG/L
14H00403	WATER	10-Feb-98	Iron	24.6	J	UG/L
14H00403	WATER	10-Feb-98	Lead	1.8	U	UG/L
14H00403	WATER	10-Feb-98	Magnesium	1360	U	UG/L
14H00403	WATER	10-Feb-98	Manganese	0.8	U	UG/L
14H00403	WATER	10-Feb-98	Mercury	0.1	U	UG/L
14H00403	WATER	10-Feb-98	Nickel	1.2	U	UG/L
14H00403	WATER	10-Feb-98	Potassium	1250	U	UG/L
14H00403	WATER	10-Feb-98	Selenium	3.6	U	UG/L
14H00403	WATER	10-Feb-98	Silver	0.7	U	UG/L
14H00403	WATER	10-Feb-98	Sodium	15800	U	UG/L
14H00403	WATER	10-Feb-98	Thallium	4.2	U	UG/L
14H00403	WATER	10-Feb-98	Vanadium	11.1	J	UG/L
14H00403	WATER	10-Feb-98	Zinc	1.2	U	UG/L
14H00501	WATER	10-Feb-98	Aluminum	22.2	U	UG/L
14H00501	WATER	10-Feb-98	Antimony	8	J	UG/L
14H00501	WATER	10-Feb-98	Arsenic	3.1	U	UG/L
14H00501	WATER	10-Feb-98	Barium	3.6	J	UG/L
14H00501	WATER	10-Feb-98	Beryllium	0.3	U	UG/L
14H00501	WATER	10-Feb-98	Cadmium	0.3	U	UG/L
14H00501	WATER	10-Feb-98	Calcium	36000	U	UG/L
14H00501	WATER	10-Feb-98	Chromium	0.9	U	UG/L
14H00501	WATER	10-Feb-98	Cobalt	0.8	U	UG/L
14H00501	WATER	10-Feb-98	Copper	13.4	J	UG/L
14H00501	WATER	10-Feb-98	Iron	15.7	U	UG/L
14H00501	WATER	10-Feb-98	Lead	1.6	U	UG/L
14H00501	WATER	10-Feb-98	Magnesium	1610	U	UG/L
14H00501	WATER	10-Feb-98	Manganese	3	U	UG/L
14H00501	WATER	10-Feb-98	Mercury	0.1	U	UG/L
14H00501	WATER	10-Feb-98	Nickel	1.9	J	UG/L
14H00501	WATER	10-Feb-98	Potassium	803	U	UG/L
14H00501	WATER	10-Feb-98	Selenium	3.6	U	UG/L
14H00501	WATER	10-Feb-98	Silver	0.7	U	UG/L
14H00501	WATER	10-Feb-98	Sodium	5040	U	UG/L
14H00501	WATER	10-Feb-98	Thallium	4.2	U	UG/L
14H00501	WATER	10-Feb-98	Vanadium	8	J	UG/L
14H00501	WATER	10-Feb-98	Zinc	20.5	U	UG/L
14H00601	WATER	10-Feb-98	Aluminum	28.9	U	UG/L
14H00601	WATER	10-Feb-98	Antimony	2.9	J	UG/L
14H00601	WATER	10-Feb-98	Arsenic	3.1	U	UG/L
14H00601	WATER	10-Feb-98	Barium	1.5	J	UG/L
14H00601	WATER	10-Feb-98	Beryllium	0.3	U	UG/L
14H00601	WATER	10-Feb-98	Cadmium	0.3	U	UG/L
14H00601	WATER	10-Feb-98	Calcium	47100	U	UG/L
14H00601	WATER	10-Feb-98	Chromium	0.9	U	UG/L
14H00601	WATER	10-Feb-98	Cobalt	0.8	U	UG/L
14H00601	WATER	10-Feb-98	Copper	6.5	J	UG/L

Appendix D
Table D-4. Summary of Filtered Groundwater
Analytical Results

Remedial Investigation
Operable Unit 4, Study Area 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

SAMP ID	MATRIX	SAMP DATE	CHEM NAME	RESULT	QUAL	UNITS
14H00601	WATER	10-Feb-98	Iron	15.7	U	UG/L
14H00601	WATER	10-Feb-98	Lead	1.6	U	UG/L
14H00601	WATER	10-Feb-98	Magnesium	8140	U	UG/L
14H00601	WATER	10-Feb-98	Manganese	1	U	UG/L
14H00601	WATER	10-Feb-98	Mercury	0.1	U	UG/L
14H00601	WATER	10-Feb-98	Nickel	1.3	J	UG/L
14H00601	WATER	10-Feb-98	Potassium	1010	U	UG/L
14H00601	WATER	10-Feb-98	Selenium	3.6	U	UG/L
14H00601	WATER	10-Feb-98	Silver	0.7	U	UG/L
14H00601	WATER	10-Feb-98	Sodium	25300	U	UG/L
14H00601	WATER	10-Feb-98	Thallium	4.2	U	UG/L
14H00601	WATER	10-Feb-98	Vanadium	7.7	J	UG/L
14H00601	WATER	10-Feb-98	Zinc	1	U	UG/L
14H00701	WATER	09-Feb-98	Aluminum	42.8	U	UG/L
14H00701	WATER	09-Feb-98	Antimony	13.7	J	UG/L
14H00701	WATER	09-Feb-98	Arsenic	3.1	U	UG/L
14H00701	WATER	09-Feb-98	Barium	1.5	J	UG/L
14H00701	WATER	09-Feb-98	Beryllium	0.3	U	UG/L
14H00701	WATER	09-Feb-98	Cadmium	0.3	U	UG/L
14H00701	WATER	09-Feb-98	Calcium	44600	U	UG/L
14H00701	WATER	09-Feb-98	Chromium	0.9	U	UG/L
14H00701	WATER	09-Feb-98	Cobalt	0.8	U	UG/L
14H00701	WATER	09-Feb-98	Copper	6.5	J	UG/L
14H00701	WATER	09-Feb-98	Iron	15.7	U	UG/L
14H00701	WATER	09-Feb-98	Lead	1.6	U	UG/L
14H00701	WATER	09-Feb-98	Magnesium	1230	U	UG/L
14H00701	WATER	09-Feb-98	Manganese	0.8	U	UG/L
14H00701	WATER	09-Feb-98	Mercury	0.1	U	UG/L
14H00701	WATER	09-Feb-98	Nickel	1.2	U	UG/L
14H00701	WATER	09-Feb-98	Potassium	366	U	UG/L
14H00701	WATER	09-Feb-98	Selenium	3.6	U	UG/L
14H00701	WATER	09-Feb-98	Silver	0.7	U	UG/L
14H00701	WATER	09-Feb-98	Sodium	2100	U	UG/L
14H00701	WATER	09-Feb-98	Thallium	4.2	U	UG/L
14H00701	WATER	09-Feb-98	Vanadium	4.9	J	UG/L
14H00701	WATER	09-Feb-98	Zinc	3.2	U	UG/L
14H00801	WATER	10-Feb-98	Aluminum	141	J	UG/L
14H00801	WATER	10-Feb-98	Antimony	2.7	J	UG/L
14H00801	WATER	10-Feb-98	Arsenic	3.1	U	UG/L
14H00801	WATER	10-Feb-98	Barium	1.2	J	UG/L
14H00801	WATER	10-Feb-98	Beryllium	0.3	U	UG/L
14H00801	WATER	10-Feb-98	Cadmium	0.3	U	UG/L
14H00801	WATER	10-Feb-98	Calcium	42700	U	UG/L
14H00801	WATER	10-Feb-98	Chromium	0.9	U	UG/L
14H00801	WATER	10-Feb-98	Cobalt	0.8	U	UG/L
14H00801	WATER	10-Feb-98	Copper	11.6	J	UG/L
14H00801	WATER	10-Feb-98	Iron	17.6	J	UG/L
14H00801	WATER	10-Feb-98	Lead	1.6	U	UG/L
14H00801	WATER	10-Feb-98	Magnesium	3700	U	UG/L
14H00801	WATER	10-Feb-98	Manganese	2.3	U	UG/L
14H00801	WATER	10-Feb-98	Mercury	0.1	U	UG/L

Appendix D
Table D-4. Summary of Filtered Groundwater
Analytical Results

Remedial Investigation
 Operable Unit 4, Study Area 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

SAMP ID	MATRIX	SAMP DATE	CHEM NAME	RESULT	QUAL	UNITS
14H00801	WATER	10-Feb-98	Nickel	2	J	UG/L
14H00801	WATER	10-Feb-98	Potassium	703	U	UG/L
14H00801	WATER	10-Feb-98	Selenium	3.6	U	UG/L
14H00801	WATER	10-Feb-98	Silver	0.7	U	UG/L
14H00801	WATER	10-Feb-98	Sodium	1360	U	UG/L
14H00801	WATER	10-Feb-98	Thallium	4.2	U	UG/L
14H00801	WATER	10-Feb-98	Vanadium	1.6	J	UG/L
14H00801	WATER	10-Feb-98	Zinc	7.9	U	UG/L

Table D-5. Summary of Surface Water Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4W00703	U4W01103	U4W01103D	U4W01304	U4W01902	U4W01003	U4W01003D	U4W01003AVE	U4W01004	U4W010XX
Sampling Date	3/17/98	3/17/98	3/17/98	3/17/98	3/17/98	10/29/97	10/29/97	10/29/97	3/17/98	00/00/00
Hardness as CaCO3	130	22.3	--	27	40.7	--	--	--	34.9	34.9
Volatile Organic Compounds ug/L										
1,1,1-Trichloroethane	1 U	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U
1,1,2,2-Tetrachloroethane	1 U	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U
1,1,2-Trichloroethane	1 U	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U
1,1-Dichloroethane	1 U	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U
1,1-Dichloroethene	1 U	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U
1,2-Dichloroethane	1 U	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U
1,2-Dichloroethene (total)	--	--	--	--	--	110	130	120	--	120
1,2-Dichloropropane	1 U	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U
2-Butanone	--	--	--	--	--	10 U	10 U	10 U	310 UR	10 U
2-Hexanone	--	--	--	--	--	10 U	10 U	10 U	310 UR	10 U
4-Methyl-2-pentanone	5 U	10 U	10 U	50 U	120 U	10 U	10 U	10 U	310 U	160 U
Acetone	6 J	--	--	--	--	10 U	10 U	10 U	310 UR	10 U
Benzene	1 U	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U
Bromochloromethane	1 U	2 U	2 U	10 U	25 U	--	--	--	62 U	62 U
Bromodichloromethane	1 U	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U
Bromoform	1 U	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U
Bromomethane	1 U	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U
Carbon disulfide	1	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U
Carbon tetrachloride	1 U	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U
Chlorobenzene	1 U	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U
Chloroethane	1 U	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U
Chloroform	1 U	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U
Chloromethane	1 U	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U
Dibromochloromethane	1 U	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U
Ethylbenzene	1 U	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U
Methylene chloride	2 U	4 U	4 U	20 U	50 U	10 U	10 U	10 U	120 U	65 U
Styrene	1 U	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U
Tetrachloroethene	1 UJ	2 UJ	2 UJ	10 UJ	19 J	10 U	10 U	10 U	62 U	36 U
Toluene	0.7 J	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U
Trichloroethene	1 U	2 U	2 U	57	36	3 J	3 U	3 U	62 U	17 J
Vinyl chloride	1 U	2 U	2 U	10 U	25 U	20	28	24	46 J	35 J
Xylene (total)	1 U	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U
cis-1,2-Dichloroethene	1 U	42	40	180	330	--	--	--	760	760
cis-1,3-Dichloropropene	1 U	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U
trans-1,2-Dichloroethene	1 U	2 U	2 U	10 U	25 U	--	--	--	62 U	62 U
trans-1,3-Dichloropropene	1 U	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U
Semivolatile Organic Compounds ug/L										
1,2,4-Trichlorobenzene	1 U	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U

Appendix D
Table D-5. Summary of Surface Water Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID	U4W00703	U4W01103	U4W01103D	U4W01304	U4W01902	U4W01003	U4W01003D	U4W01003AVE	U4W01004	U4W010XX
Sampling Date	3/17/98	3/17/98	3/17/98	3/17/98	3/17/98	10/29/97	10/29/97	10/29/97	3/17/98	00/00/00
1,2-Dibromoethane	1 U	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	62 U
1,2-Dichlorobenzene	1 U	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U
1,3-Dichlorobenzene	1 U	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U
1,4-Dichlorobenzene	1 U	2 U	2 U	10 U	25 U	10 U	10 U	10 U	62 U	36 U
2,2'-oxybis(1-Chloropropane)	--	--	--	--	--	10 U	10 U	10 U	--	10 U
2,4,5-Trichlorophenol	--	--	--	--	--	25 U	25 U	25 U	--	25 U
2,4,6-Trichlorophenol	--	--	--	--	--	10 U	10 U	10 U	--	10 U
2,4-Dichlorophenol	--	--	--	--	--	10 U	10 U	10 U	--	10 U
2,4-Dimethylphenol	--	--	--	--	--	10 U	10 U	10 U	--	10 U
2,4-Dinitrophenol	--	--	--	--	--	25 U	25 U	25 U	--	25 U
2,4-Dinitrotoluene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
2,6-Dinitrotoluene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
2-Chloronaphthalene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
2-Chlorophenol	--	--	--	--	--	10 U	10 U	10 U	--	10 U
2-Methylnaphthalene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
2-Methylphenol	--	--	--	--	--	10 U	10 U	10 U	--	10 U
2-Nitroaniline	--	--	--	--	--	25 U	25 U	25 U	--	25 U
2-Nitrophenol	--	--	--	--	--	10 U	10 U	10 U	--	10 U
3,3'-Dichlorobenzidine	--	--	--	--	--	10 UJ	10 UJ	10 UJ	--	10 UJ
3-Nitroaniline	--	--	--	--	--	25 UJ	25 UJ	25 UJ	--	25 UJ
4,6-Dinitro-2-methylphenol	--	--	--	--	--	25 U	25 U	25 U	--	25 U
4-Bromophenyl-phenylether	--	--	--	--	--	10 U	10 U	10 U	--	10 U
4-Chloro-3-methylphenol	--	--	--	--	--	10 U	10 U	10 U	--	10 U
4-Chloroaniline	--	--	--	--	--	10 UJ	10 UJ	10 UJ	--	10 UJ
4-Chlorophenyl-phenylether	--	--	--	--	--	10 U	10 U	10 U	--	10 U
4-Methylphenol	--	--	--	--	--	10 U	2 U	3.5 U	--	3.5 J
4-Nitroaniline	--	--	--	--	--	25 U	25 U	25 U	--	25 U
4-Nitrophenol	--	--	--	--	--	25 U	25 U	25 U	--	25 U
Acenaphthene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Acenaphthylene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Anthracene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Benzo(a)anthracene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Benzo(a)pyrene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Benzo(b)fluoranthene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Benzo(g,h,i)perylene	--	--	--	--	--	10 UJ	10 UJ	10 UJ	--	10 UJ
Benzo(k)fluoranthene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Butylbenzylphthalate	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Carbazole	--	--	--	--	--	10 UJ	10 UJ	10 UJ	--	10 UJ
Chrysene	--	--	--	--	--	10 UJ	10 UJ	10 UJ	--	10 U
Di-n-butylphthalate	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Di-n-octylphthalate	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Dibenz(a,h)anthracene	--	--	--	--	--	10 U	10 U	10 U	--	10 U

Appendix D

Table D-5. Summary of Surface Water Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4W00703	U4W01103	U4W01103D	U4W01304	U4W01902	U4W01003	U4W01003D	U4W01003AVE	U4W01004	U4W010XX
Sampling Date	3/17/98	3/17/98	3/17/98	3/17/98	3/17/98	10/29/97	10/29/97	10/29/97	3/17/98	00/00/00
Dibenzofuran	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Diethylphthalate	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Dimethylphthalate	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Fluoranthene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Fluorene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Hexachlorobenzene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Hexachlorobutadiene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Hexachlorocyclopentadiene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Hexachloroethane	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Indeno(1,2,3-cd)pyrene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Isophorone	--	--	--	--	--	10 U	10 U	10 U	--	10 U
N-Nitroso-di-n-propylamine	--	--	--	--	--	10 U	10 U	10 U	--	10 U
N-Nitrosodiphenylamine (1)	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Naphthalene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Nitrobenzene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Pentachlorophenol	--	--	--	--	--	25 U	25 U	25 U	--	25 U
Phenanthrene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Phenol	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Pyrene	--	--	--	--	--	10 U	10 U	10 U	--	10 U
bis(2-Chloroethoxy)methane	--	--	--	--	--	10 U	10 U	10 U	--	10 U
bis(2-Chloroethyl)ether	--	--	--	--	--	10 U	10 U	10 U	--	10 U
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	10 U	10 U	10 U	--	10 U
Pesticides/PCBs ug/L										
1,2-Dibromo-3-chloropropane	1 U	2 U	2 U	10 U	25 U	--	--	--	62 UR	--
4,4'-DDD	--	--	--	--	--	0.096 U	0.098 U	0.097 U	--	0.097 U
4,4'-DDE	--	--	--	--	--	0.096 U	0.098 U	0.097 U	--	0.097 U
4,4'-DDT	--	--	--	--	--	0.0085 J	0.008 U	0.02875 J	--	0.0288 J
Aldrin	--	--	--	--	--	0.048 U	0.049 U	0.0485 U	--	0.0485 U
Aroclor-1016	--	--	--	--	--	0.96 U	0.98 U	0.97 U	--	0.97 U
Aroclor-1221	--	--	--	--	--	1.9 U	2 U	1.95 U	--	1.95 U
Aroclor-1232	--	--	--	--	--	0.96 U	0.98 U	0.97 U	--	0.97 U
Aroclor-1242	--	--	--	--	--	0.96 U	0.98 U	0.97 U	--	0.97 U
Aroclor-1248	--	--	--	--	--	0.96 U	0.98 U	0.97 U	--	0.97 U
Aroclor-1254	--	--	--	--	--	0.96 U	0.98 U	0.97 U	--	0.97 U
Aroclor-1260	--	--	--	--	--	0.96 U	0.98 U	0.97 U	--	0.97 U
Dieldrin	--	--	--	--	--	0.096 U	0.098 U	0.097 U	--	0.097 U
Endosulfan I	--	--	--	--	--	0.048 U	0.049 U	0.0485 U	--	0.0485 U
Endosulfan II	--	--	--	--	--	0.096 U	0.098 U	0.097 U	--	0.097 U
Endosulfan sulfate	--	--	--	--	--	0.096 U	0.098 U	0.097 U	--	0.097 U
Endrin	--	--	--	--	--	0.096 U	0.098 U	0.097 U	--	0.097 U
Endrin aldehyde	--	--	--	--	--	0.096 U	0.098 U	0.097 U	--	0.097 U
Endrin ketone	--	--	--	--	--	0.006 J	0.014 J	0.01 J	--	0.01 J

Appendix D
Table D-5. Summary of Surface Water Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4W00703	U4W01103	U4W01103D	U4W01304	U4W01902	U4W01003	U4W01003D	U4W01003AVE	U4W01004	U4W010XX
Sampling Date	3/17/98	3/17/98	3/17/98	3/17/98	3/17/98	10/29/97	10/29/97	10/29/97	3/17/98	00/00/00
Heptachlor	--	--	--	--	--	0.048 U	0.049 U	0.0485 U	--	0.0485 U
Heptachlor epoxide	--	--	--	--	--	0.048 U	0.049 U	0.0485 U	--	0.0485 U
Methoxychlor	--	--	--	--	--	0.48 U	0.49 U	0.485 U	--	0.485 U
Toxaphene	--	--	--	--	--	4.8 U	4.9 U	4.85 U	--	4.85 U
alpha-BHC	--	--	--	--	--	0.048 U	0.049 U	0.0485 U	--	0.0485 U
alpha-Chlordane	--	--	--	--	--	0.048 U	0.049 U	0.0485 U	--	0.0485 U
beta-BHC	--	--	--	--	--	0.048 U	0.049 U	0.0485 U	--	0.0485 U
delta-BHC	--	--	--	--	--	0.048 U	0.049 U	0.0485 U	--	0.0485 U
gamma-BHC (Lindane)	--	--	--	--	--	0.0017 J	0.049 U	0.0131 J	--	0.0131 J
gamma-Chlordane	--	--	--	--	--	0.048 U	0.049 U	0.0485 U	--	0.0485 U
Inorganics ug/L										
Aluminum	--	--	--	--	--	609	467	538	--	538
Antimony	--	--	--	--	--	2.9 U	3.6 U	3.25 U	--	3.25 U
Arsenic	--	--	--	--	--	5.9 U	5.9 U	5.9 U	--	5.9 U
Barium	--	--	--	--	--	7.8 U	8.8 U	8.3 U	--	8.3 U
Beryllium	--	--	--	--	--	0.59 U	0.7 U	0.645 U	--	0.645 U
Cadmium	--	--	--	--	--	0.3 U	0.3 U	0.3 U	--	0.3 U
Calcium	--	--	--	--	--	6,820	7,610	7,215	--	7,215
Chromium	--	--	--	--	--	0.8 U	0.8 U	0.8 U	--	0.8 U
Cobalt	--	--	--	--	--	0.7 U	0.7 U	0.7 U	--	0.7 U
Copper	--	--	--	--	--	0.94 U	1.3 U	1.12 U	--	1.12 U
Iron	--	--	--	--	--	187	164	176	--	175.5
Lead	--	--	--	--	--	2.7 J	2.8 J	2.75 J	--	2.75 J
Magnesium	--	--	--	--	--	1,410 U	1,490 U	1,450	--	1,450
Manganese	--	--	--	--	--	4.1 J	4.4 J	4.25 J	--	4.25 J
Mercury	--	--	--	--	--	0.1 U	0.1 U	0.1 U	--	0.1 U
Nickel	--	--	--	--	--	1.3 U	1.3 U	1.3 U	--	1.3 U
Potassium	--	--	--	--	--	1,420 U	1,730 U	1,675 U	--	1,575 U
Selenium	--	--	--	--	--	4.4 U	4.4 U	4.4 U	--	4.4 U
Silver	--	--	--	--	--	0.8 U	0.8 U	0.8 U	--	0.8 U
Sodium	--	--	--	--	--	15,300 U	16,200 U	15,750 U	--	15,750 U
Thallium	--	--	--	--	--	5 U	5 U	5 U	--	5 U
Vanadium	--	--	--	--	--	1.2 J	1.1 U	1.15 J	--	1.15 J
Zinc	--	--	--	--	--	10.6 U	38.3 U	24.45 U	--	24.45 U

Table D-6. Summary of Sediment Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4D00704	U4D01003	U4D01003D	U4D01003AVE	U4D01004	U4D010X	U4D01104	U4D01104D	U4D01305	U4D01902
Sampling Date	3/17/98	10/29/97	10/29/97	10/29/97	3/17/98	00/00/00	3/17/98	3/17/98	3/17/98	3/17/98
Total Organic Carbon	13,800	16,000 >	16,000 >	16,000 >	16,000 >	16,000 >	14,900	--	16,000 >	11,900
Volatile Organic Compounds ug/kg										
1,1,1-Trichloroethane	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	110 U	13 U
1,1,2,2-Tetrachloroethane	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	110 U	13 U
1,1,2-Trichloroethane	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	110 U	13 U
1,1-Dichloroethane	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	110 U	13 U
1,1-Dichloroethene	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	13 J	13 U
1,2-Dichloroethane	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	110 U	13 U
1,2-Dichloroethene (total)	91 U	480	100	290,000	960	625	5 J	26	1,300	100
1,2-Dichloropropane	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	110 U	13 U
2-Butanone	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	110 U	13 U
2-Hexanone	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	110 U	13 U
4-Methyl-2-pentanone	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	110 U	13 U
Acetone	91 U	91 J	59 U	60,25 J	62 U	45,625 J	14 U	15 U	110 U	13 U
Benzene	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	110 U	13 U
Bromodichloromethane	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	110 U	13 U
Bromoform	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	110 U	13 U
Bromomethane	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	110 U	13 U
Carbon disulfide	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	110 U	13 U
Carbon tetrachloride	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	110 U	13 U
Chlorobenzene	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	110 U	13 U
Chloroethane	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	110 U	13 U
Chloroform	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	110 U	13 U
Chloromethane	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	110 U	13 U
Dibromochloromethane	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	110 U	13 U
Ethylbenzene	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	110 U	13 U
Methylene chloride	54 J	53 U	59 U	56 U	96 B	62 B	14 U	15 U	130 B	13 U
Styrene	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	110 U	13 U
Tetrachloroethene	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	19 J	3 J
Toluene	91 U	6 U	59 U	17,75 J	8 J	12,875 J	14 U	15 U	110 U	13 U
Trichloroethene	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	280	21
Vinyl chloride	91 U	27 J	59 U	28,25 J	1,100 J	564,125 J	14 U	15 U	25 J	13 U
Xylene (total)	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	110 U	13 U
cis-1,3-Dichloropropene	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	110 U	13 U
trans-1,3-Dichloropropene	91 U	53 U	59 U	56 U	62 U	59 U	14 U	15 U	110 U	13 U

Appendix D
Table D-6. Summary of Sediment Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID	U4D00704	U4D01003	U4D01003D	U4D01003AVE	U4D01004	U4D010X	U4D01104	U4D01104D	U4D01305	U4D01902
Sampling Date	3/17/98	10/29/97	10/29/97	10/29/97	3/17/98	00/00/00	3/17/98	3/17/98	3/17/98	3/17/98
Semivolatle Organic Compounds ug/kg										
1,2,4-Trichlorobenzene	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
1,2-Dichlorobenzene	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
1,3-Dichlorobenzene	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
1,4-Dichlorobenzene	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
2,2'-oxybis(1-Chloropropane)	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
2,4,5-Trichlorophenol	--	4,400 U	150,000 U	77200 U	--	77,200 U	--	--	--	--
2,4,6-Trichlorophenol	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
2,4-Dichlorophenol	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
2,4-Dimethylphenol	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
2,4-Dinitrophenol	--	4,400 U	150,000 U	77200 U	--	77,200 U	--	--	--	--
2,4-Dinitrotoluene	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
2,6-Dinitrotoluene	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
2-Chloronaphthalene	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
2-Chlorophenol	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
2-Methylnaphthalene	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
2-Methylphenol	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
2-Nitroaniline	--	4,400 U	150,000 U	77200 U	--	77,200 U	--	--	--	--
2-Nitrophenol	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
3,3'-Dichlorobenzidine	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
3-Nitroaniline	--	4,400 U	150,000 U	77200 U	--	77,200 U	--	--	--	--
4,6-Dinitro-2-methylphenol	--	4,400 U	150,000 U	77200 U	--	77,200 U	--	--	--	--
4-Bromophenyl-phenylether	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
4-Chloro-3-methylphenol	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
4-Chloroaniline	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
4-Chlorophenyl-phenylether	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
4-Methylphenol	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
4-Nitroaniline	--	4,400 U	150,000 U	77200 U	--	77,200 U	--	--	--	--
4-Nitrophenol	--	4,400 U	150,000 U	77200 U	--	77,200 U	--	--	--	--
Acenaphthene	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
Acenaphthylene	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
Anthracene	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
Benzo(a)anthracene	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
Benzo(a)pyrene	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
Benzo(b)fluoranthene	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
Benzo(g,h,i)perylene	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
Benzo(k)fluoranthene	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
Butylbenzylphthalate	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
Carbazole	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
Chrysene	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--

Table D-6. Summary of Sediment Analytical Results

Remedial Investigation
 Operable Unit 4, Study Areas 12, 13, and 14 - Area C
 Naval Training Center, Orlando
 Orlando, FL

Sample ID	U4D00704	U4D01003	U4D01003D	U4D01003AVE	U4D01004	U4D010X	U4D01104	U4D01104D	U4D01305	U4D01902
Sampling Date	3/17/98	10/29/97	10/29/97	10/29/97	3/17/98	00/00/00	3/17/98	3/17/98	3/17/98	3/17/98
Di-n-butylphthalate	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
Di-n-octylphthalate	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
Dibenz(a,h)anthracene	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
Dibenzofuran	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
Diethylphthalate	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
Dimethylphthalate	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
Fluoranthene	--	1,700 U	6,200 J	3525 J	--	3,525 J	--	--	--	--
Fluorene	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
Hexachlorobenzene	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
Hexachlorobutadiene	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
Hexachlorocyclopentadiene	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
Hexachloroethane	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
Indeno(1,2,3-cd)pyrene	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
Isophorone	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
N-Nitroso-di-n-propylamine	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
N-Nitrosodiphenylamine (1)	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
Naphthalene	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
Nitrobenzene	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
Pentachlorophenol	--	4,400 U	150,000 U	77200 U	--	77,200 U	--	--	--	--
Phenanthrene	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
Phenol	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
Pyrene	--	200 J	6,600 J	3400 J	--	3,400 J	--	--	--	--
bis(2-Chloroethoxy)methane	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
bis(2-Chloroethyl)ether	--	1,700 U	59,000 U	30350 U	--	30,350 U	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	170 J	11,000 J	5585 J	--	5,585 J	--	--	--	--
Pesticides/PCBs ug/kg										
4,4'-DDD	--	17 U	19 U	18 U	--	18 U	--	--	--	--
4,4'-DDE	--	17 U	6.6 J	7.55 J	--	7.55 J	--	--	--	--
4,4'-DDT	--	17 U	19 U	18 U	--	18 U	--	--	--	--
Aldrin	--	8.9 U	10 U	9.45 U	--	9.45 U	--	--	--	--
Aroclor-1016	--	170 U	190 U	180 U	--	180 U	--	--	--	--
Aroclor-1221	--	350 U	390 U	370 U	--	370 U	--	--	--	--
Aroclor-1232	--	170 U	190 U	180 U	--	180 U	--	--	--	--
Aroclor-1242	--	170 U	190 U	180 U	--	180 U	--	--	--	--
Aroclor-1248	--	170 U	190 U	180 U	--	180 U	--	--	--	--
Aroclor-1254	--	70 J	65 J	67.5 J	--	67.5 J	--	--	--	--
Aroclor-1260	--	170 U	190 U	180 U	--	180 U	--	--	--	--
Dieldrin	--	17 U	19 U	18 U	--	18 U	--	--	--	--
Endosulfan I	--	4.2 J	10 U	4.6 J	--	4.6 J	--	--	--	--
Endosulfan II	--	17 U	19 U	18 U	--	18 U	--	--	--	--

Appendix D
Table D-6. Summary of Sediment Analytical Results

Remedial Investigation
Operable Unit 4, Study Areas 12, 13, and 14 - Area C
Naval Training Center, Orlando
Orlando, FL

Sample ID	U4D00704	U4D01003	U4D01003D	U4D01003AVE	U4D01004	U4D010X	U4D01104	U4D01104D	U4D01305	U4D01902
Sampling Date	3/17/98	10/29/97	10/29/97	10/29/97	3/17/98	00/00/00	3/17/98	3/17/98	3/17/98	3/17/98
Endosulfan sulfate	--	17 U	19 U	18 U	--	18 U	--	--	--	--
Endrin	--	17 U	19 U	18 U	--	18 U	--	--	--	--
Endrin aldehyde	--	17 U	19 U	18 U	--	18 U	--	--	--	--
Endrin ketone	--	17 U	19 U	18 U	--	18 U	--	--	--	--
Heptachlor	--	3.9 J	1.2 J	2.55 J	--	2.55 J	--	--	--	--
Heptachlor epoxide	--	8.9 U	10 U	9.45 U	--	9.45 U	--	--	--	--
Methoxychlor	--	89 U	100 U	94.5 U	--	94.5 U	--	--	--	--
Toxaphene	--	890 U	1,000 U	945 U	--	945 U	--	--	--	--
alpha-BHC	--	8.9 U	10 U	9.45 U	--	9.45 U	--	--	--	--
alpha-Chlordane	--	2.1 J	1.9 J	2.0 J	--	2 J	--	--	--	--
beta-BHC	--	8.9 U	10 U	9.45 U	--	9.45 U	--	--	--	--
delta-BHC	--	5.4 J	6.7 J	6.05 J	--	6.05 J	--	--	--	--
gamma-BHC (Lindane)	--	0.54 J	10 U	2.77 J	--	2.77 J	--	--	--	--
gamma-Chlordane	--	8.9 U	10 U	9.45 U	--	9.45 U	--	--	--	--
Inorganics mg/kg										
Aluminum	--	8,330	7,160	7,745.0000	--	7,745	--	--	--	--
Antimony	--	2.9 UJ	3.2 UJ	3.05 UJ	--	3.05 UJ	--	--	--	--
Arsenic	--	6	6.6	6.3000	--	6.3	--	--	--	--
Barium	--	31.7 J	30.9 J	31.3 J	--	31.3 J	--	--	--	--
Beryllium	--	0.35 J	0.24 J	0.295 J	--	0.295 J	--	--	--	--
Cadmium	--	0.45 J	0.33	0.39 J	--	0.39 J	--	--	--	--
Calcium	--	6,810	7,350	7,080.0000	--	7,080	--	--	--	--
Chromium	--	20.9 J	16.8 J	18.85 J	--	18.85 J	--	--	--	--
Cobalt	--	0.71	0.78	0.7450	--	0.745	--	--	--	--
Copper	--	18.1 J	15.4 J	16.75 J	--	16.75 J	--	--	--	--
Iron	--	1,140	1,330	1,235.0000	--	1,235	--	--	--	--
Lead	--	41.4	34.7	38.0500	--	38.05	--	--	--	--
Magnesium	--	583 U	622 U	602.5 U	--	602.5 U	--	--	--	--
Manganese	--	7.6 J	6.1 J	6.85 J	--	6.85 J	--	--	--	--
Mercury	--	0.3 J	0.31 J	0.305 J	--	0.305 J	--	--	--	--
Nickel	--	4.7 J	3.7 J	4.2 J	--	4.2 J	--	--	--	--
Potassium	--	206 U	202 U	204 U	--	204 U	--	--	--	--
Selenium	--	4.5	4.9	4.7000	--	4.7	--	--	--	--
Silver	--	0.81	0.89	0.8500	--	0.85	--	--	--	--
Sodium	--	935 U	1,040 U	987.5 U	--	987.5 U	--	--	--	--
Thallium	--	5.1	5.8	5.3500	--	5.35	--	--	--	--
Vanadium	--	6.4 J	6.9 J	6.65 J	--	6.65 J	--	--	--	--
Zinc	--	130 J	86.7 J	108.95 J	--	108.95 J	--	--	--	--

APPENDIX E

APPENDIX E
HUMAN HEALTH RISK ASSESSMENT

APPENDIX E-1

RISK-BASED SCREENING CONCENTRATIONS

Sources: I = IRIS H = HEAST A = HEAST Alternate W = Withdrawn from IRIS or HEAST E = EPA/NCEA provisional value O = other							Basis: C = Carcinogenic effects N = Noncarcinogenic effects I = RBC at Hf of 0.1 < RBC-C					Region III SSLs		
Chemical	CAS	RfD mg/kg/d	CSF _o 1/mg/kg/d	RfD _i mg/kg/d	CSF _i 1/mg/kg/d	VOC	Risk-based concentrations					Soil, for groundwater migration		
							Tap water ug/l	Ambient air ug/m ³	Fish mg/kg	Soil Industrial mg/kg	Residential mg/kg	DAF 1 mg/kg	DAF 20 mg/kg	
ACETALDEHYDE	75070			2.57E-003 I	7.7E-003 I	y	1.6E+000 C	8.1E-001 C					3.8E-004	7.7E-003 C
ACETOCHLOR	34256821	2E-002 I					7.3E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N			
ACETONE	67641	1.00E-001 I				y	6.1E+002 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N		1.2E-001	2.5E+000 N
ACETONITRILE	75058			1.7E-002 I		y	1.2E+002 N	6.2E+001 N					2.9E-002	5.8E-001 N
ACETOPHENONE	98862	1.00E-001 I		5.70E-006 W		y	4.2E-002 N	2.1E-002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N		1.1E-005	2.2E-004 N
ACROLEIN	107028	2.00E-002 H		5.70E-006 I		y	4.2E-002 N	2.1E-002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N		1.0E-005	2.0E-004 N
ACRYLAMIDE	79061	2.00E-004 I	4.50E+000 I		4.50E+000 I		1.5E-002 C	1.4E-003 C	7.0E-004 C	1.3E+000 C	1.4E-001 C		3.7E-006	7.4E-005 C
ACRYLONITRILE	107131	1.00E-003 H	5.40E-001 I	5.70E-004 I	2.40E-001 I	y	3.7E-002 C	2.6E-002 C	5.8E-003 C	1.1E+001 C	1.2E+000 C		7.4E-006	1.5E-004 C
ALACHLOR	15972608	1.00E-002 I	8.00E-002 H				8.4E-001 C	7.8E-002 C	3.9E-002 C	7.2E+001 C	8.0E+000 C		3.5E-004	7.0E-003 C
ALAR	1598845	1.50E-001 I					5.5E+003 N	5.5E+002 N	2.0E+002 N	3.1E+005 N	1.2E+004 N			
ALDICARB	118063	1.00E-003 I					3.7E+001 N	3.7E+000 N	1.4E+000 N	2.0E+003 N	7.8E+001 N		1.0E-002	2.1E-001 N
ALDICARB SULFONE	1648884	1.00E-003 I					3.7E+001 N	3.7E+000 N	1.4E+000 N	2.0E+003 N	7.8E+001 N		7.5E-003	1.5E-001 N
ALDRIN	309002	3.00E-005 I	1.70E+001 I		1.70E+001 I		3.9E-003 C	3.7E-004 C	1.9E-004 C	3.4E-001 C	3.8E-002 C		3.8E-004	7.7E-003 C
ALUMINUM	7429905	1.00E+000 E		1.00E-003 E			3.7E+004 N	3.7E+000 N	1.4E+003 N	2.0E+006 N	7.8E+004 N			
AMINODINITROTOLUENES		6.00E-005 E					2.2E+000 N	2.2E-001 N	8.1E-002 N	1.2E+002 N	4.7E+000 N			
4-AMINOPYRIDINE	504245	2.00E-005 H					7.3E-001 N	7.3E-002 N	2.7E-002 N	4.1E+001 N	1.6E+000 N			
AMMONIA	7664417			2.86E-002 I		y	2.1E+002 N	1.0E+002 N						
ANILINE	62533	7.00E-003 E	5.70E-003 I	2.90E-004 I			1.2E+001 C	1.1E+000 N	5.5E-001 C	1.0E+003 C	1.1E+002 C I		6.8E-003	1.4E-001 C
ANTIMONY	7440360	4.00E-004 I					1.5E+001 N	1.5E+000 N	5.4E-001 N	8.2E+002 N	3.1E+001 N		6.6E-001	1.3E+001 N
ANTIMONY PENTOXIDE	1314609	5.00E-004 H					1.8E+001 N	1.8E+000 N	6.8E-001 N	1.0E+003 N	3.9E+001 N			
ANTIMONY TETROXIDE	1332816	4.00E-004 H					1.5E+001 N	1.5E+000 N	5.4E-001 N	8.2E+002 N	3.1E+001 N			
ANTIMONY TRIOXIDE	1309644	4.00E-004 H		5.70E-005 I			1.5E+001 N	2.1E-001 N	5.4E-001 N	8.2E+002 N	3.1E+001 N			
ARSENIC	7440382	3.00E-004 I	1.50E+000 I		1.51E+001 I		4.5E-002 C	4.1E-004 C	2.1E-003 C	3.8E+000 C	4.3E-001 C		1.3E-003	2.6E-002 C
ARSINE	7784421			1.40E-005 I		y	1.0E-001 N	5.1E-002 N						
ASSURE	76578148	9.00E-003 I					3.3E+002 N	3.3E+001 N	1.2E+001 N	1.8E+004 N	7.0E+002 N			
ATRAZINE	1912249	3.50E-002 I	2.20E-001 H				3.0E-001 C	2.8E-002 C	1.4E-002 C	2.6E+001 C	2.9E+000 C		4.4E-004	8.8E-003 C
AZOBENZENE	103333		1.10E-001 I		1.10E-001 I		6.1E-001 C	5.7E-002 C	2.9E-002 C	5.2E+001 C	5.8E+000 C		1.8E-003	3.5E-002 C
BARIUM	7440393	7.00E-002 I		1.40E-004 A			2.6E+003 N	5.1E-001 N	9.5E+001 N	1.4E+005 N	5.5E+003 N		1.1E+002	2.1E+003 N
BAYGON	114261	4.00E-003 I					1.5E+002 N	1.5E+001 N	5.4E+000 N	8.2E+003 N	3.1E+002 N			
BAYTHROID	68359375	2.50E-002 I					9.1E+002 N	9.1E+001 N	3.4E+001 N	5.1E+004 N	2.0E+003 N			
BENTAZON	25057890	3.00E-002 I					1.1E+003 N	1.1E+002 N	4.1E+001 N	6.1E+004 N	2.3E+003 N			
BENZALDEHYDE	100527	1.00E-001 I					3.7E+003 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N			
BENZENE	71432	3.00E-003 E	5.5E-002 I	1.70E-003 E	2.90E-002 I	y	3.2E-001 C	2.2E-001 C	5.7E-002 C	1.0E+002 C	1.2E+001 C		9.0E-005	1.8E-003 C
BENZENETHIOL	108985	1.00E-005 H				y	6.1E-002 N	3.7E-002 N	1.4E-002 N	2.0E+001 N	7.8E-001 N			
BENZIDINE	92875	3.00E-003 I	2.30E+002 I		2.30E+002 I		2.9E-004 C	2.7E-005 C	1.4E-005 C	2.5E-002 C	2.8E-003 C			
BENZOIC ACID	65850	4.00E+000 I					1.5E+005 N	1.5E+004 N	5.4E+003 N	8.2E+006 N	3.1E+005 N			
BENZYL ALCOHOL	100516	3.00E-001 H					1.1E+004 N	1.1E+003 N	4.1E+002 N	6.1E+005 N	2.3E+004 N		4.4E+000	8.8E+001 N
BENZYL CHLORIDE	100447		0.17 I			y	6.2E-002 C	3.7E-002 C	1.9E-002 C	3.4E+001 C	3.8E+000 C		1.9E-005	3.7E-004 C
BERYLLIUM	7440417	2.00E-003 I		5.7E-006 I	8.40E+000 I		7.3E+001 N	7.5E-004 C	2.7E+000 N	4.1E+003 N	1.6E+002 N		5.8E+001	1.2E+003 N
BIPHENYL	92524	5.00E-002 I				y	3.0E+002 N	1.8E+002 N	6.8E+001 N	1.0E+005 N	3.9E+003 N		4.8E+000	9.6E+001 N
BIS(2-CHLOROETHYL)ETHER	111444		1.10E+000 I		1.10E+000 I	y	9.6E-003 C	5.7E-003 C	2.9E-003 C	5.2E+000 C	5.8E-001 C		2.2E-006	4.4E-005 C
BIS(2-CHLOROISOPROPYL)ETHER	108601	4.00E-002 I	7.00E-002 H		3.50E-002 H	y	2.6E-001 C	1.8E-001 C	4.5E-002 C	8.2E+001 C	9.1E+000 C		8.4E-005	1.7E-003 C
BIS(CHLOROMETHYL)ETHER	542881		2.20E+002 I		2.20E+002 I	y	4.8E-005 C	2.8E-005 C	1.4E-005 C	2.6E-002 C	2.9E-003 C		9.7E-009	1.9E-007 C
BIS(2-ETHYLHEXYL)PHTHALATE	117817	2.00E-002 I	1.40E-002 I		1.40E-002 E		4.8E+000 C	4.5E-001 C	2.3E-001 C	4.1E+002 C	4.6E+001 C		1.4E+002	2.9E+003 C
BORON	7440428	9.00E-002 I		5.70E-003 H			3.3E+003 N	2.1E+001 N	1.2E+002 N	1.8E+005 N	7.0E+003 N			

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Chemical	CAS	RfDo mg/kg/d	CSF _o 1/mg/kg/d	RfDI mg/kg/d	CSF _I 1/mg/kg/d	VOC	Tap water ug/l	Ambient air ug/m3	Fish mg/kg	Soil Industrial mg/kg	Residential mg/kg	Soil, for groundwater migration	
												DAF 1 mg/kg	DAF 20 mg/kg
BROMODICHLOROMETHANE	75274	2.00E-002 I	6.20E-002 I			y	1.7E-001 C	1.0E-001 C	5.1E-002 C	9.2E+001 C	1.0E+001 C	5.4E-005	1.1E-003 C
BROMOETHENE	593602			8.6E-004 I	1.10E-001 H	y	1.1E-001 C	5.7E-002 C	1.6E+000 C			5.4E-005	1.1E-003 C
**BROMOFORM	75252	2.00E-002 I	7.90E-003 I		3.90E-003 I		8.5E+000 C	1.6E+000 C	4.0E-001 C	7.2E+002 C	8.1E+001 C	3.3E-003	6.7E-002 C
BROMOMETHANE	74839	1.40E-003 I		1.40E-003 I		y	8.5E+000 N	5.1E+000 N	1.9E+000 N	2.9E+003 N	1.1E+002 N	2.1E-003	4.1E-002 N
BROMOPHOS	2104963	5.00E-003 H					1.8E+002 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N		
1,3-BUTADIENE	106990				1.80E+000 H	y	7.0E-003 C	3.5E-003 C				3.9E-006	7.8E-005 C
1-BUTANOL	71363	1.00E-001 I					3.7E+003 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N	7.8E-001	1.6E+001 N
BUTYLBENZYLPHTHALATE	85687	2.00E-001 I					7.3E+003 N	7.3E+002 N	2.7E+002 N	4.1E+005 N	1.6E+004 N	8.4E+002	1.7E+004 N
BUTYLATE	2008415	5.00E-002 I					1.8E+003 N	1.8E+002 N	6.8E+001 N	1.0E+005 N	3.9E+003 N		
N-BUTYLBENZENE	104518	4.00E-002 E				y	2.4E+002 N	1.5E+002 N	5.4E+001 N	8.2E+004 N	3.1E+003 N		
SEC-BUTYLBENZENE	135988	4.00E-002 E				y	2.4E+002 N	1.5E+002 N	5.4E+001 N	8.2E+004 N	3.1E+003 N		
TERT-BUTYLBENZENE	98066	4.00E-002 E				y	2.4E+002 N	1.5E+002 N	5.4E+001 N	8.2E+004 N	3.1E+003 N		
CADMIUM-WATER	7440439	5.00E-004 I		5.7E-005 E	6.30E+000 I		1.8E+001 N	9.9E-004 C	6.8E-001 N	1.0E+003 N	3.9E+001 N	1.4E+000	2.7E+001 N
CADMIUM-FOOD	7440439	1.00E-003 I		5.7E-005 E	6.30E+000 I		3.7E+001 N	9.9E-004 C	1.4E+000 N	2.0E+003 N	7.8E+001 N	2.7E+000	5.5E+001 N
CAPROLACTAM	105602	5.00E-001 I					1.8E+004 N	1.8E+003 N	6.8E+002 N	1.0E+006 N	3.9E+004 N		
CARBARYL	63252	1.00E-001 I					3.7E+003 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N	1.5E+000	3.0E+001 N
CARBON DISULFIDE	75150	1.00E-001 I		2.00E-001 I		y	1.0E+003 N	7.3E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N	9.5E-001	1.9E+001 N
CARBON TETRACHLORIDE	56235	7.00E-004 I	1.30E-001 I	5.71E-004 E	5.30E-002 I	y	1.6E-001 C	1.2E-001 C	2.4E-002 C	4.4E+001 C	4.9E+000 C	1.1E-004	2.1E-003 C
CARBOSULFAN	55285149	1.00E-002 I					3.7E+002 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N		
CHLORAL HYDRATE	302170	1.00E-001 I					3.7E+003 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N		
CHLORANIL	118752		4.00E-001 H				1.7E-001 C	1.6E-002 C	7.9E-003 C	1.4E+001 C	1.6E+000 C		
CHLORDANE	57749	5.00E-004 I	3.5E-001 I	2.00E-004 I	3.5E-001 I		1.9E-001 C	1.8E-002 C	9.0E-003 C	1.6E+001 C	1.8E+000 C	4.6E-002	9.2E-001 C
CHLORINE	7782505	1.00E-001 I		5.7E-005 E		y	4.2E-001 N	2.1E-001 N	1.4E+002 N	2.0E+005 N	7.8E+003 N		
CHLORINE DIOXIDE	10049044			5.70E-005 I		y	4.2E-001 N	2.1E-001 N					
CHLOROACETIC ACID	79118	2.00E-003 H					7.3E+001 N	7.3E+000 N	2.7E+000 N	4.1E+003 N	1.6E+002 N		
4-CHLOROANILINE	106478	4.00E-003 I					1.5E+002 N	1.5E+001 N	5.4E+000 N	8.2E+003 N	3.1E+002 N	4.8E-002	9.7E-001 N
CHLOROBENZENE	108907	2.00E-002 I		1.7E-002 E		y	1.1E+002 N	6.2E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N	4.0E-002	8.0E-001 N
CHLOROBENZILATE	510156	2.00E-002 I	2.70E-001 H		2.70E-001 H		2.5E-001 C	2.3E-002 C	1.2E-002 C	2.1E+001 C	2.4E+000 C	1.3E-003	2.7E-002 C
P-CHLOROBENZOIC ACID	74113	2.00E-001 H					7.3E+003 N	7.3E+002 N	2.7E+002 N	4.1E+005 N	1.6E+004 N		
2-CHLORO-1,3-BUTADIENE	126998	2.00E-002 A		2.00E-003 H		y	1.4E+001 N	7.3E+000 N	2.7E+001 N	4.1E+004 N	1.6E+003 N	6.0E-003	1.2E-001 N
1-CHLOROBUTANE	109693	4.00E-001 H				y	2.4E+003 N	1.5E+003 N	5.4E+002 N	8.2E+005 N	3.1E+004 N	1.0E+000	2.0E+001 N
1-CHLORO-1,1-DIFLUOROETHANE	75683			1.40E+001 I		y	1.0E+005 N	5.1E+004 N				7.0E+001	1.4E+003 N
CHLORODIFLUOROMETHANE	75456			1.40E+001 I		y	1.0E+005 N	5.1E+004 N				7.0E+001	1.4E+003 N
CHLOROETHANE	75003	4.00E-001 E	2.90E-003 E	2.90E+000 I		y	3.6E+000 C	2.2E+000 C	1.1E+000 C	2.0E+003 C	2.2E+002 C	9.6E-004	1.9E-002 C
CHLOROFORM	67663	1.00E-002 I	6.10E-003 I	8.6E-005 E	8.10E-002 I	y	1.5E-001 C	7.7E-002 C	5.2E-001 C	9.4E+002 C	1.0E+002 C	4.5E-005	8.9E-004 C
CHLOROMETHANE	74873		1.30E-002 H	8.6E-002 E	3.5E-003 E	y	2.1E+000 C	1.8E+000 C	2.4E-001 C	4.4E+002 C	4.9E+001 C	5.2E-004	1.0E-002 C
4-CHLORO-2-METHYLANILINE	95692		5.80E-001 H				1.2E-001 C	1.1E-002 C	5.4E-003 C	9.9E+000 C	1.1E+000 C		
BETA-CHLORONAPHTHALENE	91587	8.00E-002 I				y	4.9E+002 N	2.9E+002 N	1.1E+002 N	1.6E+005 N	6.3E+003 N	1.6E+000	3.2E+001 N
O-CHLORONITROBENZENE	88733		2.50E-002 H			y	4.2E-001 C	2.5E-001 C	1.3E-001 C	2.3E+002 C	2.6E+001 C		
P-CHLORONITROBENZENE	100005		1.80E-002 H			y	5.9E-001 C	3.5E-001 C	1.8E-001 C	3.2E+002 C	3.5E+001 C		
2-CHLOROPHENOL	95578	5.00E-003 I				y	3.0E+001 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N		
2-CHLOROPROPANE	75296			2.90E-002 H		y	2.1E+002 N	1.1E+002 N				6.6E-002	1.3E+000 N
O-CHLOROTOLUENE	95496	2.00E-002 I				y	1.2E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N	6.5E-002	1.3E+000 N
CHLORPYRIFOS	2921882	3.00E-003 I					1.1E+002 N	1.1E+001 N	4.1E+000 N	6.1E+003 N	2.3E+002 N	3.2E+000	6.3E+001 N
CHLORPYRIFOS-METHYL	5598130	1.00E-002 H					3.7E+002 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N		

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Chemical	CAS	RfDo mg/kg/d	CSFo 1/mg/kg/d	RfDi mg/kg/d	CSFi 1/mg/kg/d	VOC	Risk-based concentrations					Soil, for groundwater migration	
							Tap water ug/l	Ambient air ug/m3	Fish mg/kg	Soil Industrial mg/kg	Residential mg/kg	DAF 1 mg/kg	DAF 20 mg/kg
CHROMIUM III	18065831	1.50E+00 I					5.5E+004 N	5.5E+003 N	2.0E+003 N	3.1E+006 N	1.2E+005 N	9.9E+007	2.0E+009 N
CHROMIUM VI	18540299	3.00E-003 I		3.00E-005 I	4.10E+001 H		1.1E+002 N	1.5E-004 C	4.1E+000 N	6.1E+003 N	2.3E+002 N	2.1E+000	4.2E+001 N
COBALT	7440484	6.00E-002 E					2.2E+003 N	2.2E+002 N	8.1E+001 N	1.2E+005 N	4.7E+003 N		
COKE OVEN EMISSIONS (COAL TAR)	8007452					2.2 I		2.8E-003 C					
COPPER	7440508	4.00E-002 H					1.5E+003 N	1.5E+002 N	5.4E+001 N	8.2E+004 N	3.1E+003 N	5.3E+002	1.1E+004 N
CROTONALDEHYDE	123739		1.90E+000 H			y	5.6E-003 C	3.3E-003 C	1.7E-003 C	3.0E+000 C	3.4E-001 C	1.5E-005	3.1E-004 C
CUMENE	98828	1.00E-001 I		1.10E-001 I		y	6.6E+002 N	4.0E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N	3.2E+000	6.4E+001 N
CYANIDE (FREE)	57125	2.00E-002 I					7.3E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N	7.4E+000	1.5E+002 N
CALCIUM CYANIDE	59201E	4E-002 I					1.5E+003 N	1.5E+002 N	5.4E+001 N	8.2E+004 N	3.1E+003 N		
COPPER CYANIDE	544923	5.00E-003 I					1.8E+002 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N		
CYANAZINE	21725462	2.00E-003 H	8.40E-001 H				8.0E-002 C	7.5E-003 C	3.8E-003 C	6.8E+000 C	7.6E-001 C	2.6E-005	5.3E-004 C
CYANOGEN	460195	4.00E-002 I				y	2.4E+002 N	1.5E+002 N	5.4E+001 N	8.2E+004 N	3.1E+003 N		
CYANOGEN BROMIDE	506683	9.00E-002 I					3.3E+003 N	3.3E+002 N	1.2E+002 N	1.8E+005 N	7.0E+003 N		
CYANOGEN CHLORIDE	506774	5.00E-002 I					1.8E+003 N	1.8E+002 N	6.8E+001 N	1.0E+005 N	3.9E+003 N		
HYDROGEN CYANIDE	74908	2.00E-002 I		8.60E-004 I		y	6.2E+000 N	3.1E+000 N	2.7E+001 N	4.1E+004 N	1.6E+003 N	1.1E-001	2.2E+000 N
POTASSIUM CYANIDE	151508	5.00E-002 I					1.8E+003 N	1.8E+002 N	6.8E+001 N	1.0E+005 N	3.9E+003 N		
POTASSIUM SILVER CYANIDE	506616	2.00E-001 I					7.3E+003 N	7.3E+002 N	2.7E+002 N	4.1E+005 N	1.6E+004 N		
SILVER CYANIDE	506649	1.00E-001 I					3.7E+003 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N	3.1E+001	6.2E+002 N
SODIUM CYANIDE	143339	4.00E-002 I					1.5E+003 N	1.5E+002 N	5.4E+001 N	8.2E+004 N	3.1E+003 N		
THIOCYANATE		5.00E-002 E					1.8E+003 N	1.8E+002 N	6.8E+001 N	1.0E+005 N	3.9E+003 N		
ZINC CYANIDE	557211	5.00E-002 I					1.8E+003 N	1.8E+002 N	6.8E+001 N	1.0E+005 N	3.9E+003 N	1.1E+002	2.3E+003 N
CYCLOHEXANONE	108941	5.00E+000 I					1.8E+005 N	1.8E+004 N	6.8E+003 N	1.0E+007 N	3.9E+005 N	6.1E+001	1.2E+003 N
CYHALOTHRIN/KARATE	68085858	5.00E-003 I					1.8E+002 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N		
CYPERMETHRIN	52315078	1.00E-002 I					3.7E+002 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N		
DACTHAL	1861321	1.00E-002 I					3.7E+002 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N		
DALAPON	75990	3.00E-002 I					1.1E+003 N	1.1E+002 N	4.1E+001 N	6.1E+004 N	2.3E+003 N	3.5E-001	7.1E+000 N
DDD	72548		2.40E-001 I				2.8E-001 C	2.6E-002 C	1.3E-002 C	2.4E+001 C	2.7E+000 C	5.6E-001	1.1E+001 C
DDE	72559		3.40E-001 I				2.0E-001 C	1.8E-002 C	9.3E-003 C	1.7E+001 C	1.9E+000 C	1.8E+000	3.5E+001 C
DDT	50293	5.00E-004 I	3.40E-001 I		3.40E-001 I		2.0E-001 C	1.8E-002 C	9.3E-003 C	1.7E+001 C	1.9E+000 C	5.8E-002	1.2E+000 C
DIAZINON	333415	9.00E-004 H					3.3E+001 N	3.3E+000 N	1.2E+000 N	1.8E+003 N	7.0E+001 N	2.1E-002	4.3E-001 N
DIBENZOFURAN	132649	4.00E-003 E				y	2.4E+001 N	1.5E+001 N	5.4E+000 N	8.2E+003 N	3.1E+002 N	3.8E-001	7.7E+000 N
1,4-DIBROMOBENZENE	106376	1.00E-002 I					3.7E+002 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N		
DIBROMOCHLOROMETHANE	124481	2.00E-002 I	8.40E-002 I			y	1.3E-001 C	7.5E-002 C	3.8E-002 C	6.8E+001 C	7.6E+000 C	4.1E-005	8.3E-004 C
1,2-DIBROMO-3-CHLOROPROPANE	96128		1.40E+000 H	5.70E-005 I	2.40E-003 H	y	4.7E-002 C	2.1E-001 N	2.3E-003 C	4.1E+000 C	4.6E-001 C	4.4E-005	8.7E-004 C
1,2-DIBROMOETHANE	106934		8.50E+001 I	5.70E-005 H	7.60E-001 I	y	7.5E-004 C	8.2E-003 C	3.7E-005 C	6.7E-002 C	7.5E-003 C	4.3E-007	8.5E-006 C
DIBUTYLPHTHALATE	84742	1.00E-001 I					3.7E+003 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N	2.5E+002	5.0E+003 N
DICAMBA	1918009	3.00E-002 I					1.1E+003 N	1.1E+002 N	4.1E+001 N	6.1E+004 N	2.3E+003 N	2.2E-001	4.5E+000 N
1,2-DICHLOROBENZENE	95501	9.00E-002 I				y	5.5E+002 N	3.3E+002 N	1.2E+002 N	1.8E+005 N	7.0E+003 N	4.6E-001	9.3E+000 N
1,3-DICHLOROBENZENE	541731	9.00E-004 E				y	5.5E+000 N	3.3E+000 N	1.2E+000 N	1.8E+003 N	7.0E+001 N	4.4E-003	8.7E-002 N
1,4-DICHLOROBENZENE	106467	3.00E-002 E	2.40E-002 H	2.29E-001 I	2.2E-002 E	y	4.7E-001 C	2.8E-001 C	1.3E-001 C	2.4E+002 C	2.7E+001 C	3.6E-004	7.1E-003 C
3,3'-DICHLOROBENZIDINE	91941		4.50E-001 I				1.5E-001 C	1.4E-002 C	7.0E-003 C	1.3E+001 C	1.4E+000 C	2.5E-004	4.9E-003 C
1,4-DICHLORO-2-BUTENE	764410				9.30E+000 H	y	1.3E-003 C	6.7E-004 C				4.0E-007	8.0E-006 C
DICHLORODIFLUOROMETHANE	75718	2.00E-001 I		5.00E-002 A		y	3.5E+002 N	1.8E+002 N	2.7E+002 N	4.1E+005 N	1.6E+004 N	5.5E-001	1.1E+001 N
1,1-DICHLOROETHANE	75343	1.00E-001 H		1.40E-001 A		y	8.0E+002 N	5.1E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N	2.3E-001	4.5E+000 N
1,2-DICHLOROETHANE	107062	3.00E-002 E	9.10E-002 I	1.40E-003 E	9.10E-002 I	y	1.2E-001 C	6.9E-002 C	3.5E-002 C	6.3E+001 C	7.0E+000 C	5.2E-005	1.0E-003 C

Sources: 1 = IRIS H = HEAST A = HEAST Alternate W = Withdrawn from IRIS or HEAST E = EPA-NCEA provisional value O = other							Basic: C = Carcinogenic effects N = Noncarcinogenic effects 1 = RBC at HI of 0.1 < RBC-c					Region III SSLs	
Chemical	CAS	RfDo mg/kg/d	CSFo 1/mg/kg/d	RfDi mg/kg/d	CSFi 1/mg/kg/d	VOC	Risk-based concentrations					Soil, for groundwater migration	
							Tap water ug/l	Ambient air ug/m3	Fish mg/kg	Soil Industrial mg/kg	Residential	DAF 1 mg/kg	DAF 20 mg/kg
1,1-DICHLOROETHENE	75354	9.00E-003 I	6.00E-001 I		1.75E-001 I	y	4.4E-002 C	3.6E-002 C	5.3E-003 C	9.5E+000 C	1.1E+000 C	1.8E-005	3.6E-004 C
CIS-1,2-DICHLOROETHENE	156592	1.00E-002 H				y	6.1E+001 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N	1.7E-002	3.5E-001 N
TRANS-1,2-DICHLOROETHENE	156605	2.00E-002 I				y	1.2E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N	4.1E-002	8.2E-001 N
TOTAL 1,2-DICHLOROETHENE	540590	9.00E-003 H				y	5.5E+001 N	3.3E+001 N	1.2E+001 N	1.8E+004 N	7.0E+002 N	1.9E-002	3.7E-001 N
2,4-DICHLOROPHENOL	120832	3.00E-003 I					1.1E+002 N	1.1E+001 N	4.1E+000 N	6.1E+003 N	2.3E+002 N	6.0E-002	1.2E+000 N
2,4-D	94757	1.00E-002 I					3.7E+002 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N	4.5E-001	9.0E+000 N
4-(2,4-DICHLOROPHENOXY)BUTYRIC ACID	94826	8E-003 I					2.9E+002 N	2.9E+001 N	1.1E+001 N	1.6E+004 N	6.3E+002 N		
1,2-DICHLOROPROPANE	78875		6.80E-002 H	1.14E-003 I		y	1.6E-001 C	9.2E-002 C	4.6E-002 C	8.4E+001 C	9.4E+000 C	1.0E-004	2.1E-003 C
2,3-DICHLOROPROPANOL	616235	3.00E-003 I					1.1E+002 N	1.1E+001 N	4.1E+000 N	6.1E+003 N	2.3E+002 N		
**1,3-DICHLOROPROPENE	542756	3.00E-002 I	1.00E-001 I	5.71E-003 I	1.00E-002 I	y	4.4E-001 C	6.3E-001 C	3.2E-002 C	5.7E+001 C	6.4E+000 C	1.6E-004	3.1E-003 C
DICHLORVOS	62737	5E-004 I	0.29 I	1.43E-004 I			2.3E-001 C	2.2E-002 C	1.1E-002 C	2.0E+001 C	2.2E+000 C	5.5E-005	1.1E-003 C
DICOFOL	115322		4.4E-001 W				1.5E-001 C	1.4E-002 C	7.2E-003 C	1.3E+001 C	1.5E+000 C	9.3E-004	1.9E-002 C
DICYCLOPENTADIENE	77736	3E-002 H		6.00E-005 A		y	4.4E-001 N	2.2E-001 N	4.1E+001 N	6.1E+004 N	2.3E+003 N		
DIELDRIN	60571	5.00E-005 I	1.60E+001 I		1.60E+001 I		4.2E-003 C	3.9E-004 C	2.0E-004 C	3.6E-001 C	4.0E-002 C	1.1E-004	2.2E-003 C
DIESEL EMISSIONS				1.40E-003 I				5.1E+000 N					
DIETHYLPHTHALATE	84662	8.00E-001 I					2.9E+004 N	2.9E+003 N	1.1E+003 N	1.6E+006 N	6.3E+004 N	2.3E+001	4.5E+002 N
DIETHYLENE GLYCOL, MONOBUTYL ETHER	112345			5.70E-003 H				2.1E+001 N					
DIETHYLENE GLYCOL, MONOETHYL ETHER	111900	2.00E+000 H					7.3E+004 N	7.3E+003 N	2.7E+003 N	4.1E+006 N	1.6E+005 N		
DI(2-ETHYLHEXYL)ADIPATE	103231	6.00E-001 I	1.20E-003 I				5.6E+001 C	5.2E+000 C	2.6E+000 C	4.8E+003 C	5.3E+002 C		
DIETHYLSTILBESTROL	56531		4.70E+003 H				1.4E-005 C	1.3E-006 C	6.7E-007 C	1.2E-003 C	1.4E-004 C		
DIFENZOQUAT (AVERAGE)	43222486	8.00E-002 I					2.9E+003 N	2.9E+002 N	1.1E+002 N	1.6E+005 N	6.3E+003 N		
1,1-DIFLUOROETHANE	75376			1.10E+001 I		y	8.0E+004 N	4.0E+004 N					
DIISOPROPYL METHYLPHOSPHONATE (DIMP)	1445756	8.00E-002 I					2.9E+003 N	2.9E+002 N	1.1E+002 N	1.6E+005 N	6.3E+003 N		
3,3'-DIMETHOXYBENZIDINE	119904		1.40E-002 H				4.8E+000 C	4.5E-001 C	2.3E-001 C	4.1E+002 C	4.6E+001 C		
DIMETHYLAMINE	124403			5.70E-006 W		y	4.2E-002 N	2.1E-002 N				8.5E-006	1.7E-004 N
2,4-DIMETHYLANILINE HYDROCHLORIDE	21436964		5.80E-001 H				1.2E-001 C	1.1E-002 C	5.4E-003 C	9.9E+000 C	1.1E+000 C		
2,4-DIMETHYLANILINE	95681		7.50E-001 H				8.9E-002 C	8.3E-003 C	4.2E-003 C	7.6E+000 C	8.5E-001 C		
N,N-DIMETHYLANILINE	121697	2.00E-003 I					7.3E+001 N	7.3E+000 N	2.7E+000 N	4.1E+003 N	1.6E+002 N		
3,3'-DIMETHYLBENZIDINE	119937		9.20E+000 H				7.3E-003 C	6.8E-004 C	3.4E-004 C	6.2E-001 C	6.9E-002 C		
1,1-DIMETHYLHYDRAZINE	57147		2.60E+000 W		3.50E+000 W		2.6E-002 C	1.8E-003 C	1.2E-003 C	2.2E+000 C	2.5E-001 C		
1,2-DIMETHYLHYDRAZINE	540738		3.70E+001 W		3.70E+001 W		1.8E-003 C	1.7E-004 C	8.5E-005 C	1.5E-001 C	1.7E-002 C		
2,4-DIMETHYLPHENOL	105679	2.00E-002 I					7.3E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N	3.4E-001	6.7E+000 N
2,6-DIMETHYLPHENOL	576261	6.00E-004 I					2.2E+001 N	2.2E+000 N	8.1E-001 N	1.2E+003 N	4.7E+001 N		
3,4-DIMETHYLPHENOL	95658	1.00E-003 I					3.7E+001 N	3.7E+000 N	1.4E+000 N	2.0E+003 N	7.8E+001 N		
DIMETHYLPHTHALATE	131113	1.00E+001 W					3.7E+005 N	3.7E+004 N	1.4E+004 N	2.0E+007 N	7.8E+005 N		
1,2-DINITROBENZENE	528290	4.00E-004 H					1.5E+001 N	1.5E+000 N	5.4E-001 N	8.2E+002 N	3.1E+001 N		
1,3-DINITROBENZENE	99650	1.00E-004 I					3.7E+000 N	3.7E-001 N	1.4E-001 N	2.0E+002 N	7.8E+000 N	1.8E-003	3.7E-002 N
1,4-DINITROBENZENE	100254	4.00E-004 H					1.5E+001 N	1.5E+000 N	5.4E-001 N	8.2E+002 N	3.1E+001 N		
4,6-DINITRO-O-CYCLOHEXYL PHENOL	131895	2.00E-003 I					7.3E+001 N	7.3E+000 N	2.7E+000 N	4.1E+003 N	1.6E+002 N		
4,6-DINITRO-2-METHYLPHENOL	534521	1.00E-004 E					3.7E+000 N	3.7E-001 N	1.4E-001 N	2.0E+002 N	7.8E+000 N		
2,4-DINITROPHENOL	51285	2.00E-003 I					7.3E+001 N	7.3E+000 N	2.7E+000 N	4.1E+003 N	1.6E+002 N		
DINITROTOLUENE MIX			6.80E-001 I				9.8E-002 C	9.2E-003 C	4.6E-003 C	8.4E+000 C	9.4E-001 C		
2,4-DINITROTOLUENE	121142	2.00E-003 I					7.3E+001 N	7.3E+000 N	2.7E+000 N	4.1E+003 N	1.6E+002 N	2.9E-002	5.7E-001 N
2,6-DINITROTOLUENE	606202	1.00E-003 H					3.7E+001 N	3.7E+000 N	1.4E+000 N	2.0E+003 N	7.8E+001 N	1.2E-002	2.5E-001 N
DINOSEB	88857	1.00E-003 I					3.7E+001 N	3.7E+000 N	1.4E+000 N	2.0E+003 N	7.8E+001 N	8.7E-003	1.7E-001 N

Sources: I = IRIS H = HEAST A = HEAST Alternate W = Withdrawn from IRIS or HEAST E = EPA-NCEA provisional value O = other							Basis: C = Carcinogenic effects N = Noncarcinogenic effects I = RBC at HI of 0.1 < RBC-c					Region III SSLs	
Chemical	CAS	RfDo mg/kg/d	CSFo 1/mg/kg/d	RfDi mg/kg/d	CSFi 1/mg/kg/d	VOC	Risk-based concentrations					Soil, for groundwater migration	
							Tap water ug/l	Ambient air ug/m3	Fish mg/kg	Soil Industrial mg/kg	Residential mg/kg	DAF 1 mg/kg	DAF 20 mg/kg
DIOCTYLPHTHALATE	117840	2.00E-002 H					7.3E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N	1.2E+005	2.4E+006 N
1,4-DIOXANE	123911		1.10E-002 I				6.1E+000 C	5.7E-001 C	2.9E-001 C	5.2E+002 C	5.8E+001 C	1.3E-003	2.6E-002 C
DIPHENYLAMINE	122394	2.50E-002 I					9.1E+002 N	9.1E+001 N	3.4E+001 N	5.1E+004 N	2.0E+003 N	1.3E+000	2.5E+001 N
1,2-DIPHENYLHYDRAZINE	122667		8.00E-001 I		8.00E-001 I		8.4E-002 C	7.8E-003 C	3.9E-003 C	7.2E+000 C	8.0E-001 C	1.3E-004	2.5E-003 C
DIQUAT	85007	2.20E-003 I					8.0E+001 N	8.0E+000 N	3.0E+000 N	4.5E+003 N	1.7E+002 N	1.7E-002	3.3E-001 N
DISULFOTON	298044	4.00E-005 I					1.5E+000 N	1.5E-001 N	5.4E-002 N	8.2E+001 N	3.1E+000 N	3.2E-003	6.4E-002 N
1,4-DITHIANE	505293	1.00E-002 I					3.7E+002 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N		
DIURON	330541	2.00E-003 I					7.3E+001 N	7.3E+000 N	2.7E+000 N	4.1E+003 N	1.8E+002 N	5.8E-002	1.2E+000 N
ENDOSULFAN	115297	6.00E-003 I					2.2E+002 N	2.2E+001 N	8.1E+000 N	1.2E+004 N	4.7E+002 N	9.8E-001	2.0E+001 N
ENDRIN	72208	3.00E-004 I					1.1E+001 N	1.1E+000 N	4.1E-001 N	6.1E+002 N	2.3E+001 N	2.7E-001	5.4E+000 N
EPICHLOROHYDRIN	106898	2.00E-003 H	9.90E-003 I	2.86E-004 I	4.20E-003 I y		2.0E+000 N	1.0E+000 N	3.2E-001 C	5.8E+002 C	6.5E+001 C	4.2E-004	8.4E-003 N
ETHION	563122	5.00E-004 I					1.8E+001 N	1.8E+000 N	6.8E-001 N	1.0E+003 N	3.9E+001 N	3.2E-001	6.4E+000 N
2-ETHOXYETHANOL	110805	4.00E-001 H		5.70E-002 I			1.5E+004 N	2.1E+002 N	5.4E+002 N	8.2E+005 N	3.1E+004 N	3.3E+000	6.5E+001 N
ETHYL ACETATE	141786	9.00E-001 I				y	5.5E+003 N	3.3E+003 N	1.2E+003 N	1.8E+006 N	7.0E+004 N	1.7E+000	3.5E+001 N
ETHYLBENZENE	100414	1.00E-001 I		2.90E-001 I		y	1.3E+003 N	1.1E+003 N	1.4E+002 N	2.0E+005 N	7.8E+003 N	7.5E-001	1.5E+001 N
ETHYLENE DIAMINE	107153	2.00E-002 H					7.3E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N		
ETHYLENE GLYCOL	107211	2.00E+000 I					7.3E+004 N	7.3E+003 N	2.7E+003 N	4.1E+006 N	1.6E+005 N	1.5E+001	3.0E+002 N
ETHYLENE GLYCOL, MONOBUTYL ETHER	111762	5.00E-001 I		3.70E+000 I			1.8E+004 N	1.4E+004 N	6.8E+002 N	1.0E+006 N	3.9E+004 N		
ETHYLENE OXIDE	75218		1.00E+000 H		3.50E-001 H y		2.3E-002 C	1.8E-002 C	3.2E-003 C	5.7E+000 C	6.4E-001 C	4.8E-006	9.5E-005 C
ETHYLENE THIOUREA	96457	8.00E-005 I	1.1E-001 H				6.1E-001 C	5.7E-002 C	2.9E-002 C	5.2E+001 C	5.8E+000 C		
ETHYL ETHER	60297	2.00E-001 I				y	1.2E+003 N	7.3E+002 N	2.7E+002 N	4.1E+005 N	1.6E+004 N	4.2E-001	8.5E+000 N
ETHYL METHACRYLATE	97632	9.00E-002 H				y	5.5E+002 N	3.3E+002 N	1.2E+002 N	1.8E+005 N	7.0E+003 N	1.0E+000	2.1E+001 N
FENAMIPHOS	22224926	2.50E-004 I					9.1E+000 N	9.1E-001 N	3.4E-001 N	5.1E+002 N	2.0E+001 N	7.8E-003	1.6E-001 N
FLUOMETURON	2164172	1.30E-002 I					4.7E+002 N	4.7E+001 N	1.8E+001 N	2.7E+004 N	1.0E+003 N		
FLUORINE	7782414	6.00E-002 I					2.2E+003 N	2.2E+002 N	8.1E+001 N	1.2E+005 N	4.7E+003 N		
FOMESAFEN	72178020		1.90E-001 I				3.5E-001 C	3.3E-002 C	1.7E-002 C	3.0E+001 C	3.4E+000 C		
FONOFOS	944229	2.00E-003 I					7.3E+001 N	7.3E+000 N	2.7E+000 N	4.1E+003 N	1.6E+002 N	1.8E-001	3.5E+000 N
FORMALDEHYDE	50000	2.00E-001 I			4.50E-002 I		7.3E+003 N	1.4E-001 C	2.7E+002 N	4.1E+005 N	1.6E+004 N	1.5E+000	3.0E+001 N
FORMIC ACID	64186	2.00E+000 H					7.3E+004 N	7.3E+003 N	2.7E+003 N	4.1E+006 N	1.6E+005 N		
FURAN	110009	1.00E-003 I				y	6.1E+000 N	3.7E+000 N	1.4E+000 N	2.0E+003 N	7.8E+001 N	1.5E-003	3.0E-002 N
FURAZOLIDONE	67456		3.80E+000 H				1.8E-002 C	1.6E-003 C	8.3E-004 C	1.5E+000 C	1.7E-001 C		
FURFURAL	98011	3.00E-003 I		1.00E-002 A			1.1E+002 N	3.7E+001 N	4.1E+000 N	6.1E+003 N	2.3E+002 N	2.3E-002	4.6E-001 N
GLYCIDALDEHYDE	765344	4.00E-004 I		2.90E-004 H			1.5E+001 N	1.1E+000 N	5.4E-001 N	8.2E+002 N	3.1E+001 N		
GLYPHOSATE	1071836	1.00E-001 I					3.7E+003 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N	2.6E+001	5.3E+002 N
HEPTACHLOR	76448	5.00E-004 I	4.50E+000 I		4.50E+000 I		1.5E-002 C	1.4E-003 C	7.0E-004 C	1.3E+000 C	1.4E-001 C	4.2E-002	8.4E-001 C
HEPTACHLOR EPOXIDE	1024573	1.30E-005 I	9.10E+000 I		9.10E+000 I		7.4E-003 C	6.9E-004 C	3.5E-004 C	6.3E-001 C	7.0E-002 C	1.2E-003	2.5E-002 C
HEXABROMOBENZENE	87821	2.00E-003 I					7.3E+001 N	7.3E+000 N	2.7E+000 N	4.1E+003 N	1.6E+002 N		
HEXACHLOROBENZENE	118741	8.00E-004 I	1.60E+000 I		1.60E+000 I		4.2E-002 C	3.9E-003 C	2.0E-003 C	3.6E+000 C	4.0E-001 C	2.6E-003	5.2E-002 C
HEXACHLOROBUTADIENE	87683	2.00E-004 H	7.80E-002 I		7.80E-002 I		8.6E-001 C	8.0E-002 C	4.0E-002 C	7.3E+001 C	8.2E+000 C	9.2E-002	1.8E+000 C
ALPHA-HCH	319846		6.30E+000 I		6.30E+000 I		1.1E-002 C	9.9E-004 C	5.0E-004 C	9.1E-001 C	1.0E-001 C	4.5E-005	8.9E-004 C
BETA-HCH	319857		1.80E+000 I		1.80E+000 I		3.7E-002 C	3.5E-003 C	1.8E-003 C	3.2E+000 C	3.5E-001 C	1.6E-004	3.1E-003 C
GAMMA-HCH (LINDANE)	58899	3.00E-004 I	1.30E+000 H				5.2E-002 C	4.8E-003 C	2.4E-003 C	4.4E+000 C	4.9E-001 C	2.2E-004	4.3E-003 C
TECHNICAL HCH	608731		1.80E+000 I		1.80E+000 I		3.7E-002 C	3.5E-003 C	1.8E-003 C	3.2E+000 C	3.5E-001 C		
HEXACHLOROCYCLOPENTADIENE	77474	7.00E-003 I		2.00E-005 H			2.8E+002 N	7.3E-002 N	9.5E+000 N	1.4E+004 N	5.5E+002 N	1.0E+002	2.0E+003 N
HEXACHLORODIBENZODIOXIN MIX	19408743		6.20E+003 I		4.55E+003 I		1.1E-005 C	1.4E-006 C	5.1E-007 C	9.2E-004 C	1.0E-004 C		

Sources: I = IRIS H = HEAST A = HEAST Alternate W = Withdrawn from IRIS or HEAST E = EPA/NCEA provisional value Q = other							Risk-based concentrations					Region III SSLs	
Chemical	CAS	RfDo mg/kg/d	CSFo 1/mg/kg/d	RfDi mg/kg/d	CSFi 1/mg/kg/d	VOC	Tap water ug/l	Ambient air 1/mg/m3	Fish mg/kg	Soil Industrial mg/kg	Residential mg/kg	Soil, for groundwater migration	
												DAF 1 mg/kg	DAF 20 mg/kg
HEXACHLOROETHANE	67721	1.00E-003 I	1.40E-002 I		1.40E-002 I		4.8E+000 C I	4.5E-001 C I	2.3E-001 C I	4.1E+002 C I	4.6E+001 C I	1.8E-002	3.6E-001 C
HEXACHLOROPHENE	70304	3.00E-004 I					1.1E+001 N	1.1E+000 N	4.1E-001 N	6.1E+002 N	2.3E+001 N	1.0E+002	2.0E+003 N
1,6-HEXAMETHYLENE DIISOCYANATE	822060			2.90E-006 I				1.1E-002 N					
HEXANE	110543	6.00E-002 H		5.71E-002 I		y	3.5E+002 N	2.1E+002 N	8.1E+001 N	1.2E+005 N	4.7E+003 N	6.9E-001	1.4E+001 N
2-HEXANONE	591786	4.00E-002 E		1.4E-003 E			1.5E+003 N	5.1E+000 N	5.4E+001 N	8.2E+004 N	3.1E+003 N		
HEXAZINONE	51235042	3.30E-002 I					1.2E+003 N	1.2E+002 N	4.5E+001 N	6.7E+004 N	2.6E+003 N		
HMX	2691410	5.00E-002 I					1.8E+003 N	1.8E+002 N	6.8E+001 N	1.0E+005 N	3.9E+003 N		
HYDRAZINE	302012		3.00E+000 I		1.70E+001 I		2.2E-002 C	3.7E-004 C	1.1E-003 C	1.9E+000 C	2.1E-001 C		
HYDROGEN CHLORIDE	7647010			5.70E-003 I				2.1E+001 N					
HYDROGEN SULFIDE	7783064	3.00E-003 I		2.85E-004 I			1.1E+002 N	1.0E+000 N	4.1E+000 N	6.1E+003 N	2.3E+002 N		
HYDROQUINONE	123319	4.00E-002 H					1.5E+003 N	1.5E+002 N	5.4E+001 N	8.2E+004 N	3.1E+003 N		
IRON	7439896	3.00E-001 E					1.1E+004 N	1.1E+003 N	4.1E+002 N	6.1E+005 N	2.3E+004 N		
ISOBUTANOL	78831	3.00E-001 I				y	1.8E+003 N	1.1E+003 N	4.1E+002 N	6.1E+005 N	2.3E+004 N	5.9E-001	1.2E+001 N
ISOPHORONE	78591	2.00E-001 I	9.50E-004 I				7.0E+001 C	6.6E+000 C	3.3E+000 C	6.0E+003 C	6.7E+002 C	2.1E-002	4.1E-001 C
ISOPROPALIN	33820530	1.50E-002 I					5.5E+002 N	5.5E+001 N	2.0E+001 N	3.1E+004 N	1.2E+003 N		
ISOPROPYL METHYL PHOSPHONIC ACID	1832548	1.00E-001 I					3.7E+003 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N		
TETRAETHYLLEAD	78002	1.00E-007 I					3.7E-003 N	3.7E-004 N	1.4E-004 N	2.0E-001 N	7.8E-003 N	4.6E-005	9.2E-004 N
LITHIUM	7439932	2.00E-002 E					7.3E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N		
MALATHION	121755	2.00E-002 I					7.3E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N	4.0E-001	8.1E+000 N
MALEIC ANHYDRIDE	108316	1.00E-001 I					3.7E+003 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N		
MANGANESE-NONFOOD	7439965	2.00E-002 I		1.43E-005 I			7.3E+002 N	5.2E-002 N	2.7E+001 N	4.1E+004 N	1.6E+003 N	4.8E+001	9.5E+002 N
MANGANESE-FOOD	7439965	1.40E-001 I		1.43E-005 I			5.1E+003 N	5.2E-002 N	1.9E+002 N	2.9E+005 N	1.1E+004 N	3.3E+002	6.7E+003 N
MEPHOSFOLAN	950107	9.00E-005 H					3.3E+000 N	3.3E-001 N	1.2E-001 N	1.8E+002 N	7.0E+000 N		
MEPIQUAT CHLORIDE	24307264	3.00E-002 I					1.1E+003 N	1.1E+002 N	4.1E+001 N	6.1E+004 N	2.3E+003 N		
MERCURIC CHLORIDE	7487947	3.00E-004 I					1.1E+001 N	1.1E+000 N	4.1E-001 N	6.1E+002 N	2.3E+001 N		
MERCURY (INORGANIC)	7439976			8.60E-005 I				3.1E-001 N					
METHYLMERCURY	22987926	1.00E-004 I					3.7E+000 N	3.7E-001 N	1.4E-001 N	2.0E+002 N	7.8E+000 N		
METHACRYLONITRILE	126987	1.00E-004 I		2.00E-004 A		y	1.0E+000 N	7.3E-001 N	1.4E-001 N	2.0E+002 N	7.8E+000 N	2.1E-004	4.2E-003 N
METHANOL	67581	5.00E-001 I					1.8E+004 N	1.8E+003 N	6.8E+002 N	1.0E+006 N	3.9E+004 N	3.8E+000	7.5E+001 N
METHIDATHION	950376	1.00E-003 I					3.7E+001 N	3.7E+000 N	1.4E+000 N	2.0E+003 N	7.8E+001 N		
METHOXYCHLOR	72435	5.00E-003 I					1.8E+002 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N	1.5E+001	3.1E+002 N
METHYL ACETATE	79209	1.00E+000 H				y	6.1E+003 N	3.7E+003 N	1.4E+003 N	2.0E+006 N	7.8E+004 N	1.2E+000	2.5E+001 N
METHYL ACRYLATE	96333	3.00E-002 A				y	1.8E+002 N	1.1E+002 N	4.1E+001 N	6.1E+004 N	2.3E+003 N	5.0E-001	1.0E+001 N
2-METHYLANILINE	95534		2.40E-001 H				2.8E-001 C	2.6E-002 C	1.3E-002 C	2.4E+001 C	2.7E+000 C	2.8E-004	5.7E-003 C
4-(2-METHYL-4-CHLOROPHENOXY) BUTYRIC ACID	94815	1.00E-002 I					3.7E+002 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N		
2-METHYL-4-CHLOROPHENOXYACETIC ACID (MCPA)	94746	5.00E-004 I					1.8E+001 N	1.8E+000 N	6.8E-001 N	1.0E+003 N	3.9E+001 N		
2-(2-METHYL-4-CHLOROPHENOXY)PROPIONIC ACID (MCP)	93652	1.00E-003 I					3.7E+001 N	3.7E+000 N	1.4E+000 N	2.0E+003 N	7.8E+001 N		
METHYLCYCLOHEXANE	108872			8.60E-001 H		y	6.3E+003 N	3.1E+003 N					
METHYLENE BROMIDE	74953	1.00E-002 A				y	6.1E+001 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N	1.5E-002	3.0E-001 N
METHYLENE CHLORIDE	75092	6.00E-002 I	7.50E-003 I	8.60E-001 H	1.65E-003 I	y	4.1E+000 C	3.8E+000 C	4.2E-001 C	7.6E+002 C	8.5E+001 C	9.5E-004	1.9E-002 C
4,4'-METHYLENE BIS(2-CHLOROANILINE)	101144	7.00E-004 H	1.30E-001 H		1.30E-001 H		5.2E-001 C	4.8E-002 C	2.4E-002 C	4.4E+001 C	4.9E+000 C		
4,4'-METHYLENE BIS(N,N-DIMETHYL)ANILINE	101611		4.60E-002 I				1.5E+000 C	1.4E-001 C	6.9E-002 C	1.2E+002 C	1.4E+001 C		
4,4'-METHYLENEDIPHENYL ISOCYANATE	101688			1.7E-004 I				6.2E-001 N					
METHYL ETHYL KETONE (2-BUTANONE)	78933	6.00E-001 I		2.86E-001 I		y	1.9E+003 N	1.0E+003 N	8.1E+002 N	1.2E+006 N	4.7E+004 N	4.0E-001	7.9E+000 N
METHYL HYDRAZINE	60344		1.10E+000 W				6.1E-002 C	5.7E-003 C	2.9E-003 C	5.2E+000 C	5.8E-001 C		

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Chemical	CAS	RfDo mg/kg/d	CSFo 1/mg/kg/d	RfDi mg/kg/d	CSFi 1/mg/kg/d	VOC	Risk-based concentrations					Soil, for groundwater migration	
							Tap water ug/l	Ambient air ug/m3	Fish mg/kg	Industrial mg/kg	Residential mg/kg	DAF 1 mg/kg	DAF 20 mg/kg
METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	108101	8.00E-002 H		2.00E-002 A		y	1.4E+002 N	7.3E+001 N	1.1E+002 N	1.6E+005 N	6.3E+003 N	6.5E-002	1.3E+000 N
METHYL METHACRYLATE	80626	1.40E+000 I		2.00E-001 I		y	1.4E+003 N	7.3E+002 N	1.9E+003 N	2.9E+006 N	1.1E+005 N	3.2E-001	6.5E+000 N
2-METHYL-5-NITROANILINE	99558		3.30E-002 H				2.0E+000 C	1.9E-001 C	9.6E-002 C	1.7E+002 C	1.9E+001 C		
METHYL PARATHION	298000	2.50E-004 I					9.1E+000 N	9.1E-001 N	3.4E-001 N	5.1E+002 N	2.0E+001 N	4.3E-003	8.5E-002 N
2-METHYLPHENOL	95487	5.00E-002 I					1.8E+003 N	1.8E+002 N	6.8E+001 N	1.0E+005 N	3.9E+003 N		
3-METHYLPHENOL	108394	5.00E-002 I					1.8E+003 N	1.8E+002 N	6.8E+001 N	1.0E+005 N	3.9E+003 N		
4-METHYLPHENOL	106445	5.00E-003 H					1.8E+002 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N		
METHYLSTYRENE MIX	25013154	6.00E-003 A		1.00E-002 A		y	5.5E+001 N	3.7E+001 N	8.1E+000 N	1.2E+004 N	4.7E+002 N	5.1E-002	1.0E+000 N
ALPHA-METHYLSTYRENE	98839	7.00E-002 A				y	4.3E+002 N	2.6E+002 N	9.5E+001 N	1.4E+005 N	5.5E+003 N	4.0E-001	7.9E+000 N
METHYL TERT-BUTYL ETHER	1634044			8.57E-001 I		y	6.3E+003 N	3.1E+003 N				1.4E+000	2.8E+001 N
METOLACHLOR (DUAL)	51218452	1.50E-001 I					5.5E+003 N	5.5E+002 N	2.0E+002 N	3.1E+005 N	1.2E+004 N		
MIREX	2385855	2.00E-004 I					7.3E+000 N	7.3E-001 N	2.7E-001 N	4.1E+002 N	1.6E+001 N		
MOLYBDENUM	7439987	5E-003 I					1.8E+002 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N		
MONOCHLORAMINE	10599903	1E-001 I		1.00E-001 H			3.7E+003 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N		
NALED	300765	2E-003 I			8.4E-001 I		7.3E+001 N	7.3E+000 N	2.7E+000 N	4.1E+003 N	1.6E+002 N		
NICKEL REFINERY DUST									7.5E-003 C				
NICKEL	7440020	2.00E-002 I					7.3E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N		
NITRATE	14797558	1.60E+000 I					5.8E+004 N	5.8E+003 N	2.2E+003 N	3.3E+006 N	1.3E+005 N		
NITRIC OXIDE	10102439	1.00E-001 W				y	6.1E+002 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N		
NITRITE	14797650	1.00E-001 I					3.7E+003 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N		
2-NITROANILINE	88744			5.70E-005 H					2.1E-001 N				
NITROBENZENE	98953	5.00E-004 I		6.00E-004 A		y	3.5E+000 N	2.2E+000 N	6.8E-001 N	1.0E+003 N	3.9E+001 N	1.2E-003	2.3E-002 N
NITROFURANTOIN	67209	7.00E-002 H					2.6E+003 N	2.6E+002 N	9.5E+001 N	1.4E+005 N	5.5E+003 N		
NITROFURAZONE	59870		1.50E+000 H				4.5E-002 C	4.2E-003 C	2.1E-003 C	3.8E+000 C	4.3E-001 C		
NITROGEN DIOXIDE	10102440	1.00E+000 W				y	6.1E+003 N	3.7E+003 N	1.4E+003 N	2.0E+006 N	7.8E+004 N		
NITROGLYCERIN	55630		1.4E-002 E				4.8E+000 C	4.5E-001 C	2.3E-001 C	4.1E+002 C	4.6E+001 C		
4-NITROPHENOL	100027	8.00E-003 E					2.9E+002 N	2.9E+001 N	1.1E+001 N	1.6E+004 N	6.3E+002 N	8.7E-002	1.7E+000 N
2-NITROPROPANE	79469			5.70E-003 I	9.40E+000 H	y	1.3E-003 C	6.7E-004 C				3.2E-007	6.4E-006 C
N-NITROSO-DI-N-BUTYLAMINE	924163		5.40E+000 I		5.60E+000 I	y	1.9E-003 C	1.1E-003 C	5.8E-004 C	1.1E+000 C	1.2E-001 C	1.4E-006	2.7E-005 C
N-NITROSDIETHANOLAMINE	1116547		2.80E+000 I				2.4E-002 C	2.2E-003 C	1.1E-003 C	2.0E+000 C	2.3E-001 C		
N-NITROSODIETHYLAMINE	55185		1.50E+002 I		1.50E+002 I		4.5E-004 C	4.2E-005 C	2.1E-005 C	3.8E-002 C	4.3E-003 C	1.1E-007	2.3E-006 C
N-NITROSODIMETHYLAMINE	62759		5.10E+001 I		5.10E+001 I		1.3E-003 C	1.2E-004 C	6.2E-005 C	1.1E-001 C	1.3E-002 C	2.8E-007	5.7E-006 C
N-NITROSODIPHENYLAMINE	86306		4.90E-003 I				1.4E+001 C	1.3E+000 C	6.4E-001 C	1.2E+003 C	1.3E+002 C	3.8E-002	7.6E-001 C
N-NITROSODIPROPYLAMINE	621647		7.00E+000 I				9.6E-003 C	8.9E-004 C	4.5E-004 C	8.2E-001 C	9.1E-002 C	2.4E-006	4.7E-005 C
N-NITROSO-N-ETHYLUREA	759739		1.40E+002 H				4.8E-004 C	4.5E-005 C	2.3E-005 C	4.1E-002 C	4.6E-003 C		
N-NITROSO-N-METHYLETHYLAMINE	10595956		2.20E+001 I				3.0E-003 C	2.8E-004 C	1.4E-004 C	2.6E-001 C	2.9E-002 C		
N-NITROSOPYRROLIDINE	930552		2.10E+000 I		2.10E+000 I		3.2E-002 C	3.0E-003 C	1.5E-003 C	2.7E+000 C	3.0E-001 C		
M-NITROTOLUENE	99081	2.00E-002 E				y	1.2E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N		
O-NITROTOLUENE	88722	1.00E-002 H				y	6.1E+001 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N		
P-NITROTOLUENE	99990	1.00E-002 H				y	6.1E+001 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N		
NUSTAR	85509199	7.00E-004 I					2.6E+001 N	2.6E+000 N	9.5E-001 N	1.4E+003 N	5.5E+001 N		
ORYZALIN	19044883	5.00E-002 I					1.8E+003 N	1.8E+002 N	6.8E+001 N	1.0E+005 N	3.9E+003 N		
OXADIAZON	19666309	5.00E-003 I					1.8E+002 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N		
OXAMYL	23135220	2.50E-002 I					9.1E+002 N	9.1E+001 N	3.4E+001 N	5.1E+004 N	2.0E+003 N	1.9E-001	3.8E+000 N
OXYFLUORFEN	42874033	3.00E-003 I					1.1E+002 N	1.1E+001 N	4.1E+000 N	6.1E+003 N	2.3E+002 N		

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Chemical	CAS	RfDo mg/kg/d	CSF0 1/mg/kg/d	RfDI mg/kg/d	CSFI 1/mg/kg/d	VOC	Risk-based concentrations					Soil, for groundwater migration	
							Tap water ug/l	Ambient air ug/m3	Fish mg/kg	Soil Industrial mg/kg	Residential mg/kg	DAF 1 mg/kg	DAF 20 mg/kg
PARAQUAT DICHLORIDE	1910425	4.50E-003 I					1.6E+002 N	1.6E+001 N	6.1E+000 N	9.2E+003 N	3.5E+002 N		
PARATHION	56382	6.00E-003 H					2.2E+002 N	2.2E+001 N	8.1E+000 N	1.2E+004 N	4.7E+002 N	5.0E-001	1.0E+001 N
PENTACHLOROBENZENE	608935	8.00E-004 I					2.9E+001 N	2.9E+000 N	1.1E+000 N	1.6E+003 N	6.3E+001 N	1.0E+000	2.0E+001 N
PENTACHLORONITROBENZENE	82688	3.00E-003 I	2.60E-001 H				2.6E-001 C	2.4E-002 C	1.2E-002 C	2.2E+001 C	2.5E+000 C	4.1E-003	8.2E-002 C
PENTACHLOROPHENOL	87865	3.00E-002 I	1.20E-001 I				5.6E-001 C	5.2E-002 C	2.6E-002 C	4.6E+001 C	5.3E+000 C		
PERMETHRIN	52645531	5.00E-002 I					1.8E+003 N	1.8E+002 N	6.8E+001 N	1.0E+005 N	3.9E+003 N	1.2E+002	2.4E+003 N
PHENOL	108952	6.00E-001 I					2.2E+004 N	2.2E+003 N	8.1E+002 N	1.2E+006 N	4.7E+004 N	6.7E+000	1.3E+002 N
M-PHENYLENEDIAMINE	108452	6.00E-003 I					2.2E+002 N	2.2E+001 N	8.1E+000 N	1.2E+004 N	4.7E+002 N	4.9E-002	9.8E-001 N
O-PHENYLENEDIAMINE	95545		4.70E-002 H				1.4E+000 C	1.3E-001 C	6.7E-002 C	1.2E+002 C	1.4E+001 C		
P-PHENYLENEDIAMINE	106503	1.90E-001 H					6.9E+003 N	6.9E+002 N	2.6E+002 N	3.9E+005 N	1.5E+004 N		
2-PHENYLPHENOL	90437		1.90E-003 H				3.5E+001 C	3.3E+000 C	1.7E+000 C	3.0E+003 C	3.4E+002 C		
PHOSPHINE	7803512	3.00E-004 I		8.60E-005 I			1.1E+001 N	3.1E-001 N	4.1E-001 N	6.1E+002 N	2.3E+001 N		
PHOSPHORIC ACID	7664382			2.90E-003 I				1.1E+001 N					
PHOSPHORUS (WHITE)	7723140	2.00E-005 I					7.3E-001 N	7.3E-002 N	2.7E-002 N	4.1E+001 N	1.6E+000 N		
P-PHTHALIC ACID	100210	1.00E+000 H					3.7E+004 N	3.7E+003 N	1.4E+003 N	2.0E+006 N	7.8E+004 N		
PHTHALIC ANHYDRIDE	85449	2.00E+000 I		3.43E-002 H			7.3E+004 N	1.3E+002 N	2.7E+003 N	4.1E+006 N	1.6E+005 N	2.6E+001	5.2E+002 N
POLYBROMINATED BIPHENYLS		7.00E-006 H	8.90E+000 H				7.5E-003 C	7.0E-004 C	3.5E-004 C	6.4E-001 C	7.2E-002 C		
POLYCHLORINATED BIPHENYLS	1336363		2.00E+000 I		2.00E+000 I		3.3E-002 C	3.1E-003 C	1.6E-003 C	2.9E+000 C	3.2E-001 C	2.1E-002	4.1E-001 C
AROCLOR-1016	12674112	7.00E-005 I		7.00E-002 I			9.6E-001 C	8.9E-002 C	4.5E-002 C	8.2E+001 C	5.5E+000 N	2.1E-001	4.2E+000 C
AROCLOR-1221	11104282		2.00E+000 I		2.00E+000 I		3.3E-002 C	3.1E-003 C	1.6E-003 C	2.9E+000 C	3.2E-001 C		
AROCLOR-1232	11141165		2.00E+000 I		2.00E+000 I		3.3E-002 C	3.1E-003 C	1.6E-003 C	2.9E+000 C	3.2E-001 C		
AROCLOR-1242	53469219		2.00E+000 I		2.00E+000 I		3.3E-002 C	3.1E-003 C	1.6E-003 C	2.9E+000 C	3.2E-001 C		
AROCLOR-1248	12672296		2.00E+000 I		2.00E+000 I		3.3E-002 C	3.1E-003 C	1.6E-003 C	2.9E+000 C	3.2E-001 C		
AROCLOR-1254	11097691	2.00E-005 I	2.00E+000 I		2.00E+000 I		3.3E-002 C	3.1E-003 C	1.6E-003 C	2.9E+000 C	3.2E-001 C	5.4E-002	1.1E+000 C
AROCLOR-1260	11096825		2.00E+000 I		2.00E+000 I		3.3E-002 C	3.1E-003 C	1.6E-003 C	2.9E+000 C	3.2E-001 C		
POLYCHLORINATED TERPHENYLS	61788338		4.50E+000 E				1.5E-002 C	1.4E-003 C	7.0E-004 C	1.3E+000 C	1.4E-001 C		
POLYNUCLEAR AROMATIC HYDROCARBONS:													
ACENAPHTHENE	83329	6.00E-002 I				y	3.7E+002 N	2.2E+002 N	8.1E+001 N	1.2E+005 N	4.7E+003 N	5.2E+000	1.0E+002 N
ANTHRACENE	120127	3.00E-001 I				y	1.8E+003 N	1.1E+003 N	4.1E+002 N	6.1E+005 N	2.3E+004 N	2.3E+001	4.7E+002 N
BENZ[A]ANTHRACENE	56553		7.30E-001 E				9.2E-002 C	8.6E-003 C	4.3E-003 C	7.8E+000 C	8.7E-001 C	7.3E-002	1.5E+000 C
BENZO[B]FLUORANTHENE	205992		7.30E-001 E				9.2E-002 C	8.6E-003 C	4.3E-003 C	7.8E+000 C	8.7E-001 C	2.3E-001	4.5E+000 C
BENZO[K]FLUORANTHENE	207089		7.30E-002 E				9.2E-001 C	8.6E-002 C	4.3E-002 C	7.8E+001 C	8.7E+000 C	2.3E+000	4.5E+001 C
BENZO[A]PYRENE	50328		7.30E+000 I		3.10E+000 E		9.2E-003 C	2.0E-003 C	4.3E-004 C	7.8E-001 C	8.7E-002 C	1.9E-002	3.7E-001 C
CARBAZOLE	86748		2.00E-002 H				3.3E+000 C	3.1E-001 C	1.6E-001 C	2.9E+002 C	3.2E+001 C	2.3E-002	4.7E-001 C
CHRYSENE	218019		7.30E-003 E				9.2E+000 C	8.6E-001 C	4.3E-001 C	7.8E+002 C	8.7E+001 C	7.3E+000	1.5E+002 C
DIBENZ[A,H]ANTHRACENE	53703		7.30E+000 E				9.2E-003 C	8.6E-004 C	4.3E-004 C	7.8E-001 C	8.7E-002 C	7.0E-002	1.4E+000 C
DIBENZOFURAN	132649	4.00E-003 E				y	2.4E+001 N	1.5E+001 N	5.4E+000 N	8.2E+003 N	3.1E+002 N	3.8E-001	7.7E+000 N
FLUORANTHENE	206440	4.00E-002 I					1.5E+003 N	1.5E+002 N	5.4E+001 N	8.2E+004 N	3.1E+003 N	3.1E+002	6.3E+003 N
FLUORENE	86737	4.00E-002 I				y	2.4E+002 N	1.5E+002 N	5.4E+001 N	8.2E+004 N	3.1E+003 N	6.8E+000	1.4E+002 N
INDENO[1,2,3-C,D]PYRENE	193395		7.30E-001 E				9.2E-002 C	8.6E-003 C	4.3E-003 C	7.8E+000 C	8.7E-001 C	6.4E-001	1.3E+001 C
2-METHYLNAPHTHALENE	91576	2.00E-002 E				y	1.2E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N	1.1E+000	2.2E+001 N
NAPHTHALENE	91203	2.00E-002 I		9.00E-004 I		y	6.5E+000 N	3.3E+000 N	2.7E+001 N	4.1E+004 N	1.6E+003 N	7.7E-003	1.5E-001 N
PYRENE	129000	3.00E-002 I				y	1.8E+002 N	1.1E+002 N	4.1E+001 N	6.1E+004 N	2.3E+003 N	3.4E+001	6.8E+002 N
PROMETON	1610180	1.50E-002 I					5.5E+002 N	5.5E+001 N	2.0E+001 N	3.1E+004 N	1.2E+003 N		
PROMETRYN	7297196	4.00E-003 I					1.5E+002 N	1.5E+001 N	5.4E+000 N	8.2E+003 N	3.1E+002 N		

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Chemical	CAS	RfDo mg/kg/d	CSF _o 1/mg/kg/d	RfDi mg/kg/d	CSF _I 1/mg/kg/d	VOC	Risk-based concentrations					Soil, for groundwater migration	
							Tap water ug/l	Ambient air ug/m3	Fish mg/kg	Soil Industrial mg/kg	Soil Residential mg/kg	DAF 1 mg/kg	DAF 20 mg/kg
PROPACHLOR	1918167	1.30E-002 I					4.7E+002 N	4.7E+001 N	1.8E+001 N	2.7E+004 N	1.0E+003 N		
PROPANIL	709988	5.00E-003 I					1.8E+002 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N		
PROPARGITE	2312356	2.00E-002 I					7.3E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N		
N-PROPYLBENZENE	103651	4.00E-002 E				y	2.4E+002 N	1.5E+002 N	5.4E+001 N	8.2E+004 N	3.1E+003 N	1.4E+000	2.8E+001 N
PROPYLENE GLYCOL	57556	2.00E+001 H					7.3E+005 N	7.3E+004 N	2.7E+004 N	4.1E+007 N	1.6E+006 N		
PROPYLENE GLYCOL, MONOETHYL ETHER	52125536	7.00E-001 H					2.6E+004 N	2.6E+003 N	9.5E+002 N	1.4E+006 N	5.5E+004 N		
PROPYLENE GLYCOL, MONOMETHYL ETHER	107982	7.00E-001 H		5.70E-001 I			2.6E+004 N	2.1E+003 N	9.5E+002 N	1.4E+006 N	5.5E+004 N		
PURSUIT	81335775	2.50E-001 I					9.1E+003 N	9.1E+002 N	3.4E+002 N	5.1E+005 N	2.0E+004 N		
PYRIDINE	110861	1.00E-003 I					3.7E+001 N	3.7E+000 N	1.4E+000 N	2.0E+003 N	7.8E+001 N		
QUINOLINE	91225		1.20E+001 H				5.6E-003 C	5.2E-004 C	2.6E-004 C	4.8E-001 C	5.3E-002 C		
RDX	121824	3.00E-003 I	1.10E-001 I				6.1E-001 C	5.7E-002 C	2.9E-002 C	5.2E-001 C	5.8E+000 C		
RESMETHRIN	10453866	3.00E-002 I					1.1E+003 N	1.1E+002 N	4.1E+001 N	6.1E+004 N	2.3E+003 N		
RONNEL	299843	5.00E-002 H					1.8E+003 N	1.8E+002 N	6.8E+001 N	1.0E+005 N	3.9E+003 N		
ROTENONE	83794	4.00E-003 I					1.5E+002 N	1.5E+001 N	5.4E+000 N	8.2E+003 N	3.1E+002 N		
SELENIOUS ACID	7783008	5.00E-003 I					1.8E+002 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N		
SELENIUM	7782492	5.00E-003 I					1.8E+002 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N		
SILVER	7440224	5.00E-003 I					1.8E+002 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N	9.5E-001	1.9E+001 N
SIMAZINE	122349	5.00E-003 I	1.20E-001 H				5.6E-001 C	5.2E-002 C	2.6E-002 C	4.8E+001 C	5.3E+000 C	1.6E+000	3.1E+001 N
SODIUM AZIDE	26628228	4.00E-003 I					1.5E+002 N	1.5E+001 N	5.4E+000 N	8.2E+003 N	3.1E+002 N		
SODIUM DIETHYLDITHIOCARBAMATE	148185	3.00E-002 I	2.70E-001 H				2.5E-001 C	2.3E-002 C	1.2E-002 C	2.1E+001 C	2.4E+000 C		
STRONTIUM, STABLE	7440246	6.00E-001 I					2.2E+004 N	2.2E+003 N	8.1E+002 N	1.2E+006 N	4.7E+004 N	7.7E+002	1.5E+004 N
STRYCHNINE	57249	3.00E-004 I					1.1E+001 N	1.1E+000 N	4.1E-001 N	6.1E+002 N	2.3E+001 N	8.3E-003	1.7E-001 N
STYRENE	100425	2.00E-001 I		2.86E-001 I		y	1.6E+003 N	1.0E+003 N	2.7E+002 N	4.1E+005 N	1.6E+004 N	2.9E+000	5.7E+001 N
2,3,7,8-TETRACHLORODIBENZODIOXIN	1746016		1.50E+005 H		1.50E+005 H		4.5E-007 C	4.2E-008 C	2.1E-008 C	3.8E-005 C	4.3E-006 C	4.3E-007	8.6E-006 C
1,2,4,5-TETRACHLOROENZENE	95943	3.00E-004 I					1.1E+001 N	1.1E+000 N	4.1E-001 N	6.1E+002 N	2.3E+001 N	3.3E-002	6.6E-001 N
1,1,1,2-TETRACHLOROETHANE	630206	3.00E-002 I	2.60E-002 I		2.60E-002 I	y	4.1E-001 C	2.4E-001 C	1.2E-001 C	2.2E+002 C	2.5E+001 C	2.0E-004	4.0E-003 C
1,1,1,2,2-TETRACHLOROETHANE	79345	6.00E-002 E	2.00E-001 I		2.00E-001 I	y	5.3E-002 C	3.1E-002 C	1.6E-002 C	2.9E+001 C	3.2E+000 C	3.4E-005	6.6E-004 C
TETRACHLOROETHENE	127184	1.00E-002 I	5.20E-002 E	1.4E-001 E	2.00E-003 E	y	1.1E+000 C	3.1E+000 C	6.1E-002 C	1.1E+002 C	1.2E+001 C	2.4E-003	4.8E-002 C
2,3,4,6-TETRACHLOROPHENOL	58902	3.00E-002 I					1.1E+003 N	1.1E+002 N	4.1E+001 N	6.1E+004 N	2.3E+003 N		
P,A,A,A-TETRACHLOROTOLUENE	5216251		2.00E+001 H				3.3E-003 C	3.1E-004 C	1.6E-004 C	2.9E-001 C	3.2E-002 C		
1,1,1,2-TETRAFLUOROETHANE	811972			2.29E+001 I		y	1.7E+005 N	8.4E+004 N					
TETRAHYDROFURAN	109999	2.00E-001 E	7.6E-003 E	8.6E-002 E	8.8E-003 E		8.8E+000 C	9.2E-001 C	4.2E-001 C	7.5E+002 C	8.4E+001 C		
TETRYL	479458	1.00E-002 H					3.7E+002 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N		
THALLIC OXIDE	1314325	7.00E-005 W					2.6E+000 N	2.6E-001 N	9.5E-002 N	1.4E+002 N	5.5E+000 N		
THALLIUM	7440280	7.00E-005 O					2.6E+000 N	2.6E-001 N	9.5E-002 N	1.4E+002 N	5.5E+000 N	1.8E-001	3.6E+000 N
THALLIUM ACETATE	563686	9.00E-005 I					3.3E+000 N	3.3E-001 N	1.2E-001 N	1.8E+002 N	7.0E+000 N		
THALLIUM CARBONATE	6533739	8.00E-005 I					2.9E+000 N	2.9E-001 N	1.1E-001 N	1.6E+002 N	6.3E+000 N		
THALLIUM CHLORIDE	7791120	8.00E-005 I					2.9E+000 N	2.9E-001 N	1.1E-001 N	1.6E+002 N	6.3E+000 N		
THALLIUM NITRATE	10102451	9.00E-005 I					3.3E+000 N	3.3E-001 N	1.2E-001 N	1.8E+002 N	7.0E+000 N		
THALLIUM SULFATE (2:1)	7446186	8.00E-005 I					2.9E+000 N	2.9E-001 N	1.1E-001 N	1.6E+002 N	6.3E+000 N		
THIOBENCARB	28249776	1.00E-002 I					3.7E+002 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N		
TIN	7440315	6.00E-001 H					2.2E+004 N	2.2E+003 N	8.1E+002 N	1.2E+006 N	4.7E+004 N		

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Chemical	CAS	RfDo mg/kg/d	CSF0 1/mg/kg/d	RfDi mg/kg/d	CSF1 1/mg/kg/d	VOC	Risk-based concentrations					Soil, for groundwater migration	
							Tap water ug/l	Ambient air ug/m3	Fish mg/kg	Soil Industrial mg/kg	Residential mg/kg	DAF 1 mg/kg	DAF 20 mg/kg
TITANIUM	7440326	4.00E+000 E		8.60E-003 E			1.5E+005 N	3.1E+001 N	5.4E+003 N	8.2E+006 N	3.1E+005 N		
TITANIUM DIOXIDE	13463677	4.00E+000 E		8.60E-003 E			1.5E+005 N	3.1E+001 N	5.4E+003 N	8.2E+006 N	3.1E+005 N		
1,2,4-TRIBROMOBENZENE	108883	2.00E-001 I		1.14E-001 I		y	7.5E+002 N	4.2E+002 N	2.7E+002 N	4.1E+005 N	1.6E+004 N	4.4E-001	8.8E+000 N
TOLUENE-2,4-DIAMINE	95807		3.20E+000 H				2.1E-002 C	2.0E-003 C	9.9E-004 C	1.8E+000 C	2.0E-001 C		
TOLUENE-2,5-DIAMINE	95705	6.00E-001 H					2.2E+004 N	2.2E+003 N	8.1E+002 N	1.2E+006 N	4.7E+004 N		
TOLUENE-2,6-DIAMINE	823405	2.00E-001 H					7.3E+003 N	7.3E+002 N	2.7E+002 N	4.1E+005 N	1.6E+004 N		
P-TOLUIDINE	106490		1.90E-001 H				3.5E-001 C	3.3E-002 C	1.7E-002 C	3.0E+001 C	3.4E+000 C	3.0E-004	5.9E-003 C
TOXAPHENE	8001352		1.10E+000 I		1.10E+000 I		6.1E-002 C	5.7E-003 C	2.9E-003 C	5.2E+000 C	5.8E-001 C	3.1E-002	6.3E-001 C
1,2,4-TRIBROMOBENZENE	615543	5.00E-003 I					1.8E+002 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N		
TRIBUTYL TIN OXIDE	56359	3.00E-004 I					1.1E+001 N	1.1E+000 N	4.1E-001 N	6.1E+002 N	2.3E+001 N		
2,4,6-TRICHLOROANILINE	634935		3.40E-002 H				2.0E+000 C	1.8E-001 C	9.3E-002 C	1.7E+002 C	1.9E+001 C		
1,2,4-TRICHLOROBENZENE	120821	1.00E-002 I		5.70E-002 H		y	1.9E+002 N	2.1E+002 N	1.4E+001 N	2.0E+004 N	7.8E+002 N	3.8E-001	7.5E+000 N
1,1,1-TRICHLOROETHANE	71556	2.80E-001 E		6.30E-001 E		y	3.2E+003 N	2.3E+003 N	3.8E+002 N	5.7E+005 N	2.2E+004 N	3.0E+000	6.0E+001 N
1,1,2-TRICHLOROETHANE	79005	4.00E-003 I	5.70E-002 I		5.60E-002 I	y	1.9E-001 C	1.1E-001 C	5.5E-002 C	1.0E+002 C	1.1E+001 C	3.9E-005	7.8E-004 C
TRICHLOROETHENE	79016	6.00E-003 E	1.10E-002 E		6.00E-003 E	y	1.6E+000 C	1.0E+000 C	2.9E-001 C	5.2E+002 C	5.8E+001 C	7.7E-004	1.5E-002 C
TRICHLOROFLUOROMETHANE	75694	3.00E-001 I		2.00E-001 A		y	1.3E+003 N	7.3E+002 N	4.1E+002 N	6.1E+005 N	2.3E+004 N	1.1E+000	2.3E+001 N
2,4,5-TRICHLOROPHENOL	95954	1.00E-001 I					3.7E+003 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N		
2,4,6-TRICHLOROPHENOL	88062		1.10E-002 I		1.00E-002 I		6.1E+000 C	6.3E-001 C	2.9E-001 C	5.2E+002 C	5.8E+001 C		
2,4,5-T	93765	1.00E-002 I					3.7E+002 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N	9.8E-002	2.0E+000 N
2-(2,4,5-TRICHLOROPHENOXY)PROPIONIC ACID	93721	8.00E-003 I					2.9E+002 N	2.9E+001 N	1.1E+001 N	1.6E+004 N	6.3E+002 N	1.1E+000	2.1E+001 N
1,1,2-TRICHLOROPROPANE	598776	5.00E-003 I				y	3.0E+001 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N	1.2E-002	2.5E-001 N
1,2,3-TRICHLOROPROPANE	96184	6.00E-003 I	2.00E+000 E	1.4E-003 E		y	5.3E-003 C	3.1E-003 C	1.6E-003 C	2.9E+000 C	3.2E-001 C	1.8E-006	3.6E-005 C
1,2,3-TRICHLOROPROPENE	96195	5.00E-003 H				y	3.0E+001 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N	1.2E-002	2.5E-001 N
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	76131	3.00E+001 I		8.60E+000 H		y	5.9E+004 N	3.1E+004 N	4.1E+004 N	6.1E+007 N	2.3E+006 N	1.2E+002	2.3E+003 N
1,2,4-TRIMETHYLBENZENE	95636	5.00E-002 E		1.70E-003 E		y	1.2E+001 N	6.2E+000 N	6.8E+001 N	1.0E+005 N	3.9E+003 N		
1,3,5-TRIMETHYLBENZENE	108678	5.00E-002 E		1.70E-003 E		y	1.2E+001 N	6.2E+000 N	6.8E+001 N	1.0E+005 N	3.9E+003 N		
TRIMETHYL PHOSPHATE	512581		3.70E-002 H				1.8E+000 C	1.7E-001 C	8.5E-002 C	1.5E+002 C	1.7E+001 C		
1,3,5-TRINITROBENZENE	99354	3.00E-002 I					1.1E+003 N	1.1E+002 N	4.1E+001 N	6.1E+004 N	2.3E+003 N		
2,4,6-TRINITROTOLUENE	118967	5.00E-004 I	3.00E-002 I				2.2E+000 C	2.1E-001 C	1.1E-001 C	1.9E+002 C	2.1E+001 C		
**URANIUM (SOLUBLE SALTS; from IRIS)	7440611	3.00E-003 I					1.1E+002 N	1.1E+001 N	4.1E+000 N	6.1E+003 N	2.3E+002 N		
**URANIUM (SOLUBLE SALTS; provisional)	7440611	2.00E-004 E					7.3E+000 N	7.3E-001 N	2.7E-001 N	4.1E+002 N	1.6E+001 N		
VANADIUM	7440622	7.00E-003 H					2.6E+002 N	2.6E+001 N	9.5E+000 N	1.4E+004 N	5.5E+002 N	2.8E+002	5.1E+003 N
VANADIUM PENTOXIDE	1314621	9.00E-003 I					3.3E+002 N	3.3E+001 N	1.2E+001 N	1.8E+004 N	7.0E+002 N		
VANADIUM SULFATE	16785812	2.00E-002 H					7.3E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N		
VINCLOZOLIN	50471448	2.50E-002 I					9.1E+002 N	9.1E+001 N	3.4E+001 N	5.1E+004 N	2.0E+003 N		
VINYL ACETATE	108054	1.00E+000 H		5.71E-002 I		y	4.1E+002 N	2.1E+002 N	1.4E+003 N	2.0E+006 N	7.8E+004 N	8.7E-002	1.7E+000 N
**VINYL CHLORIDE: lifetime	75014	3.00E-003 I	1.50E+000 I	2.8E-002 I	3.00E-002 I	y	4.0E-002 C	2.1E-001 C	2.1E-003 C	3.8E+000 C	4.3E-001 C	1.7E-005	3.3E-004 C
**VINYL CHLORIDE: adult	75014	3.00E-003 I	7.50E-001 I	2.8E-002 I	1.5E-002 I	y	8.1E-002 C	4.2E-001 C	4.2E-003 C	7.6E+000 C	8.5E-001 C	3.3E-005	6.6E-004 C
WARFARIN	81812	3.00E-004 I					1.1E+001 N	1.1E+000 N	4.1E-001 N	6.1E+002 N	2.3E+001 N	2.2E-002	4.4E-001 N
M-XYLENE	108383	2.00E+000 H				y	1.2E+004 N	7.3E+003 N	2.7E+003 N	4.1E+006 N	1.6E+005 N	1.3E+001	2.5E+002 N
O-XYLENE	95476	2.00E+000 H				y	1.2E+004 N	7.3E+003 N	2.7E+003 N	4.1E+006 N	1.6E+005 N	1.1E+001	2.3E+002 N
P-XYLENE	106423					y							

Sources: I = IRIS H = HEAST A = HEAST Alternative W = Withdrawn from IRIS or HEAST E = EPA-NCEA provisional value O = other							Basis: C = Carcinogenic effects N = Noncarcinogenic effects I = RBC at HI of 0.1 < RBC-c					Region III SSLs	
Chemical	CAS	RfDo mg/kg/d	CSFo 1/mg/kg/d	RfDi mg/kg/d	CSFi 1/mg/kg/d	VOC ug/l	Risk-based concentrations					Soil, for groundwater migration	
							Tap water ug/l	Ambient air ug/m3	Fish mg/kg	Soil Industrial mg/kg	Residential mg/kg	DAF 1 mg/kg	DAF 20 mg/kg
XYLENES	1330207	2.00E+000 I				y	1.2E+004 N	7.3E+003 N	2.7E+003 N	4.1E+006 N	1.6E+005 N	8.5E+000	1.7E+002 N
ZINC	7440666	3.00E-001 I					1.1E+004 N	1.1E+003 N	4.1E+002 N	6.1E+005 N	2.3E+004 N	6.8E+002	1.4E+004 N
ZINC PHOSPHIDE	1314847	3E-004 I					1.1E+001 N	1.1E+000 N	4.1E-001 N	6.1E+002 N	2.3E+001 N		
ZINEB	12122677	5E-002 I					1.8E+003 N	1.8E+002 N	6.8E+001 N	1.0E+005 N	3.9E+003 N		

APPENDIX E-2
USEPA REGION IV AND
FLORIDA SCREENING CONCENTRATIONS

APPENDIX E-2-1

FLORIDA SOIL CLEANUP TARGET LEVELS

Table II
Soil Cleanup Target Levels

Contaminant	CAS#	Direct Exposure		Leachability Based on Groundwater Criteria (mg/kg)	Leachability Based on Freshwater Surface Water Criteria (mg/kg)	Leachability Based on Marine Surface Water Criteria (mg/kg)	Leachability Based on Groundwater of Low Yield/Poor Quality (mg/kg)	Target Organ/System or Effect
		Residential	Commercial/Industrial					
		(mg/kg)	(mg/kg)					
Acenaphthene	83-32-9	1900	18000	2.1	0.7	0.7	21	-Liver
Acenaphthylene	208-96-8	1100	11000	27	0.7	0.7	270	-Body Weight -Liver
Acephate	30560-19-1	64	130	0.03	0.8	0.8	0.3	-Carcinogen -Neurological
Acetone	67-64-1	780	5500	2.8	6.8	6.8	28	-Kidney -Liver -Neurological
Acetonitrile	75-05-8	120	960	2	80	80	20	-Blood -Liver
Acetophenone	98-86-2	2700	24000	3.9	44	44	39	-None Specified
Acrolein	107-02-8	0.04	0.3	0.06	0.002	0.002	0.6	-Nasal
Acrylamide	79-06-1	0.1	0.3	0.004	0.02	0.02	0.04	-Carcinogen -Neurological
Acrylonitrile	107-13-1	0.3	0.5	0.004	0.2	0.2	0.04	-Carcinogen -Nasal -Reproductive
Alachlor	15972-60-8	12	36	0.02	0.006	0.006	0.2	-Blood -Carcinogen
Aldicarb [or Temik]	116-06-3	56	760	0.03	0.004	0.004	0.3	-Neurological
Aldrin	309-00-2	0.07	0.3	0.5	0.01	0.01	5	-Carcinogen -Liver
Allyl alcohol	107-18-6	62	460	1	0.02	0.02	10	-Kidney -Liver
Aluminum	7429-90-5	72000	*	***	***	***	***	-Body Weight
Aluminum phosphide	20859-73-8	31	730	***	***	***	***	-Body Weight
Ametryn	834-12-8	590	9300	0.8	0.08	0.08	8	-Liver
Ammonia (a)	7664-41-7	550	3700	570	4	NA	5700	-Respiratory
Aniline	62-53-3	14	100	0.03	0.02	0.02	0.3	-Blood -Carcinogen
Anthracene	120-12-7	18000	260000	2500	0.7	0.7	25000	-None Specified

Table II
Soil Cleanup Target Levels

Contaminant	CAS#	Direct Exposure		Leachability Based on Groundwater Criteria (mg/kg)	Leachability Based on Freshwater Surface Water Criteria (mg/kg)	Leachability Based on Marine Surface Water Criteria (mg/kg)	Leachability Based on Groundwater of Low Yield/Poor Quality (mg/kg)	Target Organ/System or Effect
		Residential	Commercial/Industrial					
		(mg/kg)	(mg/kg)					
Antimony (b)	7440-36-0	26	240	5	***	***	50	-Blood -Mortality
Arsenic (b)	7440-38-2	0.8	3.7	29	***	***	290	-Carcinogen -Cardiovascular -Skin
Atrazine	1912-24-9	4	12	0.06	0.04	0.04	0.6	-Body Weight -Carcinogen
Azobenzene	103-33-3	8.2	24	0.4	0.06	0.06	4	-Carcinogen
Barium (b)	7440-39-3	110**	87000	1600	***	***	16000	-Cardiovascular
Bayleton	43121-43-3	2000	29000	4.8	11	11	48	-Blood -Body Weight
Benomyl	17804-35-2	3600	64000	3.1	0.03	0.03	31	-Developmental
Bentazon	25057-89-0	1500	18000	1.2	NA	NA	12	-Blood
Benzaldehyde	100-52-7	2200	18000	4.8	0.4	0.4	48	-Gastrointestinal -Kidney
Benzene	71-43-2	1.1	1.6	0.007	0.5	0.5	0.07	-Carcinogen
Benzenethiol	108-98-5	0.1	1	0.3	NA	NA	3	-Liver
Benzo(a)anthracene	56-55-3	1.4	5	3.2	0.7	0.7	32	-Carcinogen
Benzo(a)pyrene	50-32-8	0.1	0.5	8	1.2	1.2	80	-Carcinogen
Benzo(b)fluoranthene	205-99-2	1.4	4.8	10	1.6	1.6	100	-Carcinogen
Benzo(g,h,i)perylene	191-24-2	2300	41000	32000	4.8	4.8	320000	-Neurological
Benzo(k)fluoranthene	207-08-9	15	52	25	1.6	1.6	250	-Carcinogen
Benzoic acid	65-85-0	150000	*	110	36	36	1100	-None Specified
Benzotrichloride	98-08-7	0.04	0.07	0.003	0.0002	0.0002	0.03	-Carcinogen
Benzyl alcohol	100-51-6	23000	610000	9.5	2.3	2.3	95	-Gastrointestinal

Table II
Soil Cleanup Target Levels

Contaminant	CAS#	Direct Exposure		Leachability Based on Groundwater Criteria (mg/kg)	Leachability Based on Freshwater Surface Water Criteria (mg/kg)	Leachability Based on Marine Surface Water Criteria (mg/kg)	Leachability Based on Groundwater of Low Yield/Poor Quality (mg/kg)	Target Organ/System or Effect
		Residential	Commercial/Industrial					
		(mg/kg)	(mg/kg)					
Benzyl chloride	100-44-7	0.8	1.2	0.006	0.03	0.03	0.06	-Carcinogen
Beryllium (b)(c)	7440-41-7	120	800	63	***	***	630	-Carcinogen -Gastrointestinal -Respiratory
Bidrin [or Dicrotophos]	141-66-2	5.5	67	0.005	0.1	0.1	0.05	-Developmental
Biphenyl, 1,1- [or Diphenyl]	92-52-4	2300	26000	0.2	5.8	5.8	2	-Kidney
Bis(2-chloroethyl)ether	111-44-4	0.3	0.4	0.02	0.05	0.05	0.2	-Carcinogen
Bis(2-chloroisopropyl)ether	108-60-1	4.4	7.3	0.07	0.003	0.003	0.7	-Blood -Carcinogen
Bis(2-ethylhexyl)phthalate [or DEHP]	117-81-7	76	280	3600	12	12	36000	-Carcinogen -Liver
Bisphenol A	80-05-7	3300	51000	11	1.7	1.7	110	-Body Weight
Boron	7440-42-8	7000	160000	***	NA	NA	***	-Reproductive -Respiratory
Bromacil	314-40-9	5700	72000	0.6	0.6	0.6	6	-Body Weight
Bromochloromethane	74-97-5	57	390	0.6	NA	NA	6	-None Specified
Bromodichloromethane	75-27-4	1.4	2	0.004	0.1	0.1	0.04	-Carcinogen -Kidney
Bromoform	75-25-2	48	84	0.03	2.7	2.7	0.3	-Carcinogen -Liver
Bromomethane [or Methyl bromide]	74-83-9	2.2	15	0.05	0.2	0.2	0.5	-Gastrointestinal
Butanol, 1-	71-36-3	1300	10000	3	110	110	30	-Neurological
Butanone, 2- [or MEK]	78-93-3	3100	21000	17	490	490	170	-Developmental
Butyl benzyl phthalate, n-	85-68-7	15000	320000	310	56	56	3100	-Liver
Butylate	2008-41-5	2100	22000	5.2	0.2	0.2	52	-Liver
Butylphthalyl butylglycolate	85-70-1	74000	*	4200	NA	NA	42000	-None Specified

Table II
Soil Cleanup Target Levels

Contaminant	CAS#	Direct Exposure		Leachability Based on Groundwater Criteria	Leachability Based on Freshwater Surface Water Criteria	Leachability Based on Marine Surface Water Criteria	Leachability Based on Groundwater of Low Yield/Poor Quality	Target Organ/System or Effect
		Residential	Commercial/Industrial	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	
		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	
Cadmium (b)	7440-43-9	75**	1300	8	***	***	80	-Carcinogen -Kidney
Calcium cyanide	592-01-8	3100	73000	***	NA	NA	***	-Body Weight -Neurological -Thyroid
Captan	133-06-2	190	410	3.6	0.03	0.03	36	-Body Weight -Carcinogen
Carbaryl [or Sevin]	63-25-2	6800	120000	8.7	0.0007	0.0007	87	-Kidney -Liver
Carbazole	86-74-8	53	190	0.6	6.5	6.5	6	-Carcinogen
Carbofuran	1563-66-2	58	430	0.2	0.0006	0.0006	2	-Neurological -Reproductive
Carbon disulfide	75-15-0	200	1400	5.6	0.8	0.8	56	-Developmental -Neurological
Carbon tetrachloride	56-23-5	0.4	0.6	0.04	0.06	0.06	0.4	-Carcinogen -Liver
Carbophenothion [or Trithion]	786-19-6	9.8	180	13	1.5	1.5	130	-Neurological
Chlordane	57-74-9	3.1	12	9.6	0.003	0.003	96	-Carcinogen -Liver
Chlorine	7782-50-5	7800	200000	***	***	***	***	-Body Weight
Chlorine cyanide [or Cyanogen chloride]	506-77-4	910	7200	71	0.3	0.3	710	-Body Weight -Neurological -Thyroid
Chloro-1,3-butadiene [or Chloroprene]	126-99-8	2.6	17	1.5	NA	NA	15	-Body Weight -Hair Loss -Nasal
Chloroacetic acid	79-11-8	87	920	0.07	NA	NA	0.7	-Cardiovascular
Chloroaniline, 4-	106-47-8	190	2000	0.2	0.02	0.02	2	-Spleen
Chlorobenzene	108-90-7	30	200	1.3	0.2	0.2	13	-Liver
Chlorobenzilate	510-15-6	3.9	14	0.08	0.07	0.07	0.8	-Body Weight -Carcinogen
Chloroform	67-66-3	0.4	0.5	0.03	2.8	2.8	0.3	-Carcinogen -Liver
Chloro-m-cresol, p- [or 4-chloro-3-methylphenol]	59-50-7	410	4400	0.4	0.6	0.6	4	-Body Weight

Table II
Soil Cleanup Target Levels

Contaminant	CAS#	Direct Exposure		Leachability Based on Groundwater Criteria (mg/kg)	Leachability Based on Freshwater Surface Water Criteria (mg/kg)	Leachability Based on Marine Surface Water Criteria (mg/kg)	Leachability Based on Groundwater of Low Yield/Poor Quality (mg/kg)	Target Organ/System or Effect
		Residential	Commercial/Industrial					
		(mg/kg)	(mg/kg)					
Chloromethane	74-87-3	1.7	2.3	0.01	2.3	2.3	0.1	-Carcinogen
Chloronaphthalene, beta-	91-58-7	4000	49000	260	NA	NA	2600	-Liver -Respiratory
Chloronitrobenzene, p-	100-00-5	28	55	3.7	1.6	1.6	37	-Carcinogen
Chlorophenol, 2-	95-57-8	82	640	0.7	2.5	2.5	7	-Reproductive
Chlorophenol, 3-	108-43-0	280	3400	0.2	3.1	3.1	2	-None Specified
Chlorophenol, 4-	106-48-9	220	2400	0.04	1.2	1.2	0.4	-None Specified
Chlorothalonil [or Bravo]	1897-45-6	88	280	0.2	0.06	0.06	2	-Carcinogen -Kidney
Chlorotoluene, o-	95-49-8	120	850	2.8	7.7	7.7	28	-Body Weight
Chlorotoluene, p-	106-43-4	100	730	2.5	NA	NA	25	-None Specified
Chlorpropham	101-21-3	13000	200000	51	7	7	510	-Bone Marrow -Kidney -Liver -Spleen
Chlorpyrifos	2921-88-2	220	4200	15	0.001	0.001	150	-Neurological
Chromium (hexavalent) (b)	18540-29-9	210	420	38	***	***	380	-Carcinogen -Respiratory
Chrysene	218-01-9	140	450	77	0.7	0.7	770	-Carcinogen
Cobalt	7440-48-4	4700	110000	***	NA	NA	***	-Cardiovascular -Immunological -Neurological -Reproductive
Copper	7440-50-8	110**	76000	***	***	***	***	-Gastrointestinal
Coumaphos	56-72-4	18	300	0.3	0.0007	0.0007	3	-Neurological
Crotonaldehyde	123-73-9	0.07	0.1	17	NA	NA	170	-Carcinogen
Cumene [or Isopropyl benzene]	98-82-8	160	1100	0.2	56	56	2	-Adrenals -Kidney
Cyanide (potassium salt) (b)	57-12-5	30**	39000	40	***	***	400	-Body Weight -Neurological -Thyroid

Table II
Soil Cleanup Target Levels

Contaminant	CAS#	Direct Exposure		Leachability Based on Groundwater Criteria (mg/kg)	Leachability Based on Freshwater Surface Water Criteria (mg/kg)	Leachability Based on Marine Surface Water Criteria (mg/kg)	Leachability Based on Groundwater of Low Yield/Poor Quality (mg/kg)	Target Organ/System or Effect
		Residential	Commercial/Industrial					
		(mg/kg)	(mg/kg)					
Cyanogen	460-19-5	340	2500	2000	NA	NA	20000	-None Specified
Cycloate	1134-23-2	240	2600	0.7	2.5	2.5	7	-Neurological
Cyclohexanone	108-94-1	68000	510000	150	110	110	1500	-Body Weight
Cypermethrin	52315-07-8	750	14000	70	0.005	0.005	700	-Gastrointestinal
DDD, 4,4'-	72-54-8	4.6	18	4	0.1	0.1	40	-Carcinogen
DDE, 4,4'-	72-55-9	3.3	13	18	0.1	0.1	180	-Carcinogen
DDT, 4,4'-	50-29-3	3.3	13	11	0.06	0.06	110	-Carcinogen -Liver
Diallate	2303-16-4	17	56	0.6	NA	NA	6	-Carcinogen
Diazinon	333-41-5	55	760	0.02	0.00005	0.00005	0.2	-Neurological
Dibenz(a,h)anthracene	53-70-3	0.1	0.5	30	4.7	4.7	300	-Carcinogen
Dibenzofuran	132-64-9	280	5000	15	36	36	150	-None Specified
Dibromo-3-chloropropane, 1,2- [or DBCP]	96-12-8	0.8	2.7	0.001	NA	NA	0.01	-Carcinogen -Reproductive
Dibromochloromethane	124-48-1	1.4	2.1	0.003	0.2	0.2	0.03	-Carcinogen -Liver
Dibromoethane, 1,2- [or EDB]	106-93-4	0.01	0.04	0.0001	0.07	0.07	0.001	-Carcinogen -Reproductive
Dicamba	1918-00-9	1800	24000	2.6	2.4	2.4	26	-Developmental
Dichloroacetic acid	79-43-6	200	2300	0.2	8.1	8.1	2	-None Specified
Dichloroacetoneitrile	3018-12-0	170	1400	0.03	NA	NA	0.3	-None Specified
Dichlorobenzene, 1,2-	95-50-1	650	4600	17	2.8	2.8	170	-Body Weight
Dichlorobenzene, 1,3-	541-73-1	27	180	0.3	2.8	2.8	3	-None Specified

Table II
Soil Cleanup Target Levels

Contaminant	CAS#	Direct Exposure		Leachability Based on Groundwater Criteria (mg/kg)	Leachability Based on Freshwater Surface Water Criteria (mg/kg)	Leachability Based on Marine Surface Water Criteria (mg/kg)	Leachability Based on Groundwater of Low Yield/Poor Quality (mg/kg)	Target Organ/System or Effect
		Residential	Commercial/Industrial					
		(mg/kg)	(mg/kg)					
Dichlorobenzene, 1,4-	106-46-7	6	9	2.2	2.9	2.9	22	-Carcinogen -Liver
Dichlorobenzidine, 3,3'-	91-94-1	2.1	6.3	0.4	0.002	0.002	4	-Carcinogen
Dichlorodifluoromethane	75-71-8	56	370	44	NA	NA	440	-Body Weight -Liver
Dichloroethane, 1,1-	75-34-3	290	2000	0.4	NA	NA	4	-Kidney
Dichloroethane, 1,2- [or EDC]	107-06-2	0.5	0.7	0.01	0.02	0.02	0.1	-Carcinogen
Dichloroethene, 1,1-	75-35-4	0.09	0.1	0.06	0.03	0.03	0.6	-Carcinogen -Liver
Dichloroethene, cis-1,2-	156-59-2	19	130	0.4	NA	NA	4	-Blood
Dichloroethene, trans-1,2-	156-60-5	31	210	0.7	75	75	7	-Blood -Liver
Dichlorophenol, 2,3-	576-24-9	180	2500	0.2	1.2	1.2	2	-None Specified
Dichlorophenol, 2,4-	120-83-2	130	1300	0.005	0.1	0.1	0.05	-Immunological
Dichlorophenol, 2,5-	583-78-8	200	3000	0.5	4.3	4.3	5	-None Specified
Dichlorophenol, 2,6-	87-65-0	170	2200	0.1	2.5	2.5	1	-None Specified
Dichlorophenol, 3,4-	95-77-2	200	3100	0.03	3.9	3.9	0.3	-None Specified
Dichlorophenoxy acetic acid, 2,4-	94-75-7	670	11000	0.7	0.9	0.9	7	-Kidney -Liver
Dichloropropane, 1,2-	78-87-5	0.6	0.8	0.03	15	15	0.3	-Carcinogen -Nasal
Dichloropropene, 1,3-	542-75-6	0.2	0.2	0.001	0.09	0.09	0.01	-Carcinogen -Kidney -Nasal
Dichlorprop	120-36-5	270	3300	0.3	0.3	0.3	3	-None Specified
Dichlorvos	62-73-7	0.2	0.3	0.0005	0.00002	0.00002	0.005	-Carcinogen -Neurological
Dicofol [or Kelthane]	115-32-2	2.3	7.6	0.05	0.0004	0.0004	0.5	-Adrenals -Carcinogen

Table II
Soil Cleanup Target Levels

Contaminant	CAS#	Direct Exposure		Leachability Based on Groundwater Criteria (mg/kg)	Leachability Based on Freshwater Surface Water Criteria (mg/kg)	Leachability Based on Marine Surface Water Criteria (mg/kg)	Leachability Based on Groundwater of Low Yield/Poor Quality (mg/kg)	Target Organ/System or Effect
		Residential	Commercial/Industrial					
		(mg/kg)	(mg/kg)					
Dieldrin	60-57-1	0.07	0.3	0.004	0.0001	0.0001	0.04	-Carcinogen -Liver
Diethylphthalate	84-66-2	54000	920000	86	5.9	5.9	860	-Body Weight
Dimethoate	60-51-5	8.4	86	0.0004	0.0004	0.0004	0.004	-Neurological
Dimethrin	70-38-2	19000	270000	2500	1.3	1.3	25000	-Liver
Dimethylformamide, N,N-	68-12-2	1100	7800	3	210	210	30	-Gastrointestinal -Liver
Dimethylphenol, 2,4-	105-67-9	910	9800	1.7	3.2	3.2	17	-Blood -Neurological
Dimethylphthalate	131-11-3	590000	*	380	7.8	7.8	3800	-Kidney
Di-n-butylphthalate	84-74-2	7300	140000	47	1.5	1.5	470	-Mortality
Dinitrobenzene, 1,2- (o)	528-29-0	13	130	1	0.2	0.2	10	-Spleen
Dinitrobenzene, 1,3- (m)	99-65-0	3.5	33	0.04	0.4	0.4	0.4	-Spleen
Dinitrophenol, 2,4-	51-28-5	66	620	0.06	0.01	0.01	0.6	-Eye
Dinitrotoluene, 2,4-	121-14-2	1.3	3.7	0.0008	0.07	0.07	0.008	-Carcinogen -Liver -Neurological
Dinitrotoluene, 2,6-	606-20-2	1	2.1	0.0007	0.03	0.03	0.007	-Blood -Carcinogen -Kidney -Mortality -Neurological
Di-n-octylphthalate	117-84-0	1500	27000	480000	NA	NA	4800000	-Kidney -Liver
Dinoseb	88-85-7	55	740	0.03	0.03	0.03	0.3	-Developmental
Dioxane, 1,4-	123-91-1	12	18	0.02	1	1	0.2	-Carcinogen
Dioxin [or 2,3,7,8-TCDD]	1746-01-6	0.000007	0.00003	0.003	0.000001	0.000001	0.03	-Carcinogen
Diphenamid	957-51-7	1800	25000	2.6	20	20	26	-Liver
Diphenylhydrazine, 1,2-	122-66-7	1.2	3.7	0.4	0.01	0.01	4	-Carcinogen

Table II
Soil Cleanup Target Levels

Contaminant	CAS#	Direct Exposure		Leachability Based on Groundwater Criteria (mg/kg)	Leachability Based on Freshwater Surface Water Criteria (mg/kg)	Leachability Based on Marine Surface Water Criteria (mg/kg)	Leachability Based on Groundwater of Low Yield/Poor Quality (mg/kg)	Target Organ/System or Effect
		Residential	Commercial/Industrial					
		(mg/kg)	(mg/kg)					
Disulfoton	298-04-4	2.9	56	0.1	0.1	0.1	1	-Neurological
Diuron	330-54-1	130	2000	0.3	0.2	0.2	3	-Blood
Endosulfan	115-29-7	410	6700	3.8	0.005	0.0008	38	-Body Weight -Cardiovascular -Kidney
Endothall	145-73-3	780	7800	0.4	0.4	0.4	4	-Gastrointestinal
Endrin	72-20-8	21	340	1	0.001	0.001	10	-Liver
Epichlorohydrin	106-89-8	11	74	0.03	2.4	2.4	0.3	-Carcinogen -Kidney -Nasal
Ethion	563-12-2	38	780	1.7	0.003	0.003	17	-Neurological
Ethoprop	13194-48-4	5.5	69	0.005	0.002	0.002	0.05	-Neurological
Ethoxyethanol, 2-	110-80-5	8100	65000	120	NA	NA	1200	-Body Weight -Reproductive
Ethyl acetate	141-78-6	5500	39000	26	26	26	260	-Body Weight -Mortality
Ethyl acrylate	140-88-5	1.6	2.2	25	0.6	0.6	250	-Carcinogen
Ethyl chloride [or Chloroethane]	75-00-3	2.9	4	0.06	NA	NA	0.6	-Carcinogen -Developmental
Ethyl dipropylthiocarbamate, S- [or EPTC]	759-94-4	1100	13000	11	15	15	110	-Cardiovascular
Ethyl ether	60-29-7	150	1000	5	850	850	50	-Body Weight
Ethyl methacrylate	97-63-2	380	2600	3.5	NA	NA	35	-Kidney
Ethyl p-nitrophenyl phenylphosphorothioate [or EPN]	2104-64-5	0.7	15	0.04	0.003	0.003	0.4	-Neurological
Ethylbenzene	100-41-4	1100	8400	0.6	12	12	6	-Developmental -Kidney -Liver
Ethylene diamine	107-15-3	610	5500	40	3.2	3.2	400	-Blood -Cardiovascular
Ethylene glycol	107-21-1	24000	180000	56	65	65	560	-Kidney

Table II
Soil Cleanup Target Levels

Contaminant	CAS#	Direct Exposure		Leachability Based on Groundwater Criteria (mg/kg)	Leachability Based on Freshwater Surface Water Criteria (mg/kg)	Leachability Based on Marine Surface Water Criteria (mg/kg)	Leachability Based on Groundwater of Low Yield/Poor Quality (mg/kg)	Target Organ/System or Effect
		Residential	Commercial/Industrial					
		(mg/kg)	(mg/kg)					
Ethylene oxide	75-21-8	0.3	0.4	0.05	20	20	0.5	-Carcinogen
Fenamiphos	22224-92-6	15	210	0.02	0.003	0.003	0.2	-Neurological
Fensulfothion	115-90-2	14	180	0.01	0.004	0.004	0.1	-Neurological
Fluometuron	2164-17-2	750	9700	0.9	1.8	1.8	9	-None Specified
Fluoranthene	206-44-0	2900	48000	1200	1.3	1.3	12000	-Blood -Kidney -Liver
Fluorene	86-73-7	2200	28000	160	17	17	1600	-Blood
Fluoride	7782-41-4	500**	120000	***	***	***	***	-Teeth
Fonofos	944-22-9	120	1800	0.4	0.003	0.003	4	-Liver -Neurological
Formaldehyde	50-00-0	21	29	2.4	0.4	0.4	24	-Body Weight -Carcinogen - Gastrointestinal
Furfural	98-01-1	160	2000	1	2.7	2.7	10	-Liver -Nasal
Guthion [or Azinphos, methyl]	86-50-0	110	2000	0.2	0.0002	0.0002	2	-Neurological
Heptachlor	76-44-8	0.2	0.9	23	0.1	0.1	230	-Carcinogen -Liver
Heptachlor epoxide	1024-57-3	0.1	0.4	0.6	0.006	0.006	6	-Carcinogen -Liver
Hexachloro-1,3-butadiene	87-68-3	6.3	12	1.1	110	110	11	-Carcinogen -Kidney
Hexachlorobenzene	118-74-1	0.5	1.1	2.2	0.0008	0.0008	22	-Carcinogen -Liver
Hexachlorocyclohexane, alpha-	319-84-6	0.2	0.5	0.0003	0.0006	0.0006	0.003	-Carcinogen
Hexachlorocyclohexane, beta-	319-85-7	0.6	2.1	0.001	0.003	0.003	0.01	-Carcinogen
Hexachlorocyclohexane, delta-	319-86-8	22	420	0.2	NA	NA	2	-Kidney -Liver
Hexachlorocyclohexane, gamma- [or Lindane]	58-89-9	0.7	2.2	0.009	0.003	0.003	0.09	-Carcinogen -Kidney -Liver

Table II
Soil Cleanup Target Levels

Contaminant	CAS#	Direct Exposure		Leachability Based on Groundwater Criteria (mg/kg)	Leachability Based on Freshwater Surface Water Criteria (mg/kg)	Leachability Based on Marine Surface Water Criteria (mg/kg)	Leachability Based on Groundwater of Low Yield/Poor Quality (mg/kg)	Target Organ/System or Effect
		Residential (mg/kg)	Commercial/ Industrial (mg/kg)					
Hexachlorocyclopentadiene	77-47-4	2.4	16	400	24	24	4000	-Gastrointestinal
Hexachloroethane	67-72-1	34	78	0.2	0.08	0.08	2	-Carcinogen -Kidney
Hexahydro-1,3,5-trinitro-1,3,5-triazine [or RDX]	121-82-4	6.7	16	0.007	1.3	1.3	0.07	-Carcinogen -Reproductive
Hexane, n-	110-54-3	500	3600	3.5	1200	1200	35	-Neurological
Hexanone, 2- [or Methyl butyl ketone]	591-78-6	5.1	34	1.4	NA	NA	14	-None Specified
Hexazinone	51235-04-2	1600	18000	1.1	5	5	11	-Body Weight
Hydroquinone	123-31-9	1800	19000	1.4	0.02	0.02	14	-Blood
Indeno(1,2,3-cd)pyrene	193-39-5	1.5	5.3	28	4.3	4.3	280	-Carcinogen
Iron	7439-89-6	23000	480000	***	***	***	***	-Blood -Gastrointestinal
Isobutyl alcohol	78-83-1	4100	31000	8.9	200	200	89	-Neurological
Isophorone	78-59-1	340	580	0.2	3.8	3.8	2	-Carcinogen
Lead (d)	7439-92-1	400	920	***	***	***	***	-Neurological
Linuron	330-55-2	130	2000	0.04	1.4	1.4	0.4	-Blood
Lithium	7439-93-32	1600	40000	***	NA	NA	***	-None Specified
Malathion	121-75-5	1300	20000	4.2	0.003	0.003	42	-Neurological
Maneb	12427-38-2	350	5500	6.3	0.5	0.5	63	-Thyroid
Manganese	7439-96-5	1600	22000	***	NA	NA	***	-Neurological
Mercury	7439-97-6	3.4	26	2.1	0.01	0.01	21	-Neurological
Mercury, methyl	22967-92-6	0.8	5.4	0.002	NA	NA	0.02	-Neurological

Table II
Soil Cleanup Target Levels

Contaminant	CAS#	Direct Exposure		Leachability Based on Groundwater Criteria (mg/kg)	Leachability Based on Freshwater Surface Water Criteria (mg/kg)	Leachability Based on Marine Surface Water Criteria (mg/kg)	Leachability Based on Groundwater of Low Yield/Poor Quality (mg/kg)	Target Organ/System or Effect
		Residential	Commercial/Industrial					
		(mg/kg)	(mg/kg)					
Merphos	150-50-5	2.2	41	0.5	NA	NA	5	-Body Weight -Neurological
Methacrylonitrile	126-98-7	0.8	5.4	0.02	NA	NA	0.2	-Liver
Methamidophos	10265-92-6	1.9	19	0.02	0	0	0.2	-Neurological
Methanol	67-56-1	5800	43000	20	180	180	200	-Liver -Neurological
Methidathion	950-37-8	47	530	0.003	0.0001	0.0001	0.03	-Liver
Methomyl	16752-77-5	22	150	1.2	0.007	0.007	12	-Kidney -Spleen
Methoxy-5-nitroaniline, 2-	99-59-2	17	41	0.4	NA	NA	4	-Carcinogen
Methoxychlor	72-43-5	370	7500	160	0.1	0.1	1600	-Developmental -Reproductive
Methyl acetate	79-20-9	4100	28000	26	NA	NA	260	-Liver
Methyl acrylate	96-33-3	99	680	0.9	NA	NA	9	-None Specified
Methyl isobutyl ketone [or MIBK]	108-10-1	220	1500	2.6	110	110	26	-Kidney -Liver
Methyl methacrylate	80-62-6	1400	9400	0.1	32	32	1	-Nasal
Methyl parathion [or Parathion, methyl]	298-00-0	18	310	0.06	0.0003	0.0003	0.6	-Blood -Neurological
Methyl tert-butyl ether [or MTBE]	1634-04-4	3200	22000	0.2	150	150	2	-Eye -Kidney -Liver
Methyl-4-chlorophenoxy acetic acid, 2-	94-74-6	30	440	0.02	0.4	0.4	0.2	-Kidney -Liver
Methylaniline, 2-	95-53-4	1.8	3.3	0.3	0.2	0.2	3	-Carcinogen
Methylene bis(2-chloroaniline), 4,4-	101-14-4	6.4	17	0.2	NA	NA	2	-Carcinogen -Liver -Bladder
Methylene bromide	74-95-3	58	400	0.3	NA	NA	3	-Blood
Methylene chloride	75-09-2	16	23	0.02	7.3	7.3	0.2	-Carcinogen -Liver

Table II
Soil Cleanup Target Levels

Contaminant	CAS#	Direct Exposure		Leachability Based on Groundwater Criteria (mg/kg)	Leachability Based on Freshwater Surface Water Criteria (mg/kg)	Leachability Based on Marine Surface Water Criteria (mg/kg)	Leachability Based on Groundwater of Low Yield/Poor Quality (mg/kg)	Target Organ/System or Effect
		Residential	Commercial/Industrial					
		(mg/kg)	(mg/kg)					
Methylnaphthalene, 1-	90-12-0	68	470	2.2	10	10	22	-Body Weight -Nasal
Methylnaphthalene, 2-	91-57-6	80	560	6.1	9.1	9.1	61	-Body Weight -Nasal
Methylphenol, 2- [or o-Cresol]	95-48-7	2400	28000	0.3	1.9	1.9	3	-Body Weight -Neurological
Methylphenol, 3- [or m-Cresol]	108-39-4	2500	29000	0.3	3.3	3.3	3	-Body Weight -Neurological
Methylphenol, 4- [or p-Cresol]	106-44-5	250	3000	0.03	0.5	0.5	0.3	-Maternal Death -Neurological -Respiratory
Metolachlor	51218-45-2	9100	120000	1.2	0.01	0.01	12	-Body Weight
Metribuzin	21087-64-9	32	210	2.2	0.8	0.8	22	-Body Weight -Kidney -Liver -Mortality
Mevinphos	7786-34-7	16	240	0.01	0.0003	0.0003	0.1	-Neurological
Molinate	2212-67-1	100	1200	0.1	0.1	0.1	1	-Reproductive
Molybdenum	7439-98-7	390	9700	***	NA	NA	***	-Gout
Naled	300-76-5	130	2100	0.1	0.0002	0.0002	1	-Neurological
Naphthalene	91-20-3	40	270	1.7	2.2	2.2	17	-Body Weight -Nasal
Nickel (b)	7440-02-0	110**	28000	130	***	***	1300	-Body Weight
Nitrate	14797-55-8	120000	*	***	***	***	***	-Blood
Nitrite	14797-65-0	7800	180000	***	***	***	***	-Blood
Nitroaniline, o-	88-74-4	5.7	66	0.3	NA	NA	3	-Blood
Nitroaniline, p-	100-01-6	5.2	56	0.1	5.9	5.9	1	-None Specified
Nitrobenzene	98-95-3	14	120	0.03	0.6	0.6	0.3	-Adrenals -Blood -Kidney -Liver
Nitrophenol, 4-	100-02-7	390	4400	0.3	0.3	0.3	3	-None Specified

Table II
Soil Cleanup Target Levels

Contaminant	CAS#	Direct Exposure		Leachability Based on Groundwater Criteria (mg/kg)	Leachability Based on Freshwater Surface Water Criteria (mg/kg)	Leachability Based on Marine Surface Water Criteria (mg/kg)	Leachability Based on Groundwater of Low Yield/Poor Quality (mg/kg)	Target Organ/System or Effect
		Residential	Commercial/Industrial					
		(mg/kg)	(mg/kg)					
Nitroso-di-ethylamine, N-	55-18-5	0.003	0.005	0.02	0.0007	0.0007	0.2	-Carcinogen
Nitroso-dimethylamine, N-	62-75-9	0.009	0.02	0.008	0.002	0.002	0.08	-Carcinogen
Nitroso-di-n-butylamine, N-	924-16-3	0.05	0.07	0.05	0.002	0.002	0.5	-Carcinogen
Nitroso-di-n-propylamine, N-	621-64-7	0.09	0.2	0.04	0.008	0.008	0.4	-Carcinogen
Nitroso-diphenylamine, N-	86-30-6	170	440	0.4	2.5	2.5	4	-Carcinogen
Nitroso-N-methylethylamine, N-	10595-95-6	0.01	0.02	0.03	0.005	0.005	0.3	-Carcinogen
Nitrotoluene, m-	99-08-1	210	1800	2.4	3.6	3.6	24	-Spleen
Nitrotoluene, o-	88-72-2	280	2500	3.3	7.3	7.3	33	-Spleen
Nitrotoluene, p-	99-99-0	640	9700	3.3	7.3	7.3	33	-Spleen
Octamethylpyrophosphoramidate	152-16-9	83	860	4	NA	NA	40	-Neurological
Oxamyl	23135-22-0	1100	12000	0.9	0.04	0.04	9	-Body Weight
Paraquat	1910-42-5	310	4000	160	230	230	1600	-Respiratory
Parathion	56-38-2	450	9100	10	0.01	0.01	100	-Neurological
PCBs [Aroclor mixture]	1336-36-3	0.5	2.1	17	0.002	0.002	170	-Carcinogen -Immunological
Pebulate	1114-71-2	1600	15000	8.5	7.4	7.4	85	-Blood
Pendimethalin	40487-42-1	2500	36000	28	1	1	280	-Liver
Pentachlorobenzene	608-93-5	27	250	3.9	1.2	1.2	39	-Kidney -Liver
Pentachloronitrobenzene	82-68-8	3	7.7	0.7	0.06	0.06	7	-Carcinogen -Liver
Pentachlorophenol	87-86-5	7.7	23	0.03	0.2	0.2	0.3	-Carcinogen -Kidney -Liver

Table II
Soil Cleanup Target Levels

Contaminant	CAS#	Direct Exposure		Leachability Based on Groundwater Criteria (mg/kg)	Leachability Based on Freshwater Surface Water Criteria (mg/kg)	Leachability Based on Marine Surface Water Criteria (mg/kg)	Leachability Based on Groundwater of Low Yield/Poor Quality (mg/kg)	Target Organ/System or Effect
		Residential (mg/kg)	Commercial/Industrial (mg/kg)					
Permethrin	52645-53-1	3700	67000	880	0.003	0.003	8800	-Liver
Phenanthrene	85-01-8	2000	30000	250	0.7	0.7	2500	-Kidney
Phenol	108-95-2	900**	390000	0.05	0.03	0.03	0.5	-Developmental
Phenylenediamine, p-	106-50-3	8000	83000	6.2	NA	NA	62	-Whole Body
Phenylphenol, 2-	90-43-7	460	1300	0.4	0.8	0.8	4	-Carcinogen
Phorate	298-02-2	14	280	0.3	0.001	0.001	3	-Neurological
Phosmet	732-11-6	1400	21000	5	0.004	0.004	50	-Body Weight -Liver -Neurological
Phthalic anhydride	85-44-9	8300	57000	76	NA	NA	760	-Kidney -Nasal -Respiratory
Prometon	1610-18-0	980	14000	2.4	14	14	24	-None Specified
Prometryn	7287-19-6	260	3900	0.7	0.5	0.5	7	-Bone Marrow -Kidney -Liver
Propachlor	1918-16-7	770	10000	1.1	0.1	0.1	11	-Body Weight -Liver
Propanil	709-98-8	300	4100	0.4	0.2	0.2	4	-Spleen
Propazine	139-40-2	1200	17000	0.2	2.7	2.7	2	-Body Weight
Propylene glycol	57-55-6	710000	*	560	140	140	5600	-Blood -Bone Marrow
Propylene oxide	75-56-9	3.2	8.1	22	NA	NA	220	-Carcinogen -Nasal -Respiratory
Pydrin [or Fenvalerate]	51630-58-1	1800	32000	700	0.0001	0.0001	7000	-Neurological
Pyrene	129-00-0	2200	37000	880	1.3	1.3	8800	-Kidney
Pyridine	110-86-1	13	95	0.03	5.4	5.4	0.3	-Liver
Resmethrin	10453-86-8	2200	39000	1200	0.01	0.01	12000	-Reproductive

Table II
Soil Cleanup Target Levels

Contaminant	CAS#	Direct Exposure		Leachability Based on Groundwater Criteria (mg/kg)	Leachability Based on Freshwater Surface Water Criteria (mg/kg)	Leachability Based on Marine Surface Water Criteria (mg/kg)	Leachability Based on Groundwater of Low Yield/Poor Quality (mg/kg)	Target Organ/System or Effect
		Residential	Commercial/Industrial					
		(mg/kg)	(mg/kg)					
Ronnel	299-84-3	3600	59000	1300	0.2	0.2	13000	-Liver
Selenium (b)	7782-49-2	390	10000	5	***	***	50	-Hair Loss -Neurological -Skin
Silver (b)	7440-22-4	390	9100	17	***	***	170	-Skin
Simazine	122-34-9	7.4	21	0.08	0.1	0.1	0.8	-Blood -Body Weight -Carcinogen
Strontium	7440-24-6	47000	*	***	NA	NA	***	-Bone
Strychnine	57-24-9	17	210	0.7	0.3	0.3	7	-Mortality
Styrene	100-42-5	2700	21000	3.6	16	16	36	-Blood -Liver -Neurological
Terbacil	5902-51-2	660	7700	0.5	14	14	5	-Liver -Thyroid
Terbufos	13071-79-9	1.4	17	0.02	0.001	0.001	0.2	-Neurological
Tetrachlorobenzene, 1,2,4,5-	95-94-3	6.3	51	0.5	0.5	0.5	5	-Kidney
Tetrachloroethane, 1,1,1,2-	630-20-6	4	5.7	0.01	NA	NA	0.1	-Carcinogen -Kidney -Liver
Tetrachloroethane, 1,1,2,2-	79-34-5	0.7	1.1	0.002	0.08	0.08	0.02	-Carcinogen
Tetrachloroethene [or PCE]	127-18-4	8.9	17	0.03	0.1	0.1	0.3	-Body Weight -Carcinogen -Liver
Tetrachlorophenol, 2,3,4,6-	58-90-2	1500	17000	3.2	0.07	0.07	32	-Liver
Tetraethyl dithiopyrophosphate	3689-24-5	31	420	0.1	0.0004	0.0004	1	-Bone Marrow -Neurological
Thiram	137-26-8	330	4900	1.1	0.005	0.005	11	-Neurological
Tin	7440-31-5	44000	660000	***	NA	NA	***	-Kidney -Liver
Toluene	108-88-3	380	2600	0.5	5.6	5.6	5	-Kidney -Liver -Neurological
Toluidine, p-	106-49-0	1.4	2.2	0.7	NA	NA	7	-Carcinogen

Table II
Soil Cleanup Target Levels

Contaminant	CAS#	Direct Exposure		Leachability Based on Groundwater Criteria	Leachability Based on Freshwater Surface Water Criteria	Leachability Based on Marine Surface Water Criteria	Leachability Based on Groundwater of Low Yield/Poor Quality	Target Organ/System or Effect
		Residential	Commercial/Industrial	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	
		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	
Toxaphene	8001-35-2	1	3.7	31	0.002	0.002	310	-Carcinogen -Developmental
Triallate	2303-17-5	740	9500	8.4	6	6	84	-Liver -Spleen
Tributyltin oxide	56-35-9	22	400	36	0.2	0.2	360	-Immunological
Trichloro-1,2,2-trifluoroethane, 1,1,2- [or CFC 113]	76-13-1	13000	88000	27000	NA	NA	270000	-Body Weight -Neurological
Trichloroacetic acid	76-03-9	480	4600	1.2	400	400	12	-None Specified
Trichlorobenzene, 1,2,3-	87-61-6	560	7400	4.6	5.6	5.6	46	-Adrenals -Body Weight
Trichlorobenzene, 1,2,4-	120-82-1	560	7500	5.3	1.7	1.7	53	-Adrenals -Body Weight
Trichlorobenzene, 1,3,5-	108-70-3	190	1800	16	NA	NA	160	-None Specified
Trichloroethane, 1,1,1- [or Methyl chloroform]	71-55-6	400	3300	1.9	2.6	2.6	19	-None Specified
Trichloroethane, 1,1,2-	79-00-5	1.3	1.8	0.03	0.2	0.2	0.3	-Carcinogen -Liver
Trichloroethene [or TCE]	79-01-6	6	8.5	0.03	0.9	0.9	0.3	-Carcinogen
Trichlorofluoromethane	75-69-4	200	1300	33	NA	NA	330	-Cardiovascular -Kidney -Mortality -Respiratory
Trichlorophenol, 2,4,5-	95-95-4	6000	82000	0.3	1.5	1.5	3	-Kidney -Liver
Trichlorophenol, 2,4,6-	88-06-2	72	180	0.06	0.1	0.1	0.6	-Carcinogen
Trichlorophenoxy acetic acid, 2,4,5-	93-76-5	590	8300	0.4	0.8	0.8	4	-Kidney
Trichlorophenoxy propionic acid [or Silvex]	93-72-1	590	12000	5.4	NA	NA	54	-Liver
Trichloropropane, 1,2,3-	96-18-4	0.01	0.02	0.001	0.002	0.002	0.01	-Body Weight -Carcinogen -Kidney -Liver -Mortality
Trifluralin	1582-09-8	94	220	3.5	0.6	0.6	35	-Blood -Carcinogen -Liver
Trimethyl phosphate	512-56-1	15	30	0.2	NA	NA	2	-Carcinogen

Table II
Soil Cleanup Target Levels

Contaminant	CAS#	Direct Exposure		Leachability Based on Groundwater Criteria (mg/kg)	Leachability Based on Freshwater Surface Water Criteria (mg/kg)	Leachability Based on Marine Surface Water Criteria (mg/kg)	Leachability Based on Groundwater of Low Yield/Poor Quality (mg/kg)	Target Organ/System or Effect
		Residential	Commercial/Industrial					
		(mg/kg)	(mg/kg)					
Trimethylbenzene, 1,2,3-	526-73-8	13	89	0.3	NA	NA	3	-None Specified
Trimethylbenzene, 1,2,4-	95-63-6	13	88	0.3	7.2	7.2	3	-None Specified
Trimethylbenzene, 1,3,5-	108-67-8	11	74	0.3	6.7	6.7	3	-None Specified
Trinitrobenzene, 1,3,5-	99-35-4	1300	14000	1	0.09	0.09	10	-Blood -Spleen
Trinitrotoluene, 2,4,6-	118-96-7	24	55	0.06	0.3	0.3	0.6	-Carcinogen -Liver
TRPH	NOCAS#	340	2500	340	340	340	3400	-Multiple Endpoints Mixed Contaminants
Uranium, natural	7440-61-1	120	470	***	NA	NA	***	-None Specified
Vanadium (b)	7440-62-2	15**	7400	980	NA	NA	9800	-None Specified
Vernam	1929-77-7	29	260	0.1	0.2	0.2	1	-Body Weight
Vinyl acetate	108-05-4	230	1600	0.4	3	3	4	-Body Weight -Kidney -Nasal
Vinyl chloride	75-01-4	0.03	0.04	0.007	NA	NA	0.07	-Carcinogen
Xylenes, total	1330-20-7	5900	40000	0.2	3.9	3.9	2	-Body Weight -Mortality -Neurological
Zinc (b)	7440-66-6	23000	560000	6000	***	***	60000	-Blood
Zinc phosphide	1314-84-7	23	550	***	NA	NA	***	-Body Weight
Zineb	12122-67-7	3400	53000	19	0.7	0.7	190	-Thyroid

Table II
Soil Cleanup Target Levels

Contaminant	CAS#	Direct Exposure		Leachability Based on Groundwater Criteria	Leachability Based on Freshwater Surface Water Criteria	Leachability Based on Marine Surface Water Criteria	Leachability Based on Groundwater of Low Yield/Poor Quality	Target Organ/System or Effect
		Residential	Commercial/Industrial					
		(mg/kg)	(mg/kg)					

Values rounded to two significant figures if >1 and to one significant figure if <1.

* Contaminant is not a health concern for this default exposure scenario.

** Direct exposure value based on acute toxicity considerations.

*** Leachability values may be derived using the SPLP Test to calculate site-specific SCTLs or may be determined using TCLP in the event oily wastes are present.

(a) = See discussion on the development of SCTLs for Ammonia in the Technical Report: Development of Soil Cleanup Target Levels for Chapter 62-777, F.A.C., Final Report, dated XXXX, 1999.

(b) = Leachability values derived from USEPA Soil Screening Guidance (1996). These values were derived assuming soil pH 6.8. These leachability values are dependent upon both the metal concentration in soil and soil characteristics. Thus, if site-specific soil characteristics are different than the defaults, these leachability values may not apply. If this is the case, site-specific leachability values should be derived using methods such as TCLP or SPLP.

(c) = Phytotoxicity must be considered.

(d) = Residential direct exposure value from USEPA Revised Interm Soil Guidance for CERCLA Sites and RCRA Corrective Action Facilities. OSWER Directive 9355.4-12 (1994). The industrial direct exposure value was derived using methodologies outlined in USEPA 'Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil,' December 1996.

None Specified = Information on target organ(s) not available at time of rule adoption.

NA = Not available at time of rule adoption.

APPENDIX E-2-2

**FLORIDA PRIMARY AND SECONDARY STANDARDS AND
GROUNDWATER GUIDANCE CONCENTRATIONS**

GUIDANCE CONCENTRATIONS

CAS #	PARAMETER	CONCENTRATION µg/l	CHAPTER
A			
83-32-9	Acenaphthene	20	Organoleptic
208-96-8	Acenaphthylene	10	Systemic Toxicant
30560-19-1	Acephate	7.5	Carcinogen
67-64-1	Acetone	700	Systemic Toxicant
75-05-8	Acetonitrile	500	Systemic Toxicant
98-86-2	Acetophenone	700	Systemic Toxicant
5094-66-6	Acifluorfen (Blazer)	4	Carcinogen
107-02-8	Acrolein (Propenal)	110	Organoleptic
79-06-1	Acrylamide (2-Propeneamide)	1	Carcinogen
107-13-1	Acrylonitrile	8	Carcinogen
15972-60-8	Alachlor	2	Primary Standard
118-06-3	Aldicarb (Temik)	7	Systemic Toxicant
1646-88-4	Aldicarb sulfone	7	Systemic Toxicant
1646-87-3	Aldicarb sulfoxide	10	Systemic Toxicant
309-00-2	Aldrin	0.05	Carcinogen
107-18-6	Allyl alcohol	250	Systemic Toxicant
7429-90-5	Aluminum	200	Secondary Standard
834-12-8	Ametryn	63	Systemic Toxicant
62-53-3	Aniline	6	Carcinogen
120-12-7	Anthracene	2,100	Systemic Toxicant
7440-36-0	Antimony	6	Primary Standard
7440-38-2	Arsenic	50	Primary Standard
1912-24-9	Atrazine	3	Primary Standard
103-33-3	Azobenzene	4	Carcinogen

GUIDANCE CONCENTRATIONS

CAS #	PARAMETER	CONCENTRATION ug/L	CHAPTER
B			
7440-39-3	Barium	2,000	Primary Standard
114-26-1	Baygon (Propoxur)	28	Systemic Toxicant
17804-35-2	Benomyl	350	Systemic Toxicant
25057-89-0	Bentazon	17.5	Systemic Toxicant
100-52-7	Benzaldehyde	700	Systemic Toxicant
71-43-2	Benzene	1	Primary Standard
92-87-5	Benzidine	250	Carcinogen
56-55-3	Benzo(a)anthracene	4	Carcinogen
50-32-8	Benzo(a)pyrene	0.2	Primary Standard
205-99-2	Benzo(b)fluoranthene	4	Carcinogen
191-24-2	Benzo(g,h,i)perylene	10	Systemic Toxicant
65-85-0	Benzoic acid	28,000	Systemic Toxicant
207-08-9	Benzo(k)fluoranthene	4	Carcinogen
100-51-6	Benzyl alcohol	2,100	Systemic Toxicant
100-44-7	Benzyl chloride	0.5	Carcinogen
7440-41-7	Beryllium	4	Primary Standard
319-84-6	BHC (alpha-Hexachlorocyclohexane)	0.05	Carcinogen
319-85-7	BHC (beta-Hexachlorocyclohexane)	0.1	Carcinogen
319-86-8	BHC (delta-Hexachlorocyclohexane)	0.05	Systemic Toxicant
141-68-2	Bidrin	1	Systemic Toxicant
92-52-4	1,1-Biphenyl	0.5	Organoleptic
111-91-1	Bis (2-Chloroethoxy) methane	10	Systemic Toxicant
111-44-4	Bis(chloroethyl) ether (BCEE)	1.5	Carcinogen
39638-32-9	Bis(2-Chloroisopropyl) ether	7.5	Carcinogen
542-88-1	Bis(chloromethyl) ether (Dichloromethyl ether, BCME)	10	Carcinogen
80-05-7	Bisphenol A	350	Systemic Toxicant
5094-66-6	Blazer (Acifluorfen)	4	Carcinogen

GUIDANCE CONCENTRATIONS

CAS #	PARAMETER	CONCENTRATION µg/l	CHAPTER
7440-42-8	Boron (and Borates) -	630	Systemic Toxicant
1897-45-6	Bravo (Chlorthalonil) -	3.18	Carcinogen
314-40-9	Bromacil -	90	Systemic Toxicant
75-27-4	Bromodichloromethane 0.1	0.6	Carcinogen
75-25-2	Bromoform 0.1	4	Carcinogen
101-55-3	p-Bromodiphenyl ether -	10	Systemic Toxicant
74-83-9	Bromomethane (Methyl bromide) -	10	Systemic Toxicant
1689-84-5	Bromoxynil -	140	Systemic Toxicant
71-36-3	n-Butanol (1-Butanol) -	700	Systemic Toxicant
78-93-3	2-Butanone (Methyl ethyl ketone) -	4,200	Systemic Toxicant
123-86-4	n-Butyl acetate -	2,500	Organoleptic
2008-41-5	Butylate -	350	Systemic Toxicant
85-68-7	Butyl benzyl phthalate (2.1)	1,400	Systemic Toxicant
85-70-1	Butylphthalyl butylglycolate -	7,000	Systemic Toxicant
C			
7440-43-9	Cadmium -	5	Primary Standard
2425-08-1	Captafol -	100	Carcinogen
133-08-2	Captan -	250	Carcinogen
63-25-2	Carbaryl (Sevin) -	700	Systemic Toxicant
88-74-8	Carbazole -	7.5	Carcinogen
1563-66-2	Carbofuran 0.04	40	Primary Standard
108-95-2	Carbolic acid (Phenol) -	10	Organoleptic
75-15-0	Carbon disulfide -	700	Systemic Toxicant
56-23-5	Carbon tetrachloride (Tetrachloromethane) 0.05	3	Primary Standard
5234-68-4	Carboxin -	700	Systemic Toxicant
75-69-4	CFC 11 (Trichlorofluoromethane) -	2,100	Systemic Toxicant

GUIDANCE CONCENTRATIONS

CAS #	PARAMETER	CONCENTRATION ug/L	CHAPTER
75-71-8	CFC 12 (Dichlorodifluoromethane)	1400	Systemic Toxicant
133-90-4	Chloramben	105	Systemic Toxicant
57-74-9	Chlordane	2	Primary Standard
16887-00-6	Chloride	250,000	Secondary Standard
506-77-4	Chlorine cyanide	350	Systemic Toxicant
79-11-8	Chloroacetic acid	14	Systemic Toxicant
106-47-8	p-Chloroaniline	28	Systemic Toxicant
510-15-8	Chlorobenzilate	0.13	Carcinogen
106-89-8	1-Chloro-2,3-epoxypropane (Epichlorohydrin)	3	Carcinogen
75-00-3	Chloroethane (Ethyl chloride)	140	Systemic Toxicant
75-01-4	Chloroethylene (Vinyl Chloride)	1	Primary Standard
110-75-8	2-Chloroethyl vinyl ether (Vinyl 2-chloroethyl ether)	1	Systemic Toxicant
67-66-3	Chloroform	6	Carcinogen
74-87-3	Chloromethane (Methyl chloride)	2.7	Carcinogen
59-50-7	4-chloro-3-methyl phenol	3,000	Organoleptic
94-74-6	4-Chloro-2-methylphenoxy acetic acid (MCPA)	1,000	Systemic Toxicant
91-58-7	2-Chloronaphthalene	560	Systemic Toxicant
121-73-3	p-Chloronitrobenzene	250	Carcinogen
95-57-8	2-Chlorophenol	35	Systemic Toxicant
108-43-0	3-Chlorophenol	10	Organoleptic
106-48-9	4-Chlorophenol	5.5	Organoleptic
7005-72-3	4-Chlorophenylphenyl ether	10	Systemic Toxicant
76-06-2	Chloropicrin	7.3	Organoleptic
95-49-8	o-Chlorotoluene	140	Systemic Toxicant
2921-88-2	Chlorpyrifos	21	Systemic Toxicant
5598-13-0	Chlorpyrifos-methyl	70	Systemic Toxicant
1897-45-6	Chlorthalonil (Bravo)	3.18	Carcinogen
16065-83-1	Chromium	100	Primary Standard
218-01-9	Chrysene	5	Carcinogen

GUIDANCE CONCENTRATIONS

CAS #	PARAMETER	CONCENTRATION ug/L	CHAPTER
95-50-1	1,2-Dichlorobenzene (o-Dichlorobenzene)	600	Primary Standard
541-73-1	1,3-Dichlorobenzene (m-Dichlorobenzene)	10	Organoleptic
106-46-7	1,4-Dichlorobenzene (p-Dichlorobenzene)	75	Primary Standard
91-94-1	3,3'-Dichlorobenzidine	7.5	Carcinogen
75-71-8	Dichlorodifluoromethane (CFC 12)	1400	Systemic Toxicant
75-34-3	1,1-Dichloroethane	700	Systemic Toxicant
107-06-2	1,2-Dichloroethane (Ethylene dichloride)	3	Primary Standard
75-35-4	1,1-Dichloroethylene (Vinylidene chloride)	7	Primary Standard
156-59-2	cis-1,2-Dichloroethylene	70	Primary Standard
156-60-5	trans-1,2-Dichloroethylene	100	Primary Standard
75-09-2	Dichloromethane (Methylene chloride)	5	Primary Standard
542-88-1	Dichloromethyl ether (Bis(chloromethyl)ether, BCME)	10	Carcinogen
578-24-9	2,3-Dichlorophenol	10	Organoleptic
120-83-2	2,4-Dichlorophenol	4	Organoleptic
583-78-8	2,5-Dichlorophenol	10	Organoleptic
87-65-0	2,6-Dichlorophenol	4	Organoleptic
95-77-2	3,4-Dichlorophenol	10	Organoleptic
78-87-5	1,2-Dichloropropane	5	Primary Standard
542-75-6	1,3-Dichloropropene (DCP, Telone)	1	Carcinogen
62-73-7	Dichlorvos	0.1	Carcinogen
60-57-1	Dieldrin	0.1	Carcinogen
103-23-1	Di(2-ethylhexyl) adipate	400	Primary Standard
117-81-7	Di(2-ethylhexyl) phthalate	8	Primary Standard
84-66-2	Diethyl phthalate	5,600	Systemic Toxicant
56-53-1	Diethylstilbesterol	100	Carcinogen
60-51-5	Dimethoate	5	Systemic Toxicant
119-90-4	3,3'-Dimethoxybenzidine	250	Carcinogen
70-38-2	Dimethrin	2,000	Systemic Toxicant
121-69-7	N-N-Dimethylaniline	12,500	Systemic Toxicant

GUIDANCE CONCENTRATIONS

CAS #	PARAMETER	CONCENTRATION µg/L	CHAPTER
72-20-8	Endrin	2	Primary Standard
7421-93-4	Endrin aldehyde	0.1	Systemic Toxicant
106-89-8	Epichlorohydrin (1-Chloro-2,3-epoxypropane)	3	Carcinogen
563-12-2	Ethion	3.5	Systemic Toxicant
110-80-5	2-Ethoxyethanol	25,000	Systemic Toxicant
140-88-5	Ethyl acrylate	5,000	Organoleptic
100-41-4	Ethylbenzene	700	Primary Standard
100-41-4	Ethylbenzene	30	Secondary Standard
75-00-3	Ethyl chloride (Chloroethane)	140	Systemic Toxicant
107-15-3	Ethylene diamine	10,000	Systemic Toxicant
107-06-2	Ethylene dichloride (1,2-Dichloroethane)	3	Primary Standard
107-21-1	Ethylene glycol	14,000	Systemic Toxicant
75-21-8	Ethylene oxide (1,2-Epoxyethane)	10	Carcinogen
96-45-7	Ethylene thiourea (2-Imadazol-dinethione)	15	Carcinogen
60-29-7	Ethyl ether	750	Organoleptic
97-63-2	Ethyl methacrylate	630	Systemic Toxicant
84-72-0	Ethylphthalyl ethylglycolate	21,000	Systemic Toxicant
2104-64-5	Ethyl p-nitrophenyl phenylphosphorothioate (EPN)	0.2	Systemic Toxicant
F			
22224-92-6	Fenamiphos	1.75	Systemic Toxicant
2164-17-2	Fluometuron	91	Systemic Toxicant
208-44-0	Fluoranthene (ldryl)	280	Systemic Toxicant
86-73-7	Fluorene	280	Systemic Toxicant
7782-41-4	Fluoride	4,000	Primary Standard
7782-41-4	Fluoride	2,000	Secondary Standard
944-22-9	Fonofos	14	Systemic Toxicant
50-00-0	Formaldehyde	600	Organoleptic
64-18-6	Formic acid	14,000	Systemic Toxicant

GUIDANCE CONCENTRATIONS

CAS #	PARAMETER	CONCENTRATION µg/L	CHAPTER
G			
1071-83-6	Glyphosate (Roundup)	700	Primary Standard
14127-62-9	Gross Alpha	15 pCi/L	Primary Standard
H			
76-44-8	Heptachlor	0.4	Primary Standard
1024-67-3	Heptachlor Epoxide	0.2	Primary Standard
118-74-1	Hexachlorobenzene (HCB)	1	Primary Standard
87-68-3	Hexachlorobutadiene	15	Carcinogen
319-84-6	alpha-Hexachlorocyclohexane (BHC)	0.05	Carcinogen
319-85-7	beta-Hexachlorocyclohexane (BHC)	0.1	Carcinogen
319-86-8	delta-Hexachlorocyclohexane (BHC)	0.05	Systemic Toxicant
58-89-9	gamma-Hexachlorocyclohexane (Lindane)	0.2	Primary Standard
77-47-4	Hexachlorocyclopentadiene	50	Primary Standard
19408-74-3	Hexachlorodibenzo-p-dioxin	0.00025	Carcinogen
67-72-1	Hexachloroethane	10	Carcinogen
70-30-4	Hexachlorophene	6	Systemic Toxicant
121-82-4	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	10	Carcinogen
110-54-3	n-Hexane	10	Organoleptic
61235-04-2	Hexazinone (Velpar)	231	Systemic Toxicant
74-90-8	Hydrogen cyanide	10,000	Systemic Toxicant
123-31-9	Hydroquinone	280	Systemic Toxicant
I			
206-44-0	Idryl (Fluoranthene)	280	Systemic Toxicant
96-45-7	2 Imadazoil-dinethione (Ethylene thiourea)	15	Carcinogen
193-39-5	Indeno(1,2,3-cd)pyrene	7.5	Carcinogen

GUIDANCE CONCENTRATIONS

CAS #	PARAMETER	CONCENTRATION ug/L	CHAPTER
36734-19-7	Iprodione	280	Systemic Toxicant
7439-89-6	Iron	300	Secondary Standard
78-83-1	Isobutyl alcohol	2,100	Systemic Toxicant
78-59-1	Isophorone	40	Carcinogen
33820-53-0	Isopropalin	105	Systemic Toxicant
98-82-8	Isopropyl benzene (Cumene)	0.8	Organoleptic
L			
7439-92-1	Lead	15	Primary Standard
58-89-9	Lindane (gamma-Hexachlorocyclohexane)	0.2	Primary Standard
330-55-2	Linuron	14	Systemic Toxicant
M			
121-75-5	Malathion	140	Systemic Toxicant
12427-38-2	Maneb	75	Systemic Toxicant
7439-96-5	Manganese	50	Secondary Standard
94-74-6	MCPA (4-Chloro-2-methylphenoxy acetic acid)	1,000	Systemic Toxicant
7439-97-6	Mercury	2	Primary Standard
57837-19-1	Metalaxyl	420	Systemic Toxicant
126-98-7	Methacrylonitrile	50	Systemic Toxicant
10265-92-6	Methamidophos	5	Systemic Toxicant
67-56-1	Methanol	5,000	Systemic Toxicant
16752-77-5	Methomyl	175	Systemic Toxicant
72-43-5	Methoxychlor	40	Primary Standard
99-59-2	2-Methoxy-5-nitroaniline	50	Carcinogen
79-20-9	Methyl acetate	5,000	Organoleptic
95-53-4	2-Methylaniline (o-Toluidine)	50	Carcinogen
74-83-9	Methyl bromide (Bromomethane)	10	Systemic Toxicant

GUIDANCE CONCENTRATIONS

CAS #	PARAMETER	CONCENTRATION µg/L	CHAPTER
		6.5 - 8.5	Secondary Standard
C-006	pH	10	Systemic Toxicant
85-01-8	Phenanthrene	10	Organoleptic
108-95-2	Phenol (Carbolic acid)	1,330	Systemic Toxicant
108-50-3	p-Phenylenediamine	18	Carcinogen
90-43-7	2-Phenylphenol	1.4	Systemic Toxicant
298-02-2	Phorate	140	Systemic Toxicant
732-11-6	Phosmet	125	Systemic Toxicant
7803-51-2	Phosphine	14,000	Systemic Toxicant
85-44-9	Phthalic anhydride	500	Primary Standard
1918-02-1	Picloram	0.5	Primary Standard
1336-36-3	Polychlorinated biphenyl (PCB)	105	Systemic Toxicant
1610-18-0	Prometon	28	Systemic Toxicant
7287-19-6	Prometryn	525	Systemic Toxicant
23950-58-5	Pronamide	91	Systemic Toxicant
1918-16-7	Propachlor	140	Systemic Toxicant
139-40-2	Propazine	110	Organoleptic
107-02-8	Propenal (Acrolein)	1	Carcinogen
79-06-1	2-Propeneamide (Acrylamide)	140	Systemic Toxicant
122-42-9	Propham	28	Systemic Toxicant
114-26-1	Propoxur (Baygon)	5,000	Carcinogen
75-56-9	Propylene oxide	210	Systemic Toxicant
129-00-0	Pyrene	7	Systemic Toxicant
100-86-1	Pyridine		
R			
7440-14-4	Radium	5 pCi/L	Primary Standard
121-82-4	RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)	10	Carcinogen
83-79-4	Rotenone	28	Systemic Toxicant
1071-83-6	Roundup (Glyphosphate)	700	Primary Standard

GUIDANCE CONCENTRATIONS

CAS #	PARAMETER	CONCENTRATION ug/l	CHAPTER
S			
7782-49-2	Selenium	50	Primary Standard
63-25-2	Sevin (Carbaryl)	700	Systemic Toxicant
7440-22-4	Silver	100	Secondary Standard
93-72-1	Silvex (2,4,5-TP)	50	Primary Standard
122-34-9	Simazine	4	Primary Standard
7440-28-0	Sodium	160,000	Primary Standard
7440-24-6	Strontium	4,200	Systemic Toxicant
100-42-6	Styrene (Vinyl benzene)	100	Primary Standard
14808-79-8	Sulfate	250,000	Secondary Standard
T			
93-78-5	2,4,5-T (2,4,5-Trichlorophenoxyacetic acid)	70	Systemic Toxicant
1746-01-6	2,3,7,8-TCDD (Dioxin)	0.000003	Carcinogen
34014-18-1	Tebuthiuron	490	Systemic Toxicant
542-75-6	Telone (DCP, 1,3-Dichloropropene)	1	Carcinogen
116-06-3	Temik (Aldicarb)	7	Systemic Toxicant
5902-51-2	Terbacil	91	Systemic Toxicant
13071-79-9	Terbufos	0.18	Systemic Toxicant
95-94-3	1,2,4,5-Tetrachlorobenzene	4	Systemic Toxicant
630-20-6	1,1,1,2-Tetrachloroethane	1	Carcinogen
79-34-5	1,1,2,2-Tetrachloroethane	0.2	Carcinogen
127-18-4	Tetrachloroethylene (Perchloroethylene)	3	Primary Standard
56-23-5	Tetrachloromethane (Carbon tetrachloride)	3	Primary Standard
58-90-2	2,3,4,6-Tetrachlorophenol	210	Systemic Toxicant
3689-24-5	Tetraethylthiopyrophosphate	3.5	Systemic Toxicant
7440-28-0	Thallium	2	Primary Standard

GUIDANCE CONCENTRATIONS

CAS #	PARAMETER	CONCENTRATION µg/L	CHAPTER
21564-17-0	2-(Thiocyanomethylthio)-Benzothiazole	210	Systemic Toxicant
137-26-8	Thiram	35	Systemic Toxicant
	Tin and compounds	4,200	Systemic Toxicant
108-88-3	Toluene	1,000	Primary Standard
108-88-3	Toluene	40	Secondary Standard
95-80-7	Toluene-2,4-diamine	100	Carcinogen
95-53-4	o-Toluidine (2-Methylaniline)	50	Carcinogen
106-49-0	p-Toluidine	150	Carcinogen
C-010	Total Dissolved Solids (TDS)	500000	Secondary Standard
8001-35-2	Toxaphene	3	Primary Standard
93-72-1	2,4,5-TP (Silvex)	50	Primary Standard
120-82-1	1,2,4-Trichlorobenzene	70	Primary Standard
71-55-6	1,1,1-Trichloroethane	200	Primary Standard
79-00-5	1,1,2-Trichloroethane	5	Primary Standard
79-01-6	Trichloroethylene (Trichloroethene, TCE)	3	Primary Standard
75-69-4	Trichlorofluoromethane (CFC 11)	2,100	Systemic Toxicant
95-95-4	2,4,5-Trichlorophenol	4	Organoleptic
88-06-2	2,4,6-Trichlorophenol	10	Carcinogen
93-72-1	(2,4,5-Trichlorophenoxy)propionic acid (2,4,5-TP)	50	Primary Standard
96-18-4	1,2,3-Trichloropropane	42,000 ⁵²	Systemic Toxicant
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane	500,000 ^{59,000 n}	Systemic Toxicant
1582-09-8	Trifluralin	5 ^{8.7c}	Carcinogen
	Trihalomethanes, Total	100	Primary Standard
	Trimethyl benzenes	10	Organoleptic
512-58-1	Trimethyl phosphate	12.4-23 1.35-2.1 7n # 50 1.8 c	Carcinogen
99-35-4	1,3,5-Trinitrobenzene	60 1.8	Systemic Toxicant
118-96-7	2,4,6-Trinitrotoluene	10 2.2	Carcinogen
786-19-6	Trithion	12	Systemic Toxicant

GUIDANCE CONCENTRATIONS

CAS #	PARAMETER	CONCENTRATION µg/L	CHAPTER
V			
7440-82-2	Vanadium	49 260	Systemic Toxicant
51235-04-2	Velpar (Hexazinone)	231	Systemic Toxicant
108-05-4	Vinyl acetate	250 37,000	Organoleptic
75-01-4	Vinyl Chloride (Chloroethylene)	1 0,019	Primary Standard
110-75-8	Vinyl 2-chloroethyl ether (2-Chloroethyl vinyl ether)	1	Systemic Toxicant
X			
1330-20-7	Xylenes (total)	10,000 12,000	Primary Standard
1330-20-7	Xylenes (total)	20 12,000	Secondary Standard
105-67-9	m-Xylenol (2,4-Dimethylphenol)	400	Organoleptic
Z			
7440-66-6	Zinc	5,000 11,000	Secondary Standard
12122-67-7	Zineb	350 1800	Systemic Toxicant

APPENDIX E-2-3

USEPA REGION IV WATER QUALITY CRITERIA

SC1292 CRITERIA CHART PDATED: DECEMBER 1992 EPA REG IV - WATER MANAGEMENT DIVISION 304(a) CRITERIA AND RELATED INFORMATION FOR TOXIC POLLUTANTS		EPA DETECTION LEVEL (40 CFR 136)				FRESHWATER		SALTWATER		HUMAN HEALTH (10-6 risk factor/carcinogens) Consumption of:		BIO CONC. FACTOR (3% Lipid) Weighted Avg. (l/kg)	EPA FISH TISSUE CONC. (ppm) (mg/kg)	CRITERIA DATES
DATE REVISED	COMPOUND	(ug/l)	EPA Ref. Method (ug/l)	EPA Ref. Method	Criterion Maximum Conc. (ug/l)	Criterion Continuous Conc. (ug/l)	Criterion Maximum Conc. (ug/l)	Criterion Continuous Conc. (ug/l)	Water & Organisms (ug/l)	Organisms Only (ug/l)				
11/89 18	v 1,3-Dichloropropylene (Cis)	5	--	0.34	--	--	--	--	10	*	1,700	*	1.91	10/80, 3/88:Rfd 0.0003
4/89	v 1,3-Dichloropropylene (Trans)	nr	624	0.2	601	--	--	--	10	*	1,700	*	1.91	10/80, 3/88:Rfd 0.0003
10/91 19	v 1,3-Dichloropropene	7.2	624	0.2	602	--	--	--	3,100	* Y	29,000	*	37.5	10/80, 3/88:Rfd 0.1
7/90 20	v Methyl Bromide	nr	624	1.18	601	--	--	--	48	*	4,000	*	3.75	10/80, 8/90:Rfd 0.0014
12/92 21	v Bromomethane	nr	624	0.08	601	--	--	--	t		t		3.75	10/80
4/89 22	v Methyl Chloride	nr	624	0.08	601	--	--	--	t		t		3.75	10/80
4/89 22	v Chloromethane	nr	624	0.08	601	--	--	--	4.7		1600		0.9	10/80, 1/89:q1* 0.0075, 11/85:Rfd 0.06
4/89 22	v Methylene Chloride (c)	2.8	624	0.25	601	--	--	--	4.7		1600		0.9	10/80, 1/89:q1* 0.0075, 11/85:Rfd 0.06
4/89 22	v Dichloromethane	nr	624	0.08	601	--	--	--	4.7		1600		0.9	10/80, 1/89:q1* 0.0075, 11/85:Rfd 0.06
6/89 23	v 1,1,2,2-Tetrachloroethane (c)	6.9	624	0.03	601	--	--	--	0.17	*	11	*	5	10/80, 3/88:q1* 0.2
4/89 24	v 1,1,2,2-Tetrachloroethane (c)	4.1	624	0.03	601	--	--	--	0.8	*	8.85	*	30.6	10/80, 9/87:Rfd 0.01
10/91 25	v Toluene	6	624	0.2	602	--	--	--	6,800	* Y	200,000	*	10.7	10/80, 8/90:Rfd 0.2
10/91 26	v 1,2-Trans-Dichloroethylene	1.6	624	0.1	601	--	--	--	700	n	--		1.58	10/80, 1/89:Rfd 0.02
12/92 27	v 1,1,1-Trichloroethane	3.8	624	0.03	601	--	--	--	t	Y	t		5.6	10/80
4/89 28	v 1,1,2-Trichloroethane (c)	5	624	0.02	601	--	--	--	0.60	*	42	*	4.5	10/80, 3/88:q1* 0.057, 5/88:Rfd 0.004
7/89 29	v Trichloroethylene (c)	1.9	624	0.12	601	--	--	--	2.7	*	81	*	10.6	10/80
4/89 30	v Vinyl Chloride (c)	nr	624	0.18	601	--	--	--	2	*	525	*	1.17	10/80
12/92 1	a 2-Chlorophenol	3.3	625	0.31	604	--	--	--	120	n,0	400		134	10/80, 8/88:Rfd 0.005
12/92 2	a 2,4-Dichlorophenol	2.7	625	0.39	604	--	--	--	93	* 0	790		40.7	10/80, 6/88:Rfd 0.003
12/92 3	a 2,4-Dimethylphenol	2.7	625	0.32	604	--	--	--	540	n,0	2300		93.8	10/80, 11/90:Rfd 0.02
10/91 4	a 2-Methyl-4,6-Dinitrophenol (4,6-Dinitro-O-Cresol)	24	625	16	604	--	--	--	13.4	*	765	*	5.5	10/80
4/89 5	a 2,4-Dinitrophenol	42	625	13	604	--	--	--	70	*	14,000	*	1.5	10/80, 3/88:Rfd 0.002
4/89 6	a 2-Nitrophenol	3.6	625	0.45	604	--	--	--	--		--		2.33	10/80
4/89 7	a 4-Nitrophenol	2.4	625	2.8	604	--	--	--	--		--		3.31	10/80
12/92 8	a 3-Methyl-4-Chlorophenol (P-Chloro-M-Cresol)	3	625	0.36	604	--	--	--	--	0	--	--	--	10/80
12/92 9	a Pentachlorophenol (pH,c)	3.6	625	7.4	604	20 * pH	13 * pH	13 *	0.28	*	8.2	*	11	10/80, 9/86:al 6/88:Rfd 0.03, 8/90:q1* 0.
91 10	a Phenol	1.5	625	0.14	604	--	--	--	21,000	* 0	4,600,000	*	1.4	10/80, 6/89:Rfd 0.6
90 11	a 2,4,6-Trichlorophenol (c)	2.7	625	0.64	604	--	--	--	2.1	*	6.5	*	150	10/80, 6/90: q1* 0.011
12/92 1	bn Acenaphthene	1.9	625	1.8	610	--	--	--	1200	n,0	2700		242	10/80, 11/90:Rfd 0.06
1/91 2	bn Acenaphthylene	3.5	625	2.3	610	--	--	--	--		--		30	10/80
1/91 3	bn Anthracene	1.9	625	0.66	610	--	--	--	9,600	*	110,000	*	30	10/80, 9/90:Rfd 0.3
4/89 4	bn Benzidine (c)	44	625	--	--	--	--	--	0.00012	*	0.00054	*	87.5	10/80, 3/88:q1* 230, 7/87:Rfd 0.003
4/89 5	bn Benz(a)Anthracene (PAH, c)	7.8	625	0.013	610	--	--	--	0.0044	*	0.049	*	30	10/80
4/89 6	bn Benzo(a)Pyrene (PAH, c)	2.5	625	0.023	610	--	--	--	0.0044	*	0.049	*	30	10/80, 12/91:q1* 7.3
4/89 7	bn 3,4-Benzo(b)fluoranthene (PAH, c)	2.5	625	0.018	610	--	--	--	0.0044	*	0.049	*	30	10/80
1/91 8	bn Benzo(g,h,i)Perylene	4.1	625	0.076	610	--	--	--	--		--		30	10/80
4/89 9	bn Benzo(k)Fluoranthene (PAH, c)	2.5	625	0.017	610	--	--	--	0.0044	*	0.049	*	30	10/80
4/89 10	bn Bis(2-Chloroethoxy)Methane	5.3	625	0.5	611	--	--	--	--		--		0.64	10/80
4/89 11	bn Bis(Chloroethyl)Ether (c)	5.7	625	0.3	611	--	--	--	0.031	*	1.4	*	6.9	10/80, 3/88:q1* 1.1
11/89 12	bn Bis(2-Chloroisopropyl)Ether	5.7	625	0.8	611	--	--	--	1,400	*	170,000	*	2.47	10/80, 10/89:Rfd 0.04
4/89 13	bn Bis(2-Ethylhexyl)Phthalate (c,B) Di(2-Ethylhexyl)Phthalate	2.5	625	2	606	--	--	--	1.8	*	5.9	*	130	10/80, 2/89:q1* 0.014, 1/86:Rfd 0.02

TSC1292 CRITERIA CHART DATED: DECEMBER 1992 REG IV - WATER MANAGEMENT DIVISION 304(a) CRITERIA AND RELATED INFORMATION FOR TOXIC POLLUTANTS		EPA DETECTION LEVEL (40 CFR 136)				FRESHWATER		SALTWATER		HUMAN HEALTH (10 ⁻⁶ risk factor/carcinogens) Consumption of:		BIO CONC. FACTOR (3% Lipid) Weighted Avg. (l/kg)	EPA FISH TISSUE CONC. (ppm) (mg/kg)	CRITERIA DATES
DATE REVISED	COMPOUND	EPA Ref. (ug/l)	EPA Ref. (ug/l)	EPA Ref. (ug/l)	EPA Ref. (ug/l)	Criterion Maximum Conc. (ug/l)	Criterion Continuous Conc. (ug/l)	Criterion Maximum Conc. (ug/l)	Criterion Continuous Conc. (ug/l)	Water & Organisms (ug/l)	Organisms Only (ug/l)			
4/89 14	bn 4-BromophenylPhenyl Ether p-Bromodiphenyl Ether	1.9	625	2.3	611	--	--	--	--	--	--	1640	--	10/80
12/92 15	bn Butylbenzyl Phthalate	2.5	625	0.34	606	--	--	--	--	3000	n	414	2153	10/80, 9/89:Rfd 0.2
1/91 16	bn 2-Chloronaphthalene	1.9	625	0.94	612	--	--	--	--	1700	n	202	861.5	10/80, 11/90:Rfd 0.08
4/89 17	bn 4-Chlorophenyl Phenyl Ether	4.2	625	3.9	611	--	--	--	--	--	--	1200	--	10/80
1/91 18	bn Chrysene (PAH, c)	2.5	625	0.15	610	--	--	--	--	0.0044	*	30	0.00147	10/80
4/89 19	bn Dibenz(a,h)Anthracene (PAH, c)	2.5	625	0.03	610	--	--	--	--	0.0044	*	30	0.00147	10/80
10/91 20	bn 1,2-(o)Dichlorobenzene	nr	624	1.9	625	--	--	--	--	2,700	* Y	17,000	55.6	10/80, 8/89:Rfd 0.09
4/89 21	bn 1,3-(m)Dichlorobenzene	nr	624	1.9	625	--	--	--	--	400	*	2600	55.6	10/80
7/90 22	bn 1,4-(p)Dichlorobenzene	nr	624	4.4	625	--	--	--	--	400	*	2600	55.6	10/80
1/91 23	bn 3,3'-Dichlorobenzidine (c)	16.5	625	0.13	605	--	--	--	--	0.04	*	0.077	312	10/80, 8/90:q1* 0.45
11/89 24	bn Diethyl Phthalate	1.9	625	0.49	606	--	--	--	--	23,000	*	120,000	73	10/80, 9/87:Rfd 0.8
4/89 25	bn Dimethyl Phthalate	1.6	625	0.29	606	--	--	--	--	313,000	*	2,900,000	36	10/80
4/89 26	bn Dibutyl Phthalate	2.5	625	0.36	606	--	--	--	--	2,700	*	12,000	89	10/80, 1/87:Rfd 0.1
12/92 27	bn 2,4-Dinitrotoluene (c)	5.7	625	0.02	609-EC	--	--	--	--	0.11	*	9.1	3.8	10/80, 8/91:Rfd 0.002
12/92 28	bn 2,6-Dinitrotoluene	1.9	625	0.01	609-EC	--	--	--	--	--	--	--	--	10/80, 8/91:Rfd 0.002
4/89 29	bn Di-n-Octyl Phthalate	2.5	625	3	606	--	--	--	--	--	--	--	--	10/80
4/89 30	bn 1,2-Diphenylhydrazine (c)	20	1625	--	--	--	--	--	--	0.040	*	0.54	24.9	10/80, 3/88:q1* 0.8
1/91 31	bn Fluoranthene	2.2	625	0.21	610	--	--	--	--	300	*	370	1150	10/80, 9/90:Rfd 0.04
1/91 32	bn Fluorene	1.9	625	0.21	610	--	--	--	--	1,300	*	14,000	30	10/80, 9/90:Rfd 0.04
10/91 33	bn Hexachlorobenzene (c, B)	1.9	625	0.05	612	--	--	--	--	0.00075	*	0.00077	8690	10/80, 5/88:Rfd 0.0008, 3/89:q1* 1.6
7/89 34	bn Hexachlorobutadiene (c)	0.9	625	0.34	612	--	--	--	--	0.44	*	50	2.78	10/80, 3/88:q1*, 6/89:q1* 0.078, 12/85:Rfd 0.002
12/92 35	bn Hexachlorocyclopentadiene	nr	625	0.4	612	--	--	--	--	240	*0,Y	17,000 t	4.34	10/80, 3/88:Rfd 0.007
4/89 36	bn Hexachloroethane (c)	1.6	625	0.03	612	--	--	--	--	1.9	*	8.9	86.9	10/80, 3/88:q1* 0.014, 4/87:Rfd 0.001
4/89 37	bn Indeno(1,2,3-cd)Pyrene (PAH, c)	3.7	625	0.043	610	--	--	--	--	0.0044	*	0.049	30	10/80
12/92 38	bn Isophorone (c)	2.2	625	15.7	609-EC	--	--	--	--	36	*	2600	4.38	10/80, 8/92:q1* 0.00095, 9/89:Rfd 0.2
4/89 39	bn Naphthalene	1.6	625	1.8	610	--	--	--	--	--	--	--	10.5	10/80
12/89 40	bn Nitrobenzene	1.9	625	13.7	609-EC	--	--	--	--	17	*	1,900	2.89	10/80, 5/88:Rfd 0.0005
4/89 41	bn N-Nitrosodimethylamine (c)	nr	625	0.15	607	--	--	--	--	0.00069	*	8.1	0.026	10/80, 3/88:q1* 51
12/92 42	bn N-Nitrosodi-n-Propylamine	nr	625	0.46	607	--	--	--	--	0.005	n	1.4	1.13	10/80, 3/88:q1* 7.0
4/89 43	bn N-Nitrosodiphenylamine (c)	1.9	625	0.81	607	--	--	--	--	5.0	*	16	136	10/80, 3/88:q1* 0.0049
4/89 44	bn Phenanthrene (B)	5.4	625	0.64	610	--	--	--	--	--	--	--	30	10/80
4/89 45	bn Pyrene	1.9	625	0.27	610	--	--	--	--	960	*	11,000	30	10/80, 9/90:Rfd 0.03
12/92 46	bn 1,2,4-Trichlorobenzene	1.9	625	0.05	612	--	--	--	--	--	--	--	114	10/80, 12/91:Rfd 0.01
7/90 1	p Aldrin (c)	1.9	625	0.004	608	3 *	--	1.3 *	--	0.00013	*	0.00014	4670	10/80, 12/88:q1* 17, 12/85:Rfd 0.00003
4/89 2	p a-BHC (c)	nr	625	0.003	608	--	--	--	--	0.0039	*	0.013	130	10/80, 3/88:q1* 6.3
4/89 3	p b-BHC (c)	4.2	625	0	608	--	--	--	--	0.014	*	0.046	130	10/80, 9/87:q1* 1.8
4/89 4	p g-BHC (c)	nr	625	0	608	2 *	0.08 *	0.16 *	--	0.019	*	0.063	130	10/80, 1/86:Rfd 0.0003
12/92 5	p d-BHC	3.1	625	0.009	608	--	--	--	--	--	--	--	130	10/80
4/89 6	p Chlordane (c)	nr	625	0.014	608	2.4 *	0.0043 *T	0.09 *	0.004 *T	0.00057	*	0.00059	14100	10/80, 3/88:q1* 1.3, 3/89:Rfd 0.00006
6/89 7	p 4,4'-DDT (c)	4.7	625	0.012	608	1.1 *	0.001 *W	0.13 *	0.001 *W	0.00059	*	0.00059	53600	10/80, 8/88:q1* 0.34, 12/85:Rfd 0.0005
7/90 8	p 4,4'-DDE (c)	5.6	625	0.004	608	--	--	--	--	0.00059	*	0.00059	53600	10/80, 8/88:q1* 0.34
7/90 9	p 4,4'-DDD (c)	2.8	625	0.011	608	--	--	--	--	0.00083	*	0.00084	53600	10/80, 9/88:q1* 0.24
4/89 10	p Dieldrin (c)	2.5	625	0.002	608	2.5 *	0.0019 *T	0.71 *	0.0019 *T	0.00014	*	0.00014	4670	10/80, 9/88:q1* 16, 4/87:Rfd 0.00005
12/92 11	p a-Endosulfan	--a	625	0.014	608	0.22 *	0.056 *	0.034 *	0.0087 *	74	*	159	270	10/80

1292 CRITERIA CHART
 DATED: DECEMBER 1992
 EPA REG IV - WATER MANAGEMENT DIVISION
 304(a) CRITERIA AND RELATED INFORMATION
 FOR TOXIC POLLUTANTS

DATE REVISED	COMPOUND	EPA DETECTION LEVEL (40 CFR 136)				FRESHWATER		SALTWATER		HUMAN HEALTH (10-6 risk factor/carcinogens) Consumption of:		BIO CONC. FACTOR (% Lipid) Weighted Avg. (l/kg)	EPA FISH TISSUE CONC. (ppm) (mg/kg)	CRITERIA DATES
		EPA Ref. (ug/l)	EPA Ref. Method (ug/l)	EPA Ref. Method	EPA Ref. Method	Criterion Maximum Conc. (ug/l)	Criterion Continuous Conc. (ug/l)	Criterion Maximum Conc. (ug/l)	Criterion Continuous Conc. (ug/l)	Water & Organisms (ug/l)	Organisms Only (ug/l)			
12/92	12 p b-Endosulfan	--b	625	0.004	608	0.22 *	0.056 *	0.034 *	0.0087 *	74 *	159 *	270	42.93	10/80
8/92	13 p Endosulfan Sulfate	5.6	625	0.066	608	--	--	--	--	74	159	270	42.93	10/80
8/92	14 p Endrin	nr	625	0.006	608	0.18 *	0.0023 *T	0.037 *	0.0023 *T	0.76 *	0.81	3970	3.23	10/80, 9/88:Rfd 0.0003
8/92	15 p Endrin Aldehyde	nr	625	0.023	608	--	--	--	--	0.76	0.81	3970	3.23	10/80, 9/88:Rfd 0.0003
4/89	16 p Heptachlor (c)	1.9	625	0.003	608	0.52 *	0.0038 *T	0.053 *	0.0036 *T	0.00021 *	0.00021 *	11200	0.0024	10/80, 3/88:q1* 4.5, 4/87:Rfd 0.0005
12/89	17 p Heptachlor Epoxide (c)	2.2	625	0.083	608	0.52 *	0.0038 *T	0.053 *	0.0036 *T	0.00010 *	0.00011 *	11200	0.0012	10/80, 3/88:q1* 9.1, 9/87:Rfd 0.000013
6/89	18 p PCB-1242 (PCB, c)	nr	625	0.065	608	--	0.014 *W	--	0.03 *W	0.000044 *	0.000045 *	31200	0.0014	10/80, 5/89:q1* 7.7
6/89	19 p PCB-1254 (PCB, c)	36	625	nr	608	--	0.014 *W	--	0.03 *W	0.000044 *	0.000045 *	31200	0.0014	10/80, 5/89:q1* 7.7
6/89	20 p PCB-1221 (PCB, c)	30	625	nr	608	--	0.014 *W	--	0.03 *W	0.000044 *	0.000045 *	31200	0.0014	10/80, 5/89:q1* 7.7
6/89	21 p PCB-1232 (PCB, c)	nr	625	nr	608	--	0.014 *W	--	0.03 *W	0.000044 *	0.000045 *	31200	0.0014	10/80, 5/89:q1* 7.7
6/89	22 p PCB-1248 (PCB, c)	nr	625	nr	608	--	0.014 *W	--	0.03 *W	0.000044 *	0.000045 *	31200	0.0014	10/80, 5/89:q1* 7.7
6/89	23 p PCB-1260 (PCB, c)	nr	625	nr	608	--	0.014 *W	--	0.03 *W	0.000044 *	0.000045 *	31200	0.0014	10/80, 5/89:q1* 7.7
6/89	24 p PCB-1016 (PCB, c)	nr	625	nr	608	--	0.014 *W	--	0.03 *W	0.000044 *	0.000045 *	31200	0.0014	10/80, 5/89:q1* 7.7
4/89	25 p Toxaphene (c)	nr	625	0.24	608	0.73 *	0.0002 *T	0.21 *	0.0002 *T	0.00073 *	0.00075 *	13100	0.0098	10/80, 9/86:aq life, 8/88:q1* 1.1

NON-PRIORITY POLLUTANTS

1	Aluminum (pH 6.5-9.0)	3	202.2	100	202.1	750 *	87 *	--	--	--	--	--	--	8/88
2	Ammonia	50	350.3	30	350.2	d	d	e	e	--	--	--	--	1/85
3	Barium	nr	--	nr	--	--	--	--	--	2000 *MCL	--	--	--	7/76, 8/90:Rfd 0.07, 7/91:MCL 2000
4	Bis(chloromethyl)Ether (c)	nr	--	nr	--	--	--	--	--	0.000159 *	0.0777 *	0.63	0.000049	10/80, 9/88:q1* 220
5	Boron	nr	--	nr	--	--	750 *lr	--	--	--	--	--	--	7/76, 10/89:Rfd 0.09
6	Chloride	nr	325.3	1000	325.1	860,000*	230,000*	--	--	--	--	--	--	2/88
7	Chlorine(TRC)	200	330.5	100	330.3	19 *	11 *	13 *	7.5 *	--	--	--	--	1/85
8	Chlorpyrifos	--	--	--	--	0.083 *	0.041 *	0.011 *	0.0056 *	--	--	--	--	9/86
9	Demeton	--	--	--	--	--	0.1 *	--	0.1 *	--	--	--	--	7/76
10	Dichlorodifluoromethane (HM, c)	--	--	1.81	601	--	--	--	--	5.67 *	470.8 *	3.75	1.77	10/80
11	2,4-dichlorophenoxy acetic acid	--	--	--	--	--	--	--	--	70 *MCL	--	--	--	7/76, 1/91:MCL 70
12	Dissolved Gases	--	--	--	--	--	110% saturation *	--	110% sat.	--	--	--	--	7/76
13	Dissolved Solids (chlor/sulfides)	--	--	--	--	--	--	--	--	500,000 *MCL	--	--	--	7/76
14	Guthion	--	--	--	--	--	0.01 *	--	0.01 *	--	--	--	--	7/76
15	Iron	--	--	--	--	--	1000 *	--	--	300 *MCL	--	--	--	7/76
16	Malathion	--	--	--	--	--	0.1 *	--	0.1 *	--	--	--	--	7/76
12/92	17 Manganese	--	--	--	--	--	0.03 *	--	0.03 *	30 *MCL	100 Marine*	--	--	7/76, 9/92:Rfd 0.005
18	Methoxychlor	--	--	--	--	--	0.001 *	--	0.001 *	100 *MCL	--	--	--	7/76, 8/90:Rfd 0.005, 1/91:MCL 40
19	Mirex	--	--	--	--	--	--	--	--	--	--	--	--	7/76
20	Nitrates (as N)	--	--	--	--	--	--	--	--	10000 *MCL	--	--	--	7/76
21	N-nitrosopyrrolidene (c)	--	--	--	--	--	--	--	--	0.016 *	91.9 *	--	--	10/80
22	Oil and Grease	--	--	--	--	--	0.01 low LC50 *	--	0.1 low LC50*	--	--	--	--	7/76
23	Parathion	--	--	--	--	0.065 *	0.013 *	--	--	--	--	--	--	7/76
24	Pentachlorobenzene	--	--	--	--	--	--	--	--	74 *	85 *	2125	180.6	10/80
25	pH	--	--	--	--	--	6.5-9 *	--	--	5.0-9 *	--	--	--	7/76
26	Phosphorus (elemental)	--	--	--	--	--	--	--	0.1 *	--	--	--	--	7/76

TSC1292 CRITERIA CHART UPDATED: DECEMBER 1992 EPA REG IV - WATER MANAGEMENT DIVISION 304(a) CRITERIA AND RELATED INFORMATION FOR TOXIC POLLUTANTS		EPA DETECTION LEVEL (40 CFR 136)		FRESHWATER		SALTWATER		HUMAN HEALTH (10-6 risk factor/carcinogens) Consumption of:		BIO CONC. FACTOR (3% Lipid) Weighted Avg. (l/kg)	EPA FISH TISSUE CONC. (ppm) (ng/kg)	CRITERIA DATES
DATE REVISED	COMPOUND	EPA Ref. (ug/l)	EPA Ref. (ug/l)	Criterion Maximum Conc. (ug/l)	Criterion Continuous Conc. (ug/l)	Criterion Maximum Conc. (ug/l)	Criterion Continuous Conc. (ug/l)	Water & Organisms (ug/l)	Organisms Only (ug/l)			
27	Solids (Turbidity)			<10% comp. pt. *		<10% comp. pt. *						7/76
28	Sulfide (S2-, HS-)			2 *								7/76
29	1,2,4,5-tetrachlorobenzene											10/80
30	Trichlorofluoromethane	nr	624	nr	601			38 *	48 *	1125	54	10/80
31	2,4,5-trichlorophenol							5.67 *	470.8 *	3.75	1.77	10/80
32	2-(2,4,5-trichlorophenoxy)propionic acid (D.O. and Bacteria not included)							1 * 0 50 *MCL				10/80 7/76, 1/91:MCL 50

KEY	description, definition
m	metal
v	volatile compound
a	acidic compound
bn	base neutral compound
p	pesticide
B	Draft EPA water quality criteria documents for these pollutants are available. Refer to the Federal Register (May 14, 1990, Vol. 55, No. 93, page 1987) for draft aquatic life criteria.
c	carcinogen, criteria calculated at 10 ⁻⁶ risk level
III	trivalent species
H	based on hardness equations, (values given at 50 mg/l hardness
VI	hexavalent species
pH	based on pH equation (CMC= $\exp(1.005(\text{pH})-4.830)$) (CCC= $\exp(1.005(\text{pH})-5.290)$) (Values in matrix/pH of 7.8)
PAH	polynuclear aromatic hydrocarbon, HH crit/total PAHs
PCB	polychlorinated biphenyl criteria apply to total PCBs
hrms	high resolution mass spectroscopy
EC	electron capture detector
FI	flame ionization detector
nr	not reported
*	criterion
T	based on marketability of fish
W	Final Residue value based on wildlife feeding study
t	criteria for pollutant withdrawn in National Toxics Rule
f/l	# of fibers per liter of water/consumption of H ₂ O only
Y	more stringent MCL exists
MCL	Maximum Contaminant Level/SDWA (Safe Drinking Water Act)
O	criteria based on organoleptic effects available
X	not recommended if compound known to be in sample
f	freshwater organisms
e/c	estuarine/coastal organisms
oo	open ocean (marine) organisms
RfD	verified Reference Dose for Noncarcinogens
q ₁ *	Cancer Potency Factor (slope factor)
TRC	measured as total residual chlorine
lr	long term irrigation of sensitive crops (min. standard)
s	number of species
BCF	bioconcentration=tissue/water concentration at 3% lipid conc.
al	aquatic life (same as aq life)
n	new criteria published in Final National Toxics Rule
d	see table/Ambient WQCrit./Ammonia-1984 EPA 440/5-84-004
e	see table/Ambient WQCrit./Ammonia (Salt H ₂ O) 440/5-88-004

COMPOUNDS	HARDNESS EQUATIONS		
	(acute) CMC	(chronic) CCC	95% LC50
CADMIUM	$e(1.128(\ln H)-3.828)$	$e(0.7852(\ln H)-3.49)$	$2e(1.128(\ln H)-3.828)$
CHROMIUM III	$e(0.819(\ln H)+3.688)$	$e(0.819(\ln H)+1.561)$	$2e(0.819(\ln H)+3.688)$
COPPER	$e(0.9422(\ln H)-1.464)$	$e(0.8545(\ln H)-1.465)$	$2e(0.9422(\ln H)-1.464)$
LEAD	$e(1.273(\ln H)-1.46)$	$e(1.273(\ln H)-4.705)$	$2e(1.273(\ln H)-1.46)$
NICKEL	$e(0.846(\ln H)+3.3612)$	$e(0.846(\ln H)+1.1645)$	$2e(0.846(\ln H)+3.3612)$
SILVER	$e(1.72(\ln H)-6.52)$		$e(1.72(\ln H)-6.52)$
ZINC	$e(0.8473(\ln H)+0.8604)$	$e(0.8473(\ln H)+0.7614)$	$2e(0.8473(\ln H)+0.8604)$

APPENDIX E-2-4

FLORIDA SURFACE WATER QUALITY STANDARDS

Table I
Groundwater and Surface Water Cleanup Target Levels

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Acenaphthene	83-32-9	20 Minimum Criteria Organoleptic	3 Toxicity Criteria	3 Toxicity Criteria	200	-Liver
Acenaphthylene	208-96-8	210 Minimum Criteria Systemic Toxicant	**	**	2100	-Body Weight -Liver
Acephate	30560-19-1	7.5 Minimum Criteria PQL	190 Toxicity Criteria	190 Toxicity Criteria	75	-Carcinogen -Neurological
Acetone	67-64-1	700 Minimum Criteria Systemic Toxicant	1692 Toxicity Criteria	1692 Toxicity Criteria	7000	-Kidney -Liver -Neurological
Acetonitrile	75-05-8	500 Minimum Criteria PQL	19983 Toxicity Criteria	19983 Toxicity Criteria	5000	-Blood -Liver
Acetophenone	98-86-2	700 Minimum Criteria Systemic Toxicant	7750 Toxicity Criteria	7750 Toxicity Criteria	7000	-None Specified
Acifluorfen, sodium [or Blazer]	62476-59-9	1 Minimum Criteria Health Advisory Level	190 Toxicity Criteria	190 Toxicity Criteria	10	-Kidney -Mortality
Acrolein	107-02-8	14 Minimum Criteria Systemic Toxicant	0.4 Toxicity Criteria	0.4 Toxicity Criteria	140	-Nasal
Acrylamide	79-06-1	1 Minimum Criteria PQL	5.98 Human Health	5.98 Human Health	10	-Carcinogen -Neurological
Acrylonitrile	107-13-1	1 Minimum Criteria PQL	49.9 Human Health	49.9 Human Health	10	-Carcinogen -Nasal -Reproductive
Alachlor	15972-60-8	* Primary Standard	0.596 Human Health	0.596 Human Health	***	-Blood -Carcinogen
Aldicarb [or Temik]	116-06-3	7 Minimum Criteria Systemic Toxicant	0.85 Toxicity Criteria	0.85 Toxicity Criteria	70	-Neurological
Aldicarb sulfone	1646-88-4	7 Minimum Criteria Systemic Toxicant	46 Toxicity Criteria	46 Toxicity Criteria	70	-Neurological
Aldicarb sulfoxide	1646-87-3	7 Minimum Criteria Health Advisory Level	4.2 Toxicity Criteria	4.2 Toxicity Criteria	70	-Neurological

**Table I
Groundwater and Surface Water Cleanup Target Levels**

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Aldrin	309-00-2	0.005 Minimum Criteria PQL	**	**	0.05	-Carcinogen -Liver
Allyl alcohol	107-18-6	250 Minimum Criteria PQL	5 Toxicity Criteria	5 Toxicity Criteria	2500	-Kidney -Liver
Allyl chloride	107-05-1	35 Minimum Criteria Systemic Toxicant	NA	NA	350	-Neurological
Aluminum	7429-90-5	* Secondary Standard	13 Toxicity Criteria	13 Toxicity Criteria	***	-Body Weight
Aluminum phosphide	20859-73-8	50 Minimum Criteria PQL	6.5 Toxicity Criteria	6.5 Toxicity Criteria	500	-Body Weight
Ametryn	834-12-8	63 Minimum Criteria Systemic Toxicant	6.2 Toxicity Criteria	6.2 Toxicity Criteria	630	-Liver
Ammonia	7664-41-7	2800 Minimum Criteria Systemic Toxicant	**	NA	28000	-Respiratory
Anilazine [or Dyrene]	101-05-3	2.8 Minimum Criteria Systemic Toxicant	NA	NA	28	-None Specified
Aniline	62-53-3	6.1 Minimum Criteria Carcinogen	4 Toxicity Criteria	4 Toxicity Criteria	61	-Blood -Carcinogen
Anthracene	120-12-7	2100 Minimum Criteria Systemic Toxicant	0.3 Toxicity Criteria	0.3 Toxicity Criteria	21000	-None Specified
Antimony	7440-36-0	* Primary Standard	**	**	***	-Blood -Mortality
Aramite	140-57-8	10 Minimum Criteria PQL	3 Toxicity Criteria	3 Toxicity Criteria	100	-Carcinogen
Arsenic	7440-38-2	* Primary Standard	**	**	***	-Carcinogen -Cardiovascular -Skin
Atrazine	1912-24-9	* Primary Standard	1.8 Human Health	1.8 Human Health	***	-Body Weight -Carcinogen

Table I
Groundwater and Surface Water Cleanup Target Levels

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Azobenzene	103-33-3	4 Minimum Criteria PQL	0.559 Human Health	0.559 Human Health	40	-Carcinogen
Barium	7440-39-3	* Primary Standard	# b	# b	***	-Cardiovascular
Bayleton	43121-43-3	210 Minimum Criteria Systemic Toxicant	500 Toxicity Criteria	500 Toxicity Criteria	2100	-Blood -Body Weight
Benomyl	17804-35-2	35 Minimum Criteria Systemic Toxicant	0.3 Toxicity Criteria	0.3 Toxicity Criteria	350	-Developmental
Bensulide	741-58-2	46.2 Minimum Criteria Systemic Toxicant	NA	NA	462	-None Specified
Bentazon	25057-89-0	210 Minimum Criteria Systemic Toxicant	NA	NA	2100	-Blood
Benzaldehyde	100-52-7	700 Minimum Criteria Systemic Toxicant	53.5 Toxicity Criteria	53.5 Toxicity Criteria	7000	-Gastrointestinal -Kidney
Benzene	71-43-2	* Primary Standard	**	**	***	-Carcinogen
Benzenethiol	108-98-5	20 Minimum Criteria PQL	NA	NA	200	-Liver
Benzidine	92-87-5	400 Minimum Criteria PQL	NA	NA	4000	-Carcinogen
Benzo(a)anthracene	56-55-3	0.2 Minimum Criteria PQL	**	**	2	-Carcinogen
Benzo(a)pyrene	50-32-8	* Primary Standard	**	**	***	-Carcinogen
Benzo(b)fluoranthene	205-99-2	0.2 Minimum Criteria PQL	**	**	2	-Carcinogen
Benzo(g,h,i)perylene	191-24-2	210 Minimum Criteria Systemic Toxicant	**	**	2100	-Neurological

Table I
Groundwater and Surface Water Cleanup Target Levels

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Benzo(k)fluoranthene	207-08-9	0.5 Minimum Criteria Carcinogen	**	**	5	-Carcinogen
Benzoic acid	65-85-0	28000 Minimum Criteria Systemic Toxicant	9000 Toxicity Criteria	9000 Toxicity Criteria	280000	-None Specified
Benzotrichloride	98-08-7	0.06 Minimum Criteria PQL	0.0029 Human Health	0.0029 Human Health	0.6	-Carcinogen
Benzyl alcohol	100-51-6	2100 Minimum Criteria Systemic Toxicant	500 Toxicity Criteria	500 Toxicity Criteria	21000	-Gastrointestinal
Benzyl chloride	100-44-7	0.5 Minimum Criteria PQL	2.95 Human Health	2.95 Human Health	5	-Carcinogen
Beryllium	7440-41-7	* Primary Standard	**	**	***	-Carcinogen -Gastrointestinal -Respiratory
Beta radiation		* Primary Standard			***	-Carcinogen
Bidrin [or Dicrotophos]	141-66-2	0.7 Minimum Criteria Systemic Toxicant	NA 21.5 Toxicity Criteria	NA 21.5 Toxicity Criteria	7	-Developmental
Bioallethrin	28057-48-9	35 Minimum Criteria Systemic Toxicant	NA	NA	350	-Liver
Biphenyl, 1,1- [or Diphenyl]	92-52-4	0.5 Minimum Criteria Organoleptic	18 Toxicity Criteria	18 Toxicity Criteria	5	-Kidney
Bis(2-chloroethyl)ether	111-44-4	4 Minimum Criteria PQL	9.99 Human Health	9.99 Human Health	40	-Carcinogen
Bis(2-chloroisopropyl)ether	108-60-1	10 Minimum Criteria PQL	0.5 Human Health	0.5 Human Health	100	-Blood -Carcinogen
Bis(2-ethylhexyl)adipate	103-23-1	* Primary Standard	33 Toxicity Criteria	33 Toxicity Criteria	***	-Carcinogen
Bis(2-ethylhexyl)phthalate [or DEHP]	117-81-7	* Primary Standard	0.02 Human Health	0.02 Human Health	***	-Carcinogen -Liver

Table I
Groundwater and Surface Water Cleanup Target Levels

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Bisphenol A	80-05-7	350 Minimum Criteria Systemic Toxicant	55 Toxicity Criteria	55 Toxicity Criteria	3500	-Body Weight
Boron	7440-42-8	630 Minimum Criteria Health Advisory Level	NA	NA	6300	-Reproductive -Respiratory
Bromacil	314-40-9	91 Minimum Criteria Health Advisory Level	97 Toxicity Criteria	97 Toxicity Criteria	910	-Body Weight
Bromochloromethane	74-97-5	91 Minimum Criteria Systemic Toxicant	NA	NA	910	-None Specified
Bromodichloromethane	75-27-4	0.6 Minimum Criteria Carcinogen	**	**	6	-Carcinogen -Kidney
Bromoform	75-25-2	4.4 Minimum Criteria Carcinogen	**	**	44	-Carcinogen -Liver
Bromomethane [or Methyl bromide]	74-83-9	9.8 Minimum Criteria Systemic Toxicant	35 Toxicity Criteria	35 Toxicity Criteria	98	-Gastrointestinal
Bromophenyl phenyl ether, 4-	101-55-3	406 Minimum Criteria Systemic Toxicant	NA	NA	4060	-None Specified
Bromoxynil	1689-84-5	140 Minimum Criteria Systemic Toxicant	NA	NA	1400	-None Specified
Bromoxynil octanoate	1689-99-2	140 Minimum Criteria Systemic Toxicant	NA	NA	1400	-Neurological
Butanol, 1-	71-36-3	700 Minimum Criteria Systemic Toxicant	25000 Toxicity Criteria	25000 Toxicity Criteria	7000	-Neurological
Butanone, 2- [or MEK]	78-93-3	4200 Minimum Criteria Systemic Toxicant	120000 Toxicity Criteria	120000 Toxicity Criteria	42000	-Developmental
Butyl acetate, n-	123-86-4	43 Minimum Criteria Organoleptic	1000 Toxicity Criteria	1000 Toxicity Criteria	430	-None Specified
Butyl benzyl phthalate, n-	85-68-7	140 Minimum Criteria Systemic Toxicant	25.5 Toxicity Criteria	25.5 Toxicity Criteria	1400	-Liver

**Table I
Groundwater and Surface Water Cleanup Target Levels**

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Butylate	2008-41-5	350 Minimum Criteria Systemic Toxicant	10.5 Toxicity Criteria	10.5 Toxicity Criteria	3500	-Liver
Butylphthalyl butylglycolate	85-70-1	7000 Minimum Criteria Systemic Toxicant	NA	NA	70000	-None Specified
Cacodylic acid (as Arsenic)	75-60-5	21 Minimum Criteria Systemic Toxicant	850 Toxicity Criteria	850 Toxicity Criteria	210	-Carcinogen -Cardiovascular -Skin
Cadmium	7440-43-9	* Primary Standard	a	**	***	-Carcinogen -Kidney
Calcium cyanide	592-01-8	280 Minimum Criteria Systemic Toxicant	NA	NA	2800	-Body Weight -Neurological -Thyroid
Captafol	2425-06-1	100 Minimum Criteria PQL	0.85 Toxicity Criteria	0.85 Toxicity Criteria	1000	-Carcinogen
Captan	133-06-2	250 Minimum Criteria PQL	1.9 Toxicity Criteria	1.9 Toxicity Criteria	2500	-Body Weight -Carcinogen
Carbaryl [or Sevin]	63-25-2	700 Minimum Criteria Systemic Toxicant	0.06 Toxicity Criteria	0.06 Toxicity Criteria	7000	-Kidney -Liver
Carbazole	86-74-8	4 Minimum Criteria PQL	46.5 Toxicity Criteria	46.5 Toxicity Criteria	40	-Carcinogen
Carbofuran	1563-66-2	* Primary Standard	0.1 Toxicity Criteria	0.1 Toxicity Criteria	***	-Neurological -Reproductive
Carbon disulfide	75-15-0	700 Minimum Criteria Systemic Toxicant	105 Toxicity Criteria	105 Toxicity Criteria	7000	-Developmental -Neurological
Carbon tetrachloride	56-23-5	* Primary Standard	**	**	***	-Carcinogen -Liver
Carbophenothion [or Trithion]	786-19-6	0.9 Minimum Criteria Systemic Toxicant	0.1 Toxicity Criteria	0.1 Toxicity Criteria	9	-Neurological
Carboxin	5234-68-4	700 Minimum Criteria Systemic Toxicant	60 Toxicity Criteria	60 Toxicity Criteria	7000	-Body Weight -Mortality

Table I
Groundwater and Surface Water Cleanup Target Levels

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Chloral	75-87-6	14 Minimum Criteria Systemic Toxicant	NA	NA	140	-Liver
Chloramben	133-90-4	105 Minimum Criteria Systemic Toxicant	NA	NA	1050	-Liver
Chlordane	57-74-9	* Primary Standard	**	**	***	-Carcinogen -Liver
Chloride	16887-00-6	* Secondary Standard	**	**	***	-None Specified
Chlorine	7782-50-5	700 Minimum Criteria Systemic Toxicant	**	**	7000	-Body Weight
Chlorine cyanide [or Cyanogen chloride]	506-77-4	350 Minimum Criteria Systemic Toxicant	1.45 Toxicity Criteria	1.45 Toxicity Criteria	3500	-Body Weight -Neurological -Thyroid
Chlorite, sodium	7758-19-2	100 Minimum Criteria PQL	29 Toxicity Criteria	29 Toxicity Criteria	1000	-None Specified
Chloro-1,3-butadiene [or Chloroprene]	126-99-8	140 Minimum Criteria Systemic Toxicant	NA	NA	1400	-Body Weight -Hair Loss -Nasal
Chloroacetic acid	79-11-8	14 Minimum Criteria Systemic Toxicant	NA	NA	140	-Cardiovascular
Chloroaniline, 4-	106-47-8	28 Minimum Criteria Systemic Toxicant	2.5 Toxicity Criteria	2.5 Toxicity Criteria	280	-Spleen
Chlorobenzene	108-90-7	* Primary Standard	17 Toxicity Criteria	17 Toxicity Criteria	***	-Liver
Chlorobenzilate	510-15-6	0.1 Minimum Criteria Carcinogen	0.09 Human Health	0.09 Human Health	1	-Body Weight -Carcinogen
Chloroethyl vinyl ether, 2-	110-75-8	175 Minimum Criteria Systemic Toxicant	NA	NA	1750	-None Specified
Chloroform	67-66-3	5.7 Minimum Criteria Carcinogen	**	**	57	-Carcinogen -Liver

**Table I
Groundwater and Surface Water Cleanup Target Levels**

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Chloro-m-cresol, p- [or 4-chloro-3-methylphenol]	59-50-7	63 Minimum Criteria Systemic Toxicant	100 Toxicity Criteria	100 Toxicity Criteria	630	-Body Weight
Chloromethane	74-87-3	2.7 Minimum Criteria Carcinogen	**	**	27	-Carcinogen
Chloronaphthalene, beta-	91-58-7	560 Minimum Criteria Systemic Toxicant	NA	NA	5600	-Liver -Respiratory
Chloronitrobenzene, p-	100-00-5	250 Minimum Criteria PQL	107 Toxicity Criteria	107 Toxicity Criteria	2500	-Carcinogen
Chlorophenol, 2-	95-57-8	35 Minimum Criteria Systemic Toxicant	130 Toxicity Criteria	130 Toxicity Criteria	350	-Reproductive
Chlorophenol, 3-	108-43-0	10 Minimum Criteria Organoleptic (PQL)	173.5 Toxicity Criteria	173.5 Toxicity Criteria	100	-None Specified
Chlorophenol, 4-	106-48-9	5.5 Minimum Criteria Organoleptic (PQL)	175 Toxicity Criteria	175 Toxicity Criteria	55	-None Specified
Chloropicrin	76-06-2	7.3 Minimum Criteria Organoleptic	NA	NA	73	-None Specified
Chlorothalonil [or Bravo]	1897-45-6	3.2 Minimum Criteria Carcinogen	0.8 Toxicity Criteria	0.8 Toxicity Criteria	32	-Carcinogen -Kidney
Chlorotoluene, o-	95-49-8	140 Minimum Criteria Systemic Toxicant	390 Toxicity Criteria	390 Toxicity Criteria	1400	-Body Weight
Chlorotoluene, p-	106-43-4	140 Minimum Criteria Health Advisory Level	NA	NA	1400	-None Specified
Chlorpropham	101-21-3	1400 Minimum Criteria Systemic Toxicant	190 Toxicity Criteria	190 Toxicity Criteria	14000	-Bone Marrow -Kidney -Liver -Spleen
Chlorpyrifos	2921-88-2	21 Minimum Criteria Systemic Toxicant	0.002 Toxicity Criteria	0.002 Toxicity Criteria	210	-Neurological
Chlorpyrifos, methyl	5598-13-0	70 Minimum Criteria Systemic Toxicant	0.035 Toxicity Criteria	0.035 Toxicity Criteria	700	-Reproductive

Table I
Groundwater and Surface Water Cleanup Target Levels

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Chlorsulfuron	64902-72-3	350 Minimum Criteria Systemic Toxicant	16 Toxicity Criteria	16 Toxicity Criteria	3500	-Body Weight
Chromium (hexavalent)	18540-29-9	* Primary Standard	**	**	***	-Carcinogen -Respiratory
Chromium (total)	NOCAS#	* Primary Standard	NA	NA	***	-Carcinogen
Chromium (trivalent)	16065-83-1	* Primary Standard	** Numerical a	515 Toxicity Criteria	***	-None Specified
Chrysene	218-01-9	4.8 Minimum Criteria Carcinogen	**	**	48	-Carcinogen
Cobalt	7440-48-4	420 Minimum Criteria Systemic Toxicant	NA	NA	4200	-Cardiovascular -Immunological - Neurological -Reproductive
Copper	7440-50-8	* Secondary Standard	a	**	***	-Gastrointestinal
Coumaphos	56-72-4	1.8 Minimum Criteria Systemic Toxicant	0.004 Toxicity Criteria	0.004 Toxicity Criteria	18	-Neurological
Crotonaldehyde	123-73-9	4000 Minimum Criteria Carcinogen	NA	NA	40000	-Carcinogen
Cumene [or Isopropyl benzene]	98-82-8	0.8 Minimum Criteria Organoleptic	255 Toxicity Criteria	255 Toxicity Criteria	8	-Adrenals -Kidney
Cyanazine	21725-46-2	0.1 Minimum Criteria PQL	5.5 Toxicity Criteria	5.5 Toxicity Criteria	1	-Carcinogen
Cyanide (potassium salt)	57-12-5	* Primary Standard	**	**	***	-Body Weight -Neurological -Thyroid
Cyanogen	460-19-5	10000 Minimum Criteria PQL	NA	NA	100000	-None Specified
Cycloate	1134-23-2	35 Minimum Criteria Systemic Toxicant	130 Toxicity Criteria	130 Toxicity Criteria	350	-Neurological

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Groundwater and Surface Water Cleanup Target Levels

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Cyclohexanone	108-94-1	35000 Minimum Criteria Systemic Toxicant	26350 Toxicity Criteria	26350 Toxicity Criteria	350000	-Body Weight
Cyclohexylamine	108-91-8	5000 Minimum Criteria PQL	4000 Toxicity Criteria	4000 Toxicity Criteria	50000	-Body Weight -Reproductive
Cypermethrin	52315-07-8	7 Minimum Criteria Systemic Toxicant	0.0005 Toxicity Criteria	0.0005 Toxicity Criteria	70	-Gastrointestinal
Dacthal [or DCPA]	1861-32-1	70 Minimum Criteria Systemic Toxicant	310 Toxicity Criteria	310 Toxicity Criteria	700	-Kidney -Liver -Respiratory -Thyroid
Dalapon	75-99-0	* Primary Standard	5000 Toxicity Criteria	5000 Toxicity Criteria	***	-Kidney
DDD, 4,4'-	72-54-8	0.1 Minimum Criteria Carcinogen	0.003 Human Health	0.003 Human Health	1	-Carcinogen
DDE, 4,4'-	72-55-9	0.1 Minimum Criteria Carcinogen	0.0006 Human Health	0.0006 Human Health	1	-Carcinogen
DDT, 4,4'-	50-29-3	0.1 Minimum Criteria Carcinogen	**	**	1	-Carcinogen -Liver
DEET	134-62-3	6300 Minimum Criteria Systemic Toxicant	NA	NA	63000	-Body Weight
Demeton	8065-48-3	0.3 Minimum Criteria Systemic Toxicant	1.35 Toxicity Criteria	1.35 Toxicity Criteria	3	-Eye -Neurological
Diallate	2303-16-4	0.6 Minimum Criteria Carcinogen	NA	NA	6	-Carcinogen
Diazinon	333-41-5	0.63 Minimum Criteria Systemic Toxicant	0.002 Toxicity Criteria	0.002 Toxicity Criteria	6.3	-Neurological
Dibenz(a,h)anthracene	53-70-3	0.2 Minimum Criteria PQL	**	**	2	-Carcinogen
Dibenzofuran	132-64-9	28 Minimum Criteria Systemic Toxicant	67 Toxicity Criteria	67 Toxicity Criteria	280	-None Specified

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Groundwater and Surface Water Cleanup Target Levels

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Dibromo-3-chloropropane, 1,2- [or DBCP]	96-12-8	* Primary Standard	NA	NA	***	-Carcinogen -Reproductive
Dibromoacetonitrile	3252-43-5	14 Minimum Criteria Health Advisory Level	NA	NA	140	-None Specified
Dibromochloromethane	124-48-1	0.4 Minimum Criteria Carcinogen	**	**	4	-Carcinogen -Liver
Dibromoethane, 1,2- [or EDB]	106-93-4	* Primary Standard	13 Toxicity Criteria	13 Toxicity Criteria	***	-Carcinogen -Reproductive
Dicamba	1918-00-9	210 Minimum Criteria Systemic Toxicant	195 Toxicity Criteria	195 Toxicity Criteria	2100	-Developmental
Dichloroacetic acid	79-43-6	28 Minimum Criteria Health Advisory Level	1150 Toxicity Criteria	1150 Toxicity Criteria	280	-None Specified
Dichloroacetonitrile	3018-12-0	5.6 Minimum Criteria Health Advisory Level	NA	NA	56	-None Specified
Dichlorobenzene, 1,2-	95-50-1	* Primary Standard	99 Toxicity Criteria	99 Toxicity Criteria	***	-Body Weight
Dichlorobenzene, 1,3-	541-73-1	10 Minimum Criteria Organoleptic (PQL)	85 Toxicity Criteria	85 Toxicity Criteria	100	-None Specified
Dichlorobenzene, 1,4-	106-46-7	* Primary Standard	100 Toxicity Criteria	100 Toxicity Criteria	***	-Carcinogen -Liver
Dichlorobenzidine, 3,3'-	91-94-1	12 Minimum Criteria PQL	0.06 Human Health	0.06 Human Health	120	-Carcinogen
Dichlorodifluoromethane	75-71-8	1400 Minimum Criteria Systemic Toxicant	NA	NA	14000	-Body Weight -Liver
Dichloroethane, 1,1-	75-34-3	70 Minimum Criteria Systemic Toxicant	NA	NA	700	-Kidney
Dichloroethane, 1,2- [or EDC]	107-06-2	* Primary Standard	5 Human Health	5 Human Health	***	-Carcinogen

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Groundwater and Surface Water Cleanup Target Levels**

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Dichloroethene, 1,1-	75-35-4	* Primary Standard	**	**	***	-Carcinogen -Liver
Dichloroethene, 1,2- (mixture)	540-59-0	63 Minimum Criteria Systemic Toxicant	7000 Toxicity Criteria	7000 Toxicity Criteria	630	-Blood -Liver
Dichloroethene, cis-1,2-	156-59-2	* Primary Standard	NA	NA	***	-Blood
Dichloroethene, trans-1,2-	156-60-5	* Primary Standard	11000 Toxicity Criteria	11000 Toxicity Criteria	***	-Blood -Liver
Dichlorophenol, 2,3-	576-24-9	10 Minimum Criteria PQL	56 Toxicity Criteria	56 Toxicity Criteria	100	-None Specified
Dichlorophenol, 2,4-	120-83-2	0.5 Minimum Criteria PQL	13 Toxicity Criteria	13 Toxicity Criteria	5	-Immunological
Dichlorophenol, 2,5-	583-78-8	10 Minimum Criteria PQL	90 Toxicity Criteria	90 Toxicity Criteria	100	-None Specified
Dichlorophenol, 2,6-	87-65-0	4 Minimum Criteria PQL	73 Toxicity Criteria	73 Toxicity Criteria	40	-None Specified
Dichlorophenol, 3,4-	95-77-2	0.5 Minimum Criteria PQL	61 Toxicity Criteria	61 Toxicity Criteria	5	-None Specified
Dichlorophenoxy acetic acid, 2,4-	94-75-7	* Primary Standard	80 Toxicity Criteria	80 Toxicity Criteria	***	-Kidney -Liver
Dichlorophenoxy butyric acid, 2,4- [or 2,4-DB]	94-82-6	56 Minimum Criteria Systemic Toxicant	NA	NA	560	-Blood -Cardiovascular -Mortality
Dichloropropane, 1,2-	78-87-5	* Primary Standard	2600 Toxicity Criteria	2600 Toxicity Criteria	***	-Carcinogen -Nasal
Dichloropropene, 1,3-	542-75-6	0.2 Minimum Criteria Carcinogen	12 Toxicity Criteria	12 Toxicity Criteria	2	-Carcinogen -Kidney -Nasal
Dichloroprop	120-36-5	35 Minimum Criteria Systemic Toxicant	42 Toxicity Criteria	42 Toxicity Criteria	350	-None Specified

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Groundwater and Surface Water Cleanup Target Levels

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Dichlorvos	62-73-7	0.1 Minimum Criteria Carcinogen	0.005 Toxicity Criteria	0.005 Toxicity Criteria	1	-Carcinogen -Neurological
Dicofol [or Kelthane]	115-32-2	0.4 Minimum Criteria PQL	0.003 Human Health	0.003 Human Health	4	-Adrenals -Carcinogen
Dieldrin	60-57-1	0.005 Minimum Criteria PQL	**	**	0.05	-Carcinogen -Liver
Diethylphthalate	84-66-2	5600 Minimum Criteria Systemic Toxicant	380 Toxicity Criteria	380 Toxicity Criteria	56000	-Body Weight
Diethylstilbestrol	56-53-1	100 Minimum Criteria PQL	NA	NA	1000	-Carcinogen
Dimethoate	60-51-5	0.1 Minimum Criteria Systemic Toxicant	0.1 Toxicity Criteria	0.1 Toxicity Criteria	1	-Neurological
Dimethoxybenzidine, 3,3'-	119-90-4	250 Minimum Criteria PQL	NA	NA	2500	-Carcinogen
Dimethrin	70-38-2	2100 Minimum Criteria Health Advisory Level	1.1 Toxicity Criteria	1.1 Toxicity Criteria	21000	-Liver
Dimethylaniline, N,N-	121-69-7	50 Minimum Criteria PQL	1650 Toxicity Criteria	1650 Toxicity Criteria	500	-Spleen
Dimethylbenzidine, 3,3'-	119-93-7	160 Minimum Criteria PQL	NA	NA	1600	-Carcinogen
Dimethylformamide, N,N-	68-12-2	700 Minimum Criteria Systemic Toxicant	50000 Toxicity Criteria	50000 Toxicity Criteria	7000	-Gastrointestinal -Liver
Dimethylphenol, 2,4-	105-67-9	140 Minimum Criteria Systemic Toxicant	261 Human Health	261 Human Health	1400	-Blood -Neurological
Dimethylphthalate	131-11-3	70000 Minimum Criteria Systemic Toxicant	1450 Toxicity Criteria	1450 Toxicity Criteria	700000	-Kidney
Di-n-butylphthalate	84-74-2	700 Minimum Criteria Systemic Toxicant	23 Toxicity Criteria	23 Toxicity Criteria	7000	-Mortality

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Groundwater and Surface Water Cleanup Target Levels

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Dinitrobenzene, 1,2- (o)	528-29-0	200 Minimum Criteria PQL	30 Toxicity Criteria	30 Toxicity Criteria	2000	-Spleen
Dinitrobenzene, 1,3- (m)	99-65-0	8 Minimum Criteria PQL	72 Toxicity Criteria	72 Toxicity Criteria	80	-Spleen
Dinitrobenzene, 1,4- (p)	100-25-4	50 Minimum Criteria PQL	30 Toxicity Criteria	30 Toxicity Criteria	500	-Spleen
Dinitro-o-cyclohexylphenol	131-89-5	100 Minimum Criteria PQL	NA	NA	1000	-Eye
Dinitrophenol, 2,4-	51-28-5	14 Minimum Criteria Systemic Toxicant	3 Toxicity Criteria	3 Toxicity Criteria	140	-Eye
Dinitrotoluene (mixture)	NOCAS#	0.2 Minimum Criteria PQL	NA	NA	2	-Carcinogen
Dinitrotoluene, 2,4-	121-14-2	0.1 Minimum Criteria PQL	**	**	1	-Carcinogen -Liver -Neurological
Dinitrotoluene, 2,6-	606-20-2	0.1 Minimum Criteria PQL	4 Human Health	4 Human Health	1	-Blood -Carcinogen -Kidney -Mortality - Neurological
Di-n-octylphthalate	117-84-0	140 Minimum Criteria Systemic Toxicant	NA	NA	1400	-Kidney -Liver
Dinoseb	88-85-7	* Primary Standard	5.9 Toxicity Criteria	5.9 Toxicity Criteria	***	-Developmental
Dioxane, 1,4-	123-91-1	5 Minimum Criteria PQL	245 Human Health	245 Human Health	50	-Carcinogen
Dioxin [or 2,3,7,8-TCDD]	1746-01-6	* Primary Standard	**	**	***	-Carcinogen
Diphenamid	957-51-7	210 Minimum Criteria Systemic Toxicant	1600 Toxicity Criteria	1600 Toxicity Criteria	2100	-Liver
Diphenylamine, N,N-	122-39-4	175 Minimum Criteria Systemic Toxicant	NA	NA	1750	-Body Weight -Kidney -Liver

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Groundwater and Surface Water Cleanup Target Levels

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Diphenylhydrazine, 1,2-	122-66-7	10 Minimum Criteria PQL	0.38 Human Health	0.38 Human Health	100	-Carcinogen
Diquat	85-00-7	* Primary Standard	1.5 Toxicity Criteria	1.5 Toxicity Criteria	***	-Eye
Disulfoton	298-04-4	0.3 Minimum Criteria Systemic Toxicant	0.3 Toxicity Criteria	0.3 Toxicity Criteria	3	-Neurological
Diuron	330-54-1	14 Minimum Criteria Systemic Toxicant	8 Toxicity Criteria	8 Toxicity Criteria	140	-Blood
Endosulfan	115-29-7	42 Minimum Criteria Systemic Toxicant	**	**	420	-Body Weight -Cardiovascular -Kidney
Endothall	145-73-3	* Primary Standard	105 Toxicity Criteria	105 Toxicity Criteria	***	-Gastrointestinal
Endrin	72-20-8	* Primary Standard	**	**	***	-Liver
Epichlorohydrin	106-89-8	3.5 Minimum Criteria Carcinogen	272 Human Health	272 Human Health	35	-Carcinogen -Kidney -Nasal
Ethion	563-12-2	3.5 Minimum Criteria Systemic Toxicant	0.007 Toxicity Criteria	0.007 Toxicity Criteria	35	-Neurological
Ethoprop	13194-48-4	0.7 Minimum Criteria Systemic Toxicant	0.315 Toxicity Criteria	0.315 Toxicity Criteria	7	-Neurological
Ethoxyethanol, 2-	110-80-5	25000 Minimum Criteria PQL	NA	NA	250000	-Body Weight -Reproductive
Ethyl acetate	141-78-6	6300 Minimum Criteria Systemic Toxicant	6250 Toxicity Criteria	6250 Toxicity Criteria	63000	-Body Weight -Mortality
Ethyl acrylate	140-88-5	5000 Minimum Criteria PQL	125 Toxicity Criteria	125 Toxicity Criteria	50000	-Carcinogen
Ethyl chloride [or Chloroethane]	75-00-3	12 Minimum Criteria Carcinogen	NA	NA	120	-Carcinogen -Developmental

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Groundwater and Surface Water Cleanup Target Levels**

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Ethyl dipropylthiocarbamate, S- [or EPTC]	759-94-4	175 Minimum Criteria Systemic Toxicant	235 Toxicity Criteria	235 Toxicity Criteria	1750	-Cardiovascular
Ethyl ether	60-29-7	750 Minimum Criteria Organoleptic	128000 Toxicity Criteria	128000 Toxicity Criteria	7500	-Body Weight
Ethyl methacrylate	97-63-2	630 Minimum Criteria Systemic Toxicant	NA	NA	6300	-Kidney
Ethyl p-nitrophenyl phenylphosphorothioate [or EPN]	2104-64-5	0.2 Minimum Criteria PQL	0.015 Toxicity Criteria	0.015 Toxicity Criteria	2	-Neurological
Ethylbenzene	100-41-4	* Secondary Standard	605 Toxicity Criteria	605 Toxicity Criteria	***	-Developmental -Kidney -Liver
Ethylene diamine	107-15-3	10000 Minimum Criteria PQL	800 Toxicity Criteria	800 Toxicity Criteria	100000	-Blood -Cardiovascular
Ethylene glycol	107-21-1	14000 Minimum Criteria Systemic Toxicant	16300 Toxicity Criteria	16300 Toxicity Criteria	140000	-Kidney
Ethylene oxide	75-21-8	10 Minimum Criteria PQL	4200 Toxicity Criteria	4200 Toxicity Criteria	100	-Carcinogen
Ethylene thiourea [or ETU]	96-45-7	5 Minimum Criteria PQL	1320 Toxicity Criteria	1320 Toxicity Criteria	50	-Carcinogen
Ethylphthalyl ethylglycolate [or EPEG]	84-72-0	21000 Minimum Criteria Systemic Toxicant	NA	NA	210000	-Kidney -Mortality
Famphur	52-85-7	3.5 Minimum Criteria Systemic Toxicant	NA	NA	35	-Blood
Fenamiphos	22224-92-6	1.8 Minimum Criteria Systemic Toxicant	0.225 Toxicity Criteria	0.225 Toxicity Criteria	18	-Neurological
Fensulfothion	115-90-2	1.8 Minimum Criteria Systemic Toxicant	0.5 Toxicity Criteria	0.5 Toxicity Criteria	18	-Neurological
Fluometuron	2164-17-2	91 Minimum Criteria Systemic Toxicant	190 Toxicity Criteria	190 Toxicity Criteria	910	-None Specified

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Groundwater and Surface Water Cleanup Target Levels

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Fluoranthene	206-44-0	280 Minimum Criteria Systemic Toxicant	0.3 Toxicity Criteria	0.3 Toxicity Criteria	2800	-Blood -Kidney -Liver
Fluorene	86-73-7	280 Minimum Criteria Systemic Toxicant	30 Toxicity Criteria	30 Toxicity Criteria	2800	-Blood
Fluoride	7782-41-4	* Secondary Standard	**	**	***	-Teeth
Fluoridone	59756-60-4	560 Minimum Criteria Systemic Toxicant	105 Toxicity Criteria	105 Toxicity Criteria	5600	-Body Weight -Kidney -Reproductive
Fonofos	944-22-9	14 Minimum Criteria Systemic Toxicant	0.095 Toxicity Criteria	0.095 Toxicity Criteria	140	-Liver -Neurological
Formaldehyde	50-00-0	600 Minimum Criteria Organoleptic	105 Toxicity Criteria	105 Toxicity Criteria	6000	-Body Weight -Carcinogen -Gastrointestinal
Formic acid	64-18-6	14000 Minimum Criteria Systemic Toxicant	4500 Toxicity Criteria	4500 Toxicity Criteria	140000	-Body Weight
Furfural	98-01-1	250 Minimum Criteria PQL	650 Toxicity Criteria	650 Toxicity Criteria	2500	-Liver -Nasal
Glyphosate [or Roundup]	1071-83-6	* Primary Standard	115 Toxicity Criteria	115 Toxicity Criteria	***	-Kidney
Gross alpha radiation	14127-62-9	* Primary Standard	**	**	***	-Carcinogen
Guthion [or Azinphos, methyl]	86-50-0	10.5 Minimum Criteria Systemic Toxicant	**	**	105	-Neurological
Heptachlor	76-44-8	* Primary Standard	**	**	***	-Carcinogen -Liver
Heptachlor epoxide	1024-57-3	* Primary Standard	0.002 Toxicity Criteria	0.002 Toxicity Criteria	***	-Carcinogen -Liver
Hexachloro-1,3-butadiene	87-68-3	0.5 Minimum Criteria Carcinogen	**	**	5	-Carcinogen -Kidney

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Groundwater and Surface Water Cleanup Target Levels

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Hexachlorobenzene	118-74-1	* Primary Standard	0.00036 Human Health	0.00036 Human Health	***	-Carcinogen -Liver
Hexachlorocyclohexane [technical or BHC]	608-73-1	0.02 Minimum Criteria Carcinogen	0.017 Toxicity Criteria	0.017 Toxicity Criteria	0.2	-Carcinogen
Hexachlorocyclohexane, alpha-	319-84-6	0.006 Minimum Criteria Carcinogen	0.0116 Human Health	0.0116 Human Health	0.06	-Carcinogen
Hexachlorocyclohexane, beta-	319-85-7	0.02 Minimum Criteria Carcinogen	**	**	0.2	-Carcinogen
Hexachlorocyclohexane, delta-	319-86-8	2.1 Minimum Criteria Systemic (b)	NA	NA	21	-Kidney -Liver
Hexachlorocyclohexane, gamma- [or Lindane]	58-89-9	* Primary Standard	**	**	***	-Carcinogen -Kidney -Liver
Hexachlorocyclopentadiene	77-47-4	* Primary Standard	2.95 Toxicity Criteria	2.95 Toxicity Criteria	***	-Gastrointestinal
Hexachlorodibenzo-p-dioxin (mixture)	19408-74-3	0.00025 Minimum Criteria PQL	NA	NA	0.0025	-Carcinogen
Hexachloroethane	67-72-1	2.5 Minimum Criteria Carcinogen	1.1 Human Health	1.1 Human Health	25	-Carcinogen -Kidney
Hexachlorophene	70-30-4	6 Minimum Criteria PQL	1.05 Toxicity Criteria	1.05 Toxicity Criteria	60	-Neurological
Hexahydro-1,3,5-trinitro-1,3,5-triazine [or RDX]	121-82-4	1 Minimum Criteria PQL	180 Toxicity Criteria	180 Toxicity Criteria	10	-Carcinogen -Reproductive
Hexane, n-	110-54-3	10 Minimum Criteria PQL	3400 Toxicity Criteria	3400 Toxicity Criteria	100	-Neurological
Hexanone, 2- [or Methyl butyl ketone]	591-78-6	280 Minimum Criteria Systemic Toxicant	NA	NA	2800	-None Specified
Hexazinone	51235-04-2	231 Minimum Criteria Systemic Toxicant	1020 Human Health	1020 Human Health	2310	-Body Weight

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Groundwater and Surface Water Cleanup Target Levels

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Hydrogen cyanide (as Cyanide)	74-90-8	140 Minimum Criteria Systemic Toxicant	3.45 Toxicity Criteria	3.45 Toxicity Criteria	1400	-Body Weight -Neurological -Thyroid
Hydrogen sulfide (as Sulfur)	7783-06-4	100 Minimum Criteria PQL	0.1 Toxicity Criteria	0.1 Toxicity Criteria	1000	-Gastrointestinal
Hydroquinone	123-31-9	280 Minimum Criteria Systemic Toxicant	4.5 Toxicity Criteria	4.5 Toxicity Criteria	2800	-Blood
Indeno(1,2,3-cd)pyrene	193-39-5	0.2 Minimum Criteria PQL	**	**	2	-Carcinogen
Iprodione	36734-19-7	280 Minimum Criteria Systemic Toxicant	153 Toxicity Criteria	153 Toxicity Criteria	2800	-Blood
Iron	7439-89-6	* Secondary Standard	**	**	***	-Blood -Gastrointestinal
Isobutyl alcohol	78-83-1	2100 Minimum Criteria Systemic Toxicant	47450 Toxicity Criteria	47450 Toxicity Criteria	21000	-Neurological
Isophorone	78-59-1	37 Minimum Criteria Carcinogen	645 Toxicity Criteria	645 Toxicity Criteria	370	-Carcinogen
Kepon	143-50-0	20 Minimum Criteria PQL	NA	NA	200	-Carcinogen
Lead	7439-92-1	* Primary Standard	a	**	***	-Neurological
Linuron	330-55-2	1.4 Minimum Criteria Systemic Toxicant	44.5 Toxicity Criteria	44.5 Toxicity Criteria	14	-Blood
Lithium	7439-93-32	140 Minimum Criteria Systemic Toxicant	NA	NA	1400	-None Specified
Malathion	121-75-5	140 Minimum Criteria Systemic Toxicant	**	**	1400	-Neurological
Mancozeb	8018-01-7	210 Minimum Criteria Systemic Toxicant	3.5 Toxicity Criteria	3.5 Toxicity Criteria	2100	-Thyroid

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Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Maneb	12427-38-2	75 Minimum Criteria PQL	5.5 Toxicity Criteria	5.5 Toxicity Criteria	750	-Thyroid
Manganese	7439-96-5	* Secondary Standard	NA	NA	***	-Neurological
Mercuric chloride (as Mercury)	7487-94-7	0.2 Minimum Criteria Systemic Toxicant	0.05 Toxicity Criteria	0.05 Toxicity Criteria	2	-Immunological -Kidney
Mercury	7439-97-6	* Primary Standard	**	**	***	-Neurological
Mercury, methyl	22967-92-6	0.07 Minimum Criteria Systemic Toxicant	NA	NA	0.7	-Neurological
Merphos	150-50-5	0.2 Minimum Criteria Systemic Toxicant	NA	NA	2	-Body Weight -Neurological
Metalaxyl	57837-19-1	420 Minimum Criteria Systemic Toxicant	36.5 Toxicity Criteria	36.5 Toxicity Criteria	4200	-Blood -Liver -Neurological
Methacrylonitrile	126-98-7	5 Minimum Criteria PQL	NA	NA	50	-Liver
Methamidophos	10265-92-6	5 Minimum Criteria PQL	0.000011 Toxicity Criteria	0.000011 Toxicity Criteria	50	-Neurological
Methanol	67-56-1	5000 Minimum Criteria PQL	45037 Toxicity Criteria	45037 Toxicity Criteria	50000	-Liver -Neurological
Methidathion	950-37-8	0.7 Minimum Criteria Systemic Toxicant	0.03 Toxicity Criteria	0.03 Toxicity Criteria	7	-Liver
Methomyl	16752-77-5	175 Minimum Criteria Systemic Toxicant	0.95 Toxicity Criteria	0.95 Toxicity Criteria	1750	-Kidney -Spleen
Methoxy-5-nitroaniline, 2-	99-59-2	50 Minimum Criteria PQL	NA	NA	500	-Carcinogen
Methoxychlor	72-43-5	* Primary Standard	**	**	***	-Developmental -Reproductive

Table I
Groundwater and Surface Water Cleanup Target Levels

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Methoxyethanol, 2-	109-86-4	100000 Minimum Criteria PQL	NA	NA	1000000	-Reproductive
Methyl acetate	79-20-9	5000 Minimum Criteria PQL	NA	NA	50000	-Liver
Methyl acrylate	96-33-3	210 Minimum Criteria Systemic Toxicant	NA	NA	2100	-None Specified
Methyl isobutyl ketone [or MIBK]	108-10-1	560 Minimum Criteria Systemic Toxicant	23000 Toxicity Criteria	23000 Toxicity Criteria	5600	-Kidney -Liver
Methyl methacrylate	80-62-6	25 Minimum Criteria Organoleptic	6500 Toxicity Criteria	6500 Toxicity Criteria	250	-Nasal
Methyl parathion [or Parathion, methyl]	298-00-0	1.8 Minimum Criteria Systemic Toxicant	0.01 Toxicity Criteria	0.01 Toxicity Criteria	18	-Blood -Neurological
Methyl tert-butyl ether [or MTBE]	1634-04-4	50 Minimum Criteria Organoleptic	33600 Toxicity Criteria	33600 Toxicity Criteria	500	-Eye -Kidney -Liver
Methyl(1,4-chlorophenoxy)propionic acid	7085-19-0	7 Minimum Criteria Systemic Toxicant	NA	NA	70	-None Specified
Methyl-4-chlorophenoxy acetic acid, 2-	94-74-6	3.5 Minimum Criteria Systemic Toxicant	72 Toxicity Criteria	72 Toxicity Criteria	35	-Kidney -Liver
Methyl-5-nitroaniline, 2-	99-55-8	10 Minimum Criteria PQL	NA	NA	100	-Carcinogen
Methylaniline, 2-	95-53-4	50 Minimum Criteria PQL	26 Toxicity Criteria	26 Toxicity Criteria	500	-Carcinogen
Methylene bis(2-chloroaniline), 4,4-	101-14-4	50 Minimum Criteria PQL	NA	NA	500	-Carcinogen -Liver -Bladder
Methylene bromide	74-95-3	70 Minimum Criteria Systemic Toxicant	NA	NA	700	-Blood
Methylene chloride	75-09-2	* Primary Standard	**	**	***	-Carcinogen -Liver

Table I
Groundwater and Surface Water Cleanup Target Levels

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Methylnaphthalene, 1-	90-12-0	20 Minimum Criteria Organoleptic	95 Toxicity Criteria	95 Toxicity Criteria	200	-Body Weight -Nasal
Methylnaphthalene, 2-	91-57-6	20 Minimum Criteria Organoleptic	30 Toxicity Criteria	30 Toxicity Criteria	200	-Body Weight -Nasal
Methylphenol, 2- [or o-Cresol]	95-48-7	35 Minimum Criteria Systemic Toxicant	250 Toxicity Criteria	250 Toxicity Criteria	350	-Body Weight -Neurological
Methylphenol, 3- [or m-Cresol]	108-39-4	35 Minimum Criteria Systemic Toxicant	445 Toxicity Criteria	445 Toxicity Criteria	350	-Body Weight -Neurological
Methylphenol, 4- [or p-Cresol]	106-44-5	4 Minimum Criteria PQL	70 Toxicity Criteria	70 Toxicity Criteria	40	-Maternal Death -Neurological -Respiratory
Metolachlor	51218-45-2	105 Minimum Criteria Systemic Toxicant	1.08 Toxicity Criteria	1.08 Toxicity Criteria	1050	-Body Weight
Metribuzin	21087-64-9	175 Minimum Criteria Systemic Toxicant	64 Toxicity Criteria	64 Toxicity Criteria	1750	-Body Weight -Kidney -Liver -Mortality
Metsulfuron, methyl [or Ally]	74223-64-6	1750 Minimum Criteria Systemic Toxicant	NA	NA	17500	-Body Weight
Mevinphos	7786-34-7	1.8 Minimum Criteria Systemic Toxicant	0.0475 Toxicity Criteria	0.0475 Toxicity Criteria	18	-Neurological
Mirex	2385-85-5	1.4 Minimum Criteria Systemic Toxicant	**	**	14	-Liver -Thyroid
Molinate	2212-67-1	14 Minimum Criteria Systemic Toxicant	17 Toxicity Criteria	17 Toxicity Criteria	140	-Reproductive
Molybdenum	7439-98-7	35 Minimum Criteria Systemic Toxicant	NA	NA	350	-Gout
Naled	300-76-5	14 Minimum Criteria Systemic Toxicant	0.018 Toxicity Criteria	0.018 Toxicity Criteria	140	-Neurological
Naphthalene	91-20-3	20 Minimum Criteria Organoleptic	26 Toxicity Criteria	26 Toxicity Criteria	200	-Body Weight -Nasal

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Groundwater and Surface Water Cleanup Target Levels

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Naphthylamine, 2-	91-59-8	10 Minimum Criteria PQL	NA	NA	100	-Carcinogen
Napropamide	15299-99-7	700 Minimum Criteria Systemic Toxicant	210 Toxicity Criteria	210 Toxicity Criteria	7000	-Body Weight
Nickel	7440-02-0	* Primary Standard	a	**	***	-Body Weight
Nitrate	14797-55-8	* Primary Standard	**	**	***	-Blood
Nitrate+Nitrite	NOCAS#	* Primary Standard	**	**	***	-Blood
Nitrite	14797-65-0	* Primary Standard	**	**	***	-Blood
Nitroaniline, m-	99-09-2	50 Minimum Criteria PQL	NA	NA	500	-None Specified
Nitroaniline, o-	88-74-4	50 Minimum Criteria PQL	NA	NA	500	-Blood
Nitroaniline, p-	100-01-6	21 Minimum Criteria Systemic Toxicant	1200 Toxicity Criteria	1200 Toxicity Criteria	210	-None Specified
Nitrobenzene	98-95-3	4 Minimum Criteria PQL	90 Toxicity Criteria	90 Toxicity Criteria	40	-Adrenals -Blood -Kidney -Liver
Nitrophenol, 4-	100-02-7	56 Minimum Criteria Systemic Toxicant	55 Toxicity Criteria	55 Toxicity Criteria	560	-None Specified
Nitroso-di-ethylamine, N-	55-18-5	4 Minimum Criteria PQL	0.18 Human Health	0.18 Human Health	40	-Carcinogen
Nitroso-dimethylamine, N-	62-75-9	2 Minimum Criteria PQL	0.53 Human Health	0.53 Human Health	20	-Carcinogen
Nitroso-di-n-butylamine, N-	924-16-3	4 Minimum Criteria PQL	0.16 Human Health	0.16 Human Health	40	-Carcinogen

**Table I
Groundwater and Surface Water Cleanup Target Levels**

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Nitroso-di-n-propylamine, N-	621-64-7	4 Minimum Criteria PQL	0.83 Human Health	0.83 Human Health	40	-Carcinogen
Nitroso-diphenylamine, N-	86-30-6	7.1 Minimum Criteria Carcinogen	44 Human Health	44 Human Health	71	-Carcinogen
Nitroso-N-methylethylamine, N-	10595-95-6	8 Minimum Criteria PQL	1.22 Human Health	1.22 Human Health	80	-Carcinogen
Nitrosopyrrolidine, N-	930-55-2	8 Minimum Criteria PQL	NA	NA	80	-Carcinogen
Nitrotoluene, m-	99-08-1	250 Minimum Criteria PQL	375 Toxicity Criteria	375 Toxicity Criteria	2500	-Spleen
Nitrotoluene, o-	88-72-2	250 Minimum Criteria PQL	550 Toxicity Criteria	550 Toxicity Criteria	2500	-Spleen
Nitrotoluene, p-	99-99-0	250 Minimum Criteria PQL	550 Toxicity Criteria	550 Toxicity Criteria	2500	-Spleen
Norflurazon	27314-13-2	280 Minimum Criteria Systemic Toxicant	NA	NA	2800	-Kidney -Liver -Thyroid
Octahydro-1,3,5,7-tetranitro-tetrazocine [or HMX]	2691-41-0	350 Minimum Criteria Systemic Toxicant	1250 Toxicity Criteria	1250 Toxicity Criteria	3500	-Blood
Octamethylpyrophosphoramidate	152-16-9	1000 Minimum Criteria PQL	NA	NA	10000	-Neurological
Oryzalin	19044-88-3	350 Minimum Criteria Systemic Toxicant	NA	NA	3500	-Blood -Kidney -Liver
Oxadiazon	19666-30-9	35 Minimum Criteria Systemic Toxicant	44 Toxicity Criteria	44 Toxicity Criteria	350	-Liver
Oxamyl	23135-22-0	* Primary Standard	8.5 Toxicity Criteria	8.5 Toxicity Criteria	***	-Body Weight
Paraquat	1910-42-5	31.5 Minimum Criteria Systemic Toxicant	47 Toxicity Criteria	47 Toxicity Criteria	315	-Respiratory

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Groundwater and Surface Water Cleanup Target Levels

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Parathion	56-38-2	42 Minimum Criteria Systemic Toxicant	**	**	420	-Neurological
PCBs [Aroclor mixture]	1336-36-3	* Primary Standard	**	**	***	-Carcinogen -Immunological
Pebulate	1114-71-2	350 Minimum Criteria Systemic Toxicant	305 Toxicity Criteria	305 Toxicity Criteria	3500	-Blood
Pendimethalin	40487-42-1	280 Minimum Criteria Systemic Toxicant	10 Toxicity Criteria	10 Toxicity Criteria	2800	-Liver
Pentachlorobenzene	608-93-5	5.6 Minimum Criteria Systemic Toxicant	1.7 Human Health	1.7 Human Health	56	-Kidney -Liver
Pentachloronitrobenzene	82-68-8	0.5 Minimum Criteria PQL	0.04 Human Health	0.04 Human Health	5	-Carcinogen -Liver
Pentachlorophenol	87-86-5	* Primary Standard	**	**	***	-Carcinogen -Kidney -Liver
Permethrin	52645-53-1	350 Minimum Criteria Systemic Toxicant	0.001 Toxicity Criteria	0.001 Toxicity Criteria	3500	-Liver
Phenanthrene	85-01-8	210 Minimum Criteria Systemic (a)	**	**	2100	-Kidney
Phenol	108-95-2	10 Minimum Criteria Organoleptic	6.5 Toxicity Criteria	6.5 Toxicity Criteria	100	-Developmental
Phenylenediamine, p-	106-50-3	1330 Minimum Criteria Systemic Toxicant	NA	NA	13300	-Whole Body
Phenylphenol, 2-	90-43-7	18 Minimum Criteria Carcinogen	35.5 Toxicity Criteria	35.5 Toxicity Criteria	180	-Carcinogen
Phorate	298-02-2	1.4 Minimum Criteria Systemic Toxicant	0.0055 Toxicity Criteria	0.0055 Toxicity Criteria	14	-Neurological
Phosmet	732-11-6	140 Minimum Criteria Systemic Toxicant	0.1 Toxicity Criteria	0.1 Toxicity Criteria	1400	-Body Weight -Liver -Neurological

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Groundwater and Surface Water Cleanup Target Levels

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Phosphine	7803-51-2	125 Minimum Criteria PQL	NA	NA	1250	-Body Weight
Phthalic anhydride	85-44-9	14000 Minimum Criteria Systemic Toxicant	NA	NA	140000	-Kidney -Nasal -Respiratory
Picloram	1918-02-1	* Primary Standard	70 Toxicity Criteria	70 Toxicity Criteria	***	-Liver
Potassium cyanide	151-50-8	350 Minimum Criteria Systemic Toxicant	5.5 Toxicity Criteria	5.5 Toxicity Criteria	3500	-Body Weight -Neurological -Thyroid
Profluralin	26399-36-0	42 Minimum Criteria Systemic Toxicant	NA	NA	420	-None Specified
Prometon	1610-18-0	105 Minimum Criteria Systemic Toxicant	600 Toxicity Criteria	600 Toxicity Criteria	1050	-None Specified
Prometryn	7287-19-6	28 Minimum Criteria Systemic Toxicant	21 Toxicity Criteria	21 Toxicity Criteria	280	-Bone Marrow -Kidney -Liver
Pronamide	23950-58-5	53 Minimum Criteria Systemic Toxicant	NA	NA	530	-None Specified
Propachlor	1918-16-7	91 Minimum Criteria Systemic Toxicant	11.5 Toxicity Criteria	11.5 Toxicity Criteria	910	-Body Weight -Liver
Propanil	709-98-8	35 Minimum Criteria Systemic Toxicant	20 Toxicity Criteria	20 Toxicity Criteria	350	-Spleen
Propargite	2312-35-8	140 Minimum Criteria Systemic Toxicant	1.55 Toxicity Criteria	1.55 Toxicity Criteria	1400	-None Specified
Propazine	139-40-2	14 Minimum Criteria Systemic Toxicant	185 Toxicity Criteria	185 Toxicity Criteria	140	-Body Weight
Propham	122-42-9	140 Minimum Criteria Systemic Toxicant	500 Toxicity Criteria	500 Toxicity Criteria	1400	-Neurological
Propiconazole	60207-90-1	90 Minimum Criteria Systemic Toxicant	25.5 Toxicity Criteria	25.5 Toxicity Criteria	900	-Gastrointestinal

Table I
Groundwater and Surface Water Cleanup Target Levels

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Propoxur [or Baygon]	114-26-1	2.8 Minimum Criteria Systemic Toxicant	0.35 Toxicity Criteria	0.35 Toxicity Criteria	28	-Blood -Neurological
Propylene glycol	57-55-6	140000 Minimum Criteria Systemic Toxicant	35500 Toxicity Criteria	35500 Toxicity Criteria	1400000	-Blood -Bone Marrow
Propylene oxide	75-56-9	5000 Minimum Criteria PQL	NA	NA	50000	-Carcinogen -Nasal -Respiratory
Pydrin [or Fenvalerate]	51630-58-1	1750 Minimum Criteria Systemic Toxicant	0.00035 Toxicity Criteria	0.00035 Toxicity Criteria	17500	-Neurological
Pyrene	129-00-0	210 Minimum Criteria Systemic Toxicant	0.3 Toxicity Criteria	0.3 Toxicity Criteria	2100	-Kidney
Pyridine	110-86-1	7 Minimum Criteria PQL	1300 Toxicity Criteria	1300 Toxicity Criteria	70	-Liver
Radium, 226 and 228 (combined)	7440-14-4	* Primary Standard	**	**	***	-Carcinogen
Resmethrin	10453-86-8	210 Minimum Criteria Systemic Toxicant	0.0026 Toxicity Criteria	0.0026 Toxicity Criteria	2100	-Reproductive
Ronnel	299-84-3	350 Minimum Criteria Systemic Toxicant	0.061 Toxicity Criteria	0.061 Toxicity Criteria	3500	-Liver
Rotenone	83-79-4	28 Minimum Criteria Systemic Toxicant	0.115 Toxicity Criteria	0.115 Toxicity Criteria	280	-Developmental
Selenious acid (as Selenium)	7783-00-8	35 Minimum Criteria Systemic Toxicant	40 Toxicity Criteria	40 Toxicity Criteria	350	-Hair Loss -Neurological -Skin
Selenium	7782-49-2	* Primary Standard	**	**	***	-Hair Loss -Neurological -Skin
Silver	7440-22-4	* Secondary Standard	**	0.35 Toxicity Criteria	***	-Skin
Simazine	122-34-9	* Primary Standard	5.8 Human Health	5.8 Human Health	***	-Blood -Body Weight -Carcinogen

**Table I
Groundwater and Surface Water Cleanup Target Levels**

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Sodium	7440-23-5	* Primary Standard	c	NA	***	-None Specified
Sodium cyanide (as Cyanide)	143-33-9	280 Minimum Criteria Systemic Toxicant	3.79 Toxicity Criteria	3.79 Toxicity Criteria	2800	-Neurological
Strontium	7440-24-6	4200 Minimum Criteria Systemic Toxicant	NA	NA	42000	-Bone
Strychnine	57-24-9	100 Minimum Criteria PQL	38 Toxicity Criteria	38 Toxicity Criteria	1000	-Mortality
Styrene	100-42-5	* Primary Standard	455 Toxicity Criteria	455 Toxicity Criteria	***	-Blood -Liver -Neurological
Sulfate	14808-79-8	* Secondary Standard	b	b	***	-None Specified
Tebuthiuron	34014-18-1	490 Minimum Criteria Systemic Toxicant	307 Toxicity Criteria	307 Toxicity Criteria	4900	-Body Weight
Temephos	3383-96-8	140 Minimum Criteria Systemic Toxicant	0.002 Toxicity Criteria	0.002 Toxicity Criteria	1400	-None Specified
Terbacil	5902-51-2	91 Minimum Criteria Systemic Toxicant	2450 Toxicity Criteria	2450 Toxicity Criteria	910	-Liver -Thyroid
Terbufos	13071-79-9	0.2 Minimum Criteria Systemic Toxicant	0.01 Toxicity Criteria	0.01 Toxicity Criteria	2	-Neurological
Terbutryn	886-50-0	330 Minimum Criteria PQL	3.1 Toxicity Criteria	3.1 Toxicity Criteria	3300	-Blood
Tetrachlorobenzene, 1,2,4,5-	95-94-3	2.1 Minimum Criteria Systemic Toxicant	2.3 Human Health	2.3 Human Health	21	-Kidney
Tetrachloroethane, 1,1,1,2-	630-20-6	1.3 Minimum Criteria Carcinogen	NA	NA	13	-Carcinogen -Kidney -Liver
Tetrachloroethane, 1,1,2,2-	79-34-5	0.2 Minimum Criteria Carcinogen	**	**	2	-Carcinogen

Table I
Groundwater and Surface Water Cleanup Target Levels

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Tetrachloroethene [or PCE]	127-18-4	* Primary Standard	**	**	***	-Body Weight -Carcinogen -Liver
Tetrachlorophenol, 2,3,4,6-	58-90-2	210 Minimum Criteria Systemic Toxicant	4.5 Toxicity Criteria	4.5 Toxicity Criteria	2100	-Liver
Tetraethyl dithiopyrophosphate	3689-24-5	3.5 Minimum Criteria PQL	0.0115 Toxicity Criteria	0.0115 Toxicity Criteria	35	-Bone Marrow -Neurological
Thallium	7440-28-0	* Primary Standard	**	**	***	-Blood -Hair Loss -Liver
Thiocyanomethylthio-benzothiazole, 2-	21564-17-0	210 Minimum Criteria Systemic Toxicant	0.435 Toxicity Criteria	0.435 Toxicity Criteria	2100	-Gastrointestinal
Thiram	137-26-8	35 Minimum Criteria Systemic Toxicant	0.168 Toxicity Criteria	0.168 Toxicity Criteria	350	-Neurological
Tin	7440-31-5	4200 Minimum Criteria Systemic Toxicant	NA	NA	42000	-Kidney -Liver
Toluene	108-88-3	* Secondary Standard	475 Toxicity Criteria	475 Toxicity Criteria	***	-Kidney -Liver -Neurological
Toluene-2,4-diamine	95-80-7	100 Minimum Criteria PQL	NA	NA	1000	-Carcinogen
Toluidine, p-	106-49-0	150 Minimum Criteria PQL	NA	NA	1500	-Carcinogen
Total dissolved solids [or TDS]	C-010	* Secondary Standard	NA	NA	***	-None Specified
Toxaphene	8001-35-2	* Primary Standard	**	**	***	-Carcinogen -Developmental
Triallate	2303-17-5	91 Minimum Criteria Systemic Toxicant	65 Toxicity Criteria	65 Toxicity Criteria	910	-Liver -Spleen
Tributyltin oxide	56-35-9	10 Minimum Criteria PQL	0.05 Toxicity Criteria	0.05 Toxicity Criteria	100	-Immunological

**Table I
Groundwater and Surface Water Cleanup Target Levels**

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Trichloro-1,2,2-trifluoroethane, 1,1,2- [or CFC 113]	76-13-1	500000 Minimum Criteria PQL	NA	NA	5000000	-Body Weight -Neurological
Trichloroacetic acid	76-03-9	300 Minimum Criteria Health Advisory Level	100000 Toxicity Criteria	100000 Toxicity Criteria	3000	-None Specified
Trichlorobenzene, 1,2,3-	87-61-6	70 Minimum Criteria Systemic (c)	85 Toxicity Criteria	85 Toxicity Criteria	700	-Adrenals -Body Weight
Trichlorobenzene, 1,2,4-	120-82-1	* Primary Standard	22.5 Toxicity Criteria	22.5 Toxicity Criteria	***	-Adrenals -Body Weight
Trichlorobenzene, 1,3,5-	108-70-3	40 Minimum Criteria Systemic Toxicant	NA	NA	400	-None Specified
Trichloroethane, 1,1,1- [or Methyl chloroform]	71-55-6	* Primary Standard	270 Toxicity Criteria	270 Toxicity Criteria	***	-None Specified
Trichloroethane, 1,1,2-	79-00-5	* Primary Standard	28.5 Human Health	28.5 Human Health	***	-Carcinogen -Liver
Trichloroethene [or TCE]	79-01-6	* Primary Standard	**	**	***	-Carcinogen
Trichlorofluoromethane	75-69-4	2100 Minimum Criteria Systemic Toxicant	NA	NA	21000	-Cardiovascular -Kidney -Mortality - Respiratory
Trichlorophenol, 2,4,5-	95-95-4	4 Minimum Criteria Organoleptic	22.5 Toxicity Criteria	22.5 Toxicity Criteria	40	-Kidney -Liver
Trichlorophenol, 2,4,6-	88-06-2	3.2 Minimum Criteria Carcinogen	**	**	32	-Carcinogen
Trichlorophenoxy acetic acid, 2,4,5-	93-76-5	70 Minimum Criteria Systemic Toxicant	145 Toxicity Criteria	145 Toxicity Criteria	700	-Kidney
Trichlorophenoxy propionic acid [or Silvex]	93-72-1	* Primary Standard	NA	NA	***	-Liver
Trichloropropane, 1,2,3-	96-18-4	0.2 Minimum Criteria PQL	0.26 Human Health	0.26 Human Health	2	-Body Weight -Carcinogen -Kidney -Liver - Mortality

Table I
Groundwater and Surface Water Cleanup Target Levels

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Trifluralin	1582-09-8	4.5 Minimum Criteria Carcinogen	0.78 Human Health	0.78 Human Health	45	-Blood -Carcinogen -Liver
Trimethyl phosphate	512-56-1	50 Minimum Criteria PQL	NA	NA	500	-Carcinogen
Trimethylbenzene, 1,2,3-	526-73-8	10 Minimum Criteria Organoleptic	NA	NA	100	-None Specified
Trimethylbenzene, 1,2,4-	95-63-6	10 Minimum Criteria Organoleptic	217.5 Toxicity Criteria	217.5 Toxicity Criteria	100	-None Specified
Trimethylbenzene, 1,3,5-	108-67-8	10 Minimum Criteria Organoleptic	215 Toxicity Criteria	215 Toxicity Criteria	100	-None Specified
Trinitrobenzene, 1,3,5-	99-35-4	210 Minimum Criteria Systemic Toxicant	19 Toxicity Criteria	19 Toxicity Criteria	2100	-Blood -Spleen
Trinitrotoluene, 2,4,6-	118-96-7	10 Minimum Criteria PQL	49 Toxicity Criteria	49 Toxicity Criteria	100	-Carcinogen -Liver
TRPH	NOCAS#	5000 Minimum Criteria ##	**	**	50000	-Multiple Endpoints Mixed Contaminants
Uranium, natural	7440-61-1	21 Minimum Criteria Systemic Toxicant	NA	NA	210	-None Specified
Vanadium	7440-62-2	49 Minimum Criteria Systemic Toxicant	NA	NA	490	-None Specified
Vernam	1929-77-7	7 Minimum Criteria Systemic Toxicant	11.5 Toxicity Criteria	11.5 Toxicity Criteria	70	-Body Weight
Vinyl acetate	108-05-4	88 Minimum Criteria Organoleptic	700 Toxicity Criteria	700 Toxicity Criteria	880	-Body Weight -Kidney -Nasal
Vinyl chloride	75-01-4	* Primary Standard	NA	NA	***	-Carcinogen
Xylenes, total	1330-20-7	* Secondary Standard	370 Toxicity Criteria	370 Toxicity Criteria	***	-Body Weight -Mortality -Neurological

**Table I
Groundwater and Surface Water Cleanup Target Levels**

Contaminant	CAS #	Groundwater Criteria	Freshwater Surface Water Criteria	Marine Surface Water Criteria	Groundwater of Low Yield/Poor Quality Criteria	Target Organ/System or Effect
		(ug/L)	(ug/L)	(ug/L)	(ug/L)	
Zinc	7440-66-6	* Secondary Standard	**	**	***	-Blood
Zinc chloride	7646-85-7	2100 Minimum Criteria Systemic Toxicant	1.5 Toxicity Criteria	1.5 Toxicity Criteria	21000	-Blood
Zinc phosphide	1314-84-7	2.1 Minimum Criteria Systemic Toxicant	NA	NA	21	-Body Weight
Zineb	12122-67-7	350 Minimum Criteria Systemic Toxicant	13.5 Toxicity Criteria	13.5 Toxicity Criteria	3500	-Thyroid

* = As provided in Chapters 62-550 and 62-520, F.A.C.

** = As provided in Chapter 62-302, F.A.C.

*** = Equal to 10 times the value provided in Chapters 62-550 and 62-520, F.A.C.

a = Hardness-dependent per Chapter 62-302, F.A.C.

b = Not greater than 10% above background.

c = Shall not be increased more than 50% above background or to 1275, whichever is greater (per Chapter 62-302, F.A.C.).

= Based on similarity to chloride considerations as provided in Chapter 62-302, F.A.C.

= Based on similarity to oil and grease standard as provided in Chapter 62-302, F.A.C.

62-302 = As provided in Chapter 62-302, F.A.C. If the PQL using the most sensitive and currently available technology is higher than the specified criterion, the PQL shall be used.

Note: Freshwater and Marine Surface Waters shall pass Toxicity Bioassay Tests; "pass test" shall mean mortality less than 50% in a 96-hour acute toxicity test performed, in predominantly fresh waters, on both *Cyprinella leedsi* (bannerfin shiner) and *Ceriodaphnia dubia* (water flea), and in predominantly marine waters, on both *Menidia beryllina* (inland silversides) and *Americamysis bahia* (possum shrimp).

PQL = Practical Quantitation Limit.

MRL = Minimum Risk Level from ATSDR Toxicant Profile.

Toxicity Criteria = 1/20 of applicable LC50 data.

NA = Not Available at time of Rule adoption.

Surrogate (a): Surrogate RfD based on other non-carcinogenic PAHs (e.g., pyrene).

Surrogate (b): Surrogate RfD based on oral RfD for HCH-gamma (lindane).

Surrogate (c): Surrogate RfD based on Primary Groundwater Standard for 1,2,4-trichlorobenzene.

(a) Zones of mixing for thermal discharges from non-recirculated cooling water systems and process water systems of new sources shall be allowed if supported by a demonstration, as provided in Section 316(a), Public Law 92-500 and regulations promulgated thereunder, including 40 C.F.R. Part 122, by an applicant that the proposed mixing zone will assure the protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife in and on the body of water into which the discharge is to be made and such demonstration has not been rebutted. It is the intent of the Commission that to the extent practicable, proceedings under this provision should be conducted jointly with proceedings before the federal government under Section 316(a), Public Law 92-500.

(b) Zones of mixing for blowdown discharges from recirculated cooling water systems, and for discharges from non-recirculated cooling water systems of existing sources, shall be established on the basis of the physical and biological characteristics of the RBW.

(c) When a zone of mixing is established pursuant to this Rule 62-302.520(6), F.A.C., any otherwise applicable temperature limitations contained in Rule 62-302.520, F.A.C., shall be met at its boundary; however, the Department may also establish maximum numerical temperature limits to be measured at the POD and to be used in lieu of the general temperature limits in Rule 62-3.520, F.A.C., to determine compliance by the discharge with the established mixing zone and the temperature limits in Rule 62-302.520, F.A.C.

Specific Authority: 403.061, 403.062, 403.087, 403.504, 403.704, 403.804, F.S.
 Law Implemented: 403.021, 403.061, 403.087, 403.088, 403.141, 403.161, 403.182, 403.502, 403.702, 403.708, F.S.
 History: Formerly 28-5.02, 17-3.02, Amended 10-28-70, Amended and Renumbered 3-1-79, Formerly 17-3.050, Formerly 17-302.520.

62-302.530 Table: Surface Water Quality Criteria. The following table contains both numeric and narrative surface water quality criteria to be applied except within zones of mixing. The left-hand column of the Table is a list of constituents for which a surface water criterion exists. The headings for the water quality classifications are found at the top of the Table. Applicable criteria lie within the Table. The individual criteria should be read in conjunction with other provisions in water quality standards, including Rules 62-302.500 and 62-302.510, F.A.C. The criteria contained in Rules 62-302.500 or 62-302.510 also apply to all waters unless alternative or more stringent criteria are specified in Rule 62-302.530, F.A.C.

62-302.520(6)(a) - 62-302.530

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Unless otherwise stated, all criteria express the maximum not to be exceeded at any time. In some cases, there are separate or additional limits, such as annual average criteria, which apply independently of the maximum not to be exceeded at any time.

62-302.530(cont'd.)

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Parameter	Units	Class I	Class II	Class III: Fresh	Class III: Marine	Class IV	Class V	
(10) Mercury	Micrograms/L	≤ 0.0077 annual avg	≤ 0.13 annual avg	≤ 0.13 annual avg.	≤ 0.13 annual avg.	≤ 100 in waters with a hardness in mg/L of CaCO_3 of less than 250 and shall not exceed 500 in harder waters		
(11) Benthic Invertebrates	Percent reduction of Shannon-Wiener Diversity Index	The index for benthic macroinvertebrates shall not be reduced to less than 75% of background levels as measured using organisms retained by a U. S. Standard No. 30 sieve and collected and composited from a minimum of three 1-liter-Density type artificial substrate samplers of 0.10 to 0.15 m^2 area each, incubated for a period of four weeks.	The index for benthic macroinvertebrates shall not be reduced to less than 75% of established background levels as measured using organisms retained by a U. S. Standard No. 30 sieve and collected and composited from a minimum of three natural substrate samples, taken with Ponar type samplers with minimum sampling area of 225 cm^2	The index for benthic macroinvertebrates shall not be reduced to less than 75% of established background levels as measured using organisms retained by a U. S. Standard No. 30 sieve and collected and composited from a minimum of three 1-liter-Density type artificial substrate samplers of 0.10 to 0.15 m^2 area each, incubated for a period of four weeks.	The index for benthic macroinvertebrates shall not be reduced to less than 75% of established background levels as measured using organisms retained by a U. S. Standard No. 30 sieve and collected and composited from a minimum of three natural substrate samples, taken with Ponar type samplers with minimum sampling area of 225 cm^2			
(12) (H ₂ O) Biochemical Oxygen Demand		Shall not be increased to exceed values which would cause dissolved oxygen to be depressed below the limit established for each class and, in no case, shall it be great enough to produce nuisance conditions.						
(13) Boron	Miligrams/L					≤ 0.75		
(14) Nitrates	Miligrams/L		≤ 100		≤ 100			
(15) Nitrite (free molecular)	Miligrams/L		≤ 0.1		≤ 0.1			

Notes: (1) "Annual avg." means the maximum concentration at average annual flow conditions (see Section 62-4.020(1), F.A.C.); (2) "Max" means the maximum not to be exceeded at any time; (3) "ln H" means the natural logarithm of total hardness expressed as milligrams/L of CaCO_3 . For metals criteria involving equations with hardness, the hardness shall be set at 25 mg/L if actual hardness is < 25 mg/L and set at 400 mg/L if actual hardness is > 400 mg/L; (4) Criteria are protective of human health not of aquatic life.

Parameter	Units	Class I	Class II	Class III: Fresh	Class III: Marine	Class IV	Class V
(16) Cadmium	Micrograms/L See Note (3)	$\text{Cd} \leq \frac{1}{e^{(0.7852(\ln H) - 3.49)}}$	≤ 9.3	$\text{Cd} \leq \frac{1}{e^{(0.7852(\ln H) - 3.49)}}$	≤ 9.3		
(17) Carbon tetrachloride	Micrograms/L	≤ 0.25 annual avg., 3.0 max	≤ 4.42 annual avg.	≤ 4.42 annual avg.	≤ 4.42 annual avg.		
(18) Chlorides	Miligrams/L	≤ 250	Not increased more than 10% above normal background. Normal daily and seasonal fluctuations shall be maintained.		Not increased more than 10% above normal background. Normal daily and seasonal fluctuations shall be maintained.		In predominantly marine waters, not increased more than 10% above normal background. Normal daily and seasonal fluctuations shall be maintained.
(19) Chlorine (total residual)	Miligrams/L	≤ 0.01	≤ 0.01	≤ 0.01	≤ 0.01		
(20) (a) Chromium (trivalent)	Micrograms/L measured as total recoverable Chromium See Note (3)	$\text{Cr (III)} \leq \frac{1}{e^{(0.819(\ln H) + 1.561)}}$		$\text{Cr (III)} \leq \frac{1}{e^{(0.819(\ln H) + 1.561)}}$		$\text{Cr (III)} \leq \frac{1}{e^{(0.819(\ln H) + 1.561)}}$	In predominantly fresh waters, $\leq \frac{1}{e^{(0.819(\ln H) + 1.561)}}$
(20) (b) Chromium (hexavalent)	Micrograms/L	≤ 11	≤ 50	≤ 11	≤ 50	≤ 11	In predominantly fresh waters, ≤ 11 . In predominantly marine waters, ≤ 50

Notes: (1) "Annual avg." means the maximum concentration at average annual flow conditions (see Section 62-4.020(1), F.A.C.); (2) "Max" means the maximum not to be exceeded at any time; (3) "ln H" means the natural logarithm of total hardness expressed as milligrams/L of CaCO_3 . For metals criteria involving equations with hardness, the hardness shall be set at 25 mg/L if actual hardness is < 25 mg/L and set at 400 mg/L if actual hardness is > 400 mg/L; (4) Criteria are protective of human health not of aquatic life.

Parameter	Units	Class I	Class II	Class III: Fresh	Class III: Marine	Class IV	Class V
(35) "General Criteria" - see Section 62.302 510, F.A.C. and individual criteria							
(36)(a) Halomethanes (Total trihalomethanes (total of bromoform, chloroform, dichlorobromomethane, dichlorochloromethane, and chloroform) individual halomethanes shall not exceed (h)1 in (h)5 below:	Micrograms/L.	≤ 100					
(36)(b) 1. Halomethanes (individual) Bromoform	Micrograms/L.	≤ 4.3 annual avg.	≤ 3.0 annual avg.	≤ 3.0 annual avg.	≤ 3.0 annual avg.		
(36)(b) 2. Halomethanes (individual) Chlorobromomethane	Micrograms/L.	≤ 0.41 annual avg.	≤ 3.4 annual avg.	≤ 3.4 annual avg.	≤ 3.4 annual avg.		
(36)(b) 3. Halomethanes (individual) Chloroform	Micrograms/L.	≤ 5.67 annual avg.	≤ 470.8 annual avg.	≤ 470.8 annual avg.	≤ 470.8 annual avg.		

Notes: (1) "Annual avg." means the maximum concentration at average annual flow conditions (see Section 62-4.020(1), F.A.C.); (2) "Max" means the maximum not to be exceeded at any time; (3) "ln H" means the natural logarithm of total hardness expressed as milligrams/L of CaCO₃. For metals criteria involving equations with hardness, the hardness shall be set at 25 mg/L if actual hardness is < 25 mg/L and set at 400 mg/L if actual hardness is > 400 mg/L; (4) Criteria are protective of human health not of aquatic life.

Parameter	Units	Class I	Class II	Class III: Fresh	Class III: Marine	Class IV	Class V
(36)(b) 4. Halomethanes (individual) Chloromethane (methyl chloride)	Micrograms/L.	≤ 5.67 annual avg.	≤ 470.8 annual avg.	≤ 470.8 annual avg.	≤ 470.8 annual avg.		
(36)(b) 5. Halomethanes (individual) Dichlorobromomethane	Micrograms/L.	≤ 0.27 annual avg.	≤ 22 annual avg.	≤ 22 annual avg.	≤ 22 annual avg.		
(37) 1. Hexachlorocyclopentadiene	Micrograms/L.	≤ 0.45 annual avg.	≤ 49.7 annual avg.	≤ 49.7 annual avg.	≤ 49.7 annual avg.		
(38) Inhibitors (see Nitrazines)							
(39) Iron	Milligrams/L.	≤ 0.3	≤ 0.3	≤ 1.0	≤ 0.3	≤ 1.0	≤ 50
(40) Lead	Micrograms/L. See Note (3).	$\ln \leq \frac{1}{273} (\ln H) - 4.705$	≤ 5.6	$\ln \leq \frac{1}{273} (\ln H) - 4.705$	≤ 5.6	≤ 50	≤ 50
(41) Benzene	Milligrams/L.		≤ 0.1				
(42) Mercury	Micrograms/L.	≤ 0.012	≤ 0.025	≤ 0.012	≤ 0.025	≤ 0.2	≤ 0.2
(43) Minimum Criteria (see Section 62-302 500, F.A.C.)							
(44) Mixing Zones (See Section 62-1 246, F.A.C.)							
(45) Nickel	Micrograms/L. See Note (3).	$\ln \leq \frac{1}{273} (\ln H) - 1.645$	≤ 8.3	$\ln \leq \frac{1}{273} (\ln H) - 1.645$	≤ 8.3	≤ 100	

Notes: (1) "Annual avg." means the maximum concentration at average annual flow conditions (see Section 62-4.020(1), F.A.C.); (2) "Max" means the maximum not to be exceeded at any time; (3) "ln H" means the natural logarithm of total hardness expressed as milligrams/L of CaCO₃. For metals criteria involving equations with hardness, the hardness shall be set at 25 mg/L if actual hardness is < 25 mg/L and set at 400 mg/L if actual hardness is > 400 mg/L; (4) Criteria are protective of human health not of aquatic life.

Parameter	Units	Class I	Class II	Class III: Fresh	Class III: Marine	Class IV	Class V
(51)(q) Parathion	Micrograms/L	≤ 0.04	≤ 0.04	≤ 0.04	≤ 0.04		
(51)(r) Toxaphene	Micrograms/L	≤ 0.0012	≤ 0.0002	≤ 0.0002	≤ 0.0002		
(52)(a) pH (Class I and Class IV Waters)	Standard Units	Shall not vary more than one unit above or below natural background provided that the pH is not lowered to less than 6 units or raised above 8.5 units. If natural background is less than 6 units, the pH shall not vary below natural background or vary more than one unit above natural background. If natural background is higher than 8.5 units, the pH shall not vary above natural background or vary more than one unit below background.					
(52)(b) pH (Class II Waters)	Standard Units	Shall not vary more than one unit above or below natural background of coastal waters as defined in Section 62-302.520(3)(b), F.A.C., or more than two-tenths unit above or below natural background of open waters as defined in Section 62-302.520(3)(d), F.A.C., provided that the pH is not lowered to less than 6.5 units or raised above 8.5 units. If natural background is less than 6.5 units, the pH shall not vary below natural background or vary more than one unit above natural background for coastal waters or more than two-tenths unit above natural background for open waters. If natural background is higher than 8.5 units, the pH shall not vary above natural background or vary more than one unit below natural background of coastal waters or more than two-tenths unit below natural background of open waters.					
(52)(c) pH (Class III Waters)	Standard Units	Shall not vary more than one unit above or below natural background of predominantly fresh waters and coastal waters as defined in Section 62-302.520(3)(b), F.A.C. or more than two-tenths unit above or below natural background of open waters as defined in Section 62-302.520(3)(d), F.A.C., provided that the pH is not lowered to less than 6 units in predominantly fresh waters, or less than 6.5 units in predominantly marine waters, or raised above 8.5 units. If natural background is less than 6 units, in predominantly fresh waters or 6.5 units in predominantly marine waters, the pH shall not vary below natural background or vary more than one unit above natural background of predominantly fresh waters and coastal waters, or more than two-tenths unit above natural background of open waters. If natural background is higher than 8.5 units, the pH shall not vary above natural background or vary more than one unit below natural background of predominantly fresh waters and coastal waters, or more than two-tenths unit below natural background of open waters.					
(52)(d) pH (Class V Waters)	Standard Units	Not lower than 5.0 nor greater than 9.5 except certain swamp waters which may be as low as 4.5.					
(53)(a) Phenolic Compounds: Total		Phenolic compounds other than those produced by the natural decay of plant material, listed or unlisted, shall not impart the flesh of edible fish or shellfish or produce objectionable taste or odor in a drinking water supply.					

Notes: (1) "Annual avg." means the maximum concentration at average annual flow conditions (see Section 62-4.020(1), F.A.C.); (2) "Max" means the maximum not to be exceeded at any time; (3) "ln H" means the natural logarithm of total hardness expressed as milligrams/L of CaCO₃. For metals criteria involving equations with hardness, the hardness shall be set at 25 mg/L if actual hardness is < 25 mg/L and set at 400 mg/L if actual hardness is > 400 mg/L; (4) Criteria are protective of human health not of aquatic life.

Parameter	Units	Class I	Class II	Class III: Fresh	Class III: Marine	Class IV	Class V
(53)(h) Phenolic Compounds: Total	Micrograms/L	1. The total of all chlorinated phenols, and chlorinated cresols, except as set forth in (c) 1. to (c) 6. below, shall not exceed 1.0 unless higher values are shown not to be chronically toxic. Such higher values shall be approved in writing by the Secretary. 2. The compounds listed in (c) 1. to (c) 6. below shall not exceed the limits specified for each compound.					1. The total of the following Phenolic compounds shall not exceed 50: a) Chlorinated phenolic b) Chlorinated cresols, and c) 2,4-dinitrophenol.
(53)(c) 1 Phenolic Compound: 2-chlorophenol	Micrograms/L	≤ 120	< 400 See Note (4)	< 400 See Note (4)	< 400 See Note (4)	< 400 See Note (4)	
(53)(c) 2 Phenolic Compound: 2,4-dichlorophenol	Micrograms/L	< 93 See Note (4)	< 700 See Note (4)	< 700 See Note (4)	< 790 See Note (4)	< 790 See Note (4)	
(53)(c) 3 Phenolic Compound: 2,4,6-trichlorophenol	Micrograms/L	≤ 30 max; ≤ 0.28 annual avg. ≤ e ^{-1.005(pH-5.29)}	≤ 79	≤ 30 max; ≤ 8.2 annual avg. ≤ e ^{-1.005(pH-5.29)}	≤ 79	≤ 30	
(53)(c) 4 Phenolic Compound: 2,4,6-trichlorocresol	Micrograms/L	≤ 2.1 annual avg.	≤ 6.5 annual avg.	≤ 6.5 annual avg.	≤ 6.5 annual avg.	≤ 6.5 annual avg.	
(53)(c) 5 Phenolic Compound: 2,4-dinitrophenol	Micrograms/L	≤ 0.697 See Note (4)	≤ 14.26 See Note (4)	≤ 14.26 See Note (4)	≤ 14.26 See Note (4)	≤ 14.26 See Note (4)	
(53)(c) 6 Phenolic Compound: Phenol	Micrograms/L	≤ 0.3	≤ 0.3	≤ 0.3	≤ 0.3	≤ 0.3	≤ 0.3
(53) Hexachlorocyclopentadiene (Hexachlorocyclopentadiene)	Micrograms/L		≤ 0.1		≤ 0.1		

Notes: (1) "Annual avg." means the maximum concentration at average annual flow conditions (see Section 62-4.020(1), F.A.C.); (2) "Max" means the maximum not to be exceeded at any time; (3) "ln H" means the natural logarithm of total hardness expressed as milligrams/L of CaCO₃. For metals criteria involving equations with hardness, the hardness shall be set at 25 mg/L if actual hardness is < 25 mg/L and set at 400 mg/L if actual hardness is > 400 mg/L; (4) Criteria are protective of human health not of aquatic life.

Parameter	Units	Class I	Class II	Class III: Fresh	Class III: Marine	Class IV	Class V
(64) Tetrachloroethene (1,1,2,2-tetrachloroethene)	Micrograms/L	≤ 0.8 annual avg., ≤ 1.0 max	≤ 8.5 annual avg.	≤ 8.5 annual avg.	≤ 8.5 annual avg.		
(65) Thallium	Micrograms/L	< 1.7	< 6.1	< 6.1	< 6.1		
(66) Thermal Criteria (See Section 62-402.520)							
(67) Total Dissolved Solids	Percent of the saturation value for gases at the existing atmospheric and hydrostatic pressures	≤ 110% of saturation value					
(68) Transparency	Density of the composition point for photosynthetic activity	Shall not be reduced by more than 10% as compared to the natural background value.	Shall not be reduced by more than 10% as compared to the natural background value.	Shall not be reduced by more than 10% as compared to the natural background value.	Shall not be reduced by more than 10% as compared to the natural background value.		
(69) Trichloroethylene (Trichloroethene)	Micrograms/L	≤ 2.7 annual avg., ≤ 3.0 max	≤ 81.7 annual avg.	≤ 81.7 annual avg.	≤ 81.7 annual avg.		
(70) Turbidity	Nephelometric Turbidity Units (NTU)	≤ 29 above natural background conditions	≤ 29 above natural background conditions	≤ 29 above natural background conditions			
(71) Zinc	Micrograms/L (See Note (3))	Zn ≤ $\frac{10.8473(\ln H) + 0.7614}{0.7614}$	≤ 86	Zn ≤ $\frac{10.8473(\ln H) + 0.7614}{0.7614}$	≤ 86	≤ 1,000	≤ 1,000

Notes: (1) "Annual avg." means the maximum concentration at average annual flow conditions (see Section 62-4.020(1), F.A.C.); (2) "Max" means the maximum not to be exceeded at any time; (3) "ln H" means the natural logarithm of total hardness expressed as milligrams/L of CaCO₃. For metals criteria involving equations with hardness, the hardness shall be set at 25 mg/L if actual hardness is < 25 mg/L and set at 400 mg/L if actual hardness is > 400 mg/L; (4) Criteria are protective of human health not of aquatic life.

HH based, was not used for Cecil 207/008

DEP 1995 SURFACE WATER QUALITY STANDARDS 62-302

Specific Authority: 403.061, 403.062, 403.087, 403.504, 403.704, 403.804, F.S.
 Law Implemented: 403.021, 403.061, 403.087, 403.088, 403.141, 403.161, 403.182, 403.502, 403.702, 403.708, F.S.
 History: New 1-28-90, Formerly 17-3.065, Amended 2-13-92, 6-17-92, 4-25-93, Formerly 17-302.530, Amended 1-23-95.

62-302.600 Classified Waters.

(1) The surface waters of the State of Florida are classified as Class III - Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife, except for certain waters which are described in this section. A water body may be designated as an Outstanding Florida Water or an Outstanding National Resource Water in addition to being classified as Class I, Class II, or Class III. A water body may also have special standards applied to it. Outstanding Florida Waters and Outstanding National Resource Waters are listed in Rule 62-302.700, F.A.C.

(2) Unless otherwise specified, the following shall apply:

(a) The landward extent of a classification shall coincide with the landward extent of waters of the state, as defined in FAC Rules 62-301.400.

(b) Water quality classifications shall be interpreted to include associated water bodies such as tidal creeks, coves, bays and baysous.

(1) Exceptions to Class III:

(a) All secondary and tertiary canals wholly within agricultural areas are classified as Class IV and are not individually listed as exceptions to Class III. "Secondary and tertiary canals" shall mean any wholly artificial canal or ditch which is behind a control structure and which is part of a water control system that is connected to the works (set forth in Section 373.086, F.S.) of a water works (set forth in Section 373.086, F.S.) of a water works management district created under Section 373.069, F.S., and that is permitted by such water management district pursuant to Section 373.103, Section 373.413, or Section 373.416, F.S. Agricultural areas shall generally include lands actively used solely for the production of food and fiber which are zoned for agricultural use where county zoning is in effect. Agricultural areas exclude lands which are platted and subdivided or in a transition phase to residential use?

62-302.530 cont. - 62-302.600 (3) (a)

Effective 1-23-95

APPENDIX E-3

**DERIVATION OF SURFACE SOIL AND GROUNDWATER SCREENING
CONCENTRATIONS OF ESSENTIAL NUTRIENTS FOR COPC SELECTION**

DERIVATION OF SURFACE SOIL AND GROUNDWATER SCREENING CONCENTRATIONS OF ESSENTIAL NUTRIENTS FOR COPC SELECTION

Certain inorganics (calcium, iron, magnesium, potassium, and sodium) that are present as naturally-occurring constituents in soil and groundwater are required in limited intakes to maintain normal human physiological functions, and are therefore considered essential nutrients. The Risk Assessment Guidance for Superfund (RAGS), Volume I, Part A, regarding the treatment of essential nutrients in selection of human health contaminants of potential concern (COPCs), states that essential nutrients need not be quantitatively evaluated in a public health risk assessment if they are: 1) present at low concentrations (only slightly above background); and 2) toxic only at doses much higher than those which might be related to exposure at the site (USEPA, 1989). In this report, "only slightly above background" is interpreted to mean that the arithmetic mean of the site concentrations is less than two times the arithmetic mean of the background concentrations. The focus of this section of the document is the technical approach for determining that an analyte is "toxic only at doses higher than those associated with exposures at the site" and a mechanism for making that determination by employing soil and groundwater screening concentrations. The screening concentrations are used to streamline the process and to eliminate the need to calculate essential nutrient doses as part of COPC selection at every site. If the maximum concentration of an essential nutrient does not exceed the appropriate screening concentration shown below, the essential nutrient is considered non-toxic. Essential nutrients are not retained as COPCs if they are detected at concentrations that are either consistent with background or do not exceed the screening concentrations.

Currently, no published essential nutrient screening concentrations for use in risk assessment COPC selection are available. Therefore, HLA-ES has derived surface soil and groundwater screening concentrations of essential nutrients that, when contacted in accordance with the exposure assumptions described below, are not expected to result in adverse health effects. The screening concentrations for groundwater and surface soil are presented in Table E-3-1. The essential nutrient concentrations in surface soil and groundwater are to be compared directly to the nutrient screening concentrations for the purposes of COPC selection.

**Table E-3-1
Essential Nutrient Screening Concentrations
for Surface Soil and Groundwater**

Remedial Investigation
Operable Unit 4
Naval Training Center
Orlando, Florida

Essential Nutrient	Surface Soil Screening Concentration (mg/kg)	Groundwater Screening Concentration (µg/L)
Calcium	¹ 1,000,000	1,055,398
Iron	47,824	13,267
Magnesium	460,468	118,807
Potassium	¹ 1,000,000	297,016
Sodium	¹ 1,000,000	396,022

¹ Actual calculated screening concentration is greater than 1,000,000 mg/kg (Table E-3-5), indicating that this essential nutrient would not be present at toxic levels in surface soil.

As described below, screening concentrations for surface soil and groundwater represent conservative screening concentrations for other media. These surface soil and groundwater screening concentrations are used to screen sediment, subsurface soil, sludge, and surface water, respectively.

DOCUMENTATION OF SURFACE SOIL AND GROUNDWATER SCREENING CONCENTRATIONS

The essential nutrient toxicity screening concentrations were derived in two steps: first, a "non-toxic" dose was identified for each essential nutrient; second, the soil and groundwater concentrations associated with the "non-toxic" doses were calculated using standard residential exposure assumptions. The details of the derivation of the screening values are presented below.

Identification of non-toxic doses

The identification of doses which are not toxic is often accomplished by identifying Reference Doses (RfDs) which are published by USEPA. These RfDs represent doses, including a margin of safety, to which even sensitive subpopulations could be exposed for a lifetime without adverse non-carcinogenic effects. Because no RfDs for calcium, iron, magnesium, potassium, or sodium are available in the Integrated Risk Information System (IRIS) (USEPA, 1998) or the Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997), other published non-toxic doses were sought out. Recommended Dietary Allowances (RDAs) prepared by the Food and Nutrition Board (FNB) of the National Research Council (NRC, 1989) have been selected here to represent non-toxic doses.

RDAs are defined by the FNB as "the levels of intake of essential nutrients that, on the basis of scientific knowledge, are judged by the Food and Nutrition Board to be adequate to meet the known nutrient needs of practically all healthy persons." It is assumed here that, because the RDA represents a requirement for good nutrition, it also represents a dose that is non-toxic. Although some essential nutrients (arsenic for example) have been classified as carcinogens, none of the five nutrients discussed here have been classified as carcinogens. The available RDA data for calcium, iron, magnesium, potassium and sodium are presented in Table E-3-2. From this data set, RDAs for children were preferentially selected to coincide with the child exposure scenario. RDAs were converted from units of mg/day to units of mg/kg/day by dividing the RDA by the child resident body weight of 15 kg (USEPA, 1991). Dermal RDAs were developed by adjusting the oral RDA to compensate for the oral absorption efficiency in a manner similar to that presented in Appendix A of RAGS, Volume I, Part A (USEPA, 1989).

**Table E-3-2
Recommended Dietary Allowances¹**

Remedial Investigation
Operable Unit 4
Naval Training Center
Orlando, Florida

Nutrient	RDA	Age (years)	Oral Absorption (%)	Typical Dietary Intake (mg/day)	Toxicity Threshold (mg/day)	Oral RDA (mg/kg/day) ²	Dermal RDA (mg/kg/day) ³
Calcium	800 (mg/day)	1-10	40	743 (average of all ages)	NA	53.3	21.2
	1200 (mg/day)	11-24		1179	NA		
	800 (mg/day)	>24		743 (average of all ages); 530 (women ages 35-50)	>2500		
Iron	10 (mg/day)	1-20	10-15	10-15	25-75 (NOAEL); 3000 (lethal)	0.67	0.067
	15 (mg/day)	>20	10-15	10-15	25-75 (NOAEL); 14000 (lethal)		
Magnesium	6 (mg/kg/day)	1-15	50	193 (age 1-5)	NA	6	3
	4.5 (mg/kg/day)	>15		207-329	NA		
Potassium	15-20 (mg/kg/day)	1-10	90	1500	NA	15	13.5
	1600-2000 (mg/day)	>20		2500	18000 (hyperkalemia)		
Sodium	300 (mg/day)	2-5	90 ⁴	NA	NA	20	18
	500 (mg/day)	Adult		1800-5000	2400 (intake not to be exceeded)		

¹ All data are from the National Resource Council (1989).

² Adjusted oral RDA calculated by dividing the RDA (mg/kg) by the bodyweight of a child ages 1-6 (15 kg) (USEPA, 1991); RDAs provided in mg/kg/day were not modified.

³ Adjusted dermal RDA calculated by multiplying the oral RDA by the oral absorption efficiency (USEPA, 1989).

⁴ Oral absorption data not available; value for potassium used as a surrogate based on physio-chemical similarities.

Notes: % = percent.

RDA = recommended daily allowance.

mg/day = milligrams per day.

mg/kg = milligrams per kilogram.

mg/kg/day = milligrams per kilogram per day.

Calculation of screening concentrations

Risk-based screening concentrations for essential nutrients were derived by estimating concentrations in soil and groundwater that correspond to the RDAs for a residential exposure scenario. When the dose is equal to the RDA, the hazard quotient for the situation would equal one. Risk calculation spreadsheets have been used to assist in the calculation of the screening concentrations. When the concentration of an essential nutrient and the associated hazard quotient are known, only a simple calculation is needed to identify the concentration associated with a hazard quotient of one. An arbitrary nutrient concentration has been entered into risk spreadsheets to derive associated hazard quotient values as shown in Tables E-3-3 and E-3-4. Once that information was available, the equality was used to calculate screening soil concentration with the target hazard quotient equal to one.

Screening groundwater concentrations were calculated in a similar manner.

To derive screening concentrations that would be protective to the majority of the exposed population, the exposure assumptions for the most sensitive receptor (e.g., a child resident) were used. For groundwater, screening concentrations were based on ingestion of groundwater as drinking water. For surface soil, screening concentrations were based on ingestion of surface soil and dermal contact with surface soil. Child resident exposure to surface soil and groundwater used as drinking water is usually greater than or equal to oral and dermal exposure to media treated as soil and groundwater, respectively, for exposure assessment. Therefore, screening values for surface soil represent conservative screening values for sediment, subsurface soil, and sludge, and screening values for groundwater used as drinking water represent conservative screening values for surface water.

The exposure parameters for the child resident are presented in the accompanying surface soil and groundwater screening concentration spreadsheets (Tables E-3-3 and E-3-4, respectively).

The calculated essential nutrient screening concentrations for surface soil and groundwater are presented in Table E-3-5. These values represent the concentrations of individual essential nutrients in media that, if contacted in accordance with the exposure parameters used to derive the screening concentration, would theoretically result in the receptor receiving his or her recommended dietary allowance of an essential nutrient solely from the contacted media. For some nutrients, the calculated screening concentrations exceed 1,000,000 mg/kg (i.e., 100%). Such concentrations indicate that no concentration of nutrient in the particular medium would result in an intake that exceeds the RDA, given the exposure assumptions on which the screening value is based. Because these screening concentrations do not take into account the additivity of exposures between media (and other dietary intakes, including food), a receptor exposed to essential nutrients that are present in multiple media at the screening concentrations would, in essence, be receiving more than his or her recommended dietary allowance of nutrient. However, data provided in Table E-3-2 indicate that the toxicity threshold for most essential nutrients is several times greater than the RDA; the RDA is not a toxicity threshold value. Therefore, these screening concentrations do not represent concentrations which, if exceeded, would necessarily result in deleterious effects.

TABLE E-3.3
 DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL - ESSENTIAL NUTRIENTS
 CHILD RESIDENT
 OPERABLE UNIT 4
 NTC ORLANDO

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical specific	chemical-specific	
INGESTION RATE	IR	200	mg/day	USEPA, 1991
FRACTION INGESTED	FI	100%	unitless	Assumption
ADHERENCE FACTOR	AF	1	mg/cm ² -event	USEPA, 1992a
AGE-SPECIFIC SURFACE AREA	SA _i	age-specific	cm ²	USEPA, 1989
ABSORPTION FRACTION	ABS _d	chemical specific	unitless	USEPA, 1992b
CONVERSION FACTOR	CF	1.00E-06	kg/mg	SEE BELOW
BODY WEIGHT	BW	15	kg	USEPA, 1991
AGE-SPECIFIC BODY WEIGHT	BW _i	age-specific	kg	USEPA, 1989
EXPOSURE FREQUENCY	EF	350	days/year *	USEPA, 1991
EXPOSURE DURATION	ED	6	years	USEPA, 1991
AGE-SPECIFIC EXPOSURE DURATION	ED _i	age-specific	years	Assumption
AGE-WEIGHTED SURFACE AREA [1]	SA _{soil/adj}	766	cm ² -year/kg	Per USEPA, 1992a
DOSE ABSORBED PER EVENT	DA _{event}	chemical specific	mg/cm ² -event	Per USEPA, 1992a
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	6	years	USEPA, 1991

$$\text{CANCER RISK} = \text{INTAKE (mg/kg-day)} \times \text{CANCER SLOPE FACTOR (mg/kg-day)}^{-1}$$

$$\text{HAZARD QUOTIENT} = \text{INTAKE (mg/kg-day)} / \text{RECOMMENDED DIETARY ALLOWANCE (mg/kg-day)}$$

$$\text{INTAKE-INGESTION} = \frac{\text{CS} \times \text{IR} \times \text{FI} \times \text{CF} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT} \times 365 \text{ days/yr}}$$

$$\text{INTAKE-DERMAL} = (\text{DA}_{\text{event}} \times \text{EF} / \text{AT} \times 365 \text{ days/year}) \times \text{SA}_{\text{soil/adj}}$$

Where:

$$\text{SA}_{\text{soil/adj}} = \text{SUM} (\text{SA}_i \times \text{ED}_i / \text{BW}_i)$$

$$\text{DA}_{\text{event}} = \text{CS} \times \text{AF} \times \text{ABS}_d \times \text{CF}$$

Note:

For noncarcinogenic effects: AT = ED

* Units for exposure frequency are in events/year in the calculation of the dermally absorbed dose.
 [1] In estimating the dermally absorbed dose for children age 1 through 6, the time-weighted, bodyweight normalized surface area exposed is calculated from surface area, exposure duration, and body weight for each of 6 age periods, age 1 through 6, per USEPA, 1992.
 USEPA, 1989. Exposure Factors Handbook, EPA/600/8-89/043; May 1989.
 USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance. "Standard Default Exposure Factors", OSWER Directive 9285.6-03.
 USEPA, 1992a. Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/011B; January 1992 and Dermal Exposure Appendix of this document.
 USEPA, 1992b. USEPA Region IV Guidance Memo February 10, 1992.
 CF = 10E-09 kg/ug for organics

TABLE E-3.J
 DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL - ESSENTIAL NUTRIENTS
 CHILD RESIDENT
 OPERABLE UNIT 4
 NTC ORLANDO

CARCINOGENIC EFFECTS

COMPOUND [1]	INORGANIC OR ORGANIC LO	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF (mg/kg-day) ⁻¹	CANCER RISK DIGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [1] (mg/kg-day) ⁻¹	CANCER RISK DERMAL	TOTAL CANCER RISK
SUMMARY CANCER RISK						0.0E+00				0E+00	0E+00

[1] Essential nutrients are not considered carcinogenic from exposure through the oral or dermal routes.
 [2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (February 10, 1992).
 [3] Calculated from Oral RDAs

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC LO	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RDA (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RDA [1] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Calcium	I	5000	mg/kg	6.4E-02	5.3E+01	1.2E-03	0.001	6.1E-04	2.1E+01	2.9E-05	1.2E-03
Iron	I	5000	mg/kg	6.4E-02	6.7E-01	9.5E-02	0.001	6.1E-04	6.7E-02	9.1E-03	1.0E-01
Magnesium	I	5000	mg/kg	6.4E-02	6.0E+00	1.1E-02	0.001	6.1E-04	3.0E+00	2.0E-04	1.1E-02
Potassium	I	5000	mg/kg	6.4E-02	1.5E+01	4.3E-03	0.001	6.1E-04	1.4E+01	4.5E-05	4.3E-03
Sodium	I	5000	mg/kg	6.4E-02	2.0E+01	3.2E-03	0.001	6.1E-04	1.8E+01	3.4E-05	3.2E-03
SUMMARY HAZARD INDEX						1.1E-01				9E-03	1E-01

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (February 10, 1992).
 [2] Calculated from Oral RDAs

TABLE E-3.4
 INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) - ESSENTIAL NUTRIENTS
 CHILD RESIDENT
 OPERABLE UNIT 4
 NTC ORLANDO

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION WATER	CW	chemical specific	ug/liter	
INGESTION RATE	IR	0.79	liters/day	USEPA, 1989
BODY WEIGHT	BW	15	kg	USEPA, 1991
CONVERSION FACTOR	CR	0.001	mg/ug	
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1991
EXPOSURE DURATION	ED	6	years	USEPA, 1991
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	6	years	USEPA, 1991

<p>USEPA, 1989. Exposure Factors Handbook, Final Report, EPA/600/8-89/043, May 1989.</p> <p>USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.</p>	<p>CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)⁻¹</p> <p>HAZARD QUOTIENT = INTAKE (mg/kg-day) / RECOMMENDED DIETARY ALLOWANCE (mg/kg-day)</p> <p>INTAKE_{ing} = $\frac{CW \times IR \times EF \times ED \times CF}{BW \times AT \times 365 \text{ days/year}}$</p> <p>NOTE: For noncarcinogenic effects AT = ED</p>
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TABLE E-3.4
 INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) - ESSENTIAL NUTRIENTS
 CHILD RESIDENT
 OPERABLE UNIT 4
 NTC ORLANDO

CARCINOGENIC EFFECTS

COMPOUND [1]	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	CANCER SLOPE FACTOR (mg/kg-day) ⁻¹	CANCER RISK INGESTION
TOTAL CANCER RISK					0E+00

[1] Essential nutrients are not considered carcinogenic from exposure through the oral route.

NONCARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	RECOMMENDED DIETARY ALLOWANCE (mg/kg-day)	HAZARD QUOTIENT INGESTION
Calcium	5000	ug/liter	2.5E-01	5.3E+01	4.7E-03
Iron	5000	ug/liter	2.5E-01	6.7E-01	3.8E-01
Magnesium	5000	ug/liter	2.5E-01	6.0E+00	4.2E-02
Potassium	5000	ug/liter	2.5E-01	1.5E+01	1.7E-02
Sodium	5000	ug/liter	2.5E-01	2.0E+01	1.3E-02
TOTAL HAZARD INDEX					5E-01

**Table E-3-5
Theoretical Essential Nutrient Screening Concentrations
For Surface Soil and Groundwater**

Remedial Investigation
Operable Unit 4
Naval Training Center
Orlando, Florida

Essential Nutrient	Surface Soil Screening Concentration (mg/kg) ¹	Groundwater Screening Concentration (µg/l) ²
Calcium	³ 4,070,824	1,055,398
Iron	47,824	13,267
Magnesium	460,468	118,807
Potassium	³ 1,160,864	297,016
Sodium	³ 1,547,819	396,022

¹ Surface soil screening concentrations calculated as described in text, using RDAs presented in Table E-3-2 and the exposure parameters and risk calculations presented in Table E-3-3.

² Surface soil screening concentrations calculated as described in text, using RDAs presented in Table E-3-2 and the exposure parameters and risk calculations presented in Table E-3-4.

³ The calculation of a screening concentration larger than 1,000,000 mg/kg indicates that no concentration results in an intake greater than the RDA, given the standard exposure parameters.

Notes: mg/kg = milligrams per kilogram.
µg/l = micrograms per liter.

REFERENCES

National Research Council (NRC). (1989) "Recommended Dietary Allowances, Tenth Edition". National Research Council Subcommittee on the Tenth Edition of the RDAs, Food and Nutrition Board Commission on Life Sciences. National Academy of Sciences. National Academy Press, Washington, D.C.

USEPA (1989) "Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part A)". U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C., December. EPA/540/1-89/002.

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USEPA (1997). "Health Effects Assessment Summary Tables: FY-1997 Annual". U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C., July, 1997. EPA 540-R-94-020.

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APPENDIX E-4

PHYSICAL CHARACTERISTICS OF EXPOSED POPULATIONS

Table E-4-1
Exposure Parameters for Surface Soil Ingestion, Inhalation, and Dermal Contact
RME Resident (Adult and Child)

Remedial Investigation
 Operable Unit 4
 Naval Training Center
 Orlando, Florida

$$INTAKE_{ing} = \frac{CS \times IR_{soil} \times FI \times CF \times EF \times ED}{BW \times AT \times 365 \text{ days/year}}$$

$$DA_{event} = CS \times AF \times ABS_d \times CF$$

$$INTAKE_{dermal} = \frac{DA_{event} \times SA \times EF \times ED}{BW \times AT \times 365 \text{ days/year}}$$

$$INTAKE_{inh} = \frac{CA \times IR_{air} \times ET \times EF \times ED}{BW \times AT \times 365 \text{ days/year}}$$

Parameter	Symbol	Child Value (Age 1-6)	Adult Value	Units	Source
Concentration in Soil	CS	Chemical-specific		Chemical-specific	
Soil Ingestion Rate	IR _{soil}	200	100	mg/day	[2]
Fraction Ingested	FI	100%	100%	unitless	Assumption
Conversion Factor					
Inorganics	CF	1 × 10 ⁻⁶	1 × 10 ⁻⁶	kg/mg	
Organics	CF	1 × 10 ⁻⁹	1 × 10 ⁻⁹	kg/μg	
Exposure Frequency	EF	350	350	days/year	[2]
Exposure Duration	ED	6	24	years	[2]
Exposure Time [1]	ET	24	24	hours/day	[2]
Averaging Time	AT				
Cancer		70	70	years	[2]
Noncancer		6	24	years	[2]
Surface Area	SA		5750	cm ²	Appendix X-7
Age-weighted Surface Area	SA _{soil/ad}	766		cm ² -year/kg	Appendix X-7
See notes at end of table.					

Table E-4-1 (Continued)
Exposure Parameters for Surface Soil Ingestion, Inhalation, and Dermal Contact
RME Resident (Adult and Child)

Remedial Investigation
Operable Unit 4
Naval Training Center
Orlando, Florida

Parameter	Symbol	Child Value (Age 1-6)	Adult Value	Units	Source
Surface Area	SA		5750	cm ²	Appendix X-7
Age-weighted Surface Area	SA _{soil/edj}	766		cm ² -year/kg	Appendix X-7
Inhalation Rate	IR _{air}	0.625	0.833	m ³ /hour	[2]
Body Weight	BW	15	70	kg	[2]
Adherence Factor	AF	1	1	mg/cm ² -event	[3], [5]
Absorption Fraction	ABS _d	Chemical-specific		unitless	[5]
Particulate Emission Factor	PEF	1.24x10 ⁹	1.24x10 ⁹	m ³ /kg	[4]
Concentration in Air	CA	Chemical-specific		mg/m ³	[4]

References:

- [1] Exposure Time is used only in the Inhalation of Particulates Scenario.
- [2] USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Parameters".
- [3] USEPA, 1992. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January, 1992.
- [4] Florida Soil Cleanup Goal Variable; FDEP, 1995.
- [5] USEPA, 1995. USEPA Region IV Guidance Memorandum: November 1995.

Table E-4-2
Exposure Parameters for Surface Soil Ingestion, Inhalation, and Dermal Contact
RME Trespasser/Recreational User (Adult and Adolescent)

Remedial Investigation
 Operable Unit 4
 Naval Training Center
 Orlando, Florida

$$INTAKE_{ing} = \frac{CS \times IR_{soil} \times FI \times CF \times EF \times ED}{BW \times AT \times 365 \text{ days/year}}$$

$$DA_{event} = CS \times AF \times ABS_d \times CF$$

$$INTAKE_{dermal} = \frac{DA_{event} \times SA \times EF \times ED}{BW \times AT \times 365 \text{ days/year}}$$

$$INTAKE_{inh} = \frac{CA \times IR_{air} \times ET \times EF \times ED}{BW \times AT \times 365 \text{ days/year}}$$

Parameter	Symbol	Adolescent Value (Age 6-16)	Adult Value	Units	Source
Concentration in Soil	CS	Chemical-specific		Chemical-specific	
Particulate Emission Factor	PEF	1.24x10 ⁹	1.24x10 ⁹	m ³ /kg	[2]
Dose Absorbed per Unit Area per Event	DA _{event}	Chemical-specific		mg/m ² -event	[3]
Soil Ingestion Rate	IR _{soil}	100	100	mg/day	[4]
Fraction Ingested	FI	100%	100%	unitless	Assumption
Conversion Factor					
Inorganics	CF	1x 10 ⁶	1x 10 ⁶	kg/mg	
Organics	CF	1x 10 ⁹	1x 10 ⁹	kg/μg	
Exposure Frequency	EF	45	45	days/year	Assumption
Exposure Duration	ED	10	20	years	[4]
Exposure Time [1]	ET	4	4	hours/day	Assumption
Averaging Time	AT				
Cancer		70	70	years	[4]
Non-cancer		10	20	years	[4]

See notes at end of table.

Table E-4-2 (Continued)
Exposure Parameters for Surface Soil Ingestion, Inhalation, and Dermal Contact
RME Trespasser/Recreational User (Adult and Adolescent)

Remedial Investigation
Operable Unit 4
Naval Training Center
Orlando, Florida

Parameter	Symbol	Adolescent Value (Age 6-16)	Adult Value	Units	Source
Surface Area	SA	Site-specific	5750	cm ²	Appendix E-7
Age-weighted Surface Area	SA _{soil/adj}	1013		cm ² -year/kg	Appendix E-7
Inhalation Rate	IR _{in}	0.412	2.5	m ³ /hour	[4]
Body Weight	BW	45	70	kg	[4,5]
Adherence Factor	AF	1	1	mg/cm ² -event	[3], [5]
Absorption Fraction	ABS _d	Chemical-specific		unitless	[5]
Concentration in Air	CA	Chemical-specific		mg/m ³	[2]

References:

- [1] Exposure Time is used only in the Inhalation of Particulate Scenario.
- [2] Florida Soil Cleanup Goal Variable; FDEP, 1995.
- [3] USEPA. 1992. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January, 1992.
- [4] USEPA. 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Parameters".
- [5] USEPA. 1995. USEPA Region IV Guidance Memorandum; November 1995.
- [6] USEPA. 1989. Exposure Factors Handbook; EPA/600/8-89/043; July 1989.

Table E-4-3
Exposure Parameters for Surface Soil Ingestion, Inhalation, and Dermal Contact
RME Site Maintenance Worker (Adult)

Remedial Investigation
 Operable Unit 4
 Naval Training Center
 Orlando, Florida

$$INTAKE_{ing} = \frac{CS \times IR_{soil} \times FI \times CF \times EF \times ED}{BW \times AT \times 365 \text{ days/year}}$$

$$INTAKE_{inh} = \frac{CA \times IR_{air} \times ET \times EF \times ED}{BW \times AT \times 356 \text{ days/year}}$$

$$INTAKE_{dermal} = \frac{DA_{event} \times SA \times EF \times ED}{BW \times AT \times 365 \text{ days/year}}$$

$$DA_{event} = CS \times AF \times ABS_d \times CF$$

Parameter	Symbol	Adult Value	Units	Source
Concentration in Soil	CS	Chemical-specific	Chemical-specific	
Particulate Emission Factor	PEF	1.24x10 ⁹	m ³ /kg	[2]
Soil Ingestion Rate	IR _{soil}	50	mg/day	[3]
Fraction Ingested	FI	100%	unitless	Assumption
Conversion Factor Inorganics	CF	1 × 10 ⁶	kg/mg	
Organics	CF	1 × 10 ⁹	kg/μg	
Exposure Frequency	EF	30	days/year	Assumption
Exposure Duration	ED	25	years	[3]
Exposure Time [1]	ET	8	hours/day	Assumption
Averaging Time	AT			
Cancer		70	years	[3]
Non-cancer		25	years	[3]
Surface Area	SA	5750	cm ²	Appendix E-7
Inhalation Rate	IR _{air}	2.5	m ³ /hour	[3]
Body Weight	BW	70	kg	[3]

See notes at end of table.

Table E-4-3 (Continued)
Exposure Parameters for Surface Soil Ingestion, Inhalation, and Dermal Contact
RME Site Maintenance Worker (Adult)

Remedial Investigation
 Operable Unit 4
 Naval Training Center
 Orlando, Florida

Parameter	Symbol	Adult Value	Units	Source
Adherence Factor	AF	1	mg/cm ² -event	[4], [5]
Absorption Fraction	ABS _d	Chemical-specific	unitless	[5]
Concentration in Air	CA	Chemical-specific	mg/m ³	[2]
References:				
[1]	Exposure Time is only used in the Inhalation of Particulates Scenario.			
[2]	Florida Soil Cleanup Goal Variable; FDEP, 1995.			
[3]	USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Parameters".			
[4]	USEPA, 1992. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January, 1992.			
[5]	USEPA, 1995. USEPA Region IV Guidance Memorandum; November, 1995.			

Table E-4-4
Exposure Parameters for Surface Soil and Subsurface Soil
Ingestion, Inhalation, and Dermal Contact
RME Excavation Worker (Adult)

Remedial Investigation
Operable Unit 4
Naval Training Center
Orlando, Florida

$$INTAKE_{ing} = \frac{CS \times IR_{soil} \times FI \times CF \times EF \times ED}{BW \times AT \times 365 \text{ days/year}}$$

$$INTAKE_{inh} = \frac{CA \times IR_{air} \times ET \times EF \times ED}{BW \times AT \times 356 \text{ days/year}}$$

$$DA_{event} = CS \times AF \times ABS_d \times CF$$

$$INTAKE_{dermal} = \frac{DA_{event} \times SA \times EF \times ED}{BW \times AT \times 365 \text{ days/year}}$$

Parameter	Symbol	Adult Value	Units	Source
Concentration in Soil	CS	Chemical-specific	Chemical-specific	
Particulate Emission Factor	PEF	1.24x10 ⁹	m ³ /kg	[5]
Soil Ingestion Rate	IR _{soil}	480	mg/day	[3]
Fraction Ingested	FI	100%	unitless	Assumption
Conversion Factor				
Inorganics	CF	1 × 10 ⁻⁶	kg/mg	
Organics	CF	1 × 10 ⁻⁹	kg/μg	
Exposure Frequency	EF	30	days/year	Assumption
Exposure Duration	ED	1	years	[3]
Exposure Time [1]	ET	8	hours/day	Assumption
Averaging Time	AT			
Cancer		70	years	[3]
Non-cancer		1	years	[3]
Surface Area	SA	5,750	cm ²	Appendix X-7
Inhalation Rate	IR _{air}	2.5	m ³ /hour	[3]
Body Weight	BW	70	kg	[3]
Adherence Factor	AF	1	mg/cm ² -event	[4]
Absorption Fraction	ABS _d	Chemical-specific	unitless	[4]
Concentration in Air	CA	Chemical-specific	mg/m ³	[5]

Table E-4-4 (Continued)
Exposure Parameters for Surface Soil and Subsurface Soil
Ingestion, Inhalation, and Dermal Contact
RME Excavation Worker (Adult)

Remedial Investigation
Operable Unit 4
Naval Training Center
Orlando, Florida

References:

- [1] Exposure Time is only used in the Inhalation of Particulates Scenario.
- [2] USEPA, 1989. Exposure Factors Handbook; EPA/600/8-89/0-43; May 1989.
- [3] USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance. "Standard Default Exposure Parameters."
- [4] USEPA, 1995. USEPA Region IV Guidance Memorandum; November 1995.
- [5] Florida Soil Cleanup Goal Variable, FDEP, 1995.

Table E-4-5
Exposure Parameters for Surface Soil Ingestion, Inhalation, and Dermal Contact
RME Occupational Worker (Adult)

Remedial Investigation
 Operable Unit 4
 Naval Training Center
 Orlando, Florida

$$INTAKE_{ing} = \frac{CS \times IR_{soil} \times FI \times CF \times EF \times ED}{BW \times AT \times 365 \text{ days/year}}$$

$$INTAKE_{inh} = \frac{CA \times IR_{air} \times ET \times EF \times ED}{BW \times AT \times 356 \text{ days/year}}$$

$$DA_{event} = CS \times AF \times ABS_d \times CF$$

$$INTAKE_{dermal} = \frac{DA_{event} \times SA \times EF \times ED}{BW \times AT \times 365 \text{ days/year}}$$

Parameter	Symbol	Adult Value	Units	Source
Concentration in Soil	CS	Chemical-specific	Chemical-specific	
Particulate Emission Factor	PEF	1.24x10 ⁹	m ³ /kg	[5]
Soil Ingestion Rate	IR _{soil}	50	mg/day	[2]
Fraction Ingested	FI	100%	unitless	Assumption
Conversion Factor				
Inorganics	CF	1x 10 ⁻⁶	kg/mg	
Organics	CF	1x 10 ⁻⁹	kg/ μ g	
Exposure Frequency	EF	250	days/year	[2]
Exposure Duration	ED	25	years	[2]
Exposure Time [1]	ET	8	hours/day	Assumption
Averaging Time	AT			
Cancer		70	years	[2]
Non-cancer		25	years	[2]
Surface Area	SA	2300	cm ²	[3]
Inhalation Rate	IR _{air}	0.833	m ³ /hour	[2]

See notes at end of table.

Table E-4-5 (Continued)
Exposure Parameters for Surface Soil Ingestion, Inhalation, and Dermal Contact
RME Occupational Worker (Adult)

Remedial Investigation
Operable Unit 4
Naval Training Center
Orlando, Florida

Parameter	Symbol	Adult Value	Units	Source
Body Weight	BW	70	kg	[2]
Concentration in Air	CA	Chemical-specific	mg/m ³	[5]
Adherence Factor	AF	1	mg/cm ² -event	[3], [5]
Absorption Fraction	ABS _d	Chemical-specific	unitless	[4]

References:

- [1] Exposure Time is only used in the Inhalation of Particulates Scenario.
- [2] USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Parameters".
- [3] USEPA, 1992. Dermal Exposure Assessment: Principles and Applications: EPA/600/8-91/011B; January, 1992
- [4] USEPA, 1995. USEPA Region IV Guidance Memorandum; November 1995.
- [5] Florida Soil Cleanup Goal Variable, FDEP, 1995.

**Table E-4-6
Exposure Parameters for Groundwater Ingestion and Inhalation via Showering
RME Resident (Adult and Child)**

Remedial Investigation
Operable Unit 4
Naval Training Center
Orlando, Florida

$$Intake_{ing} = \frac{CW \times IR_{groundwater} \times CF \times EF \times ED}{BW \times AT \times 365 \text{ days/year}}$$

$$INTAKE_{inh} = \frac{CA_{air} \times ET \times EF \times ED}{CF2 \times AT \times 356 \text{ days/year}}$$

Parameter	Symbol	Child Value (Age 1-6)	Adult Value	Units	Source
Concentration in Groundwater	CW	Chemical-specific		μg/liter	
Water Ingestion Rate	IR _{water}	1	2	liters/day	[2]
Conversion Factor	CF1 CF2	0.001 24	0.001 24	mg/μg hours/day	
Exposure Frequency	EF	350	350	days/year	[2]
Exposure Duration	ED	6	24	years	[2]
Averaging Time	AT				
Cancer		70	70	years	[2]
Non-cancer		6	24	years	[2]
Body Weight	BW	15	70	kg	[2]
Concentration Shower Air	CA _{air}	Appendix E-8	Appendix E-8	μg/m ³	[3]
Exposure Time [1]	ET	0.2	0.2	hours/day	[4]

References:

- [1] Exposure time is only used in the inhalation of volatiles while showering scenario; see Appendix E-8.
- [2] USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Parameters".
- [3] This parameter is modeled; see Appendix X-8.
- [4] USEPA, 1989. Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part A) EPA/540/1-89/002; December, 1989.

Table E-4-7
Exposure Parameters for Groundwater Inhalation Via Indoor Air
RME Resident (Adult and Child)

Remedial Investigation
 Operable Unit 4
 Naval Training Center
 Orlando, Florida

$$RBSL_{cancer} = \frac{TR_c \times AT \times C1}{ET \times ED \times EF \times C2 \times UR}$$

$$RBSL_{noncancer} = \frac{TR_{nc} \times AT \times RfC}{ET \times ED \times EF \times C2}$$

$$Risk = \left(\frac{EPC}{RBSL} \right) (1 \times 10^{-5})$$

Parameter	Symbol	Child Value	Adult Value	Units	Source	
Concentration in Groundwater	EPC	chemical-specific	chemical-specific	µg/liter	Appendix X-9	
Target Cancer Risk	TR _c	1 x 10 ⁻⁶	1 x 10 ⁻⁶	unitless	[1]	
Target Noncancer Risk	TR _{nc}	1	1	unitless	[1]	
Cancer Unit Risk	UR	chemical-specific	chemical-specific	(µg/m ³) ⁻¹	[2]	
Reference Concentration	RfC	chemical-specific	chemical-specific	mg/m ³	[2]	
Conversion Factor	C1	0.001	0.001	mg/µg		
	C2	1/24	1/24	day/hours		
Exposure Duration	ED	6	24	years	[3]	
Exposure Time	ET	16	16	hours/day	Assumption	
Exposure Frequency	EF	350	350	days/year	[3]	
Averaging Time	AT					
		Cancer	70	70	years	[3]
		Noncancer	24	24	years	[3]

Table E-4-8
Exposure Parameters for Groundwater Inhalation Via Indoor Air
RME Occupational Worker

Remedial Investigation
 Operable Unit 4
 Naval Training Center
 Orlando, Florida

$$RBSL_{cancer} = \frac{TRc \times AT \times C1}{ET \times ED \times EF \times C2 \times UR}$$

$$RBSL_{noncancer} = \frac{TRnc \times AT \times RfC}{ET \times ED \times EF \times C2}$$

$$Risk = \left(\frac{EPC}{RBSL} \right) (1 \times 10^{-6})$$

Parameter	Symbol	Adult Value	Units	Source	
Concentration in Groundwater	EPC	chemical-specific	μg/liter	Appendix E-9	
Target Cancer Risk	TR _c	1 x 10 ⁶	unitless	[1]	
Target Noncancer Risk	TR _{nc}	1	unitless	[1]	
Cancer Unit Risk	UR	chemical-specific	(μg/m ³) ⁻¹	[2]	
Reference Concentration	RfC	chemical-specific	mg/m ³	[2]	
Conversion Factor	C1	0.001	mg/μg		
	C2	1/24	day/hours		
Exposure Duration	ED	25	years	[3]	
Exposure Time	ET	8	hours/days	Assumption	
Exposure Frequency	EF	250	days/year	[3]	
Averaging Time	AT	Cancer	70	years	[3]
		Noncancer	25	years	[3]

References:

- [1] USEPA, 1995. USEPA Region IV Guidance Memorandum; November, 1995.
- [2] USEPA, 1998. Integrated Risk Information System; April, 1998.
- [3] USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Parameters".

**Table E-4-9
Exposure Parameters for Sediment Ingestion and Dermal Contact
RME Resident (Adult and Child)**

Remedial Investigation
Operable Unit 4
Naval Training Center
Orlando, Florida

$$DA_{event} = CS \times AF \times ABS_d \times CF$$

$$INTAKE_{dermal} = \frac{DA_{event} \times SA \times EF \times ED}{BW \times AT \times 365 \text{ days/year}}$$

Parameter	Symbol	Child Value (Age 1-6)	Adult Value	Units	Source
Concentration in Sediment	CS	Chemical-specific		Chemical-specific	
Conversion Factor					
Inorganics	CF	1 × 10 ⁶	1 × 10 ⁶	kg/mg	
Organics	CF	1 × 10 ⁹	1 × 10 ⁹	kg/μg	
Exposure Frequency	EF	100	100	days/year	Assumption
Exposure Duration	ED	6	24	years	[1]
Averaging Time	AT				
Cancer		70	70	years	[1]
Non-cancer		6	24	years	[1]
Surface Area	SA		3190	cm ²	[2]
Age-weighted Surface Area	SA _{oil/adi}	1408		cm ² -year/kg	Appendix E-7
Body Weight	BW	15	70	kg	[2]
Adherence Factor	AF	1	1	mg/cm ² -event	[2]
Absorption Fraction	ABS _d	Chemical-specific		unitless	[3]

References:

- [1] USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Parameters".
- [2] USEPA, 1992. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January, 1992 (based on lower legs and feet)
- [3] USEPA, 1992. USEPA Region IV Guidance Memorandum; February 10, 1992.

Table E-4-10
Exposure Parameters for Sediment Ingestion and Dermal Contact
RME Trespasser/Recreational User (Adult and Adolescent)

Remedial Investigation
Operable Unit 4
Naval Training Center
Orlando, Florida

$$DA_{event} = CS \times AF \times ABS_d \times CF$$

$$INTAKE_{dermal} = \frac{DA_{event} \times SA \times EF \times ED}{BW \times AT \times 365 \text{ days/year}}$$

Parameter	Symbol	Adolescent Value (Age 6-16)	Adult Value	Units	Source
Concentration in Sediment	CS	Chemical-specific		Chemical-specific	
Conversion Factor					
Inorganics	CF	1×10^{-6}	1×10^{-6}	kg/mg	
Organics	CF	1×10^{-9}	1×10^{-9}	kg/ μ g	
Exposure Frequency	EF	45	45	days/year	Assumption
Exposure Duration	ED	10	20	years	[1]
Averaging Time	AT				
Cancer		70	70	years	[1]
Non-cancer		10	20	years	[1]
Surface Area	SA		3190	cm ²	[2]
Age-weighted Surface Area	SA _{boil/adj}	251		cm ² -year/kg	Appendix X-7
Body Weight	BW	45	70	kg	[1,4]
Adherence Factor	AF	1	1	mg/cm ² -event	[2]
Absorption Fraction	ABS _d	Chemical-specific		unitless	[3]

References:

- [1] USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Parameters".
- [2] USEPA, 1992. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January, 1992 (based on lower legs and feet).
- [3] USEPA, 1992. USEPA Region IV Guidance Memorandum; February 10, 1992.
- [4] USEPA, 1989. Exposure Factors Handbook; EPA/600/8-89/043; July 1989.

Table E-4-11
Exposure Parameters for Surface Water Ingestion and Dermal Contact
RME Resident (Adult and Child)

Remedial Investigation
Operable Unit 4
Naval Training Center
Orlando, Florida

$$INTAKE_{ing} = \frac{CW \times IR_{surface\ water} \times CF1 \times EF \times ED}{BW \times AT \times 365\ days/year}$$

$$DA_{event} = PC_{event} \times CW \times CF1 \times CF2$$

$$INTAKE_{dermal} = \frac{DA_{event} \times SA \times EF \times ED \times EV}{BW \times AT \times 365\ days/year}$$

Parameter	Symbol	Child Value (Age 1-6)	Adult Value	Units	Source
Concentration in Surface Water	CW	Chemical-specific	Chemical-specific		
Surface Water Ingestion Rate	IR _{surface water}	0.13	0.026	liters/day	[1]
Conversion Factor	CF1	0.001	0.001	mg/ μ g	
	CF2	0.001	0.001	liters/cm ²	
Exposure Frequency	EF	100	100	days/year	Assumption
Exposure Duration	ED	6	24	years	Assumption
Event Frequency	EV	1	1	events/day	Assumption
Averaging Time	AT				
Cancer		70	70	years	[2]
Non-cancer		6	24	years	[2]
Surface Area	SA		5,750	cm ²	[3]
Age-weighted Surface Area	SA _{soil/adj}	766		cm ² -year/kg	Appendix E-7
Body Weight	BW	15	70	kg	[2]
Diffusion Depth per Event	PC _{event}	Chemical-specific		cm/event	[4]

References:

- [1] USEPA, 1988. Superfund Exposure Assessment Manual; EPA/540//1-88/001; April 1989.
- [2] USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Parameters".
- [3] USEPA, 1992. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January, 1992
- [4] Calculated per USEPA, 1992 [3]; see Appendix X-7.

Table E-4-12
Exposure Parameters for Surface Water Ingestion and Dermal Contact
RME Trespasser/Recreational User (Adult and Adolescent)

Remedial Investigation
Operable Unit 4
Naval Training Center
Orlando, Florida

$$INTAKE_{ing} = \frac{CW \times IR_{surface\ water} \times CF1 \times EF \times ED}{BW \times AT \times 365\ days/year}$$

$$DA_{event} = PC_{event} \times CW \times CF1 \times CF2$$

$$INTAKE_{dermal} = \frac{DA_{event} \times SA \times EF \times ED \times EV}{BW \times AT \times 365\ days/year}$$

Parameter	Symbol	Adolescent Value (Age 6-16)	Adult Value	Units	Source
Concentration in Surface Water	CS	Chemical-specific	Chemical-specific		
Surface Water Ingestion Rate	$IR_{surface\ water}$	0.026	0.026	liters/day	[1]
Fraction Ingested	FI	100%	100%	unitless	Assumption
Conversion Factor	CF1 CF2	0.001 0.001	0.001 0.001	mg/ μ g liters/cm ²	
Exposure Frequency	EF	45	45	days/year	Assumption
Exposure Duration	ED	10	20	years	[2]
Event Frequency	EV	1	1	events/day	Assumption
Averaging Time	AT				
Cancer		70	70	years	[2]
Non-cancer		10	20	years	[2]
Surface Area	SA		5,750	cm ²	[3]
Age-weighted Surface Area	$SA_{bol/edj}$	1136		cm ² -year/kg	Appendix E-7
Body Weight	BW	45	70	kg	[2,5]
Diffusion Depth per Event	PC_{event}	Chemical-specific		cm/event	[4]

References:

- [1] USEPA, 1988. Superfund Exposure Assessment Manual; EPA/540/1-88/001; April 1988.
- [2] USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Parameters".
- [3] USEPA, 1992. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January, 1992.
- [4] Calculated per USEPA, 1992 [3]; see Appendix X-7.
- [5] USEPA, 1989, Exposure Factors Handbook; EPA/600/8-89/043; May 1989.

Table E-4-13
Exposure Parameters for Surface Soil Ingestion and Dermal Contact
Central Tendency Resident (Adult and Child)

Remedial Investigation
 Operable Unit 4
 Naval Training Center
 Orlando, Florida

$$INTAKE_{ing} = \frac{CS \times IR_{soil} \times FI \times CF \times EF \times ED}{BW \times AT \times 365 \text{ days/year}}$$

$$DA_{event} = CS \times AF \times ABS_d \times CF$$

$$INTAKE_{dermal} = \frac{DA_{event} \times SA \times EF \times ED}{BW \times AT \times 365 \text{ days/year}}$$

$$INTAKE_{inh} = \frac{CA \times IR_{air} \times ET \times EF \times ED}{BW \times AT \times 365 \text{ days/year}}$$

Parameter	Symbol	Child Value (Age 1-6)	Adult Value	Units	Source
Concentration in Soil	CS	Chemical-specific	Chemical-specific		
Soil Ingestion Rate	IR _{soil}	100	50	mg/day	[4]
Fraction Ingested	FI	100%	100%	unitless	Assumption
Conversion Factor					
Inorganics	CF	1 × 10 ⁻⁶	1 × 10 ⁻⁶	kg/mg	
Organics	CF	1 × 10 ⁻⁹	1 × 10 ⁻⁹	kg/μg	
Exposure Frequency	EF	350	350	days/year	[1]
Exposure Duration	ED	2	7	years	[2]
Averaging Time	AT				
Cancer		70	70	years	[1]
Noncancer		2	7	years	[2]
Surface Area	SA		5000	cm ²	[4]
Age-weighted Surface Area	SA _{soil/adj}	766		cm ² -year/kg	[4]
Dose Absorbed per Unit Area per Event	DA _{event}	Chemical-specific		mg/cm ² -event	[2]
Particulate Emission Factor	PEF	1.24x10 ⁹	1.24x10 ⁹	m ³ /kg	[5]
See notes at end of table					

Table E-4-13 (Continued)
Exposure Parameters for Surface Soil Ingestion and Dermal Contact
Central Tendency Resident (Adult and Child)

Remedial Investigation
Operable Unit 4
Naval Training Center
Orlando, Florida

Parameter	Symbol	Child Value (Age 1-6)	Adult Value	Units	Source
Body Weight	BW	15	70	kg	[1]
Adherence Factor	AF	0.2	0.2	mg/cm ² -event	[2]
Absorption Fraction	ABS _d	Chemical-specific		unitless	[3]
Concentration in Air	CA	Chemical-specific		mg/m ³	[5]

References:

- [1] USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Parameters".
- [2] USEPA, 1992. Region 6 Memorandum: "Central Tendency and RME Exposure Parameters".
- [3] USEPA, 1995b. USEPA Region IV Guidance Memorandum; November, 1995.
- [4] USEPA, 1996. Exposure Factors Handbook, 1996
- [5] Florida Soil Cleanup Goal Variable, FDEP, 1995.

Table E-4-14
Exposure Parameters for Surface Soil Ingestion and Dermal Contact
Central Tendency Occupational Worker (Adult)

Remedial Investigation
 Operable Unit 4
 Naval Training Center
 Orlando, Florida

$$INTAKE_{ing} = \frac{CS \times IR_{soil} \times FI \times CF \times EF \times ED}{BW \times AT \times 365 \text{ days/year}}$$

$$INTAKE_{inh} = \frac{CA \times IR_{air} \times ET \times EF \times ED}{BW \times AT \times 365 \text{ days/year}}$$

$$DA_{event} = CS \times AF \times ABS_d \times CF$$

$$INTAKE_{dermal} = \frac{DA_{event} \times SA \times EF \times ED}{BW \times AT \times 365 \text{ days/year}}$$

Parameter	Symbol	Adult Value	Units	Source
Concentration in Soil	CS	Chemical-specific	Chemical-specific	
Particulate Emission Factor	PEF	1.24E+09	m ³ /kg	[1]
Soil Ingestion Rate	IR _{soil}	50	mg/day	[2]
Fraction Ingested	FI	100%	unitless	Assumption
Conversion Factor				
Inorganics	CF	1 × 10 ⁻⁶	kg/mg	
Organics	CF	1 × 10 ⁻⁹	kg/μg	
Exposure Frequency	EF	250	days/year	[2]
Exposure Duration	ED	9	years	[2]
Averaging Time	AT			
Cancer		70	years	[2]
Non-cancer		9	years	[2]
Surface Area	SA	2300	cm ²	[3]

See notes at end of table

Table E-4-14 (Continued)
Exposure Parameters for Surface Soil Ingestion and Dermal Contact
Central Tendency Occupational Worker (Adult)

Remedial Investigation
 Operable Unit 4
 Naval Training Center
 Orlando, Florida

Parameter	Symbol	Adult Value	Units	Source
Body Weight	BW	70	kg	[2]
Concentration in Air	CA	Chemical-specific	mg/m ³	[1]
Adherence Factor	AF	0.2	mg/cm ² -event	[4]
Absorption Fraction	ABS _s	Chemical-specific	unitless	[5]

References:

- [1] Florida Soil Cleanup Goal Variable. FDEP, 1995.
- [2] USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Parameters".
- [3] USEPA, 1992. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January, 1992.
- [4] USEPA, 1992. Region 6 Memorandum: Central Tendency and RME Exposure Parameters.
- [5] USEPA. 1995. USEPA Region IV Guidance Memorandum; November, 1995.

**- Table E-4-15
Exposure Parameters for Groundwater Ingestion
Central Tendency Resident (Adult and Child)**

Remedial Investigation
Operable Unit 4
Naval Training Center
Orlando, Florida

$$Intake_{ing} = \frac{CW \times IR_{groundwater} \times CF \times EF \times ED}{BW \times AT \times 365 \text{ days/year}}$$

$$INTAKE_{inh} = \frac{CA_{air} \times ET \times EF \times ED}{CF2 \times AT \times 356 \text{ days/year}}$$

Parameter	Symbol	Child Value (Age 1-6)	Adult Value	Units	Source
Concentration in Groundwater	CW	Chemical-specific		μg/liter	
Water Ingestion Rate	IR _{water}	0.7	1.4	liters/day	[1]
Conversion Factor	CF	0.001	0.001	mg/μg	
Exposure Frequency	EF	350	350	days/year	[1]
Exposure Duration	ED	2	7	years	[1]
Averaging Time	AT				
Cancer		70	70	years	[1]
Non-cancer		2	7	years	[1]
Body Weight	BW	15	70	kg	[1]

References:

- [1] USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Parameters".

Table E-4-16
Exposure Parameters for Surface Water Ingestion and Dermal Contact
Central Tendency Resident (Adult and Child)

Remedial Investigation
 Operable Unit 4
 Naval Training Center
 Orlando, Florida

$$INTAKE_{ing} = \frac{CW \times IR_{surface\ water} \times CF1 \times EF \times ED}{BW \times AT \times 365\ days/year}$$

$$DA_{event} = PC_{event} \times CW \times CF1 \times CF2$$

$$INTAKE_{dermal} = \frac{DA_{event} \times SA \times EF \times ED \times EV}{BW \times AT \times 365\ days/year}$$

Parameter	Symbol	Child Value (Age 1-6)	Adult Value	Units	Source
Concentration in Surface Water	CW	Chemical-specific	Chemical-specific		
Surface Water Ingestion Rate	$IR_{surface\ water}$	0.13	0.026	liters/day	[1]
Conversion Factor	CF1 CF2	0.001 0.001	0.001 0.001	mg/ μ g liters/cm ³	
Exposure Frequency	EF	100	45	days/year	Assumption
Exposure Duration	ED	2	7	years	[5]
Event Frequency	EV	1	1	events/day	Assumption
Averaging Time	AT				
Cancer		70	70	years	[2]
Non-cancer		6	24	years	[2]
Surface Area	SA		5,000	cm ²	[6]
Age-weighted Surface Area	$SA_{wt/adj}$	766		cm ² -year/kg	Appendix E-7
Body Weight	BW	15	70	kg	[2]
Diffusion Depth per Event	PC_{event}	Chemical-specific		cm/event	[4]

References:

- [1] USEPA, 1988. Superfund Exposure Assessment Manual; EPA/540//1-88/001; April 1989.
- [2] USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Parameters".
- [3] USEPA, 1992a. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January, 1992
- [4] Calculated per USEPA, 1992 [3]; see Appendix E-7.
- [5] USEPA, 1992b. Region 6 Memorandum: Central Tendency and RME Exposure Parameters.
- [6] USEPA, 1996. Exposure Factors Handbook.

APPENDIX E-5

DETERMINATION OF BENZO(A)PYRENE EQUIVALENT CONCENTRATIONS

Table E-5.1

Determination of Benzo(a)pyrene Equivalent Concentrations

Remedial Investigation
 Operable Unit 4
 Naval Training Center
 Orlando, Florida

	TEF	12B00101 adjusted	12B00201 adjusted	12B00301 adjusted	12B00401 adjusted	12B00401D adjusted
Polynuclear Aromatic Hydrocarbons (ug/kg)						
Benzo(a)anthracene	0.1	340U 17				
Benzo(a)pyrene	1	340U 170				
Benzo(b)fluoranthene	0.1	340U 17				
Benzo(k)fluoranthene	0.01	340U 1.7				
Chrysene	0.001	340U 0.17				
Dibenz(a,h)anthracene	1	340U 170				
Indeno(1,2,3-cd)pyrene	0.1	340U 17				
Benzo(a)pyrene Equivalent Concentration (ug/kg)		393	393	393	393	393

TEF = Toxicity Equivalency Factor

Table E-5.1
Determination of Benzo(a)pyrene Equivalent Concentrations

Remedial Investigation
 Operable Unit 4
 Naval Training Center
 Orlando, Florida

	13B00501 adjusted		14B00101 adjusted		14B00201 adjusted		14B00301 adjusted		14B00401 adjusted		U4S00501 adjusted	
Polynuclear Aromatic Hydrocarbons (ug/kg)												
Benzo(a)anthracene	410U	20.5	110J	11	340U	17	340U	17	350U	17.5	550U	27.5
Benzo(a)pyrene	410U	205	350U	175	340U	170	340U	170	350U	175	61J	61
Benzo(b)fluoranthene	410U	20.5	220J	22	340U	17	340U	17	350U	17.5	77J	7.7
Benzo(k)fluoranthene	410U	2.05	180J	1.8	340U	1.7	340U	1.7	350U	1.75	550U	2.75
Chrysene	410U	0.205	200J	0.2	340U	0.17	340U	0.17	350U	0.175	63J	0.063
Dibenz(a,h)anthracene	410U	205	350U	175	340U	170	340U	170	350U	175	550U	275
Indeno(1,2,3-cd)pyrene	410U	20.5	140J	14	340U	17	340U	17	350U	17.5	550U	27.5
Benzo(a)pyrene Equivalent Concentration (ug/kg)		474		399		393		393		404		402

Table C-5.1

Determination of Benzo(a)pyrene Equivalent Concentrations

Remedial Investigation
 Operable Unit 4
 Naval Training Center
 Orlando, Florida

	U4S00501D adjusted		U4S00601 adjusted		U4S00701 adjusted		U4S00801 adjusted		U4S00901 adjusted		U4S01001 adjusted	
Polynuclear Aromatic Hydrocarbons (ug/kg)												
Benzo(a)anthracene	460U	23	1300	130	340U	17	340U	17	260J	26	340U	17
Benzo(a)pyrene	53J	53	1500	1500	340U	170	340U	170	330J	330	340U	170
Benzo(b)fluoranthene	92J	9.2	3200J	320	340U	17	340U	17	630	63	340U	17
Benzo(k)fluoranthene	460U	2.3	3200J	32	340U	1.7	340U	1.7	230J	2.3	340U	1.7
Chrysene	76J	0.076	2500	2.5	340U	0.17	340U	0.17	460	0.46	340U	0.17
Dibenz(a,h)anthracene	460U	230	230J	230	340U	170	340U	170	360U	180	340U	170
Indeno(1,2,3-cd)pyrene	460U	23	890	89	340U	17	340U	17	200J	20	340U	17
Benzo(a)pyrene Equivalent Concentration (ug/kg)		341		2304		393		393		622		393

TEF = Toxicity Equivalency Factor

Table E-5.1
Determination of Benzo(a)pyrene Equivalent Concentrations

Remedial Investigation
 Operable Unit 4
 Naval Training Center
 Orlando, Florida

	U4S01101 adjusted		U4S01201 adjusted		U4S01201D adjusted		U4S01301 adjusted		U4S01401 adjusted		U4S01501 adjusted	
Polynuclear Aromatic Hydrocarbons (ug/kg)												
Benzo(a)anthracene	140J	14	55J	5.5	130J	13	470U	23.5	370U	18.5	1200	120
Benzo(a)pyrene	120J	120	78J	78	120J	120	470U	235	370U	185	1600	1600
Benzo(b)fluoranthene	180J	18	170J	17	180J	18	470U	23.5	49J	4.9	2100	210
Benzo(k)fluoranthene	72J	0.72	160J	1.6	67J	0.67	470U	2.3	370U	1.85	600	6
Chrysene	140J	0.14	120J	0.12	190J	0.19	470U	0.235	48J	0.048	1700	1.7
Dibenz(a,h)anthracene	370U	185	360U	180	350U	175	470U	235	370U	185	200J	200
Indeno(1,2,3-cd)pyrene	70J	7	58J	5.8	61J	6.1	470U	23.5	370U	18.5	570	57
Benzo(a)pyrene Equivalent Concentration (ug/kg)		345		288		333		543		414		2195

APPENDIX E-6

RISK CALCULATION SPREADSHEETS

TABLE E-6.1

CURRENT AND FUTURE LAND USE DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
 ADULT TRESPASSER and RECREATIONAL USER
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	100	mg/day	USEPA, 1991
FRACTION INGESTED	FI	100%	unitless	USEPA, 1995
ADHERENCE FACTOR	AF	1	mg/cm ² -event	USEPA, 1992a
ABSORPTION FRACTION	ABS _d	chemical specific	unitless	USEPA, 1992b
SURFACE AREA EXPOSED	SA	5,750	cm ²	USEPA, 1992a
DOSE ABSORBED PER EVENT	DA _{event}	chemical specific	mg/cm ² -event	USEPA, 1992a
CONVERSION FACTOR	CF	1.00E-06	kg/mg	inorganics
	CF	1.00E-09	kg/ug	organics
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	45	days/year [1]	Assumption
EXPOSURE DURATION	ED	20	years	Assumption
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	20	years	Assumption

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose.
 USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.
 USEPA, 1992a. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; 1/92.
 USEPA, 1992b. USEPA Region IV Guidance Memorandum; February 10, 1992.

CANCER RISINTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)⁻¹

HAZARD QUINTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE}_{\text{-INGESTION}} = \frac{\text{CS} \times \text{IR} \times \text{FI} \times \text{CF} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT} \times 365 \text{ days/yr}}$$

$$\text{INTAKE}_{\text{-DERMAL}} = \frac{\text{DA}_{\text{event}} \times \text{SA} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT} \times 365 \text{ days/yr}}$$

Where:

$$\text{DA}_{\text{event}} = \text{AF} \times \text{ABS}_d \times \text{CF}$$

Note: For noncarcinogenic effects: AT = ED

TABLE E-6.1

CURRENT AND FUTURE LAND USE DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT TRESPASSER and RECREATIONAL USER
NAVAL TRAINING CENTER
ORLANDO, FLORIDA
OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF (mg/kg-day) ⁻¹	CANCER RISK INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2] (mg/kg-day) ⁻¹	CANCER RISK DERMAL	TOTAL CANCER RISK
Tetrachloroethene	O	27	ug/kg	1.4E-09	5.2E-02	7.1E-11	0.01	7.8E-10	5.2E-02	4.1E-11	1.1E-10
Benzo(a)pyrene equivalent	O	265	ug/kg	1.3E-08	7.3E+00	9.7E-08	0.01	7.7E-09	8.0E+00	6.1E-08	1.6E-07
Aroclor-1254	O	69.4	ug/kg	3.5E-09	2.0E+00	7.0E-09	0.06	1.2E-08	2.2E+00	2.7E-08	3.3E-08
Aroclor-1260	O	25	ug/kg	1.3E-09	2.0E+00	2.5E-09	0.06	4.3E-09	2.2E+00	9.5E-09	1.2E-08
SUMMARY CANCER RISK						1E-07				1E-07	2E-07
[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (February 10, 1992).											
[2] Calculated from oral CSFs.											

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Tetrachloroethene	O	27	ug/kg	4.8E-09	1.0E-02	4.8E-07	0.01	2.7E-09	1.0E-02	2.7E-07	7.5E-07
Benzo(a)anthracene	O	260	ug/kg	4.6E-08	3.0E-02	1.5E-06	0.01	2.6E-08	2.7E-02	9.8E-07	2.5E-06
Benzo(a)pyrene	O	330	ug/kg	5.8E-08	3.0E-02	1.9E-06	0.01	3.3E-08	2.7E-02	1.2E-06	3.2E-06
Benzo(b)fluoranthene	O	630	ug/kg	1.1E-07	3.0E-02	3.7E-06	0.01	6.4E-08	2.7E-02	2.4E-06	6.1E-06
Benzo(k)fluoranthene	O	230	ug/kg	4.1E-08	3.0E-02	1.4E-06	0.01	2.3E-08	2.7E-02	8.6E-07	2.2E-06
Chrysene	O	460	ug/kg	8.1E-08	3.0E-02	2.7E-06	0.01	4.7E-08	2.7E-02	1.7E-06	4.4E-06
Indeno(1,2,3-cd)pyrene	O	200	ug/kg	3.5E-08	3.0E-02	1.2E-06	0.01	2.0E-08	2.7E-02	7.5E-07	1.9E-06
Aroclor-1254	O	69.4	ug/kg	1.2E-08	2.0E-05	6.1E-04	0.06	4.2E-08	1.8E-05	2.3E-03	3.0E-03
Aroclor-1260	O	25	ug/kg	4.4E-09	2.0E-05	2.2E-04	0.06	1.5E-08	1.8E-05	8.4E-04	1.1E-03
Aluminum	I	9740	mg/kg	1.7E-03	1.0E+00	1.7E-03	0.001	9.9E-05	2.0E-01	4.9E-04	2.2E-03
Barium	I	59.7	mg/kg	1.1E-05	7.0E-02	1.5E-04	0.001	6.0E-07	4.9E-03	1.2E-04	2.7E-04
Chromium	I	14.6	mg/kg	2.6E-06	3.0E-03	8.6E-04	0.001	1.5E-07	3.3E-04	4.5E-04	1.3E-03
Iron	I	6400	mg/kg	1.1E-03	3.0E-01	3.8E-03	0.001	6.5E-05	6.0E-03	1.1E-02	1.5E-02
Vanadium	I	4.8	mg/kg	8.5E-07	7.0E-03	1.2E-04	0.001	4.9E-08	2.1E-04	2.3E-04	3.5E-04
SUMMARY HAZARD INDEX						0.007				0.02	0.02
[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (February 10, 1992).											
[2] Calculated from oral RfDs.											
ND = no data available.											

TABLE E-6.2

CURRENT AND FUTURE LAND USE INHALATION OF PARTICULATES - SURFACE SOIL
 ADULT TRESPASSER AND RECREATIONAL USER
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1.24E+09	m ³ /kg	default [1]
CONCENTRATION AIR	CA	chemical-specific	mg/m ³	
INHALATION RATE	IR	2.5	m ³ /hour	USEPA, 1995
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE TIME	ET	4	hours/day	Assumption
EXPOSURE FREQUENCY	EF	45	days/year	Assumption
EXPOSURE DURATION	ED	20	years	Assumption
CONVERSION FACTOR	CF	0.001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	20	years	USEPA, 1991

[1] PEF has been derived in the PEF Appendix to this report.
 USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.
 USEPA, 1995. Supplemental Guidance to RAGS: Region IV, Human Health Risk Assessment Bulletin No. 3.

CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR (mg/kg-day)⁻¹

HAZARD QUOTIENT = INTAKE (mg/kg-day) / INHALATION REFERENCE DOSE (mg/kg-day)

INTAKE = $\frac{CA \times IR \times ET \times EF \times ED}{BW \times AT \times 365 \text{ days/yr}}$

Where:

CA = C x CF x (1/PEF)

Note: For noncarcinogenic effects, AT = ED

TABLE E-6.2

CURRENT AND FUTURE LAND USE INHALATION OF PARTICULATES - SURFACE SOIL
 ADULT TRESPASSER AND RECREATIONAL USER
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m ³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Tetrachloroethene	O	27	ug/kg	2.18E-11	3.8E-13	ND	
Benzo(a)anthracene	O	370	ug/kg	2.98E-10	5.3E-12	ND	
Benzo(a)pyrene	O	410	ug/kg	3.31E-10	5.8E-12	ND	
Benzo(b)fluoranthene	O	610	ug/kg	4.92E-10	8.7E-12	ND	
Benzo(k)fluoranthene	O	410	ug/kg	3.31E-10	5.8E-12	ND	
Chrysene	O	520	ug/kg	4.19E-10	7.4E-12	ND	
Dibenzo(a,h)anthracene	O	200	ug/kg	1.61E-10	2.8E-12	ND	
Indeno(1,2,3-cd)pyrene	O	290	ug/kg	2.34E-10	4.1E-12	ND	
Aroclor-1254	O	131	ug/kg	1.06E-10	1.9E-12	ND	
Aroclor-1260	O	25	ug/kg	2.02E-11	3.6E-13	ND	
Aluminum	I	9740	mg/kg	7.85E-06	1.4E-07	ND	
Arsenic	I	1.6	mg/kg	1.29E-09	2.3E-11	ND	
Beryllium	I	0.18	mg/kg	1.45E-10	2.6E-12	0.0000057	4.5E-07
Chromium	I	14.6	mg/kg	1.18E-08	2.1E-10	ND	
Iron	I	4580	mg/kg	3.69E-06	6.5E-08	ND	
SUMMARY HAZARD INDEX							4E-07
ND = no data available.							

TABLE E-6.3

CURRENT AND FUTURE LAND USE DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
 ADOLESCENT TRESPASSER AND RECREATIONAL USER
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	100	mg/day	USEPA, 1991
FRACTION INGESTED	FI	100%	unitless	Assumption
ADHERENCE FACTOR	AF	1	mg/cm ² -event	USEPA, 1992a
AGE-SPECIFIC SURFACE AREA	SA _i	age-specific	cm ²	USEPA, 1989
ABSORPTION FRACTION	ABS _d	chemical-specific	unitless	USEPA, 1992b
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganics
	CF	1.00E-09	kg/mg	Organics
BODY WEIGHT	BW	45	kg	USEPA, 1995
AGE-SPECIFIC BODY WEIGHT	BW _i	age-specific	kg	USEPA, 1989
EXPOSURE FREQUENCY	EF	45	days/year [1]	Assumption
EXPOSURE DURATION	ED	10	years	USEPA, 1995
AGE-SPECIFIC EXPOSURE DURATION	ED _i	age-specific	years	Assumption
AGE-WEIGHTED SURFACE AREA [2]	SA _{soil/adj}	1013	cm ² -year/kg	Per USEPA, 1992a
DOSE ABSORBED PER EVENT	DA _{event}	chemical-specific	mg/cm ² -event	Per USEPA, 1992a
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	10	years	USEPA, 1995

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)⁻¹

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

INTAKE_{INGESTION} = $\frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365 \text{ days/yr}}$

INTAKE_{DERMAL} = AT x 365 days/year) x SA_{soil/adj}

Where:

SA_{soil/adj} = SUM (SA_i x ED_i / BW_i)

DA_{event} = CS x AF x ABS_d x CF

Note: For noncarcinogenic effects: AT = ED.

[1] Units for exposure frequency are in events/year in the calculation of the dermally absorbed dose.

[2] In estimating the dermally absorbed dose for children age 7 through 16, the time-weighted, bodyweight normalized surface area exposed is calculated from surface area, exposure duration, and body weight for each of 10 age periods, age 7 through 16, per USEPA, 1992. USEPA, 1989. Exposure Factors Handbook; EPA/600/8-89/043; May 1989.

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.

USEPA, 1992a. Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/011B; January 1992 and Appendix ? to this report.

USEPA, 1992b. USEPA Region IV Guidance Memorandum, February 10, 1992.

USEPA, 1995. Supplemental Guidance to RAGS: Region 4 Bulletins, Bulletin No. 3, November 1995.

TABLE E-6.3

CURRENT AND FUTURE LAND USE DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
 ADOLESCENT TRESPASSER AND RECREATIONAL USER
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] (mg/kg-day) ⁻¹	CANCER RISK INGESTION	DERMAL ABS [2]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [1,3] (mg/kg-day) ⁻¹	CANCER RISK DERMAL	TOTAL CANCER RISK
Tetrachloroethene	O	27	ug/kg	1.1E-09	5.2E-02	5.5E-11	0.01	4.8E-10	5.2E-02	2.5E-11	8.0E-11
Benzo(a)pyrene equivalent	O	265	ug/kg	1.0E-08	7.3E+00	7.6E-08	0.01	4.7E-09	8.0E+00	3.8E-08	1.1E-07
Aroclor-1254	O	69.4	ug/kg	2.7E-09	2.0E+00	5.4E-09	0.06	7.4E-09	2.2E+00	1.6E-08	2.2E-08
Aroclor-1260	O	25	ug/kg	9.8E-10	2.0E+00	2.0E-09	0.06	2.7E-09	2.2E+00	5.9E-09	7.8E-09
SUMMARY CANCER RISK						8E-08				6E-08	1E-07
[1] Relative potency factors were applied to the CSFs for carcinogenic PAHs. Relative potency factors are derived in "Provisional Guidance for Quantitative Risk Assessment for Polycyclic Aromatic Hydrocarbons," USEPA, 1993.											
[2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (February 10, 1992).											
[3] Calculated from oral CSFs.											
NE = not evaluated.											

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Tetrachloroethene	O	27	ug/kg	7.4E-09	1.0E-02	7.4E-07	0.01	3.4E-09	1.0E-02	3.4E-07	1.1E-06
Benzo(a)anthracene	O	260	ug/kg	7.1E-08	3.0E-02	2.4E-06	0.01	3.2E-08	2.7E-02	1.2E-06	3.6E-06
Benzo(a)pyrene	O	330	ug/kg	9.0E-08	3.0E-02	3.0E-06	0.01	4.1E-08	2.7E-02	1.5E-06	4.5E-06
Benzo(b)fluoranthene	O	630	ug/kg	1.7E-07	3.0E-02	5.8E-06	0.01	7.9E-08	2.7E-02	2.9E-06	8.7E-06
Benzo(k)fluoranthene	O	230	ug/kg	6.3E-08	3.0E-02	2.1E-06	0.01	2.9E-08	2.7E-02	1.1E-06	3.2E-06
Chrysene	O	460	ug/kg	1.3E-07	3.0E-02	4.2E-06	0.01	5.7E-08	2.7E-02	2.1E-06	6.3E-06
Indeno(1,2,3-cd)pyrene	O	200	ug/kg	5.5E-08	3.0E-02	1.8E-06	0.01	2.5E-08	2.7E-02	9.3E-07	2.8E-06
Aroclor-1254	O	69.4	ug/kg	1.9E-08	2.0E-05	9.5E-04	0.06	5.2E-08	1.8E-05	2.9E-03	3.8E-03
Aroclor-1260	O	25	ug/kg	6.8E-09	2.0E-05	3.4E-04	0.06	1.9E-08	1.8E-05	1.0E-03	1.4E-03
Aluminum	I	9740	mg/kg	2.7E-03	1.0E+00	2.7E-03	0.001	1.2E-04	2.0E-01	6.1E-04	3.3E-03
Barium	I	59.7	mg/kg	1.6E-05	7.0E-02	2.3E-04	0.001	7.5E-07	4.9E-03	1.5E-04	3.9E-04
Chromium	I	14.6	mg/kg	4.0E-06	3.0E-03	1.3E-03	0.001	1.8E-07	3.3E-04	5.5E-04	1.9E-03
Iron	I	6400	mg/kg	1.8E-03	3.0E-01	5.8E-03	0.001	8.0E-05	6.0E-03	1.3E-02	1.9E-02
Vanadium	I	4.8	mg/kg	1.3E-06	7.0E-03	1.9E-04	0.001	6.0E-08	2.1E-04	2.9E-04	4.7E-04
SUMMARY HAZARD INDEX						0.01				0.02	0.03
[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (February 10, 1992).											
[2] Calculated from oral RfDs.											
ND = no data available.											

TABLE E-6.4

FUTURE LAND USE INHALATION OF PARTICULATES - SURFACE SOIL
 ADOLESCENT TRESPASSER AND RECREATIONAL USER
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1.24E+09	m ³ /kg	default [1]
CONCENTRATION AIR	CA	chemical-specific	mg/m ³	
INHALATION RATE	IR	0.412	m ³ /hour	USEPA, 1997
BODY WEIGHT	BW	45	kg	USEPA, 1995
EXPOSURE TIME	ET	4	hours/day	Assumption
EXPOSURE FREQUENCY	EF	45	days/year	Assumption
EXPOSURE DURATION	ED	10	years	USEPA, 1995
CONVERSION FACTOR	CF	0.001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	10	years	USEPA, 1995

[1] PEF has been derived in the PEF Appendix to this report.
 USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.
 USEPA 1995. Supplemental Guidance to RAGS, Region 4 Bulletins, Bulletin No. 3, November 1995.
 USEPA 1997. Exposure Factors Handbook Vol 1, August 1997.

$$\text{CANCER RISK} = \text{INTAKE (mg/kg-day)} \times \text{INHALATION CANCER SLOPE FACTOR (mg/kg-day)}^{-1}$$

$$\text{HAZARD QUOTIENT} = \text{INTAKE (mg/kg-day)} / \text{INHALATION REFERENCE DOSE (mg/kg-day)}$$

$$\text{INTAKE} = \frac{\text{CA} \times \text{IR} \times \text{ET} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT} \times 365 \text{ days/yr}}$$

Where:

$$\text{CA} = \text{C} \times \text{CF} \times (1/\text{PEF})$$

Notes: For noncarcinogenic effects: AT = ED

TABLE E-6.4

FUTURE LAND USE INHALATION OF PARTICULATES - SURFACE SOIL
 ADOLESCENT TRESPASSER AND RECREATIONAL USER
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m ³)	INTAKE (mg/kg-day)	INHALATION CSF (mg/kg-day) ⁻¹	CANCER RISK
Tetrachloroethene	O	27	ug/kg	2.18E-11	1.4E-14	2.0E-03	2.8E-17
Benzo(a)pyrene equivalent	O	728	ug/kg	5.87E-10	3.8E-13	3.1E+00	1.2E-12
Aroclor-1254	O	130	ug/kg	1.05E-10	6.8E-14	2.0E+00	1.4E-13
Aroclor-1260	O	25	ug/kg	2.02E-11	1.3E-14	2.0E+00	2.6E-14
Arsenic	I	1.6	mg/kg	1.29E-09	8.3E-13	1.5E+01	1.2E-11
Beryllium	I	0.18	mg/kg	1.45E-10	9.4E-14	8.4E+00	7.9E-13
Chromium	I	14.6	mg/kg	1.18E-08	7.6E-12	4.1E+01	3.1E-10
SUMMARY CANCER RISK							3E-10
NE = not evaluated.							

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m ³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Tetrachloroethene	O	27	ug/kg	2.18E-11	9.8E-14	ND	
Benzo(a)anthracene	O	370	ug/kg	2.98E-10	1.3E-12	ND	
Benzo(a)pyrene	O	410	ug/kg	3.31E-10	1.5E-12	ND	
Benzo(b)fluoranthene	O	610	ug/kg	4.92E-10	2.2E-12	ND	
Benzo(k)fluoranthene	O	410	ug/kg	3.31E-10	1.5E-12	ND	
Chrysene	O	520	ug/kg	4.19E-10	1.9E-12	ND	
Dibenzo(a,h)anthracene	O	200	ug/kg	1.61E-10	7.3E-13	ND	
Indeno(1,2,3-cd)pyrene	O	290	ug/kg	2.34E-10	1.1E-12	ND	
Aroclor-1254	O	131	ug/kg	1.06E-10	4.8E-13	ND	
Aroclor-1260	O	25	ug/kg	2.02E-11	9.1E-14	ND	
Aluminum	I	9740	mg/kg	7.85E-06	3.5E-08	ND	
Arsenic	I	1.6	mg/kg	1.29E-09	5.8E-12	ND	
Beryllium	I	0.18	mg/kg	1.45E-10	6.6E-13	0.0000057	1.1E-07
Chromium	I	14.6	mg/kg	1.18E-08	5.3E-11	ND	
Iron	I	4580	mg/kg	3.69E-06	1.7E-08	ND	
SUMMARY HAZARD INDEX							1E-07
ND = no data available.							

TABLE E-6.5

CURRENT AND FUTURE LAND USE DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
 SITE MAINTENANCE WORKER
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	50	mg/day	USEPA, 1992a
FRACTION INGESTED	FI	100%	unitless	Assumption
ADHERENCE FACTOR	AF	1	mg/cm ² -event	USEPA, 1992a
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1992b
SURFACE AREA EXPOSED	SA	5,750	cm ²	USEPA, 1992a
DOSE ABSORBED PER EVENT	DA _{event}	chemical-specific	mg/cm ² -event	USEPA, 1992a
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	24	days/year [1]	Assumption
EXPOSURE DURATION	ED	25	years	USEPA, 1995
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	25	years	USEPA, 1995

$$\text{CANCER RISK} = \text{INTAKE (mg/kg-day)} \times \text{CANCER SLOPE FACTOR (mg/kg-day)}^{-1}$$

$$\text{HAZARD QUOTIENT} = \text{INTAKE (mg/kg-day)} / \text{REFERENCE DOSE (mg/kg-day)}$$

$$\text{INTAKE}_{\text{-INGESTION}} = \frac{\text{CS} \times \text{IR} \times \text{FI} \times \text{CF} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT} \times 365 \text{ days/yr}}$$

$$\text{INTAKE}_{\text{-DERMAL}} = \frac{\text{DA}_{\text{event}} \times \text{SA} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT} \times 365 \text{ days/yr}}$$

Where:

$$\text{DA}_{\text{event}} = \text{CS} \times \text{AF} \times \text{ABS} \times \text{CF}$$

Note: For noncarcinogenic effects, AT = ED

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose.

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors";

OSWER Directive 9285.6-03.

USEPA, 1992a. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January 1992.

USEPA, 1992b. USEPA Region IV Guidance Memorandum; February 10, 1992.

USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.

TABLE E-6.5

CURRENT AND FUTURE LAND USE DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
 SITE MAINTENANCE WORKER
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF (mg/kg-day) ⁻¹	CANCER RISK INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2] (mg/kg-day) ⁻¹	CANCER RISK DERMAL	TOTAL CANCER RISK
Tetrachloroethene	O	27	ug/kg	4.5E-10	5.2E-02	2.4E-11	0.01	5.2E-10	5.2E-02	2.7E-11	5.1E-11
Benzo(a)pyrene equivalent	O	265	ug/kg	4.4E-09	7.3E+00	3.2E-08	0.01	5.1E-09	8.0E+00	4.1E-08	7.3E-08
Aroclor-1254	O	69.4	ug/kg	1.2E-09	2.0E+00	2.3E-09	0.06	8.0E-09	2.2E+00	1.8E-08	2.0E-08
Aroclor-1260	O	25	ug/kg	4.2E-10	2.0E+00	8.4E-10	0.06	2.9E-09	2.2E+00	6.4E-09	7.2E-09
SUMMARY CANCER RISK						4E-08				6E-08	1E-07
[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (February 10, 1992).											
[2] Calculated from oral CSFs.											
NE = not evaluated.											

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Tetrachloroethene	O	27	ug/kg	1.3E-09	1.0E-02	1.3E-07	0.01	1.5E-09	1.0E-02	1.5E-07	2.7E-07
Benzo(a)anthracene	O	260	ug/kg	1.2E-08	3.0E-02	4.1E-07	0.01	1.4E-08	2.7E-02	5.2E-07	9.3E-07
Benzo(a)pyrene	O	330	ug/kg	1.5E-08	3.0E-02	5.2E-07	0.01	1.8E-08	2.7E-02	6.6E-07	1.2E-06
Benzo(b)fluoranthene	O	630	ug/kg	3.0E-08	3.0E-02	9.9E-07	0.01	3.4E-08	2.7E-02	1.3E-06	2.2E-06
Benzo(k)fluoranthene	O	230	ug/kg	1.1E-08	3.0E-02	3.6E-07	0.01	1.2E-08	2.7E-02	4.6E-07	8.2E-07
Chrysene	O	460	ug/kg	2.2E-08	3.0E-02	7.2E-07	0.01	2.5E-08	2.7E-02	9.2E-07	1.6E-06
Indeno(1,2,3-cd)pyrene	O	200	ug/kg	9.4E-09	3.0E-02	3.1E-07	0.01	1.1E-08	2.7E-02	4.0E-07	7.1E-07
Aroclor-1254	O	69.4	ug/kg	3.3E-09	2.0E-05	1.6E-04	0.06	2.2E-08	1.8E-05	1.2E-03	1.4E-03
Aroclor-1260	O	25	ug/kg	1.2E-09	2.0E-05	5.9E-05	0.06	8.1E-09	1.8E-05	4.5E-04	5.1E-04
Aluminum	I	9740	mg/kg	4.6E-04	1.0E+00	4.6E-04	0.001	5.3E-05	2.0E-01	2.6E-04	7.2E-04
Barium	I	59.7	mg/kg	2.8E-06	7.0E-02	4.0E-05	0.001	3.2E-07	4.9E-03	6.6E-05	1.1E-04
Chromium	I	14.6	mg/kg	6.9E-07	3.0E-03	2.3E-04	0.001	7.9E-08	3.3E-04	2.4E-04	4.7E-04
Iron	I	6400	mg/kg	3.0E-04	3.0E-01	1.0E-03	0.001	3.5E-05	6.0E-03	5.8E-03	6.8E-03
Vanadium	I	4.8	mg/kg	2.3E-07	7.0E-03	3.2E-05	0.001	2.6E-08	2.1E-04	1.2E-04	1.6E-04
SUMMARY HAZARD INDEX						0.002				0.008	0.01
[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (February 10, 1992).											
[2] Calculated from oral RfDs.											
ND = no data available.											

TABLE E-6.6

CURRENT AND FUTURE LAND USE INHALATION OF PARTICULATES - SURFACE SOIL
 SITE MAINTENANCE WORKER
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1.24E+09	m ³ /kg	default [1]
CONCENTRATION AIR	CA	chemical-specific	mg/m ³	
INHALATION RATE	IR	2.5	m ³ /hour	USEPA, 1995
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE TIME	ET	8	hours/day	Assumption
EXPOSURE FREQUENCY	EF	24	days/year	Assumption
EXPOSURE DURATION	ED	25	years	USEPA, 1995
CONVERSION FACTOR	CF	0.001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	25	years	USEPA, 1995

CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR (mg/kg-day)⁻¹

HAZARD QUOTIENT = INTAKE (mg/kg-day) / INHALATION REFERENCE DOSE (mg/kg-day)

INTAKE = $\frac{CA \times IR \times ET \times EF \times ED}{BW \times AT \times 365 \text{ days/yr}}$

Where:

CA = C x CF x (1/PEF)

Note: For noncarcinogenic effects, AT = ED

[1] PEF has been derived in the PEF Appendix to this report.
 USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance:
 "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.
 USEPA, 1995. Supplemental Guidance to RAGS: Region 4 Bulletins, Bulletin No. 3, November 1995.

TABLE E-6.6

CURRENT AND FUTURE LAND USE INHALATION OF PARTICULATES - SURFACE SOIL
 SITE MAINTENANCE WORKER
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m ³)	INTAKE (mg/kg-day)	INHALATION CSF (mg/kg-day) ⁻¹	CANCER RISK
Tetrachloroethene	O	27	ug/kg	2.18E-11	1.5E-13	0.002	2.9E-16
Benzo(a)pyrene equivalent	O	728	ug/kg	5.87E-10	3.9E-12	3.1	1.2E-11
Aroclor-1254	O	130	ug/kg	1.05E-10	7.0E-13	2	1.4E-12
Aroclor-1260	O	25	ug/kg	2.02E-11	1.4E-13	2	2.7E-13
Arsenic	I	1.6	mg/kg	1.29E-09	8.7E-12	15	1.3E-10
Beryllium	I	0.18	mg/kg	1.45E-10	9.7E-13	8.4	8.2E-12
Chromium	I	14.6	mg/kg	1.18E-08	7.9E-11	41	3.2E-09
SUMMARY CANCER RISK							3E-09
NE = not evaluated.							

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m ³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Tetrachloroethene	O	27	ug/kg	2.18E-11	4.1E-13	ND	
Benzo(a)anthracene	O	370	ug/kg	2.98E-10	5.6E-12	ND	
Benzo(a)pyrene	O	410	ug/kg	3.31E-10	6.2E-12	ND	
Benzo(b)fluoranthene	O	610	ug/kg	4.92E-10	9.2E-12	ND	
Benzo(k)fluoranthene	O	410	ug/kg	3.31E-10	6.2E-12	ND	
Chrysene	O	520	ug/kg	4.19E-10	7.9E-12	ND	
Dibenzo(a,h)anthracene	O	200	ug/kg	1.61E-10	3.0E-12	ND	
Indeno(1,2,3-cd)pyrene	O	290	ug/kg	2.34E-10	4.4E-12	ND	
Aroclor-1254	O	131	ug/kg	1.06E-10	2.0E-12	ND	
Aroclor-1260	O	25	ug/kg	2.02E-11	3.8E-13	ND	
Aluminum	I	9740	mg/kg	7.85E-06	1.5E-07	ND	
Arsenic	I	1.6	mg/kg	1.29E-09	2.4E-11	ND	
Beryllium	I	0.18	mg/kg	1.45E-10	2.7E-12	0.0000057	4.8E-07
Chromium	I	14.6	mg/kg	1.18E-08	2.2E-10	ND	
Iron	I	4580	mg/kg	3.69E-06	6.9E-08	ND	
SUMMARY HAZARD INDEX							5E-07
ND = no data available.							

TABLE E-6.7

FUTURE LAND USE DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
 ADULT RESIDENT
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	100	mg/day	USEPA, 1995
FRACTION INGESTED	FI	100%	unitless	USEPA, 1995
ADHERENCE FACTOR	AF	1	mg/cm ² -event	USEPA, 1995
ABSORPTION FRACTION	ABS _d	chemical-specific	unitless	USEPA, 1992b
SURFACE AREA EXPOSED	SA	5,750	cm ²	USEPA, 1992a
DOSE ABSORBED PER EVENT	DA _{event}	chemical-specific	mg/cm ² -event	USEPA, 1992a
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	350	days/year [1]	Assumption
EXPOSURE DURATION	ED	24	years	USEPA, 1995
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	24	years	USEPA, 1995

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)⁻¹

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE}_{\text{INGESTION}} = \frac{\text{CS} \times \text{IR} \times \text{FI} \times \text{CF} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT} \times 365 \text{ days/yr}}$$

$$\text{INTAKE}_{\text{DERMAL}} = \frac{\text{DA}_{\text{event}} \times \text{SA} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT} \times 365 \text{ days/yr}}$$

Where:

$$\text{DA}_{\text{event}} = \text{CS} \times \text{AF} \times \text{ABS}_d \times \text{CF}$$

Note: For noncarcinogenic effects, AT = ED.

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose.

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors";

OSWER Directive 9285.6-03.

USEPA, 1992a. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January 1992.

USEPA, 1992b. USEPA Region IV Guidance Memorandum, February 10, 1992.

USEPA, 1995. Supplemental Guidance to RAGS: Region IV, Human Health Risk Assessment Bulletin No. 3.

TABLE E-6.7

FUTURE LAND USE DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT RESIDENT
NAVAL TRAINING CENTER
ORLANDO, FLORIDA
OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] (mg/kg-day) ⁻¹	CANCER RISK INGESTION	DERMAL ABS [2]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [3] (mg/kg-day) ⁻¹	CANCER RISK DERMAL	TOTAL CANCER RISK
Tetrachloroethene	O	27	ug/kg	1.3E-08	5.2E-02	6.6E-10	0.01	7.3E-09	5.2E-02	3.8E-10	1.0E-09
Benzo(a)pyrene equivalent	O	728	ug/kg	3.4E-07	7.3E+00	2.5E-06	0.01	2.0E-07	8.0E+00	1.6E-06	4.1E-06
Aroclor-1254	O	130	ug/kg	6.1E-08	2.0E+00	1.2E-07	0.06	2.1E-07	2.2E+00	4.6E-07	5.9E-07
Aroclor-1260	O	25	ug/kg	1.2E-08	2.0E+00	2.3E-08	0.06	4.1E-08	2.2E+00	8.9E-08	1.1E-07
Arsenic	I	1.6	mg/kg	7.5E-07	1.5E+00	1.1E-06	0.001	4.3E-08	1.5E+00	6.5E-08	1.2E-06
Beryllium	I	0.18	mg/kg	8.5E-08	4.3E+00	3.6E-07	0.001	4.9E-09	4.3E+02	2.1E-06	2.5E-06
SUMMARY CANCER RISK						4E-06				4E-06	8E-06
[1] Relative potency factors were applied to the CSFs for carcinogenic PAHs. Relative potency factors are derived in "Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons," USEPA, 1993.											
[2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (February 10, 1992).											
[3] Calculated from oral CSFs.											
ND = no data available.											

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Tetrachloroethene	O	27	ug/kg	3.7E-08	1.0E-02	3.7E-06	0.01	2.1E-08	1.0E-02	2.1E-06	5.8E-06
Benzo(a)anthracene	O	370	ug/kg	5.1E-07	3.0E-02	1.7E-05	0.01	2.9E-07	2.7E-02	1.1E-05	2.8E-05
Benzo(a)pyrene	O	410	ug/kg	5.6E-07	3.0E-02	1.9E-05	0.01	3.2E-07	2.7E-02	1.2E-05	3.1E-05
Benzo(b)fluoranthene	O	610	ug/kg	8.4E-07	3.0E-02	2.8E-05	0.01	4.8E-07	2.7E-02	1.8E-05	4.6E-05
Benzo(k)fluoranthene	O	410	ug/kg	5.6E-07	3.0E-02	1.9E-05	0.01	3.2E-07	2.7E-02	1.2E-05	3.1E-05
Chrysene	O	520	ug/kg	7.1E-07	3.0E-02	2.4E-05	0.01	4.1E-07	2.7E-02	1.5E-05	3.9E-05
Dibenzo(a,h)anthracene	O	200	ug/kg	2.7E-07	3.0E-02	9.1E-06	0.01	1.6E-07	2.7E-02	5.8E-06	1.5E-05
Indeno(1,2,3-cd)pyrene	O	290	ug/kg	4.0E-07	3.0E-02	1.3E-05	0.01	2.3E-07	2.7E-02	8.5E-06	2.2E-05
Aroclor-1254	O	130	ug/kg	1.8E-07	2.0E-05	8.9E-03	0.06	6.1E-07	1.8E-05	3.4E-02	4.3E-02
Aroclor-1260	O	25	ug/kg	3.4E-08	2.0E-05	1.7E-03	0.06	1.2E-07	1.8E-05	6.6E-03	8.3E-03
Aluminum	I	9740	mg/kg	1.3E-02	1.0E+00	1.3E-02	0.001	7.7E-04	2.0E-01	3.8E-03	1.7E-02
Arsenic	I	1.6	mg/kg	2.2E-06	3.0E-04	7.3E-03	0.001	1.3E-07	2.9E-04	4.3E-04	7.7E-03
Beryllium	I	0.18	mg/kg	2.5E-07	2.0E-03	1.2E-04	0.001	1.4E-08	2.0E-05	7.1E-04	8.3E-04
Chromium	I	14.6	mg/kg	2.0E-05	5.0E-03	4.0E-03	0.001	1.2E-06	5.5E-04	2.1E-03	6.1E-03
Iron	I	4580	mg/kg	6.3E-03	3.0E-01	2.1E-02	0.001	3.6E-04	6.0E-03	6.0E-02	8.1E-02
SUMMARY HAZARD INDEX						6E-02				1E-01	2E-01
[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (February 10, 1992).											
[2] Calculated from oral RfDs.											
ND = no data available.											

TABLE E-6.8

FUTURE LAND USE INHALATION OF PARTICULATES - SURFACE SOIL
 ADULT RESIDENT
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1.24E+09	m ³ /kg	default [1]
CONCENTRATION AIR	CA	chemical-specific	mg/m ³	
INHALATION RATE	IR	0.833	m ³ /hour	USEPA, 1995
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE TIME	ET	24	hours/day	Assumption
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1995
EXPOSURE DURATION	ED	24	years	USEPA, 1995
CONVERSION FACTOR	CF	0.001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	24	years	USEPA, 1995

[1] PEF has been derived in the PEF Appendix to this report.

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.

USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.

$$\text{CANCER RISK} = \text{INTAKE (mg/kg-day)} \times \text{INHALATION CANCER SLOPE FACTOR (mg/kg-day)}^{-1}$$

$$\text{HAZARD QUOTIENT} = \text{INTAKE (mg/kg-day)} / \text{INHALATION REFERENCE DOSE (mg/kg-day)}$$

$$\text{INTAKE} = \frac{\text{CA} \times \text{IR} \times \text{ET} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT} \times 365 \text{ days/yr}}$$

Where:

$$\text{CA} = \text{C} \times \text{CF} \times (1/\text{PEF})$$

Note:

For noncarcinogenic effects: AT = ED

TABLE E-6.8

FUTURE LAND USE INHALATION OF PARTICULATES - SURFACE SOIL
 ADULT RESIDENT
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m ³)	INTAKE (mg/kg-day)	INHALATION CSF (mg/kg-day) ⁻¹	CANCER RISK
Tetrachloroethene	O	27	ug/kg	2.18E-11	2.0E-12	2.0E-03	4.1E-15
Benzo(a)pyrene equivalent	O	728	ug/kg	5.87E-10	5.5E-11	3.1E+00	1.7E-10
Aroclor-1254	O	130	ug/kg	1.05E-10	9.8E-12	2.0E+00	2.0E-11
Aroclor-1260	O	25	ug/kg	2.02E-11	1.9E-12	2.0E+00	3.8E-12
Arsenic	I	1.6	mg/kg	1.29E-09	1.2E-10	1.5E+01	1.8E-09
Beryllium	I	0.18	mg/kg	1.45E-10	1.4E-11	8.4E+00	1.1E-10
Chromium	I	14.6	mg/kg	1.18E-08	1.1E-09	4.1E+01	4.5E-08
SUMMARY CANCER RISK							5E-08
ND = no data available.							

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m ³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Tetrachloroethene	O	27	ug/kg	2.18E-11	6.0E-12	ND	
Benzo(a)anthracene	O	370	ug/kg	2.98E-10	8.2E-11	ND	
Benzo(a)pyrene	O	410	ug/kg	3.31E-10	9.1E-11	ND	
Benzo(b)fluoranthene	O	610	ug/kg	4.92E-10	1.3E-10	ND	
Benzo(k)fluoranthene	O	410	ug/kg	3.31E-10	9.1E-11	ND	
Chrysene	O	520	ug/kg	4.19E-10	1.1E-10	ND	
Dibenzo(a,h)anthracene	O	200	ug/kg	1.61E-10	4.4E-11	ND	
Indeno(1,2,3-cd)pyrene	O	290	ug/kg	2.34E-10	6.4E-11	ND	
Aroclor-1254	O	130	ug/kg	1.05E-10	2.9E-11	ND	
Aroclor-1260	O	25	ug/kg	2.02E-11	5.5E-12	ND	
Aluminum	I	9740	mg/kg	7.85E-06	2.2E-06	ND	
Arsenic	I	1.6	mg/kg	1.29E-09	3.5E-10	ND	
Beryllium	I	0.18	mg/kg	1.45E-10	4.0E-11	0.0000057	7.0E-06
Chromium	I	14.6	mg/kg	1.18E-08	3.2E-09	ND	
Iron	I	4580	mg/kg	3.69E-06	1.0E-06	ND	
SUMMARY HAZARD INDEX							7E-06
ND = no data available.							

TABLE E-6.9

FUTURE LAND USE DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
CHILD RESIDENT
NAVAL TRAINING CENTER
ORLANDO, FLORIDA
OPERABLE UNIT 4

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	200	mg/day	USEPA, 1995
FRACTION INGESTED	FI	100%	unitless	USEPA, 1995
ADHERENCE FACTOR	AF	1	mg/cm ² -event	USEPA, 1995
AGE-SPECIFIC SURFACE AREA	SA	age-specific	cm ²	USEPA, 1989
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1992b
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
BODY WEIGHT	BW	15	kg	USEPA, 1991
AGE-SPECIFIC BODY WEIGHT	BW	age-specific	kg	USEPA, 1989
EXPOSURE FREQUENCY	EF	350	days/year [1]	USEPA, 1995
EXPOSURE DURATION	ED	6	years	USEPA, 1995
AGE-SPECIFIC EXPOSURE DURATION	ED	age-specific	years	Assumption
AGE-WEIGHTED SURFACE AREA [2]	SA _{soil/adj}	766	cm ² -year/kg	USEPA, 1992a
DOSE ABSORBED PER EVENT	DA _{event}	chemical-specific	mg/cm ² -event	USEPA, 1992a
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	6	years	USEPA, 1995

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)⁻¹

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

INTAKE_{INGESTION} = $\frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365 \text{ days/yr}}$

INTAKE_{DERMAL} = (DA_{event} x EF / AT x 365 days/year) x SA_{soil/adj}

Where:

SA_{soil/adj} = SUM (SA x ED / BW)

DA_{event} = CS x AF x ABS x CF

Note: For noncarcinogenic effects, AT = ED.

[1] Units for exposure frequency are in events/year in the calculation of the dermally absorbed dose.

[2] In estimating the dermally absorbed dose for children age1 through 6, the time-weighted, bodyweight normalized surface area exposed is calculated from surface area, exposure duration, and body weight for each of 6 age periods, age 1 through 6, per USEPA, 1992. USEPA, 1989. Exposure Factors Handbook; EPA/600/8-89/043; May 1989.

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.

USEPA, 1992a. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January 1992.

USEPA, 1992b. USEPA Region IV Guidance Memorandum, February 10, 1992.

USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.

TABLE E-6.9

FUTURE LAND USE DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
CHILD RESIDENT
NAVAL TRAINING CENTER
ORLANDO, FLORIDA
OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] (mg/kg-day) ⁻¹	CANCER RISK INGESTION	DERMAL ABS [2]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [1, 3] (mg/kg-day) ⁻¹	CANCER RISK DERMAL	TOTAL CANCER RISK
Tetrachloroethene	O	27	ug/kg	3.0E-08	5.2E-02	1.5E-09	0.01	2.8E-09	5.2E-02	1.5E-10	1.7E-09
Benzo(a)pyrene equivalent	O	265	ug/kg	2.9E-07	7.3E+00	2.1E-06	0.01	2.8E-08	8.0E+00	2.2E-07	2.3E-06
Aroclor-1254	O	69.4	ug/kg	7.6E-08	2.0E+00	1.5E-07	0.06	4.4E-08	2.2E+00	9.6E-08	2.5E-07
Aroclor-1260	O	25	ug/kg	2.7E-08	2.0E+00	5.5E-08	0.06	1.6E-08	2.2E+00	3.5E-08	8.9E-08
SUMMARY CANCER RISK						2E-06				4E-07	3E-06
[1] Relative potency factors were applied to the CSFs of carcinogenic PAHs. Relative potency factors are derived in "Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons," USEPA, 1993.											
[2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (February 10, 1992).											
[3] Calculated from oral CSFs.											
NE = not evaluated.											

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Tetrachloroethene	O	27	ug/kg	3.5E-07	1.0E-02	3.5E-05	0.01	3.3E-08	1.0E-02	3.3E-06	3.8E-05
Benzo(a)anthracene	O	260	ug/kg	3.3E-06	3.0E-02	1.1E-04	0.01	3.2E-07	2.7E-02	1.2E-05	1.2E-04
Benzo(a)pyrene	O	330	ug/kg	4.2E-06	3.0E-02	1.4E-04	0.01	4.0E-07	2.7E-02	1.5E-05	1.6E-04
Benzo(b)fluoranthene	O	630	ug/kg	8.1E-06	3.0E-02	2.7E-04	0.01	7.7E-07	2.7E-02	2.9E-05	3.0E-04
Benzo(k)fluoranthene	O	230	ug/kg	2.9E-06	3.0E-02	9.8E-05	0.01	2.8E-07	2.7E-02	1.0E-05	1.1E-04
Chrysene	O	460	ug/kg	5.9E-06	3.0E-02	2.0E-04	0.01	5.6E-07	2.7E-02	2.1E-05	2.2E-04
Indeno(1,2,3-cd)pyrene	O	200	ug/kg	2.6E-06	3.0E-02	8.5E-05	0.01	2.4E-07	2.7E-02	9.1E-06	9.4E-05
Aroclor-1254	O	69.4	ug/kg	8.9E-07	2.0E-05	4.4E-02	0.06	5.1E-07	1.8E-05	2.8E-02	7.3E-02
Aroclor-1260	O	25	ug/kg	3.2E-07	2.0E-05	1.6E-02	0.06	1.8E-07	1.8E-05	1.0E-02	2.6E-02
Aluminum	I	9740	mg/kg	1.2E-01	1.0E+00	1.2E-01	0.001	1.2E-03	2.0E-01	6.0E-03	1.3E-01
Barium	I	59.7	mg/kg	7.6E-04	7.0E-02	1.1E-02	0.001	7.3E-06	4.9E-03	1.5E-03	1.2E-02
Chromium	I	14.6	mg/kg	1.9E-04	3.0E-03	6.2E-02	0.001	1.8E-06	3.3E-04	5.4E-03	6.8E-02
Iron	I	6400	mg/kg	8.2E-02	3.0E-01	2.7E-01	0.001	7.8E-04	6.0E-03	1.3E-01	4.0E-01
Vanadium	I	4.8	mg/kg	6.1E-05	7.0E-03	8.8E-03	0.001	5.9E-07	2.1E-04	2.8E-03	1.2E-02
SUMMARY HAZARD INDEX						0.5				0.2	0.7
[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (February 10, 1992).											
[2] Calculated from oral RfDs.											
ND = no data available.											

TABLE E-6.10

FUTURE LAND USE INHALATION OF PARTICULATES - SURFACE SOIL
CHILD RESIDENT
NAVAL TRAINING CENTER
ORLANDO, FLORIDA
OPERABLE UNIT 4

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1.24E+09	m ³ /kg	default [1]
CONCENTRATION IN AIR	CA	chemical-specific	mg/m ³	
INHALATION RATE	IR	0.625	m ³ /hour	USEPA, 1995
BODY WEIGHT	BW	15	kg	USEPA, 1991
EXPOSURE TIME	ET	24	hours/day	Assumption
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1991
EXPOSURE DURATION	ED	6	years	USEPA, 1991
CONVERSION FACTOR	CF	0.001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	6	years	USEPA, 1991

[1] PEF has been derived in the PEF Appendix to this report.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.
USEPA, 1995. Supplemental Guidance to RAGS: Region 4 Bulletins, Bulletin No. 3, November 1995.

CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR (mg/kg-day)⁻¹

HAZARD QUOTIENT = INTAKE (mg/kg-day) / INHALATION REFERENCE DOSE (mg/kg-day)

INTAKE = $\frac{CA \times IR \times ET \times EF \times ED}{BW \times AT \times 365 \text{ days/yr}}$

Where:

CA = C x CF x (1/PEF)

Note:

For noncarcinogenic effects: AT = ED

TABLE E-6.10

FUTURE LAND USE INHALATION OF PARTICULATES - SURFACE SOIL
CHILD RESIDENT
NAVAL TRAINING CENTER
ORLANDO, FLORIDA
OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m ³)	INTAKE (mg/kg-day)	INHALATION CSF (mg/kg-day) ⁻¹	CANCER RISK
Tetrachloroethene	O	27	ug/kg	2.18E-11	1.8E-12	2.0E-03	3.6E-15
Benzo(a)pyrene equivalent	O	728	ug/kg	5.87E-10	4.8E-11	3.1E+00	1.5E-10
Aroclor-1254	O	130	ug/kg	1.05E-10	8.6E-12	2.0E+00	1.7E-11
Aroclor-1260	O	25	ug/kg	2.02E-11	1.7E-12	2.0E+00	3.3E-12
Arsenic	I	1.6	mg/kg	1.29E-09	1.1E-10	1.5E+01	1.6E-09
Beryllium	I	0.18	mg/kg	1.45E-10	1.2E-11	8.4E+00	1.0E-10
Chromium	I	14.6	mg/kg	1.18E-08	9.7E-10	4.1E+01	4.0E-08
SUMMARY CANCER RISK							4E-08
NE = not evaluated.							

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m ³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Tetrachloroethene	O	27	ug/kg	2.18E-11	2.1E-11	ND	
Benzo(a)anthracene	O	370	ug/kg	2.98E-10	2.9E-10	ND	
Benzo(a)pyrene	O	410	ug/kg	3.31E-10	3.2E-10	ND	
Benzo(b)fluoranthene	O	610	ug/kg	4.92E-10	4.7E-10	ND	
Benzo(k)fluoranthene	O	410	ug/kg	3.31E-10	3.2E-10	ND	
Chrysene	O	520	ug/kg	4.19E-10	4.0E-10	ND	
Dibenzo(a,h)anthracene	O	200	ug/kg	1.61E-10	1.5E-10	ND	
Indeno(1,2,3-cd)pyrene	O	290	ug/kg	2.34E-10	2.2E-10	ND	
Aroclor-1254	O	131	ug/kg	1.06E-10	1.0E-10	ND	
Aroclor-1260	O	25	ug/kg	2.02E-11	1.9E-11	ND	
Aluminum	I	9740	mg/kg	7.85E-06	7.5E-06	ND	
Arsenic	I	1.6	mg/kg	1.29E-09	1.2E-09	ND	
Beryllium	I	0.18	mg/kg	1.45E-10	1.4E-10	0.0000057	2.4E-05
Chromium	I	14.6	mg/kg	1.18E-08	1.1E-08	ND	
Iron	I	4580	mg/kg	3.69E-06	3.5E-06	ND	
SUMMARY HAZARD INDEX							2E-05
ND = no data available.							

TABLE E-6.11

FUTURE LAND USE DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
 OCCUPATIONAL WORKER
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	50	mg/day	USEPA, 1995
FRACTION INGESTED	FI	100%	unitless	Assumption
ADHERENCE FACTOR	AF	1	mg/cm ² -event	USEPA, 1995
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1992b
SURFACE AREA EXPOSED	SA	2,300	cm ²	USEPA, 1992a
DOSE ABSORBED PER EVENT	DA _{event}	chemical-specific	mg/cm ² -event	USEPA, 1992a
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	250	days/year [1]	USEPA, 1995
EXPOSURE DURATION	ED	25	years	USEPA, 1995
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	25	years	USEPA, 1995

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose.
 USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.
 USEPA, 1992a. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January 1992.
 USEPA, 1992b. USEPA Region IV Guidance Memorandum; February 10, 1992.
 USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.

$$\text{CANCER RISK} = \text{INTAKE (mg/kg-day)} \times \text{CANCER SLOPE FACTOR (mg/kg-day)}^{-1}$$

$$\text{HAZARD QUOTIENT} = \text{INTAKE (mg/kg-day)} / \text{REFERENCE DOSE (mg/kg-day)}$$

$$\text{INTAKE-INGESTION} = \frac{\text{CS} \times \text{IR} \times \text{FI} \times \text{CF} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT} \times 365 \text{ days/yr}}$$

$$\text{INTAKE-DERMAL} = \frac{\text{DA}_{\text{event}} \times \text{SA} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT} \times 365 \text{ days/yr}}$$

Where:

$$\text{DA}_{\text{event}} = \text{CS} \times \text{AF} \times \text{ABS} \times \text{CF}$$

Note: For noncarcinogenic effects, AT = ED

TABLE E-6.11

FUTURE LAND USE DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
 OCCUPATIONAL WORKER
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF (mg/kg-day) ⁻¹	CANCER RISK INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2] (mg/kg-day) ⁻¹	CANCER RISK DERMAL	TOTAL CANCER RISK
Tetrachloroethene	O	27	ug/kg	4.7E-09	5.2E-02	2.5E-10	0.01	2.2E-09	5.2E-02	1.1E-10	3.6E-10
Benzo(a)pyrene equivalent	O	265	ug/kg	4.6E-08	7.3E+00	3.4E-07	0.01	2.1E-08	8.0E+00	1.7E-07	5.1E-07
Aroclor-1254	O	69.4	ug/kg	1.2E-08	2.0E+00	2.4E-08	0.06	3.3E-08	2.2E+00	7.4E-08	9.8E-08
Aroclor-1260	O	25	ug/kg	4.4E-09	2.0E+00	8.7E-09	0.06	1.2E-08	2.2E+00	2.7E-08	3.5E-08
SUMMARY CANCER RISK						4E-07				3E-07	6E-07
[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (February 10, 1992).											
[2] Calculated from oral CSFs.											
NE = not evaluated.											

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Tetrachloroethene	O	27	ug/kg	1.3E-08	1.0E-02	1.3E-06	0.01	6.1E-09	1.0E-02	6.1E-07	1.9E-06
Benzo(a)anthracene	O	260	ug/kg	1.3E-07	3.0E-02	4.2E-06	0.01	5.9E-08	2.7E-02	2.2E-06	6.4E-06
Benzo(a)pyrene	O	330	ug/kg	1.6E-07	3.0E-02	5.4E-06	0.01	7.4E-08	2.7E-02	2.8E-06	8.1E-06
Benzo(b)fluoranthene	O	630	ug/kg	3.1E-07	3.0E-02	1.0E-05	0.01	1.4E-07	2.7E-02	5.3E-06	1.6E-05
Benzo(k)fluoranthene	O	230	ug/kg	1.1E-07	3.0E-02	3.8E-06	0.01	5.2E-08	2.7E-02	1.9E-06	5.7E-06
Chrysene	O	460	ug/kg	2.3E-07	3.0E-02	7.5E-06	0.01	1.0E-07	2.7E-02	3.8E-06	1.1E-05
Indeno(1,2,3-cd)pyrene	O	200	ug/kg	9.8E-08	3.0E-02	3.3E-06	0.01	4.5E-08	2.7E-02	1.7E-06	4.9E-06
Aroclor-1254	O	69.4	ug/kg	3.4E-08	2.0E-05	1.7E-03	0.06	9.4E-08	1.8E-05	5.2E-03	6.9E-03
Aroclor-1260	O	25	ug/kg	1.2E-08	2.0E-05	6.1E-04	0.06	3.4E-08	1.8E-05	1.9E-03	2.5E-03
Aluminum	I	9740	mg/kg	4.8E-03	1.0E+00	4.8E-03	0.001	2.2E-04	2.0E-01	1.1E-03	5.9E-03
Barium	I	59.7	mg/kg	2.9E-05	7.0E-02	4.2E-04	0.001	1.3E-06	4.9E-03	2.7E-04	6.9E-04
Chromium	I	14.6	mg/kg	7.1E-06	3.0E-03	2.4E-03	0.001	3.3E-07	3.3E-04	1.0E-03	3.4E-03
Iron	I	6400	mg/kg	3.1E-03	3.0E-01	1.0E-02	0.001	1.4E-04	6.0E-03	2.4E-02	3.4E-02
Vanadium	I	4.8	mg/kg	2.3E-06	7.0E-03	3.4E-04	0.001	1.1E-07	2.1E-04	5.1E-04	8.5E-04
SUMMARY HAZARD INDEX						0.02				0.03	0.05
[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (February 10, 1992).											
[2] Calculated from oral RfDs.											
ND = no data available.											

TABLE E-6.12

FUTURE LAND USE INHALATION OF PARTICULATES - SURFACE SOIL
 OCCUPATIONAL WORKER
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1.24E+09	m ³ /kg	default [1]
CONCENTRATION AIR	CA	chemical-specific	mg/m ³	
INHALATION RATE	IR	0.833	m ³ /hour	USEPA, 1995
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE TIME	ET	8	hours/day	Assumption
EXPOSURE FREQUENCY	EF	250	days/year	Assumption
EXPOSURE DURATION	ED	25	years	USEPA, 1995
CONVERSION FACTOR	CF	0.001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	25	years	USEPA, 1995

<p>[1] PEF has been derived in the PEF Appendix to this report. USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: *Standard Default Exposure Factors*; OSWER Directive 9285.6-03. USEPA, 1995. Supplemental Guidance to RAGS: Region 4 Bulletins, Bulletin No. 3, November 1995.</p>	<p>CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR (mg/kg-day)⁻¹</p> <p>HAZARD QUOTIENT = INTAKE (mg/kg-day) / INHALATION REFERENCE DOSE (mg/kg-day)</p> <p>INTAKE = $\frac{CA \times IR \times ET \times EF \times ED}{BW \times AT \times 365 \text{ days/yr}}$</p> <p>Where: CA = C x CF x (1/PEF)</p> <p>Note: For noncarcinogenic effects, AT = ED.</p>
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TABLE E-6.12

FUTURE LAND USE INHALATION OF PARTICULATES - SURFACE SOIL
 OCCUPATIONAL WORKER
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m ³)	INTAKE (mg/kg-day)	INHALATION CSF (mg/kg-day) ⁻¹	CANCER RISK
Tetrachloroethene	O	27	ug/kg	2.18E-11	5.1E-13	0.002	1.0E-15
Benzo(a)pyrene equivalent	O	728	ug/kg	5.87E-10	1.4E-11	3.1	4.2E-11
Aroclor-1254	O	130	ug/kg	1.05E-10	2.4E-12	2	4.9E-12
Aroclor-1260	O	25	ug/kg	2.02E-11	4.7E-13	2	9.4E-13
Arsenic	I	1.6	mg/kg	1.29E-09	3.0E-11	15	4.5E-10
Beryllium	I	0.18	mg/kg	1.45E-10	3.4E-12	8.4	2.8E-11
Chromium	I	14.6	mg/kg	1.18E-08	2.7E-10	41	1.1E-08
SUMMARY CANCER RISK							1E-08
NE = not evaluated.							

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m ³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Tetrachloroethene	O	27	ug/kg	2.18E-11	1.4E-12	ND	
Benzo(a)anthracene	O	370	ug/kg	2.98E-10	1.9E-11	ND	
Benzo(a)pyrene	O	410	ug/kg	3.31E-10	2.2E-11	ND	
Benzo(b)fluoranthene	O	610	ug/kg	4.92E-10	3.2E-11	ND	
Benzo(k)fluoranthene	O	410	ug/kg	3.31E-10	2.2E-11	ND	
Chrysene	O	520	ug/kg	4.19E-10	2.7E-11	ND	
Dibenzo(a,h)anthracene	O	200	ug/kg	1.61E-10	1.1E-11	ND	
Indeno(1,2,3-cd)pyrene	O	290	ug/kg	2.34E-10	1.5E-11	ND	
Aroclor-1254	O	131	ug/kg	1.06E-10	6.9E-12	ND	
Aroclor-1260	O	25	ug/kg	2.02E-11	1.3E-12	ND	
Aluminum	I	9740	mg/kg	7.85E-06	5.1E-07	ND	
Arsenic	I	1.6	mg/kg	1.29E-09	8.4E-11	ND	
Beryllium	I	0.18	mg/kg	1.45E-10	9.5E-12	0.0000057	1.7E-06
Chromium	I	14.6	mg/kg	1.18E-08	7.7E-10	ND	
Iron	I	4580	mg/kg	3.69E-06	2.4E-07	ND	
SUMMARY HAZARD INDEX							2E-06
ND = no data available.							

TABLE E-6.13

FUTURE LAND USE DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
 EXCAVATION WORKER
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	480	mg/day	USEPA, 1995
FRACTION INGESTED	FI	100%	unitless	Assumption
ADHERENCE FACTOR	AF	1	mg/cm ² -event	USEPA, 1995
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1992b
SURFACE AREA EXPOSED	SA	5,750	cm ²	USEPA, 1992a
DOSE ABSORBED PER EVENT	DA _{event}	chemical-specific	mg/cm ² -event	USEPA, 1992a
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	250	days/year [1]	Assumption
EXPOSURE DURATION	ED	0.083	years	USEPA, 1991
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	0.083	years	USEPA, 1991

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)⁻¹
 HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE}_{\text{INGESTION}} = \frac{\text{CS} \times \text{IR} \times \text{FI} \times \text{CF} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT} \times 365 \text{ days/yr}}$$

$$\text{INTAKE}_{\text{DERMAL}} = \frac{\text{DA}_{\text{event}} \times \text{SA} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT} \times 365 \text{ days/yr}}$$

Where:
 DA_{event} = CS x AF x ABS x CF

Note: For noncarcinogenic effects, AT = ED

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose.
 USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors";
 OSWER Directive 9285.6-03.
 USEPA, 1992a. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January 1992.
 USEPA, 1992b. USEPA Region IV Guidance Memorandum; February 10, 1992.
 USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.

TABLE E-6.13

FUTURE LAND USE DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
EXCAVATION WORKER
NAVAL TRAINING CENTER
ORLANDO, FLORIDA
OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF (mg/kg-day) ⁻¹	CANCER RISK INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2] (mg/kg-day) ⁻¹	CANCER RISK DERMAL	TOTAL CANCER RISK
Tetrachloroethene	O	27	ug/kg	1.5E-10	5.2E-02	7.8E-12	0.01	1.8E-11	5.2E-02	9.4E-13	8.8E-12
Benzo(a)pyrene equivalent	O	265	ug/kg	1.5E-09	7.3E+00	1.1E-08	0.01	1.8E-10	8.0E+00	1.4E-09	1.2E-08
Aroclor-1254	O	69.4	ug/kg	3.9E-10	2.0E+00	7.7E-10	0.06	2.8E-10	2.2E+00	6.1E-10	1.4E-09
Aroclor-1260	O	25	ug/kg	1.4E-10	2.0E+00	2.8E-10	0.06	1.0E-10	2.2E+00	2.2E-10	5.0E-10
SUMMARY CANCER RISK						1E-08				2E-09	1E-08
[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (February 10, 1992).											
[2] Calculated from oral CSFs.											
NE = not evaluated.											

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Tetrachloroethene	O	27	ug/kg	1.3E-07	1.0E-01	1.3E-06	0.01	1.5E-08	1.0E-01	1.5E-07	1.4E-06
Benzo(a)anthracene	O	260	ug/kg	1.2E-06	3.0E-01	4.1E-06	0.01	1.5E-07	2.7E-01	5.4E-07	4.6E-06
Benzo(a)pyrene	O	330	ug/kg	1.5E-06	3.0E-01	5.2E-06	0.01	1.9E-07	2.7E-01	6.9E-07	5.9E-06
Benzo(b)fluoranthene	O	630	ug/kg	3.0E-06	3.0E-01	9.9E-06	0.01	3.5E-07	2.7E-01	1.3E-06	1.1E-05
Benzo(k)fluoranthene	O	230	ug/kg	1.1E-06	3.0E-01	3.6E-06	0.01	1.3E-07	2.7E-01	4.8E-07	4.1E-06
Chrysene	O	460	ug/kg	2.2E-06	3.0E-01	7.2E-06	0.01	2.6E-07	2.7E-01	9.6E-07	8.2E-06
Indeno(1,2,3-cd)pyrene	O	200	ug/kg	9.4E-07	3.0E-01	3.1E-06	0.01	1.1E-07	2.7E-01	4.2E-07	3.5E-06
Aroclor-1254	O	69.4	ug/kg	3.3E-07	5.0E-05	6.5E-03	0.06	2.3E-07	4.5E-05	5.2E-03	1.2E-02
Aroclor-1260	O	25	ug/kg	1.2E-07	5.0E-05	2.3E-03	0.06	8.4E-08	4.5E-05	1.9E-03	4.2E-03
Aluminum	I	9740	mg/kg	4.6E-02	1.0E+00	4.6E-02	0.001	5.5E-04	2.0E-01	2.7E-03	4.8E-02
Barium	I	59.7	mg/kg	2.8E-04	7.0E-02	4.0E-03	0.001	3.4E-06	4.9E-03	6.9E-04	4.7E-03
Chromium	I	14.6	mg/kg	6.9E-05	2.0E-02	3.4E-03	0.001	8.2E-07	2.2E-03	3.7E-04	3.8E-03
Iron	I	6400	mg/kg	3.0E-02	3.0E-01	1.0E-01	0.001	3.6E-04	6.0E-03	6.0E-02	1.6E-01
Vanadium	I	4.8	mg/kg	2.3E-05	7.0E-03	3.2E-03	0.001	2.7E-07	2.1E-04	1.3E-03	4.5E-03
SUMMARY HAZARD INDEX						0.2				0.07	0.2
[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (February 10, 1992).											
[2] Calculated from oral RfDs.											
ND = no data available.											

TABLE E-6.14

FUTURE LAND USE INHALATION OF PARTICULATES - SURFACE SOIL
 EXCAVATION WORKER
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1.24E+09	m ³ /kg	default [1]
CONCENTRATION AIR	CA	chemical-specific	mg/m ³	
INHALATION RATE	IR	2.5	m ³ /hour	USEPA, 1995
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE TIME	ET	8	hours/day	Assumption
EXPOSURE FREQUENCY	EF	30	days/year	Assumption
EXPOSURE DURATION	ED	1	years	Assumption
CONVERSION FACTOR	CF	0.001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	1	years	USEPA, 1991

CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR (mg/kg-day)⁻¹

'HAZARD QUOTIENT' = INTAKE (mg/kg-day) / INHALATION REFERENCE DOSE (mg/kg-day)

INTAKE = $\frac{CA \times IR \times ET \times EF \times ED}{BW \times AT \times 365 \text{ days/yr}}$

Where:

CA = C x CF x (1/PEF)

Note: For noncarcinogens, AT = ED.

[1] PEF has been derived in the PEF Appendix to this report.
 USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance:
 Standard Default Exposure Factors; OSWER Directive 9285.6-03.
 USEPA, 1995. Supplemental Guidance to RAGS: Region IV, Human Health Risk Assessment Bulletin No. 3.

TABLE E-6.14

FUTURE LAND USE INHALATION OF PARTICULATES - SURFACE SOIL
EXCAVATION WORKER
NAVAL TRAINING CENTER
ORLANDO, FLORIDA
OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m ³)	INTAKE (mg/kg-day)	INHALATION CSF (mg/kg-day) ⁻¹	CANCER RISK
Tetrachloroethene	O	27	ug/kg	2.18E-11	7.3E-15	2.0E-03	1.5E-17
Benzo(a)pyrene equivalent	O	728	ug/kg	5.87E-10	2.0E-13	3.1E+00	6.1E-13
Aroclor-1254	O	130	ug/kg	1.05E-10	3.5E-14	2.0E+00	7.0E-14
Aroclor-1260	O	25	ug/kg	2.02E-11	6.8E-15	2.0E+00	1.4E-14
Arsenic	I	1.6	mg/kg	1.29E-09	4.3E-13	1.5E+01	6.5E-12
Beryllium	I	0.18	mg/kg	1.45E-10	4.9E-14	8.4E+00	4.1E-13
Chromium	I	14.6	mg/kg	1.18E-08	3.9E-12	4.1E+01	1.6E-10
SUMMARY CANCER RISK							2E-10
NE = not evaluated.							

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m ³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Tetrachloroethene	O	27	ug/kg	2.18E-11	5.1E-13	ND	
Benzo(a)anthracene	O	370	ug/kg	2.98E-10	7.0E-12	ND	
Benzo(a)pyrene	O	410	ug/kg	3.31E-10	7.8E-12	ND	
Benzo(b)fluoranthene	O	610	ug/kg	4.92E-10	1.2E-11	ND	
Benzo(k)fluoranthene	O	410	ug/kg	3.31E-10	7.8E-12	ND	
Chrysene	O	520	ug/kg	4.19E-10	9.8E-12	ND	
Dibenzo(a,h)anthracene	O	200	ug/kg	1.61E-10	3.8E-12	ND	
Indeno(1,2,3-cd)pyrene	O	2990	ug/kg	2.41E-09	5.7E-11	ND	
Aroclor-1254	O	131	ug/kg	1.06E-10	2.5E-12	ND	
Aroclor-1260	O	25	ug/kg	2.02E-11	4.7E-13	ND	
Aluminum	I	9740	mg/kg	7.85E-06	1.8E-07	ND	
Arsenic	I	1.6	mg/kg	1.29E-09	3.0E-11	ND	
Beryllium	I	0.18	mg/kg	1.45E-10	3.4E-12	0.0000057	6.0E-07
Chromium	I	14.6	mg/kg	1.18E-08	2.8E-10	ND	
Iron	I	4580	mg/kg	3.69E-06	8.7E-08	ND	
SUMMARY HAZARD INDEX							6E-07
ND = no data available.							

TABLE E-6.15

FUTURE LAND USE DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SUBSURFACE SOIL
EXCAVATION WORKER
NAVAL TRAINING CENTER ORLANDO
ORLANDO, FLORIDA
OPERABLE UNIT 4

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	480	mg/day	USEPA, 1995
FRACTION INGESTED	FI	100%	unitless	Assumption
ADHERENCE FACTOR	AF	1	mg/cm ² -event	USEPA, 1995
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1995
SURFACE AREA EXPOSED	SA	5,750	cm ²	USEPA, 1992
DOSE ABSORBED PER EVENT	DA _{event}	chemical-specific	mg/cm ² -event	USEPA, 1992
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	250	days/year [1]	Assumption
EXPOSURE DURATION	ED	0.083	years	USEPA, 1991
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	0.083	years	USEPA, 1991

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors";
OSWER Directive 9285.6-03.
USEPA, 1992. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January 1992.
USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.

EQUATIONS

$$\text{CANCER RISK} = \text{INTAKE (mg/kg-day)} \times \text{CANCER SLOPE FACTOR (mg/kg-day)}^{-1}$$

$$\text{HAZARD QUOTIENT} = \text{INTAKE (mg/kg-day)} / \text{REFERENCE DOSE (mg/kg-day)}$$

$$\text{INTAKE}_{\text{INGESTION}} = \frac{\text{CS} \times \text{IR} \times \text{FI} \times \text{CF} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT} \times 365 \text{ days/yr}}$$

$$\text{INTAKE}_{\text{DERMAL}} = \frac{\text{DA}_{\text{event}} \times \text{SA} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT} \times 365 \text{ days/yr}}$$

Where:

$$\text{DA}_{\text{event}} = \text{CS} \times \text{AF} \times \text{ABS} \times \text{CF}$$

Note: For noncarcinogenic effects, AT = ED

TABLE E-6.15

FUTURE LAND USE DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SUBSURFACE SOIL
EXCAVATION WORKER
NAVAL TRAINING CENTER ORLANDO
ORLANDO, FLORIDA
OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF (mg/kg-day) ⁻¹	CANCER RISK INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2] (mg/kg-day) ⁻¹	CANCER RISK DERMAL	TOTAL CANCER RISK
Tetrachloroethene	O	10.5	ug/kg	5.8E-11	5.2E-02	3.0E-12	0.01	7.0E-12	5.2E-02	3.6E-13	3.4E-12
SUMMARY CANCER RISK						3E-12				4E-13	3E-12
[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November 1995).											
[2] Calculated from oral CSFs.											
NE = not evaluated.											

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Tetrachloroethene	O	10.5	ug/kg	4.9E-08	1.0E-01	4.9E-07	0.01	5.9E-09	1.0E-01	5.9E-08	5.5E-07
SUMMARY HAZARD INDEX						0.0000005				0.00000006	0.0000006
[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November 1995).											
[2] Calculated from oral RfDs.											
ND = no data available.											

TABLE E-6.16

FUTURE LAND USE INHALATION OF PARTICULATES AND VAPORS - SUBSURFACE SOIL
 EXCAVATION WORKER
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1.2E+07	m ³ /kg	default [1]
VOLATILIZATION FACTOR	VF	chemical-specific	m ³ /kg	USEPA, 1996
CONCENTRATION AIR	CA	chemical-specific	mg/m ³	
INHALATION RATE	IR	2.5	m ³ /hour	USEPA, 1995
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE TIME	ET	8	hours/day	Assumption
EXPOSURE FREQUENCY	EF	250	days/year	Assumption
EXPOSURE DURATION	ED	0.083	years	Assumption
CONVERSION FACTOR	CF	0.001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	0.083	years	USEPA, 1991

CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR (mg/kg-day) ⁻¹

HAZARD QUOTIENT = INTAKE (mg/kg-day) / INHALATION REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE} = \frac{\text{CA} \times \text{IR} \times \text{ET} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT} \times 365 \text{ days/yr}}$$

Where:

$\text{CA} = \text{C} \times \text{CF} \times (1/\text{PEF})$

Note: For noncarcinogens, AT = ED.

[1] PEF has been derived in the PEF Appendix to this report.
 USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance:
 Standard Default Exposure Factors; OSWER Directive 9285.6-03.
 USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.
 USEPA, 1996. Soil Screening Guidance: Technical Background Document. EPA/540/R95/128.

TABLE E-6.16

FUTURE LAND USE INHALATION OF PARTICULATES AND VAPORS - SUBSURFACE SOIL
 EXCAVATION WORKER
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	VOLATILIZATION FACTOR (m ³ /kg)	AIR CONCENTRATION (mg/m ³)	INTAKE (mg/kg-day)	INHALATION CSF (mg/kg-day) ⁻¹	CANCER RISK
Tetrachloroethene	O	10.5	ug/kg	3.26E+02	3.22E-05	7.5E-09	2.0E-03	1.5E-11
SUMMARY CANCER RISK								1E-11
NE = not evaluated.								

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	VOLATILIZATION FACTOR (m ³ /kg)	AIR CONCENTRATION (mg/m ³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Tetrachloroethene	O	10.5	ug/kg	3.26E+02	3.22E-05	6.3E-06	1.4E-01	4.5E-05
SUMMARY HAZARD INDEX								0.00005
ND = no data available.								

TABLE E-6.17

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) - NORTHERN PLUME VOC
 ADULT RESIDENT
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION WATER	CW	chemical-specific	ug/liter	
INGESTION RATE	IR	2	liters/day	USEPA, 1991
BODY WEIGHT	BW	70	kg	USEPA, 1991
CONVERSION FACTOR	CF	0.001	mg/ug	
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1991
EXPOSURE DURATION	ED	24	years	USEPA, 1991
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	24	years	USEPA, 1991

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.	$\text{CANCER RISK} = \text{INTAKE (mg/kg-day)} \times \text{CANCER SLOPE FACTOR (mg/kg-day)}^{-1}$ $\text{HAZARD QUOTIENT} = \text{INTAKE (mg/kg-day)} / \text{REFERENCE DOSE (mg/kg-day)}$ $\text{INTAKE} = \frac{\text{CW} \times \text{IR} \times \text{EF} \times \text{ED} \times \text{CF}}{\text{BW} \times \text{AT} \times 365 \text{ days/year}}$ <p>Note: For noncarcinogenic effects, AT = ED.</p>
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TABLE E-6.17

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) - NORTHERN PLUME VOC
 ADULT RESIDENT
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	CANCER SLOPE FACTOR (mg/kg-day) ⁻¹	CANCER RISK INGESTION
Tetrachloroethene	1900	UG/LITER	1.8E-02	0.052	9.3E-04
Trichloroethene	410	UG/LITER	3.9E-03	0.011	4.2E-05
TOTAL CANCER RISK					1E-03
NE = not evaluated.					

NONCARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT INGESTION
cis-1,2-Dichloroethene	350	UG/LITER	9.6E-03	1.0E-02	9.6E-01
Tetrachloroethene	1900	UG/LITER	5.2E-02	1.0E-02	5.2E+00
Trichloroethene	410	UG/LITER	1.1E-02	6.0E-03	1.9E+00
Aluminum	4630	UG/LITER	1.3E-01	1.0E+00	1.3E-01
Barium	46	UG/LITER	1.3E-03	7.0E-02	1.8E-02
Chromium	8.4	UG/LITER	2.3E-04	3.0E-03	7.7E-02
Iron	751	UG/LITER	2.1E-02	3.0E-01	6.9E-02
Mercury	0.39	UG/LITER	1.1E-05	3.0E-04	3.6E-02
TOTAL HAZARD INDEX					8
ND = no data available.					

TABLE E-6.18

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) - NORTHERN PLUME VOC

CHILD RESIDENT
 NAVAL TRAINING CENTER ORLANDO
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE	
CONCENTRATION WATER	CW	chemical-specific	ug/liter		<p>CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)⁻¹</p> <p>HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)</p> <p>INTAKE = $\frac{CW \times IR \times EF \times ED \times CF}{BW \times AT \times 365 \text{ days/year}}$</p> <p>Note: For noncarcinogenic effects, AT = ED.</p>
INGESTION RATE	IR	1	liters/day	USEPA, 1995	
BODY WEIGHT	BW	15	kg	USEPA, 1991	
CONVERSION FACTOR	CF	0.001	mg/ug		
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1991	
EXPOSURE DURATION	ED	6	years	USEPA, 1991	
AVERAGING TIME					
CANCER	AT	70	years	USEPA, 1991	
NONCANCER	AT	6	years	USEPA, 1991	
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03. USEPA, 1995. Region IV Supplemental Guidance to RAGS, Bulletin No. 3, November.					

TABLE E-6.18

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) - NORTHERN PLUME VOC
 CHILD RESIDENT
 NAVAL TRAINING CENTER ORLANDO
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	CANCER SLOPE FACTOR (mg/kg-day) ⁻¹	CANCER RISK INGESTION
Tetrachloroethene	1900	UG/LITER	1.0E-02	0.052	5.4E-04
Trichloroethene	410	UG/LITER	2.2E-03	0.011	2.5E-05
TOTAL CANCER RISK					6E-04
NE = not evaluated.					

NONCARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT INGESTION
cis-1,2-Dichloroethene	350	UG/LITER	2.2E-02	1.0E-02	2.2E+00
Tetrachloroethene	1900	UG/LITER	1.2E-01	1.0E-02	1.2E+01
Trichloroethene	410	UG/LITER	2.6E-02	6.0E-03	4.4E+00
Aluminum	4630	UG/LITER	3.0E-01	1.0E+00	3.0E-01
Barium	46	UG/LITER	2.9E-03	7.0E-02	4.2E-02
Chromium	8.4	UG/LITER	5.4E-04	3.0E-03	1.8E-01
Iron	751	UG/LITER	4.8E-02	3.0E-01	1.6E-01
Mercury	0.39	UG/LITER	2.5E-05	3.0E-04	8.3E-02
TOTAL HAZARD INDEX					20
ND = no data available.					

TABLE E-6.19

INHALATION EXPOSURE TO VOCs WHILE SHOWERING - NORTHERN PLUME VOC
 ADULT RESIDENT
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SHOWER AIR	CA [1]	chemical-specific	ug/m ³	Modeled
CONVERSION FACTOR 1	CF ₁	24	hours/day	
EXPOSURE TIME SHOWER	ET	0.2	hours/day	USEPA, 1989
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1991
EXPOSURE DURATION	ED	24	years	USEPA, 1991
CONVERSION FACTOR 2	CF ₂	365	days/year	
AVERAGING TIME CANCER	AT	70	years	USEPA, 1989
AVERAGING TIME NONCANCER	AT	24	years	USEPA, 1989

EQUATIONS

$$\text{CANCER RISK} = \text{AVG. CONC. (ug/m}^3\text{)} * \text{CANCER UNIT RISK (ug/m}^3\text{)}^{-1}$$

$$\text{HAZARD QUOTIENT} = \text{AVG. CONC. (ug/m}^3\text{)} / \text{REF. CONC. (ug/m}^3\text{)}$$

$$\text{AVG. CONC.} = \frac{\text{CA}_{\text{air}} * \text{EF} * \text{ET} * \text{ED}}{\text{AT} * \text{CF}_1 * \text{CF}_2}$$

[1] Calculated via model by Foster and Chrostowski, Air Pollution Control Association Annual Meeting, 1987.

USEPA, 1989. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual, (Part A)

EPA/540/1-89/002; December 1989.

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Assumptions".

TABLE E-6.19

INHALATION EXPOSURE TO VOCs WHILE SHOWERING - NORTHERN PLUME VOC
 ADULT RESIDENT
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	VOLATILE OR NON-VOLATILE? V/NV	SHOWER AIR CONCENTRATION (ug/m ³)	AVERAGE AIR CONCENTRATION LIFETIME (ug/m ³)	INHALATION CANCER UNIT RISK (ug/m ³) ⁻¹	CANCER RISK
Tetrachloroethene	V	7.6E+03	2.1E+01	5.8E-07	1.2E-05
Trichloroethene	V	1.8E+03	4.9E+00	2.0E-06	9.8E-06
SUMMARY CANCER RISK					2E-05
ND = no data available. NA = not applicable. This analyte is not volatile and has therefore not been evaluated via this volatilization model.					

NONCARCINOGENIC EFFECTS

COMPOUND	VOLATILE OR NON-VOLATILE? V/NV	SHOWER AIR CONCENTRATION (ug/m ³)	AVERAGE AIR CONCENTRATION FOR TIME PERIOD (ug/m ³)	CHRONIC INHALATION RfC [1] (ug/m ³)	HAZARD QUOTIENT
cis-1,2-Dichloroethene	V	1.7E+03	1.4E+01	ND	NA
Tetrachloroethene	V	7.6E+03	6.1E+01	4.9E+02	1.2E-01
Trichloroethene	V	1.8E+03	1.4E+01	ND	NA
Aluminum	NV		NA		NA
Barium	NV		NA		NA
Chromium	NV		NA		NA
Iron	NV		NA		NA
Mercury	NV		NA		NA
SUMMARY HAZARD INDEX					0.1
[1] RfC is the Reference Concentration published by USEPA. ND = no data available. NA = not applicable. The analyte is not volatile and has therefore not been evaluated via this volatilization model.					

TABLE E-6.20

CONCENTRATION OF VOCs WHILE SHOWERING - NORTHERN PLUME VOC
 ADULT RESIDENT
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EMPIRICAL CONSTANTS

CONSTANT	SYMBOL	VALUE	UNIT	SOURCE
Liquid-film mass transfer for CO ₂	K _l (CO ₂)	20	cm/hr	Calculated
Gas-film mass transfer for water	K _g (H ₂ O)	3000	cm/hr	Calculated
Molar gas constant x Temperature	RT	0.024	atm-m ³ /mole	
Reference temperature	T ₁	293	K	
Temperature of shower water	T _s	318	K	Assumption
Viscosity of water at shower temperature	u _s	0.6178	cp	Calculated
Viscosity of water at reference temperature	u ₁	0.65	cp	Calculated
Shower droplet free-fall time	t _s	1.5	sec	Assumption
Droplet diameter	d	1	mm	Foster & Chrostowski, 1987
Flow rate in shower	FR	20	l/min	Assumption
Volume of shower area	SV	12	m ³	Assumption
Air exchange rate	R	0.03	min ⁻¹	Calculated
Time in shower	D _s	12	min	USEPA, 1989
Time at which concentration is being calculated	t	12	min	Assumption
Foster, S.A. and Chrostowski, P.C., 1987. Inhalation Exposures to Volatile Organic Contaminants in the Shower.				
USEPA, 1989, Exposure Factors Handbook; EPA/600/8-89/043, May 1989.				
All equations and definitions of terms are presented in Appendix E-8 to this report, Calculation of Air Concentration Using the Shower Model				

TABLE E-6.20

CONCENTRATION OF VOCs WHILE SHOWERING - NORTHERN PLUME VOC
 ADULT RESIDENT
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

SHOWER CONCENTRATIONS

COMPOUND	C _w (ug/l)	MW (g/mol)	H (atm-m ³ /mol)	k _l (cm/hr)	k _g (cm/hr)	K _L (cm/hr)	K _{al} (cm/hr)	C _{wd} (ug/l)	S (ug/m ³ -min)	C _(voc) (ug/m ³)
cis-1,2-Dichloroethene	350	97.0	0.0041	1.3E+01	1.3E+03	1.3E+01	1.4E+01	1.0E+02	1.7E+02	1.7E+03
Trichloroethene	410	131.4	0.0091	1.2E+01	1.1E+03	1.1E+01	1.2E+01	1.1E+02	1.8E+02	1.8E+03
Tetrachloroethene	1900	166.0	0.018	1.0E+01	9.9E+02	1.0E+01	1.1E+01	4.5E+02	7.5E+02	7.6E+03
C _w = Concentration in groundwater			K _L = Mass transfer coefficient							
MW = Molecular weight			K _{al} = Temperature correction of mass transfer coefficient							
H = Henry's Law constant			C _{wd} = Analyte concentration in water droplet							
k _l = Chemical-specific mass-transfer coefficient			S = Release rate of analyte to air							
k _g = Chemical-specific gas mass-transfer coefficient			C _(voc) = Analyte concentration in bathroom air at time t.							
$C_{(voc)} = (S/R) \times (e^{(RDs)} - 1) \times e^{(-Rt)}$										

TABLE E-6.21

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) - SOUTHERN VOC PLUME
 ADULT RESIDENT
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION WATER	CW	chemical-specific	ug/liter	
INGESTION RATE	IR	2	liters/day	USEPA, 1991
BODY WEIGHT	BW	70	kg	USEPA, 1991
CONVERSION FACTOR	CF	0.001	mg/ug	
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1991
EXPOSURE DURATION	ED	24	years	USEPA, 1991
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	24	years	USEPA, 1991
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.				

$CANCER\ RISK = INTAKE\ (mg/kg\text{-}day) \times CANCER\ SLOPE\ FACTOR\ (mg/kg\text{-}day)^{-1}$

 $HAZARD\ QUOTIENT = INTAKE\ (mg/kg\text{-}day) / REFERENCE\ DOSE\ (mg/kg\text{-}day)$

 $INTAKE = \frac{CW \times IR \times EF \times ED \times CF}{BW \times AT \times 365\ days/year}$

Note: For noncarcinogenic effects, AT = ED.

TABLE E-6.21

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) - SOUTHERN VOC PLUME
 ADULT RESIDENT
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	CANCER SLOPE FACTOR (mg/kg-day) ⁻¹	CANCER RISK INGESTION
Tetrachloroethene	110	UG/LITER	1.0E-03	0.052	5.4E-05
Trichloroethene	23	UG/LITER	2.2E-04	0.011	2.4E-06
TOTAL CANCER RISK					6E-05
NE = not evaluated.					

NONCARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT INGESTION
cis-1,2-Dichloroethene	12	UG/LITER	3.3E-04	1.0E-02	3.3E-02
trans-1,2-Dichloroethene	1.4	UG/LITER	3.8E-05	2.0E-02	1.9E-03
Tetrachloroethene	110	UG/LITER	3.0E-03	1.0E-02	3.0E-01
Trichloroethene	23	UG/LITER	6.3E-04	6.0E-03	1.1E-01
Aluminum	3780	UG/LITER	1.0E-01	1.0E+00	1.0E-01
Barium	25.2	UG/LITER	6.9E-04	7.0E-02	9.9E-03
Chromium	6.8	UG/LITER	1.9E-04	3.0E-03	6.2E-02
Iron	738	UG/LITER	2.0E-02	3.0E-01	6.7E-02
Mercury	0.1	UG/LITER	2.7E-06	3.0E-04	9.1E-03
TOTAL HAZARD INDEX					0.7
ND = no data available.					

TABLE E-6.22

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) - SOUTHERN VOC PLUME
 CHILD RESIDENT
 NAVAL TRAINING CENTER ORLANDO
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION WATER	CW	chemical-specific	ug/liter	
INGESTION RATE	IR	1	liters/day	USEPA, 1995
BODY WEIGHT	BW	15	kg	USEPA, 1991
CONVERSION FACTOR	CF	0.001	mg/ug	
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1991
EXPOSURE DURATION	ED	6	years	USEPA, 1991
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	6	years	USEPA, 1991

<p>USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.</p> <p>USEPA, 1995. Region IV Supplemental Guidance to RAGS, Bulletin No. 3, November.</p>	<p>CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)⁻¹</p> <p>HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)</p> <p>INTAKE = $\frac{CW \times IR \times EF \times ED \times CF}{BW \times AT \times 365 \text{ days/year}}$</p> <p>Note: For noncarcinogenic effects, AT = ED.</p>
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TABLE E-6.22

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) - SOUTHERN VOC PLUME
 CHILD RESIDENT
 NAVAL TRAINING CENTER ORLANDO
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	CANCER SLOPE FACTOR (mg/kg-day) ⁻¹	CANCER RISK INGESTION
Tetrachloroethene	110	UG/LITER	6.0E-04	0.052	3.1E-05
Trichloroethene	23	UG/LITER	1.3E-04	0.011	1.4E-06
TOTAL CANCER RISK					3E-05
NE = not evaluated.					

NONCARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT INGESTION
cis-1,2-Dichloroethene	12	UG/LITER	7.7E-04	1.0E-02	7.7E-02
trans-1,2-Dichloroethene	1.4	UG/LITER	8.9E-05	2.0E-02	4.5E-03
Tetrachloroethene	110	UG/LITER	7.0E-03	1.0E-02	7.0E-01
Trichloroethene	23	UG/LITER	1.5E-03	6.0E-03	2.5E-01
Aluminum	3780	UG/LITER	2.4E-01	1.0E+00	2.4E-01
Barium	25.2	UG/LITER	1.6E-03	7.0E-02	2.3E-02
Chromium	6.8	UG/LITER	4.3E-04	3.0E-03	1.4E-01
Iron	738	UG/LITER	4.7E-02	3.0E-01	1.6E-01
Mercury	0.1	UG/LITER	6.4E-06	3.0E-04	2.1E-02
TOTAL HAZARD INDEX					2
ND = no data available.					

TABLE E-6.23

INHALATION EXPOSURE TO VOCs WHILE SHOWERING - SOUTHERN VOC PLUME
 ADULT RESIDENT
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SHOWER AIR	CA [1]	chemical-specific	ug/m ³	Modeled
CONVERSION FACTOR 1	CF ₁	24	hours/day	
EXPOSURE TIME SHOWER	ET	0.2	hours/day	USEPA, 1989
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1991
EXPOSURE DURATION	ED	24	years	USEPA, 1991
CONVERSION FACTOR 2	CF ₂	365	days/year	
AVERAGING TIME CANCER	AT	70	years	USEPA, 1989
AVERAGING TIME NONCANCER	AT	24	years	USEPA, 1989

[1] Calculated via model by Foster and Chrostowski, Air Pollution Control Association Annual Meeting, 1987.
 USEPA, 1989. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual, (Part A)
 EPA/540/1-89/002; December 1989.
 USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Assumptions".

CANCER RISK = AVG. CONC. (ug/m³) * CANCER UNIT RISK (ug/m³)⁻¹

HAZARD QUOTIENT = AVG.CONC.(ug/m³)/REF. CONC. (ug/m³)

AVG. CONC. = $\frac{CA_{air} * EF * ET * ED}{AT * CF1 * CF2}$

TABLE E-6.23

INHALATION EXPOSURE TO VOCs WHILE SHOWERING - SOUTHERN VOC PLUME

ADULT RESIDENT
NAVAL TRAINING CENTER
ORLANDO, FLORIDA
OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	VOLATILE OR NON-VOLATILE? V/NV	SHOWER AIR CONCENTRATION (ug/m ³)	AVERAGE AIR CONCENTRATION LIFETIME (ug/m ³)	INHALATION CANCER UNIT RISK (ug/m ³) ⁻¹	CANCER RISK
Tetrachloroethene	V	4.4E+02	1.2E+00	5.8E-07	7.0E-07
Trichloroethene	V	1.0E+02	2.8E-01	2.0E-06	5.5E-07
SUMMARY CANCER RISK					1E-06
ND = no data available.					
NA = not applicable. This analyte is not volatile and has therefore not been evaluated via this volatilization model.					

NONCARCINOGENIC EFFECTS

COMPOUND	VOLATILE OR NON-VOLATILE? V/NV	SHOWER AIR CONCENTRATION (ug/m ³)	AVERAGE AIR CONCENTRATION FOR TIME PERIOD (ug/m ³)	CHRONIC INHALATION RfC [1] (ug/m ³)	HAZARD QUOTIENT
cis-1,2-Dichloroethene	V	5.8E+01	4.6E-01	ND	NA
trans-1,2-Dichloroethene	V	7.0E+00	5.6E-02	ND	NA
Tetrachloroethene	V	4.4E+02	3.5E+00	4.9E+02	7.2E-03
Trichloroethene	V	1.0E+02	8.0E-01	ND	NA
Aluminum	NV		NA		NA
Antimony	NV		NA		NA
Barium	NV		NA		NA
Chromium	NV		NA		NA
Iron	NV		NA		NA
Mercury	NV		NA		NA
SUMMARY HAZARD INDEX					0.007
[1] RfC is the Reference Concentration published by USEPA.					
ND = no data available.					
NA = not applicable. The analyte is not volatile and has therefore not been evaluated via this volatilization model.					

TABLE E-6.24

CONCENTRATION OF VOCs WHILE SHOWERING - SOUTHERN VOC PLUME
 ADULT RESIDENT
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EMPIRICAL CONSTANTS

CONSTANT	SYMBOL	VALUE	UNIT	SOURCE
Liquid-film mass transfer for CO ₂	K _l (CO ₂)	20	cm/hr	Calculated
Gas-film mass transfer for water	K _g (H ₂ O)	3000	cm/hr	Calculated
Molar gas constant x Temperature	RT	0.024	atm-m ³ /mole	
Reference temperature	T ₁	293	K	
Temperature of shower water	T _s	318	K	Assumption
Viscosity of water at shower temperature	u _s	0.6178	cp	Calculated
Viscosity of water at reference temperature	u ₁	0.65	cp	Calculated
Shower droplet free-fall time	t _s	1.5	sec	Assumption
Droplet diameter	d	1	mm	Foster & Chrostowski, 1987
Flow rate in shower	FR	20	l/min	Assumption
Volume of shower area	SV	12	m ³	Assumption
Air exchange rate	R	0.03	min ⁻¹	Calculated
Time in shower	D _s	12	min	USEPA, 1989
Time at which concentration is being calculated	t	12	min	Assumption
Foster, S.A. and Chrostowski, P.C., 1987. Inhalation Exposures to Volatile Organic Contaminants in the Shower.				
USEPA, 1989, Exposure Factors Handbook; EPA/600/8-89/043, May 1989.				
All equations and definitions of terms are presented in Appendix E-8 to this report, Calculation of Air Concentration Using the Shower Model				

TABLE E-6.24

CONCENTRATION OF VOCs WHILE SHOWERING - SOUTHERN VOC PLUME
 ADULT RESIDENT
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

SHOWER CONCENTRATIONS

COMPOUND	C _w (ug/l)	MW (g/mol)	H (atm-m ³ /mol)	k _l (cm/hr)	k _g (cm/hr)	K _L (cm/hr)	K _{al} (cm/hr)	C _{w,d} (ug/l)	S (ug/m ³ -min)	C _(voc) (ug/m ³)
cis-1,2-Dichloroethene	12	97.0	0.0041	1.3E+01	1.3E+03	1.3E+01	1.4E+01	3.5E+00	5.8E+00	5.8E+01
trans-1,2-Dichloroethene	1.4	97.0	0.0094	1.3E+01	1.3E+03	1.3E+01	1.4E+01	4.1E-01	6.9E-01	7.0E+00
Trichloroethene	23	131.4	0.0091	1.2E+01	1.1E+03	1.1E+01	1.2E+01	6.0E+00	1.0E+01	1.0E+02
Tetrachloroethene	110	166.0	0.018	1.0E+01	9.9E+02	1.0E+01	1.1E+01	2.6E+01	4.4E+01	4.4E+02
C _w = Concentration in groundwater			K _L = Mass transfer coefficient							
MW = Molecular weight			K _{al} = Temperature correction of mass transfer coefficient							
H = Henry's Law constant			C _{w,d} = Analyte concentration in water droplet							
k _l = Chemical-specific mass-transfer coefficient			S = Release rate of analyte to air							
k _g = Chemical-specific gas mass-transfer coefficient			C _(voc) = Analyte concentration in bathroom air at time t.							
$C_{(voc)} = (S/R) \times (e^{(RDs)} - 1) \times e^{(-Rt)}$										

TABLE E-6.25

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) ANTIMONY PLUME
 ADULT RESIDENT
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE	
CONCENTRATION WATER	CW	chemical-specific	ug/liter		<p>CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)⁻¹</p> <p>HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)</p> <p>INTAKE = $\frac{CW \times IR \times EF \times ED \times CF}{BW \times AT \times 365 \text{ days/year}}$</p> <p>Note: For noncarcinogenic effects, AT = ED.</p>
INGESTION RATE	IR	2	liters/day	USEPA, 1991	
BODY WEIGHT	BW	70	kg	USEPA, 1991	
CONVERSION FACTOR	CF	0.001	mg/ug		
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1991	
EXPOSURE DURATION	ED	24	years	USEPA, 1991	
AVERAGING TIME					
CANCER	AT	70	years	USEPA, 1991	
NONCANCER	AT	24	years	USEPA, 1991	
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.					

TABLE E-6.25

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) ANTIMONY PLUME
 ADULT RESIDENT
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	CANCER SLOPE FACTOR (mg/kg-day) ⁻¹	CANCER RISK INGESTION
Tetrachloroethene	7.5	UG/LITER	7.0E-05	0.052	3.7E-06
Trichloroethene	0.88	UG/LITER	8.3E-06	0.011	9.1E-08
TOTAL CANCER RISK					4E-06
NE = not evaluated.					

NONCARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT INGESTION
Tetrachloroethene	7.5	UG/LITER	2.1E-04	1.0E-02	2.1E-02
Trichloroethene	0.88	UG/LITER	2.4E-05	6.0E-03	4.0E-03
Aluminum	170	UG/LITER	4.7E-03	1.0E+00	4.7E-03
Antimony	14.1	UG/LITER	3.9E-04	4.0E-04	9.7E-01
Barium	3.4	UG/LITER	9.3E-05	7.0E-02	1.3E-03
Chromium	0.99	UG/LITER	2.7E-05	3.0E-03	9.0E-03
Iron	28.4	UG/LITER	7.8E-04	3.0E-01	2.6E-03
TOTAL HAZARD INDEX					1
ND = no data available.					

TABLE E-6.26

FUTURE LAND USE INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) ANTIMONY PLUME
 CHILD RESIDENT
 NAVAL TRAINING CENTER ORLANDO
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION WATER	CW	chemical-specific	ug/liter	
INGESTION RATE	IR	1	liters/day	USEPA, 1995
BODY WEIGHT	BW	15	kg	USEPA, 1991
CONVERSION FACTOR	CF	0.001	mg/ug	
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1991
EXPOSURE DURATION	ED	6	years	USEPA, 1991
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	6	years	USEPA, 1991

$CANCER\ RISK = INTAKE\ (mg/kg\text{-}day) \times CANCER\ SLOPE\ FACTOR\ (mg/kg\text{-}day)^{-1}$
 $HAZARD\ QUOTIENT = INTAKE\ (mg/kg\text{-}day) / REFERENCE\ DOSE\ (mg/kg\text{-}day)$

$INTAKE = \frac{CW \times IR \times EF \times ED \times CF}{BW \times AT \times 365\ days/year}$

Note: For noncarcinogenic effects, AT = ED.

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance:
 "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.
 USEPA, 1995. Region IV Supplemental Guidance to RAGS, Bulletin No. 3, November.

TABLE E-6.26

FUTURE LAND USE INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) ANTIMONY PLUME
 CHILD RESIDENT
 NAVAL TRAINING CENTER ORLANDO
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	CANCER SLOPE FACTOR (mg/kg-day) ⁻¹	CANCER RISK INGESTION
Tetrachloroethene	7.5	UG/LITER	4.1E-05	0.052	2.1E-06
Trichloroethene	0.88	UG/LITER	4.8E-06	0.011	5.3E-08
TOTAL CANCER RISK					2E-06
NE = not evaluated.					

NONCARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT INGESTION
Tetrachloroethene	7.5	UG/LITER	4.8E-04	1.0E-02	4.8E-02
Trichloroethene	0.88	UG/LITER	5.6E-05	6.0E-03	9.4E-03
Aluminum	170	UG/LITER	1.1E-02	1.0E+00	1.1E-02
Antimony	14.1	UG/LITER	9.0E-04	4.0E-04	2.3E+00
Barium	3.4	UG/LITER	2.2E-04	7.0E-02	3.1E-03
Chromium	0.99	UG/LITER	6.3E-05	3.0E-03	2.1E-02
Iron	28.4	UG/LITER	1.8E-03	3.0E-01	6.1E-03
TOTAL HAZARD INDEX					2
ND = no data available.					

TABLE E-6.27

INHALATION EXPOSURE TO VOCs WHILE SHOWERING - ANTIMONY PLUME
 ADULT RESIDENT
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SHOWER AIR	CA [1]	chemical-specific	ug/m ³	Modeled
CONVERSION FACTOR 1	CF ₁	24	hours/day	
EXPOSURE TIME SHOWER	ET	0.2	hours/day	USEPA, 1989
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1991
EXPOSURE DURATION	ED	24	years	USEPA, 1991
CONVERSION FACTOR 2	CF ₂	365	days/year	
AVERAGING TIME CANCER	AT	70	years	USEPA, 1989
AVERAGING TIME NONCANCER	AT	24	years	USEPA, 1989

EQUATIONS

$$\text{CANCER RISK} = \text{AVG. CONC. (ug/m}^3\text{)} * \text{CANCER UNIT RISK (ug/m}^3\text{)}^{-1}$$

$$\text{HAZARD QUOTIENT} = \text{AVG.CONC.(ug/m}^3\text{)}/\text{REF. CONC. (ug/m}^3\text{)}$$

$$\text{AVG. CONC.} = \frac{\text{CA}_{\text{air}} * \text{EF} * \text{ET} * \text{ED}}{\text{AT} * \text{CF}_1 * \text{CF}_2}$$

[1] Calculated via model by Foster and Chrostowski, Air Pollution Control Association Annual Meeting, 1987.
 USEPA, 1989. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual, (Part A)
 EPA/540/1-89/002; December 1989.
 USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Assumptions".

TABLE E-6.27

INHALATION EXPOSURE TO VOCs WHILE SHOWERING - ANTIMONY PLUME
 ADULT RESIDENT
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	VOLATILE OR NON-VOLATILE? V/NV	SHOWER AIR CONCENTRATION (ug/m ³)	AVERAGE AIR CONCENTRATION LIFETIME (ug/m ³)	INHALATION CANCER UNIT RISK (ug/m ³) ⁻¹	CANCER RISK
Tetrachloroethene	V	3.0E+01	8.2E-02	5.8E-07	4.8E-08
Trichloroethene	V	3.8E+00	1.1E-02	2.0E-06	2.1E-08
SUMMARY CANCER RISK					7E-08
ND = no data available.					
NA = not applicable. This analyte is not volatile and has therefore not been evaluated via this volatilization model.					

NONCARCINOGENIC EFFECTS

COMPOUND	VOLATILE OR NON-VOLATILE? V/NV	SHOWER AIR CONCENTRATION (ug/m ³)	AVERAGE AIR CONCENTRATION FOR TIME PERIOD (ug/m ³)	CHRONIC INHALATION RfC [1] (ug/m ³)	HAZARD QUOTIENT
Tetrachloroethene	V	3.0E+01	2.4E-01	4.9E+02	4.9E-04
Trichloroethene	V	3.8E+00	3.1E-02	ND	NA
Aluminum	NV		NA		NA
Antimony	NV		NA		NA
Barium	NV		NA		NA
Chromium	NV		NA		NA
Iron	NV		NA		NA
Mercury	NV		NA		NA
SUMMARY HAZARD INDEX					0.0005
[1] RfC is the Reference Concentration published by USEPA.					
ND = no data available.					
NA = not applicable. The analyte is not volatile and has therefore not been evaluated via this volatilization model.					

TABLE E-6.28

CONCENTRATION OF VOCs WHILE SHOWERING - ANTIMONY PLUME
 ADULT RESIDENT
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EMPIRICAL CONSTANTS

CONSTANT	SYMBOL	VALUE	UNIT	SOURCE
Liquid-film mass transfer for CO ₂	K _l (CO ₂)	20	cm/hr	Calculated
Gas-film mass transfer for water	K _g (H ₂ O)	3000	cm/hr	Calculated
Molar gas constant x Temperature	RT	0.024	atm-m ³ /mole	
Reference temperature	T ₁	293	K	
Temperature of shower water	T _s	318	K	Assumption
Viscosity of water at shower temperature	u _s	0.6178	cp	Calculated
Viscosity of water at reference temperature	u ₁	0.65	cp	Calculated
Shower droplet free-fall time	t _s	1.5	sec	Assumption
Droplet diameter	d	1	mm	Foster & Chrostowski, 1987
Flow rate in shower	FR	20	l/min	Assumption
Volume of shower area	SV	12	m ³	Assumption
Air exchange rate	R	0.03	min ⁻¹	Calculated
Time in shower	D _s	12	min	USEPA, 1989
Time at which concentration is being calculated	t	12	min	Assumption
Foster, S.A. and Chrostowski, P.C., 1987. Inhalation Exposures to Volatile Organic Contaminants in the Shower.				
USEPA, 1989, Exposure Factors Handbook; EPA/600/8-89/043, May 1989.				
All equations and definitions of terms are presented in Appendix E-8 to this report, Calculation of Air Concentration Using the Shower Model				

TABLE E-6.28

CONCENTRATION OF VOCs WHILE SHOWERING - ANTIMONY PLUME
 ADULT RESIDENT
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

SHOWER CONCENTRATIONS

COMPOUND	C _w (ug/l)	MW (g/mol)	H (atm-m ³ /mol)	k _l (cm/hr)	k _g (cm/hr)	K _L (cm/hr)	K _{al} (cm/hr)	C _{wd} (ug/l)	S (ug/m ³ -min)	C _(voc) (ug/m ³)
Trichloroethene	0.88	131.4	0.0091	1.2E+01	1.1E+03	1.1E+01	1.2E+01	2.3E-01	3.8E-01	3.8E+00
Tetrachloroethene	7.5	166.0	0.018	1.0E+01	9.9E+02	1.0E+01	1.1E+01	1.8E+00	3.0E+00	3.0E+01
C _w = Concentration in groundwater			K _L = Mass transfer coefficient							
MW = Molecular weight			K _{al} = Temperature correction of mass transfer coefficient							
H = Henry's Law constant			C _{wd} = Analyte concentration in water droplet							
k _l = Chemical-specific mass-transfer coefficient			S = Release rate of analyte to air							
k _g = Chemical-specific gas mass-transfer coefficient			C _(voc) = Analyte concentration in bathroom air at time t.							
$C_{(voc)} = (S/R) \times (e^{(RDs)} - 1) \times e^{(-Rt)}$										

TABLE E-6.29
PARAMETERS FOR CALCULATION OF VOLATILIZATION FROM GROUNDWATER TO INDOOR AIR
RESIDENT
NAVAL TRAINING CENTER- OPERABLE UNIT 4
ORLANDO, FLORIDA

PARAMETER	VALUE	UNITS	SOURCE
HENRY'S LAW CONSTANT	chemical-specific	dimensionless	USEPA, 1996
SOIL BULK DENSITY	1.50E+00	g-soil/cm3-soil	USEPA, 1996
WATER CONTENT VADOSE ZONE SOILS	0.15	cm3-water/cm3-soil	USEPA, 1996
AIR CONTENT VADOSE ZONE SOILS	0.284	cm3-air/cm3-soil	USEPA, 1996
SOIL-WATER PARTITION COEFFICIENT	chemical-specific	cm3-water/g-soil	
SOURCE-BUILDING SEPARATION AT t=0; SOIL	15	cm	Site-Specific
SOURCE-BUILDING SEPARATION AT t=0; GROUNDWATER	122	cm	Site-Specific
AREA OF BASEMENT	828000	cm2	USEPA, 1996 (2)
AREA OF CRACKS IN BASEMENT	8280	cm2	USEPA, 1996
FRACTION OF AREA REPRESENTED BY CRACKS	0.01		USEPA, 1996
BUILDING VENTILATION RATE	29000	cm3/sec	USEPA, 1996
AVERAGE VAPOR FLOW RATE INTO BUILDING(SEE CELL H8)	2.59	cm3/sec	USEPA, 1996
ENCLOSED SPACE WALL THICKNESS	15	cm	USEPA, 1996
EFFECTIVE DIFFUSION COEFFICIENT IN SOIL	chemical-specific	cm2/sec	USEPA, 1996
EFFECTIVE DIFFUSION COEFFICIENT IN GROUNDWATER	chemical-specific	cm2/sec	USEPA, 1996
EFFECTIVE DIFFUSION COEFFICIENT THROUGH CRACKS	chemical-specific	cm2/sec	USEPA, 1996
AVERAGE CONTAMINANT LEVEL IN SOIL		g/g	USEPA, 1996
AVERAGE CONTAMINANT LEVEL IN GROUNDWATER		g/cm3	USEPA, 1996
THICKNESS OF SOURCE AREA - SOIL	122	cm	Site-Specific
THICKNESS OF SOURCE AREA - GROUNDWATER	914.4	cm	Site-Specific
DIFFUSION COEFFICIENT IN AIR	chemical-specific	cm2/sec	USEPA, 1996
DIFFUSION COEFFICIENT IN WATER	chemical-specific	cm2/sec	USEPA, 1996
SOIL POROSITY IN IMPACTED ZONE	0.434	cm3/cm3	USEPA, 1996
THICKNESS OF CAPILLARY FRINGE	43.18	cm	USEPA, 1996
THICKNESS OF VADOSE ZONE	82.19	cm	USEPA, 1996
EFFECTIVE DIFFUSION THROUGH CAPILLARY FRINGE	NA	cm3/cm3	NA
AIR CONTENT CAPILLARY FRINGE	0.038	cm3-air/cm3-soil	USEPA, 1996
WATER CONTENT CAPILLARY FRINGE	0.342	cm3-water/cm3-soil	USEPA, 1996
AIR CONTENT IN WALL CRACKS	0.284	cm3-air/cm3-tot.vol.	USEPA, 1996
WATER CONTENT WALL CRACKS	0.15	cm3-water/cm3-tot.vol.	USEPA, 1996
AVERAGING TIME FOR VAPOR FLUX	9.46E-08	sec	USEPA, 1996 (1)
AIR CONCENTRATION - INDOOR AIR - soil related	chemical-specific	kg/m3	USEPA, 1996
AIR CONCENTRATION - INDOOR AIR - groundwater related	chemical-specific		
VOLATILIZATION FACTOR - SUBSURFACE SOIL:INDOOR AIR	chemical-specific	m3/kg	USEPA, 1996
VOLATILIZATION FACTOR - GROUNDWATER:INDOOR AIR	chemical specific	m3/kg	NA
FRACTION ORGANIC CARBON IN SOIL	0.002	unitless	Site-Specific
CONVERSION FACTOR 1	1.0E+03	cm3-kg/m3-g	USEPA, 1996
TIME TO DEplete VOLATILES FROM SOURCE - groundwater		sec	Calculated in model
TIME TO DEplete VOLATILES FROM SOURCE - soil		sec	Calculated in model
SOIL GAS CONCENTRATION at equilibrium-soil source		g/cm3	Calculated in model
SOIL GAS CONCENTRATION at equilibrium - groundwater source	chemical-specific	g/cm3	Calculated in model

NOTES:

USEPA, 1996. Soil Screening Guidance: Technical Background Document. Appendix H. EPA/540/R-95/128

(1) Value for resident (30 year exposure duration).

(2) Value has been adjusted to accommodate absence of basement in homes in Florida.

NOTE: All equations presented in the text accompanying this Table.

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TABLE E-6.29
 PARAMETERS FOR CALCULATION OF VOLATILIZATION FROM GROUNDWATER TO INDOOR AIR
 RESIDENT
 NAVAL TRAINING CENTER- OPERABLE UNIT 4
 ORLANDO, FLORIDA

CHEMICAL	H (unitless)	Koc (cm ³ /g)	D _g (cm ² /sec)	D _l (cm ² /sec)	D _{air-GW} (cm ³ /cm ³)	D _{air-GW} (cm ² /sec)	beta-GW	phi-GW	alpha-GW
cis-1,2-Dichloroethene*	7.10E-01	3.00E+02	7.20E-02	8.20E-06	8.85E-06	2.56E-05	1.04E+00	1.22E-09	1.15E-05
Tetrachloroethene	7.10E-01	3.00E+02	7.20E-02	8.20E-06	8.85E-06	2.56E-05	1.04E+00	1.22E-09	1.15E-05
trans-1,2-Dichloroethene*	2.18E-01	4.90E+01	7.07E-02	1.19E-05	1.51E-05	4.38E-05	1.07E+00	6.40E-10	0.00E+00
Trichloroethene	4.30E-01	9.40E+01	7.90E-02	9.10E-06	1.10E-05	3.18E-05	1.04E+00	9.18E-10	1.90E-05

TABLE E-6.29
 PARAMETERS FOR CALCULATION OF VOLATILIZATION FROM GROUNDWATER TO INDOOR AIR
 RESIDENT
 NAVAL TRAINING CENTER- OPERABLE UNIT 4
 ORLANDO, FLORIDA

CHEMICAL	C _{v,eq-gw} (g/cm ³)	CS (g/g)	C _{w,eq} (g/cm ³)	T _D -GW (sec)	Is T>T _D -GW?	E-GW	C _{air,conc} -GW (kg/m ³)	VF-GW (m ³ /L)
cis-1,2-Dichloroethene*	7.10E-01	1	1	2.93E+10	NO	NA	8.18E-03	1.22E+02
Tetrachloroethene	7.10E-01	1	1	2.93E+10	NO	NA	8.18E-03	1.22E+02
trans-1,2-Dichloroethene*	2.18E-01	1	1	5.64E+10	NO	NA	0.00E+00	#DIV/0!
Trichloroethene	4.30E-01	1	1	3.91E+10	NO	NA	8.18E-03	1.22E+02

Table E-6.30

ADULT RESIDENT
 NAVAL TRAINING CENTER - OPERABLE UNIT 4
 ORLANDO, FLORIDA
 EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
TARGET CANCER RISK	TRc	1E-06	unitless	ASTM, 1996
TARGET NON-CANCER RISK	TRnc	1	unitless	USEPA, 1996
CANCER UNIT RISK	UR	chemical-specific	(ug/m3)-1	USEPA, 1998
REFERENCE CONCENTRATION	RC	chemical-specific	mg/m3	USEPA, 1998
CONVERSION FACTOR 1	C1	0.001	1 mg/1000 ug	
CONVERSION FACTOR 2	C2	1 / 24	1 day/24 hours	
EXPOSURE PERIOD	EP	24	years	
EVENT FREQUENCY	EF1	1	event/day	
EXPOSURE DURATION	ED	16	hours/event	
EXPOSURE FREQUENCY(DAYS)	EF2	350	days/year	
AVERAGING PERIOD				
CANCER	AP	70	years	
NONCANCER	AP	24	years	

VF values are derived in "Vapor Migration to Indoor Air" Model
 (1) Values for chemicals obtained from IRIS, HEAST.

AIR RBSL_{cancer} (mg/m3) = $\frac{TRc \times AP \times C1}{EF \times ED \times EF \times C2 \times UR}$

AIR RBSL_{non-cancer} (mg/m3) = $\frac{TRnc \times AP \times RC}{EF \times ED \times EF \times C2}$

SOIL RBSL (mg/kg) = VF (m3/kg) x AIR RBSL (mg/m3)
GW RBSL (mg/L) = VF (m3/kg) x kg/L x AIR RBSL (mg/m3)
 (where 1 kg water = 1 L)

Note:
 For noncarcinogenic effects: AP = EP
 RBSL = Risk Based Screening Level
 UR = Unit Risk
 RC = Reference Concentration

Table E-6.30

ADULT RESIDENT
 NAVAL TRAINING CENTER - OPERABLE UNIT 4
 ORLANDO, FLORIDA
 CARCINOGENIC EFFECTS

COMPOUND	INHALATION UR (ug/m3)*-1	AIR RBSL (mg/m3)	VF-QW (m3/kg)	RBSL - QW (mg/l.)
ORGANICS				
cis-1,2-Dichloroethene	NC	NC	1.22E+02	NC
Tetrachloroethene	5.80E-07	7.87E-03	1.22E+02	9.62E-01
trans-1,2-Dichloroethene	NC	NC	#DIV/0!	NC
Trichloroethene	2.00E-06	2.28E-03	1.22E+02	2.79E-01

NC = Not Carcinogenic

NONCARCINOGENIC EFFECTS

COMPOUND	INHALATION R/C (mg/m3)	AIR RBSL (mg/m3)	VF-QW (m3/kg)	RBSL - QW (mg/l.)
ORGANICS				
cis-1,2-Dichloroethene	ND	ND	1.22E+02	ND
Tetrachloroethene	ND	ND	1.22E+02	ND
trans-1,2-Dichloroethene	ND	ND	#DIV/0!	ND
Trichloroethene	ND	ND	1.22E+02	ND

ND = No data available

Table E-6.31

CHILD RESIDENT
 NAVAL TRAINING CENTER - OPERABLE UNIT 4
 ORLANDO, FLORIDA
 EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
TARGET CANCER RISK	TRc	1E-06	unitless	ASTM, 1996
TARGET NON-CANCER RISK	TRnc	1	unitless	USEPA, 1996
CANCER UNIT RISK	UR	chemical-specific	(ug/m3) ⁻¹	USEPA, 1998
REFERENCE CONCENTRATION	RIC	chemical-specific	mg/m3	USEPA, 1998
CONVERSION FACTOR 1	C1	0.001	1 mg/1000 ug	
CONVERSION FACTOR 2	C2	1 / 24	1 day/24 hours	
EXPOSURE PERIOD	EP	6	years	
EVENT FREQUENCY	EF1	1	event/day	
EXPOSURE DURATION	ED	16	hours/event	
EXPOSURE FREQUENCY(DAYS)	EF2	350	days/year	
AVERAGING PERIOD				
CANCER	AP	70	years	
NONCANCER	AP	6	years	

VF values are derived in "Vapor Migration to Indoor Air" Model.
 (1) Values for chemicals obtained from IRIS, HEAST.

AIR RBSL_{cancer} (mg/m3) = $\frac{TRc \times AP \times C1}{EF \times ED \times EF \times C2 \times UR}$

AIR RBSL_{non-cancer} (mg/m3) = $\frac{TRnc \times AP \times RFC}{EF \times ED \times EF \times C2}$

SOIL RBSL (mg/kg) = VF (m3/kg) x AIR RBSL (mg/m3)
GW RBSL (mg/L) = VF (m3/kg) x kg/L x AIR RBSL (mg/m3)
 (where 1 kg water = 1 L)

Note:
 For noncarcinogenic effects: AP = EP
 RBSL = Risk Based Screening Level
 UR = Unit Risk
 RFC = Reference Concentration

Table E-6.31

CHILD RESIDENT
 NAVAL TRAINING CENTER - OPERABLE UNIT 4
 ORLANDO, FLORIDA
 CARCINOGENIC EFFECTS

COMPOUND	INHALATION UR (ug/m3) ⁻¹	AIR RBSL (mg/m3)	VF-GW (m3/kg)	RBSL - GW (mg/L)
ORGANICS				
cis-1,2-Dichloroethene	NC	NC	1.22E+02	NC
Tetrachloroethene	5.80E-07	3.15E-02	1.22E+02	3.85E+00
trans-1,2-Dichloroethene	NC	NC	#DIV/0!	NC
Trichloroethene	2.00E-06	9.13E-03	1.22E+02	1.12E+00

NC = Not Carcinogenic

NONCARCINOGENIC EFFECTS

COMPOUND	INHALATION R/C (mg/m3)	AIR RBSL (mg/m3)	VF-GW (m3/kg)	RBSL - GW (mg/L)
ORGANICS				
cis-1,2-Dichloroethene	ND	ND	1.22E+02	ND
Tetrachloroethene	ND	ND	1.22E+02	ND
trans-1,2-Dichloroethene	ND	ND	#DIV/0!	ND
Trichloroethene	ND	ND	1.22E+02	ND

ND = No data available

VAPOR

TABLE E-6.32
 PARAMETERS FOR CALCULATION OF VOLATILIZATION FROM GROUNDWATER TO INDOOR AIR
 OCCUPATIONAL WORKER
 NAVAL TRAINING CENTER- OPERABLE UNIT 4
 ORLANDO, FLORIDA

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
HENRY'S LAW CONSTANT	H	chemical-specific	dimensionless	USEPA, 1996
SOIL BULK DENSITY	Pb	1.50E+00	g-soil/cm3-soil	USEPA, 1996
WATER CONTENT VADOSE ZONE SOILS	0 _w	0.15	cm3-water/cm3-soil	USEPA, 1996
AIR CONTENT VADOSE ZONE SOILS	0 _a	0.284	cm3-air/cm3-soil	USEPA, 1996
SOIL-WATER PARTITION COEFFICIENT	Kd	chemical-specific	cm3 water/g-soil	
SOURCE-BUILDING SEPARATION AT t=0; SOIL	L _T ⁰ -SOIL	122	cm	Site-Specific
SOURCE-BUILDING SEPARATION AT t=0; GROUNDWATER	L _T ⁰ -GW	122	cm	Site-Specific
AREA OF BASEMENT	A _B	3720000	cm2	MDEQ, 1998
AREA OF CRACKS IN BASEMENT	A _{CRACK}	37200	cm2	per USEPA, 1996
FRACTION OF AREA REPRESENTED BY CRACKS	n	0.01		USEPA, 1996
BUILDING VENTILATION RATE	Q _{BUILDING}	5040000	cm3/sec	MDEQ, 1998
AVERAGE VAPOR FLOW RATE INTO BUILDING(SEE CELL H8)	Q _{SOIL}	2.59	cm3/sec	USEPA, 1996
ENCLOSED SPACE WALL THICKNESS	L _{CRACK}	15	cm	USEPA, 1996
EFFECTIVE DIFFUSION COEFFICIENT IN SOIL	D _{eff} -SOIL	chemical-specific	cm2/sec	USEPA, 1996
EFFECTIVE DIFFUSION COEFFICIENT IN GROUNDWATER	D _{eff} -GW	chemical-specific	cm2/sec	USEPA, 1996
EFFECTIVE DIFFUSION COEFFICIENT THROUGH CRACKS	D _{eff} -CRACK	chemical-specific	cm2/sec	USEPA, 1996
AVERAGE CONTAMINANT LEVEL IN SOIL	C _s		g/g	USEPA, 1996
AVERAGE CONTAMINANT LEVEL IN GROUNDWATER	C _{w,eq}		g/cm3	USEPA, 1996
THICKNESS OF SOURCE AREA - SOIL	H _c -SOIL	122	cm	Site-Specific
THICKNESS OF SOURCE AREA - GROUNDWATER	H _c -GW	122	cm	Site-Specific
DIFFUSION COEFFICIENT IN AIR	D _a	chemical-specific	cm2/sec	USEPA, 1996
DIFFUSION COEFFICIENT IN WATER	D _w	chemical-specific	cm2/sec	USEPA, 1996
SOIL POROSITY IN IMPACTED ZONE	0 _T	0.434	cm3/cm3	USEPA, 1996
THICKNESS OF CAPILLARY FRINGE	h _{cap}	43.18	cm	USEPA, 1996
THICKNESS OF VADOSE ZONE	h _v	82.29	cm	USEPA, 1996
EFFECTIVE DIFFUSION THROUGH CAPILLARY FRINGE	D _{eff} -CAP	NA	cm3/cm3	NA
AIR CONTENT CAPILLARY FRINGE	0 _A -CAP	0.038	cm3-air/cm3-soil	USEPA, 1996
WATER CONTENT CAPILLARY FRINGE	0 _w -CAP	0.342	cm3-water/cm3-soil	USEPA, 1996
AIR CONTENT IN WALL CRACKS	0 _A -CRACK	0.284	cm3-air/cm3-tot.vol.	USEPA, 1996
WATER CONTENT WALL CRACKS	0 _w -CRACK	0.15	cm3-water/cm3-tot.vol.	USEPA, 1996
AVERAGING TIME FOR VAPOR FLUX	T	7.88E+08	sec	USEPA, 1996 (1)
AIR CONCENTRATION - INDOOR AIR - soil related	C _{BUILDING} -SOIL	chemical-specific	kg/m3	USEPA, 1996
AIR CONCENTRATION - INDOOR AIR - groundwater related	C _{BUILDING} -GW	chemical-specific		
VOLATILIZATION FACTOR - SUBSURFACE SOIL:INDOOR AIR	V _F SOIL	chemical-specific	m3/kg	USEPA, 1996
VOLATILIZATION FACTOR - GROUNDWATER:INDOOR AIR	V _F GW	chemical specific	m3/kg	NA
FRACTION ORGANIC CARBON IN SOIL	foc	0.002	unitless	Site-Specific
CONVERSION FACTOR 1	CF1	1.0E+03	cm3-kg/m3-g	USEPA, 1996
TIME TO DEplete VOLATILES FROM SOURCE - groundwater	T _D -GW		sec	Calculated in model
TIME TO DEplete VOLATILES FROM SOURCE - soil	T _D -SOIL		sec	Calculated in model
SOIL GAS CONCENTRATION at equilibrium-soil source	C _{v,eq} -soil		g/cm3	Calculated in model
SOIL GAS CONCENTRATION at equilibrium - groundwater source	C _{v,eq} -GW	chemical-specific	g/cm3	Calculated in model

NOTES:

USEPA, 1996. Soil Screening Guidance: Technical Background Document. Appendix H. EPA/540/R-95/128
 MDEQ, 1998. Michigan Department of Natural Resources "Risk-Based Screening Levels for Groundwater and Soil Volatilization to Indoor Air
 (1) Value for commercial/industrial worker (25 year exposure duration).
 Inhalation Criteria". Parameter values are based on median values obtained by MDEQ from the literature.

NOTE: All equations presented in the text accompanying this Table.

TABLE E-6.32
 PARAMETERS FOR CALCULATION OF VOLATILIZATION FROM GROUNDWATER TO INDOOR AIR
 OCCUPATIONAL WORKER
 NAVAL TRAINING CENTER- OPERABLE UNIT 4
 ORLANDO, FLORIDA

CHEMICAL	H (unitless)	K _{oc} (cm ³ /g)	D ₁ (cm ² /sec)	D ₂ (cm ² /sec)	D _{air-water} (cm ³ /cm ³)	beta-GW	phi-GW	alpha-GW
cis-1,2-Dichloroethene*	7.10E-01	3.00E+02	7.20E-02	8.20E-06	8.85E-06	1.05E+00	1.23E-09	1.11E-07
Tetrachloroethene	7.10E-01	3.00E+02	7.20E-02	8.20E-06	8.85E-06	1.05E+00	1.23E-09	1.11E-07
trans-1,2-Dichloroethene*	2.18E-01	4.90E+01	7.07E-02	1.19E-05	1.51E-05	1.09E+00	6.42E-10	2.06E-07
Trichloroethene	4.30E-01	9.40E+01	7.90E-02	9.10E-06	1.10E-05	1.06E+00	9.20E-10	1.45E-07

VAPOR

TABLE E-6.32
 PARAMETERS FOR CALCULATION OF VOLATILIZATION FROM GROUNDWATER TO INDOOR AIR
 OCCUPATIONAL WORKER
 NAVAL TRAINING CENTER- OPERABLE UNIT 4
 ORLANDO, FLORIDA

CHEMICAL	C v,eq-gw (g/cm3)	CS (g/g)	C w,eq (g/cm3)	T ₀ -GW (sec)	Is T>T ₀ -GW?	E-GW	C _{air,eq} -GW (kg/m3)	VF-GW (m3/L)
cis-1,2-Dichloroethene*	7.10E-01	1	1	1.27E+09	NO	NA	7.89E-05	1.27E+04
Tetrachloroethene	7.10E-01	1	1	1.27E+09	NO	NA	7.89E-05	1.27E+04
trans-1,2-Dichloroethene*	2.18E-01	1	1	2.48E+09	NO	NA	4.49E-05	2.23E+04
Trichloroethene	4.30E-01	1	1	1.70E+09	NO	NA	6.22E-05	1.61E+04

Table E-6.33

COMERCIAL WORKER
 NAVAL TRAINING CENTER - OPERABLE UNIT 4
 ORLANDO, FLORIDA
 EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
TARGET CANCER RISK	TRc	1E-06	unitless	
TARGET NON-CANCER RISK	TRnc	1	unitless	
CANCER UNIT RISK	UR	chemical-specific	(ug/m3)-1	USEPA, 1998
REFERENCE CONCENTRATION	RfC	chemical-specific	mg/m3	USEPA, 1998
CONVERSION FACTOR 1	C1	0.001	1 mg/1000 ug	
CONVERSION FACTOR 2	C2	1 / 24	1 day/24 hours	
EXPOSURE PERIOD	EP	25	years	
EVENT FREQUENCY	EF1	1	event/day	
EXPOSURE DURATION	ED	8	hours/event	
EXPOSURE FREQUENCY(DAYS)	EF2	250	days/year	
AVERAGING PERIOD				
CANCER	AP	70	years	
NONCANCER	AP	25	years	

VF values are derived in "Vapor Migration to Indoor Air" Model.
 (1) Values for chemicals obtained from IRIS, HEAST.

$$\text{AIR RBSL}_{\text{cancer}} \text{ (mg/m3)} = \frac{\text{TRc} \times \text{AP} \times \text{C1}}{\text{EF} \times \text{ED} \times \text{EF} \times \text{C2} \times \text{UR}}$$

$$\text{AIR RBSL}_{\text{non-cancer}} \text{ (mg/m3)} = \frac{\text{TRnc} \times \text{AP} \times \text{RfC}}{\text{EF} \times \text{ED} \times \text{EF} \times \text{C2}}$$

$$\text{SOIL RBSL} \text{ (mg/kg)} = \text{VF} \text{ (m3/kg)} \times \text{AIR RBSL} \text{ (mg/m3)}$$

$$\text{GW RBSL} \text{ (mg/L)} = \text{VF} \text{ (m3/kg)} \times \text{kg/L} \times \text{AIR RBSL} \text{ (mg/m3)}$$

(where 1 kg water = 1 L)

Note:
 For noncarcinogenic effects: AP = EP
 RBSL = Risk Based Screening Level
 UR = Unit Risk
 RfC = Reference Concentration

Table E-6.33

COMERCIAL WORKER
NAVAL TRAINING CENTER - OPERABLE UNIT 4
ORLANDO, FLORIDA

CARCINOGENIC EFFECTS

COMPOUND	INHALATION UR (ug/m3) ^{a-1}	AIR RBSL (mg/m3)	VF-GW (m3/kg)	RBSL - GW (mg/L)
ORGANICS				
cis-1,2-Dichloroethene	NC	NC	1.27E+04	NC
Tetrachloroethene	5.80E-07	2.11E-02	1.27E+04	2.68E+02
trans-1,2-Dichloroethene	NC	NC	2.23E+04	NC
Trichloroethene	2.00E-06	6.13E-03	1.61E+04	9.85E+01

NC = Not Carcinogenic

NONCARCINOGENIC EFFECTS

COMPOUND	INHALATION RfC (mg/m3)	AIR RBSL (mg/m3)	VF-GW (m3/kg)	RBSL - GW (mg/L)
ORGANICS				
cis-1,2-Dichloroethene	ND	ND	1.27E+04	ND
Tetrachloroethene	ND	ND	1.27E+04	ND
trans-1,2-Dichloroethene	ND	ND	2.23E+04	ND
Trichloroethene	ND	ND	1.61E+04	ND

ND = No data available

Value for 4-methyl-2-pentanone used for 2-hexanone

TABLE X-6.34

INHALATION OF GROUNDWATER VOC INDOOR AIR (UNFILTERED SAMPLES)
 RESIDENT/OCCUPATIONAL WORKER
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION WATER	EPC	chemical-specific	ug/liter	
INGESTION RATE	IR	2	liters/day	USEPA, 1991
BODY WEIGHT	BW	70	kg	USEPA, 1991
CONVERSION FACTOR	CF	0.001	mg/ug	USEPA, 1991
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1991
EXPOSURE DURATION	ED	24	years	USEPA, 1991
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	24	years	USEPA, 1991
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance "Standard Default Exposure Factors", OSWER Directive 9215.4-03.				

CANCER RISK = $Risk = (EPC / RBSL) \times 1 \times 10^{-4}$

HAZARD QUOTIENT =

INTAKE =

Note: For noncarcinogenic effects, AT = ED.

TABLE X-6.34

INHALATION OF GROUNDWATER VOC INDOOR AIR (UNFILTERED SAMPLES)
 RESIDENT/OCCUPATIONAL WORKER
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	EXPOSURE POINT CONCENTRATION	UNITS	RISK-BASED ADULT RESIDENTIAL SCREENING LEVEL (ug/L)	RISK-BASED CHILD RESIDENTIAL SCREENING LEVEL (ug/L)	RISK-BASED INDUSTRIAL SCREENING LEVEL (ug/L)	RESIDENTIAL CANCER RISK	CHILD CANCER RISK	COMMERICAL CANCER RISK
Northern VOC Plume								
Tetrachloroethene	1900	ug/l	9.6E+02	3.9E+03	2.7E+05	2.0E-06	4.9E-07	7.1E-09
Trichloroethene	410	ug/l	2.8E+02	1.1E+03	9.9E+04	1.5E-06	3.7E-07	4.2E-09
Southern VOC Plume								
Tetrachloroethene	110	ug/l	9.6E+02	3.9E+03	2.7E+05	1.1E-07	2.9E-08	4.1E-10
Trichloroethene	23	ug/l	2.8E+02	1.1E+03	9.9E+04	8.2E-08	2.1E-08	2.3E-10
Antimony Plume								
Tetrachloroethene	7.5	ug/l	9.6E+02	3.9E+03	2.7E+05	7.8E-09	1.9E-09	2.8E-11
Trichloroethene	0.88	ug/l	2.8E+02	1.1E+03	9.9E+04	3.2E-09	7.9E-10	8.9E-12

TABLE E-6.35

CURRENT AND FUTURE LAND USE INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER
 ADULT TRESPASSER AND RECREATIONAL USER - WADING
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION WATER	CW	chemical-specific	ug/liter	
INGESTION RATE [1]	IR	0.026	liters/day	USEPA, 1995
SURFACE AREA [2]	SA	5,750	cm ²	USEPA, 1992
EVENT FREQUENCY	EV	1	events/day	Assumption
BODY WEIGHT	BW	70	kg	USEPA, 1991
DOSE ABSORBED PER EVENT	DA _{event}	chemical-specific	mg/cm ² -event	Calculated
EXPOSURE TIME	ET	2.6	hours/day	Assumption
EXPOSURE FREQUENCY	EF	45	days/year	Assumption
EXPOSURE DURATION	ED	20	years	Assumption
DIFFUSION DEPTH PER EVENT	PC _{event}	chemical-specific	cm/event	[3]
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	20	years	Assumption
CONVERSION FACTOR	CF1	0.001	mg/ug	
CONVERSION FACTOR	CF2	0.001	liter/cm ³	

[1] Ingestion Rate = 0.026 l/day = 10 ml/hour x 2.6 hours/day x 0.001 l/ml

[2] Surface area assumes lower legs, hands, and feet are exposed.

[3] PC_{event} is calculated per Appendix E-6 to this report.

USEPA, 1989. Exposure Factors Handbook; EPA/600/8-89/043; May 1989.

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Parameters";

USEPA, 1992. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B.

USEPA, 1995. Supplemental Guidance to RAGS: Region 4 Bulletins, Bulletin No. 3, November 1995.

$$\text{CANCER RISK} = \text{INTAKE (mg/kg-day)} \times \text{CANCER SLOPE FACTOR (mg/kg-day)}^{-1}$$

$$\text{HAZARD QUOTIENT} = \text{INTAKE (mg/kg-day)} / \text{REFERENCE DOSE (mg/kg-day)}$$

$$\text{INTAKE-INGESTION} = \frac{\text{CW} \times \text{IR} \times \text{EF} \times \text{ED} \times \text{CF1}}{\text{BW} \times \text{AT} \times 365 \text{ days/yr}}$$

$$\text{INTAKE-DERMAL} = \frac{\text{DA}_{\text{event}} \times \text{EV} \times \text{EF} \times \text{ED} \times \text{SA}}{\text{AT} \times \text{BW} \times 365 \text{ days/yr}}$$

Where:

$$\text{DA}_{\text{event}} = \text{PC}_{\text{event}} \times \text{CW} \times \text{CF1} \times \text{CF2}$$

Note:

For noncarcinogenic effects, AT = ED.

TABLE E-6.35

CURRENT AND FUTURE LAND USE INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER
ADULT TRESPASSER AND RECREATIONAL USER - WADING
NAVAL TRAINING CENTER
ORLANDO, FLORIDIA
OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF	CANCER RISK INGESTION	PCEVENT [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2]	CANCER RISK DERMAL	TOTAL CANCER RISK
Tetrachloroethene	O	19	ug/L	2.5E-07	0.052	1.3E-08	1.56	8.6E-05	0.052	4.5E-06	4.5E-06
Trichloroethene	O	57	ug/L	7.5E-07	0.011	8.2E-09	0.849	1.4E-04	0.011	1.5E-06	1.5E-06
Vinyl chloride	O	35	ug/L	4.6E-07	1.9	8.7E-07	0.022	2.2E-06	ND	8.7E-07	8.7E-07
4,4'-DDT	O	0.03	ug/L	3.9E-10	0.34	1.3E-10	6.91	6.0E-07	1.7	1.0E-06	1.0E-06
SUMMARY CANCER RISK						9E-07				7E-06	8E-06

[1] This chemical-specific value is calculated in Table E-6-39 of this appendix.
[2] Calculated from oral CSFs.
NE = not evaluated.

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	PCEVENT[1] (cm/event)	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
cis-1,2-Dichloroethene	O	760	ug/L	3.5E-05	1.0E-02	3.5E-03	0.0327	2.5E-04	1.0E-02	2.5E-02	2.9E-02
Tetrachloroethene	O	19	ug/L	8.7E-07	1.0E-02	8.7E-05	1.56	3.0E-04	1.0E-02	3.0E-02	3.0E-02
Trichloroethene	O	57	ug/L	2.6E-06	6.0E-03	4.4E-04	0.849	4.9E-04	6.0E-03	8.2E-02	8.2E-02
Vinyl chloride	O	35	ug/L	1.6E-06	ND	ND	0.022	7.8E-06	ND	ND	ND
4,4'-DDT	O	0.03	ug/L	1.4E-09	5.0E-04	2.7E-06	6.91	2.1E-06	1.0E-04	2.1E-02	2.1E-02
Endrin ketone	O	0.01	ug/L	4.6E-10	3.0E-04	1.5E-06	0.303	3.1E-08	ND	1.5E-06	1.5E-06
Aluminum	I	538	ug/L	2.5E-05	1.0E+00	2.5E-05	0.0026	1.4E-05	2.0E-01	7.1E-05	9.5E-05
SUMMARY HAZARD INDEX						0.004				0.2	0.2

[1] This chemical-specific value is calculated in Table E-6-39 of this appendix.
[2] Calculated from oral RfDs.
ND = no data available.

TABLE E-6.36

CURRENT AND FUTURE LAND USE INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER
 ADOLESCENT TRESPASSER AND RECREATIONAL USER - WADING
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDIA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION WATER	CW	chemical-specific	ug/liter	
INGESTION RATE [1]	IR	0.026	liters/day	USEPA, 1995
AGE-SPECIFIC SURFACE AREA [2]	SA	age-specific	cm ²	USEPA, 1989
EVENT FREQUENCY	EV	1	events/day	Assumption
BODY WEIGHT	BW	45	kg	USEPA, 1995
DOSE ABSORBED PER EVENT	DA _{event}	chemical-specific	mg/cm ² -event	Calculated
EXPOSURE FREQUENCY	EF	45	days/year	Assumption
EXPOSURE DURATION	ED	10	years	USEPA, 1995
AGE-WEIGHTED SURFACE AREA [3]	SAsw/adj	1013	cm ² -yr/kg	Calculated per USEPA, 1992
DIFFUSION DEPTH PER EVENT [4]	PC _{event}	chemical-specific	cm/event	Calculated per USEPA, 1992
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	10	years	USEPA, 1995
CONVERSION FACTOR	CF1	0.001	mg/ug	
CONVERSION FACTOR	CF2	0.001	liter/cm ³	

[1] Ingestion Rate = 0.026 l/day = 10 ml/hour x 2.6 hours/day x 0.001 l/ml.
 [2] Surface area assumes lower legs, hands, and feet are exposed.
 [3] Age-weighted, body weight normalized surface area.
 [4] PC_{event} calculated per the Dermal Guidance Appendix E to this report.

USEPA, 1989. Exposure Factors Handbook; EPA/600/8-89/043; May 1989.
 USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Parameters";
 USEPA, 1992. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)⁻¹

'HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

INTAKE-INGESTION = $\frac{CW \times IR \times EF \times ED \times CF1}{BW \times AT \times 365 \text{ days/yr}}$

INTAKE-DERMAL = $\frac{DA_{event} \times EV \times EF \times SAsw/adj}{AT \times 365 \text{ days/yr}}$

Where:
 SAsw/adj = Sum (SA x ED / BW)
 DA_{event} = PC_{event} x CW x CF1 x CF2

Note: For noncarcinogenic effects, AT = ED.

TABLE E-6.36

CURRENT AND FUTURE LAND USE INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER
 ADOLESCENT TRESPASSER AND RECREATIONAL USER - WADING
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDIA
 OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF	CANCER RISK INGESTION	PCEVENT [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2]	CANCER RISK DERMAL	TOTAL CANCER RISK
Tetrachloroethene	O	19	ug/L	1.9E-07	0.052	1.0E-08	1.56	5.3E-05	0.052	2.7E-06	2.8E-06
Trichloroethene	O	57	ug/L	5.8E-07	0.011	6.4E-09	0.849	8.6E-05	0.011	9.5E-07	9.6E-07
Vinyl chloride	O	35	ug/L	3.6E-07	1.9	6.8E-07	0.022	1.4E-06	ND	6.8E-07	6.8E-07
4,4'-DDT	O	0.03	ug/L	3.1E-10	0.34	1.0E-10	6.91	3.7E-07	1.7	6.3E-07	6.3E-07
SUMMARY CANCER RISK						7E-07				4E-06	5E-06
[1] This chemical-specific value has been calculated in Table E-6-39 of this appendix.											
[2] Calculated from oral CSFs.											
ND = no data available.											

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	PCEVENT [1] (cm/event)	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
cis-1,2-Dichloroethene	O	760	ug/L	5.4E-05	1.0E-02	5.4E-03	0.0327	3.1E-04	1.0E-02	3.1E-02	3.6E-02
Tetrachloroethene	O	19	ug/L	1.4E-06	1.0E-02	1.4E-04	1.56	3.7E-04	1.0E-02	3.7E-02	3.7E-02
Trichloroethene	O	57	ug/L	4.1E-06	6.0E-03	6.8E-04	0.849	6.0E-04	6.0E-03	1.0E-01	1.0E-01
Vinyl chloride	O	35	ug/L	2.5E-06	ND	ND	0.022	9.6E-06	ND	ND	ND
4,4'-DDT	O	0.03	ug/L	2.1E-09	5.0E-04	4.3E-06	6.91	2.6E-06	1.0E-04	2.6E-02	2.6E-02
Endrin ketone	O	0.01	ug/L	7.1E-10	3.0E-04	2.4E-06	0.303	3.8E-08	ND	ND	2.4E-06
Aluminum	I	538	ug/L	3.8E-05	1.0E+00	3.8E-05	0.0026	1.7E-05	2.0E-01	8.7E-05	1.3E-04
SUMMARY HAZARD INDEX						0.006				0.2	0.2
[1] This chemical-specific value has been calculated in Table E-6-39 of this appendix.											
[2] Calculated from oral RfDs.											
ND = no data available.											

TABLE E-6.37

FUTURE LAND USE INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER
 ADULT RESIDENT - WADING
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4
 EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION WATER	CW	chemical-specific	ug/liter	
INGESTION RATE [1]	IR	0.026	liters/day	USEPA, 1995
SURFACE AREA [2]	SA	5,750	cm ²	USEPA, 1989
EVENT FREQUENCY	EV	1	events/day	Assumption
BODY WEIGHT	BW	70	kg	USEPA, 1991
DOSE ABSORBED PER EVENT	DAevent	chemical-specific	mg/cm ² -event	Calculated
EXPOSURE TIME	ET	2.6	hours/day	Assumption
EXPOSURE FREQUENCY	EF	100	days/year	Assumption
EXPOSURE DURATION	ED	24	years	Assumption
DIFFUSION DEPTH PER EVENT	PCevent	chemical-specific	cm/event	Calculated per USEPA, 1992 [3]
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	24	years	USEPA, 1995
CONVERSION FACTOR	CF1	0.001	mg/ug	
CONVERSION FACTOR	CF2	0.001	liter/cm ³	

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)⁻¹

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

INTAKE-INGESTION = $\frac{CW \times IR \times EF \times ED \times CF1}{BW \times AT \times 365 \text{ days/yr}}$

INTAKE-DERMAL = $\frac{DAevent \times EV \times EF \times ED \times SA}{AT \times BW \times 365 \text{ days/yr}}$

Where:
 DAevent = PCevent x CW x CF1 x CF2

Note: For noncarcinogenic effects, AT = ED.

[1] Ingestion Rate = 0.026 l/day = 10 ml/hour x 2.6 hours/day x 0.001 l/ml

[2] Surface area assumes lower legs, hands, and feet are exposed.

[3] PCevent is calculated in the Dermal Guidance Appendix E to this report.

USEPA, 1989. Exposure Factors Handbook; EPA/600/8-89/043; May 1989.

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Parameters."

USEPA, 1992. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B.

USEPA, 1995. Supplemental Guidance to RAGS: Region 4 Bulletins, Bulletin No. 3, November 1995.

TABLE E-6.37

FUTURE LAND USE INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER
 ADULT RESIDENT - WADING
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4
 CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] (mg/kg-day) ⁻¹	CANCER RISK INGESTION	PCEVENT[2] (cm/event)	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [1, 3] (mg/kg-day) ⁻¹	CANCER RISK DERMAL	TOTAL CANCER RISK
Tetrachloroethene	O	19	ug/L	6.6E-07	5.2E-02	3.4E-08	1.56	2.3E-04	5.2E-02	1.2E-05	1.2E-05
Trichloroethene	O	57	ug/L	2.0E-06	1.1E-02	2.2E-08	0.849	3.7E-04	1.1E-02	4.1E-06	4.1E-06
Vinyl chloride	O	35	ug/L	1.2E-06	1.9E+00	2.3E-06	0.022	5.9E-06	ND	2.3E-06	2.3E-06
4,4'-DDT	O	0.03	ug/L	1.0E-09	3.4E-01	3.6E-10	6.91	1.6E-06	1.7E+00	2.7E-06	2.7E-06
SUMMARY CANCER RISK						2E-06				2E-05	2E-05

[1] Relative potency factors were applied to the CSFs of carcinogenic PAHs. Relative potency factors are derived in "Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons," USEPA, 1993.
 [2] This chemical-specific value is calculated in Table E-6-39 of this appendix.
 [3] Calculated from oral CSFs.
 ND = no data available.

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	PCEVENT[1] (cm/event)	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day) ⁻¹	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
cis-1,2-Dichloroethene	O	760	ug/L	7.7E-05	1.0E-02	7.7E-03	0.0327	5.6E-04	1.0E-02	5.6E-02	6.4E-02
Tetrachloroethene	O	19	ug/L	1.9E-06	1.0E-02	1.9E-04	1.56	6.7E-04	1.0E-02	6.7E-02	6.7E-02
Trichloroethene	O	57	ug/L	5.8E-06	6.0E-03	9.7E-04	0.849	1.1E-03	6.0E-03	1.8E-01	1.8E-01
Vinyl chloride	O	35	ug/L	3.6E-06	ND		0.022	1.7E-05	ND		
4,4'-DDT	O	0.03	ug/L	3.1E-09	5.0E-04	6.1E-06	6.91	4.7E-06	1.0E-04	4.7E-02	4.7E-02
Endrin ketone	O	0.01	ug/L	1.0E-09	3.0E-04	3.4E-06	0.303	6.8E-08	ND		3.4E-06
Aluminum	I	538	ug/L	5.5E-05	1.0E+00	5.5E-05	0.0026	3.1E-05	2.0E-01	1.6E-04	2.1E-04
SUMMARY HAZARD INDEX						0.009				0.4	0.4

[1] This chemical-specific value is calculated in Table E-6-39 of this appendix.
 [2] Calculated from oral RfDs.
 ND = no data available.

TABLE E-6.38

FUTURE LAND USE INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER
 CHILD RESIDENT - WADING
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION WATER	CW	chemical-specific	ug/liter	
INGESTION RATE [1]	IR	0.13	liters/day	USEPA, 1995
AGE-SPECIFIC SURFACE AREA [2]	SA	age-specific	cm ²	USEPA, 1989
EVENT FREQUENCY	EV	1	events/day	Assumption
BODY WEIGHT	BW	15	kg	USEPA, 1991
DOSE ABSORBED PER EVENT	DA _{event}	chemical-specific	mg/cm ² -event	Calculated
EXPOSURE FREQUENCY	EF	100	days/year	Assumption
EXPOSURE DURATION	ED	6	years	Assumption
AGE-WEIGHTED SURFACE AREA [3]	SAsw/adj	766	cm ² -yr/kg	Calculated per USEPA, 1992
DIFFUSION DEPTH PER EVENT [4]	PC _{event}	chemical-specific	cm/event	Calculated per USEPA, 1992
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	6	years	Assumption
CONVERSION FACTOR	CF1	0.001	mg/ug	
CONVERSION FACTOR	CF2	0.001	liter/cm ³	

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)⁻¹

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

INTAKE-INGESTION = $\frac{CW \times IR \times EF \times ED \times CF1}{BW \times AT \times 365 \text{ days/yr}}$

INTAKE-DERMAL = $\frac{DA_{event} \times EV \times EF \times SAsw/adj}{AT \times 365 \text{ days/yr}}$

Where:

SAsw/adj = Sum (SA x ED / BW)
 DA_{event} = PC_{event} x CW x CF1 x CF2

Note: For noncarcinogenic effects, AT = ED.

[1] Ingestion Rate = 0.13 l/day = 50 ml/hour x 2.6 hours/day x 0.001 l/ml.
 [2] Surface area assumes lower legs, hands, and feet are exposed.
 [3] Age-weighted, body weight normalized surface area.
 [4] PC_{event} calculated per the Dermal Guidance Appendix E to this report.

USEPA, 1989. Exposure Factors Handbook; EPA/600/8-89/043; May 1989.
 USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Parameters";
 USEPA, 1992. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B

TABLE E-6.38

FUTURE LAND USE INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER
CHILD RESIDENT - WADING
NAVAL TRAINING CENTER
ORLANDO, FLORIDIA
OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF	CANCER RISK INGESTION	PCEVENT [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2]	CANCER RISK DERMAL	TOTAL CANCER RISK
Tetrachloroethene	O	19	ug/L	3.9E-06	0.052	2.0E-07	1.56	8.9E-05	0.052	4.6E-06	4.8E-06
Trichloroethene	O	57	ug/L	1.2E-05	0.011	1.3E-07	0.849	1.5E-04	0.011	1.6E-06	1.7E-06
Vinyl chloride	O	35	ug/L	7.1E-06	1.9	1.4E-05	0.022	2.3E-06	ND	1.4E-05	1.4E-05
4,4'-DDT	O	0.03	ug/L	6.1E-09	0.34	2.1E-09	6.91	6.2E-07	1.7	1.1E-06	1.1E-06
SUMMARY CANCER RISK						1E-05				7E-06	2E-05
[1] This chemical-specific value has been calculated in Table E-6-39 of this appendix. [2] Calculated from oral CSFs. ND = no data available.											

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	PCEVENT [1] (cm/event)	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
cis-1,2-Dichloroethene	O	760	ug/L	1.8E-03	1.0E-02	1.8E-01	0.0327	8.7E-04	1.0E-02	8.7E-02	2.7E-01
Tetrachloroethene	O	19	ug/L	4.5E-05	1.0E-02	4.5E-03	1.56	1.0E-03	1.0E-02	1.0E-01	1.1E-01
Trichloroethene	O	57	ug/L	1.4E-04	6.0E-03	2.3E-02	0.849	1.7E-03	6.0E-03	2.8E-01	3.0E-01
Vinyl chloride	O	35	ug/L	8.3E-05	ND	ND	0.022	2.7E-05	ND	ND	ND
4,4'-DDT	O	0.03	ug/L	7.1E-08	5.0E-04	1.4E-04	6.91	7.3E-06	1.0E-04	7.3E-02	7.3E-02
Endrin ketone	O	0.01	ug/L	2.4E-08	3.0E-04	7.9E-05	0.303	1.1E-07	ND	ND	7.9E-05
Aluminum	I	538	ug/L	1.3E-03	1.0E+00	1.3E-03	0.0026	4.9E-05	2.0E-01	2.4E-04	1.5E-03
SUMMARY HAZARD INDEX						0.2				0.5	0.8
[1] This chemical-specific value has been calculated in Table E-6-39 of this appendix. [2] Calculated from oral RfDs. ND = no data available.											

CURRENT USE INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER
ADULT AND/OR CHILD RESIDENT/TRESPASSER/RECREATIONAL USER
NAVAL TRAINING CENTER - OPERABLE UNIT 4
ORLANDO, FLORIDA

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
Diffusion depth per event	PC_{event}	chemical specific	cm/event	
Permeability Constant	PC	chemical specific	cm/hr	USEPA, 1992
Duration of a Single Event	t_{event}	2.6	hr	USEPA, 1989
Thickness of Stratum Corneum	L_{sc}	10	um	USEPA, 1992
Octanol-water partition coefficient/ 10^4	B	chemical specific	dimensionless	USEPA, 1992
Pi	π	3.14	dimensionless	USEPA, 1992
Time to Reach Steady State	T	chemical specific	hr	USEPA, 1992
	t^*	chemical specific	hr	USEPA, 1992
Stratum Corneum Diffusion Coefficient	D_{sc}	chemical specific	cm^2/hr	USEPA, 1992

INORGANICS

$$PC_{event} = PC \times t_{event}$$

ORGANICS

$$PC_{event} = 2PC \times (6T \times t_{event} / \pi)^{0.5}$$

Where $t_{event} < t^*$

and: $PC_{event} = PC \times ((t_{event} / (1+B)) + 2T \times ((1+3B) / (1+B)))$

Where $t_{event} > t^*$

Note: $T = L_{sc}^2 / 6D_{sc}$

REFERENCES

USEPA, 1989. Risk Assessment Guidance for Superfund, Volume I, Part A, EPA/540/1-89/002, December 1989. This value is receptor-specific
USEPA, 1992. Dermal Exposure Assessment: Principles and Applications.
The term T is not calculated here. Values are provided in USEPA, 1992.

COMPOUND	INORGANIC OR ORGANIC? I/O	PC (cm/hr)	T (hr)	t^* (hr)	B (unitless)	PC_{event} (cm/event)
cis-1,2-Dichloroethene	O	1.0E-02	3.4E-01	8.2E-01	7.2E-03	3.27E-02
Tetrachloroethene	O	3.7E-01	9.0E-01	4.3E+00	2.5E-01	1.56E+00
Trichloroethene	O	2.3E-01	5.5E-01	1.3E+00	2.6E-02	8.49E-01
Vinyl chloride	O	7.3E-03	2.1E-01	5.1E-01	2.3E-03	2.20E-02
4,4'-DDT	O	4.3E-01	1.3E+01	6.0E+01	2.3E+02	6.91E+00
Endrin ketone	O	1.6E-02	1.8E+01	9.4E+01	3.6E+00	3.03E-01

NA = Not applicable. For inorganic analytes, this term is not used to calculate PC_{event} .

REFERENCES:

Unless otherwise noted, values are taken from USEPA, 1992. Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/011B
Values for trans-1,2-Dichloroethene used as a surrogate for cis-1,2-Dichloroethene.
Value for endrin used as a surrogate for endrin ketone.

TABLE E-6.40

CURRENT AND FUTURE LAND USE DIRECT CONTACT WITH SEDIMENT
 ADULT TRESPASSER AND RECREATIONAL USER
 NAVAL TRAINING CENTER - OPERABLE UNIT 4
 ORLANDO, FLORIDA

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SEDIMENT	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	NA	mg/day	
FRACTION INGESTED	FI	100%	unitless	Assumption
ADHERENCE FACTOR	AF	1	mg/cm ² -event	USEPA, 1995
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1995
SURFACE AREA EXPOSED	SA	3190	cm ²	USEPA, 1997
DOSE ABSORBED PER EVENT	DA _{event}	chemical-specific	mg/cm ² -event	USEPA, 1992
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	45	days/year [1]	Assumption
EXPOSURE DURATION	ED	20	years	USEPA, 1991
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	20	years	USEPA, 1991

$$\text{CANCER RISK} = \text{INTAKE (mg/kg-day)} \times \text{CANCER SLOPE FACTOR (mg/kg-day)}^{-1}$$

$$\text{HAZARD QUOTIENT} = \text{INTAKE (mg/kg-day)} / \text{REFERENCE DOSE (mg/kg-day)}$$

$$\text{INTAKE-INGESTION} = \frac{\text{CS} \times \text{IR} \times \text{FI} \times \text{CF} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT} \times 365 \text{ days/yr}}$$

$$\text{INTAKE-DERMAL} = \frac{(\text{DA}_{\text{event}} \times \text{EF} \times \text{ED} \times \text{SA})}{\text{BW} \times \text{AT} \times 365 \text{ days/yr}}$$

Where:

$$\text{DA}_{\text{event}} = \text{CS} \times \text{AF} \times \text{ABS} \times \text{CF}$$

Note: For noncarcinogenic effects, AT = ED.

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose.
 USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.
 USEPA, 1992. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January 1992.
 USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.
 USEPA, 1997. Exposure Factors Handbook, August 1997.
 NA = not applicable, sediment is always submerged with surface water.

TABLE E-6.40

CURRENT AND FUTURE LAND USE DIRECT CONTACT WITH SEDIMENT
ADULT TRESPASSER AND RECREATIONAL USER
NAVAL TRAINING CENTER - OPERABLE UNIT 4
ORLANDO, FLORIDA

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SEDIMENT CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF (mg/kg-day) ⁻¹	CANCER RISK INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2] (mg/kg-day) ⁻¹	CANCER RISK DERMAL	TOTAL CANCER RISK
Vinyl chloride	O	564	ug/kg	0.0E+00	1.9	0.0E+00	0.01	9.1E-09	ND		
Arsenic	I	6.3	mg/kg	0.0E+00	1.5	0.0E+00	0.001	1.0E-08	1.5	1.5E-08	1.5E-08
SUMMARY CANCER RISK						0E+00				2E-08	2E-08
<p>[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November 1995). [2] Calculated from oral CSFs. NE = not evaluated.</p>											

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SEDIMENT CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Vinyl chloride	O	564	ug/kg	0.0E+00	ND		0.01	3.2E-08	ND		
Arsenic	I	6.3	mg/kg	0.0E+00	0.0003	0.0E+00	0.001	3.5E-08	0.00029	1.2E-04	1.2E-04
Thallium	I	5.4	mg/kg	0.0E+00	0.00008	0.0E+00	0.001	3.0E-08	0.00008	3.8E-04	3.8E-04
SUMMARY HAZARD INDEX						0				0.0005	0.0005
<p>[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November 1995). [2] Calculated from oral RfDs. ND = no data available.</p>											

TABLE E-6.41

CURRENT AND FUTURE LAND USE DIRECT CONTACT WITH SEDIMENT
 ADOLESCENT TRESPASSER AND RECREATIONAL USER
 NAVAL TRAINING CENTER - OPERABLE UNIT 4
 ORLANDO, FLORIDA

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SEDIMENT	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	NA	mg/day	Assumption
FRACTION INGESTED	FI	100%	unitless	Assumption
ADHERENCE FACTOR	AF	1	mg/cm ² -event	USEPA, 1995
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1995
AGE-WEIGHTED SURFACE AREA	SA _{soil/adj}	251	cm ² [1]	USEPA, 1997
DOSE ABSORBED PER EVENT	DA _{event}	chemical-specific	mg/cm ² -event	USEPA, 1992
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	15	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	100	days/year [2]	Assumption
EXPOSURE DURATION	ED	6	years	USEPA, 1995
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	6	years	USEPA, 1995

[1] In estimating the dermally absorbed dose for children age 6 through 16, the time-weighted, bodyweight normalized surface area exposed (lower legs and feet) is calculated from surface area, exposure duration, and body weight for each of 10 age periods, age 6 through 16, per USEPA, 1992 (see Appendix E-7 to this report).

[2] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose.

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors", OSWER Directive 9285 6-03.

USEPA, 1992. Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/011B, January 1992.

USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.

USEPA, 1997. Exposure Factors Handbook, August 1997.

NA = not applicable, sediment is always submerged with surface water.

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)⁻¹

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

INTAKE-INGESTION = $\frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365 \text{ days/yr}}$

INTAKE-DERMAL = (DA_{event} x EF / AT x 365 days/year) x SA_{soil/adj}

Where:

SA_{soil/adj} = SUM(SA_i x ED_i/BW_i)

DA_{event} = CS x AF x ABS x CF

Note: For noncarcinogenic effects, AT = ED.

TABLE E-6.41

CURRENT AND FUTURE LAND USE DIRECT CONTACT WITH SEDIMENT
 ADOLESCENT TRESPASSER AND RECREATIONAL USER
 NAVAL TRAINING CENTER - OPERABLE UNIT 4
 ORLANDO, FLORIDA

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SEDIMENT CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF (mg/kg-day) ⁻¹	CANCER RISK INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2] (mg/kg-day) ⁻¹	CANCER RISK DERMAL	TOTAL CANCER RISK
Vinyl chloride	O	564	ug/kg	0.0E+00	1.9	0.0E+00	0.01	5.5E-09	ND		
Arsenic	I	6.3	mg/kg	0.0E+00	1.5	0.0E+00	0.001	6.2E-09	1.5	9.3E-09	9.3E-09
SUMMARY CANCER RISK						0E+00				9E-09	9E-09
[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November 1995). [2] Calculated from oral CSFs. NE = not evaluated.											

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC	SEDIMENT CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Vinyl chloride	O	564	ug/kg	0.0E+00	ND		0.01	6.5E-08	ND		
Arsenic	I	6.3	mg/kg	0.0E+00	0.0003	0.0E+00	0.001	7.2E-08	0.00029	2.5E-04	2.5E-04
Thallium	I	5.4	mg/kg	0.0E+00	0.00008	0.0E+00	0.001	6.2E-08	0.00008	7.7E-04	7.7E-04
SUMMARY HAZARD INDEX						0				0.001	0.001
[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (February 10, 1992). [2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November 1995). ND = no data available.											

TABLE E-6.42

FUTURE LAND USE DIRECT CONTACT WITH SEDIMENT
 ADULT RESIDENT
 NAVAL TRAINING CENTER- OPERABLE UNIT 4
 ORLANDO, FLORIDA

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SEDIMENT	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	NA	mg/day	USEPA, 1995
FRACTION INGESTED	FI	100%	unitless	Assumption
ADHERENCE FACTOR	AF	1	mg/cm ² -event	USEPA, 1995
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1995
SURFACE AREA EXPOSED	SA	3190.0	cm ²	USEPA, 1997
DOSE ABSORBED PER EVENT	DA _{event}	chemical-specific	mg/cm ² -event	USEPA, 1992
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	100	days/year [1]	Assumption
EXPOSURE DURATION	ED	24	years	USEPA, 1991
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	24	years	USEPA, 1991

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose.
 USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.
 USEPA, 1992. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January 1992.
 USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.
 USEPA, 1997. Exposure Factors Handbook, August 1997.
 NA = not applicable, sediment is always submerged with surface water.

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)⁻¹

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

INTAKE-INGESTION = $\frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365 \text{ days/yr}}$

INTAKE-DERMAL = $\frac{(DA_{event} \times EF \times ED \times SA)}{BW \times AT \times 365 \text{ days/yr}}$

Where:
 DA_{event} = CS x AF x ABS x CF

Note: For noncarcinogenic effects, AT = ED.

TABLE E-6.42

FUTURE LAND USE DIRECT CONTACT WITH SEDIMENT
 ADULT RESIDENT
 NAVAL TRAINING CENTER- OPERABLE UNIT 4
 ORLANDO, FLORIDA

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SEDIMENT CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF (mg/kg-day) ⁻¹	CANCER RISK INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2] (mg/kg-day) ⁻¹	CANCER RISK DERMAL	TOTAL CANCER RISK
Vinyl chloride	O	564	ug/kg	0.0E+00	1.9	0.0E+00	0.01	2.4E-08	ND		
Arsenic	I	6.3	mg/kg	0.0E+00	1.5	0.0E+00	0.001	2.7E-08	1.5	4.0E-08	4.0E-08
SUMMARY CANCER RISK						0E+00				4E-08	4E-08
[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November 1995). [2] Calculated from oral CSFs. NE = not evaluated.											

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SEDIMENT CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Vinyl chloride	O	564	ug/kg	0.0E+00	ND		0.01	7.0E-08	ND		
Arsenic	I	6.3	mg/kg	0.0E+00	0.0003	0.0E+00	0.001	7.9E-08	0.00029	2.7E-04	2.7E-04
Thallium	I	5.4	mg/kg	0.0E+00	0.00008	0.0E+00	0.001	6.7E-08	0.00008	8.4E-04	8.4E-04
SUMMARY HAZARD INDEX						0				0.001	0.001
[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November 1995). [2] Calculated from oral RfDs. ND = no data available.											

TABLE E-6.43

FUTURE LAND USE DIRECT CONTACT WITH SEDIMENT
 CHILD RESIDENT
 NAVAL TRAINING CENTER - OPERABLE UNIT 4
 ORLANDO, FLORIDA

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SEDIMENT	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	NA	mg/day	Assumption
FRACTION INGESTED	FI	100%	unitless	Assumption
ADHERENCE FACTOR	AF	1	mg/cm ² -event	USEPA, 1995
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1995
AGE-WEIGHTED SURFACE AREA	SA _{soil/adj}	1,408	cm ² [1]	USEPA, 1997
DOSE ABSORBED PER EVENT	DA _{event}	chemical-specific	mg/cm ² -event	USEPA, 1992
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	15	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	100	days/year [2]	Assumption
EXPOSURE DURATION	ED	6	years	USEPA, 1995
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	6	years	USEPA, 1995

[1] In estimating the dermally absorbed dose for children age 1 through 6, the time-weighted, bodyweight normalized surface area exposed (lower legs and feet) is calculated from surface area, exposure duration, and body weight for each of 6 age periods, age 1 through 6, per USEPA, 1992 (see Appendix E-7 to this report).

[2] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose. USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03. USEPA, 1992. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January 1992. USEPA, 1995. Supplemental Guidance to RAGS: Region IV, Human Health Risk Assessment Bulletin No. 3. USEPA, 1997. Exposure Factors Handbook, August 1997. NA = not applicable, sediment is always submerged with surface water.

$$\text{CANCER RISK} = \text{INTAKE (mg/kg-day)} \times \text{CANCER SLOPE FACTOR (mg/kg-day)}^{-1}$$

$$\text{HAZARD QUOTIENT} = \text{INTAKE (mg/kg-day)} / \text{REFERENCE DOSE (mg/kg-day)}$$

$$\text{INTAKE-INGESTION} = \frac{\text{CS} \times \text{IR} \times \text{FI} \times \text{CF} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT} \times 365 \text{ days/yr}}$$

$$\text{INTAKE-DERMAL} = (\text{DA}_{\text{event}} \times \text{EF} / \text{AT} \times 365 \text{ days/year}) \times \text{SA}_{\text{soil/adj}}$$

Where:

$$\text{SA}_{\text{soil/adj}} = \text{SUM}(\text{SA}_i \times \text{EDI}/\text{BW}_i)$$

$$\text{DA}_{\text{event}} = \text{CS} \times \text{AF} \times \text{ABS} \times \text{CF}$$

Note: For noncarcinogenic effects, AT = ED.

TABLE E-6.43

FUTURE LAND USE DIRECT CONTACT WITH SEDIMENT
CHILD RESIDENT
NAVAL TRAINING CENTER - OPERABLE UNIT 4
ORLANDO, FLORIDA

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SEDIMENT CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF (mg/kg-day) ⁻¹	CANCER RISK INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2] (mg/kg-day) ⁻¹	CANCER RISK DERMAL	TOTAL CANCER RISK
Vinyl chloride	O	564	ug/kg	0.0E+00	1.9	0.0E+00	0.01	3.1E-08	ND		
Arsenic	I	6.3	mg/kg	0.0E+00	1.5	0.0E+00	0.001	3.5E-08	1.5	5.2E-08	5.2E-08
SUMMARY CANCER RISK						0E+00				5E-08	5E-08
[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November 1995). [2] Calculated from oral CSFs. NE = not evaluated.											

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC	SEDIMENT CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Vinyl chloride	O	564	ug/kg	0.0E+00	ND		0.01	3.6E-07	ND		
Arsenic	I	6.3	mg/kg	0.0E+00	0.0003	0.0E+00	0.001	4.1E-07	0.00029	1.4E-03	1.4E-03
Thallium	I	5.4	mg/kg	0.0E+00	0.00008	0.0E+00	0.001	3.5E-07	0.00008	4.3E-03	4.3E-03
SUMMARY HAZARD INDEX						0				0.006	0.006
[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November 1995). [2] Calculated from oral RfDs. ND = no data available.											

TABLE E-6.44

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL (CENTRAL TENDENCY)
 ADULT RESIDENT
 NTC ORLANDO
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	50	mg/day	USEPA, 1996
FRACTION INGESTED	FI	100%	unitless	USEPA, 1995
ADHERENCE FACTOR	AF	0.2	mg/cm ² -event	USEPA, 1992a
ABSORPTION FRACTION	ABS _d	chemical-specific	unitless	USEPA, 1995
SURFACE AREA EXPOSED	SA	5,000	cm ²	USEPA, 1992a
DOSE ABSORBED PER EVENT	DA _{event}	chemical-specific	mg/cm ² -event	USEPA, 1992b
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	350	days/year [1]	USEPA, 1992a
EXPOSURE DURATION	ED	7	years	USEPA, 1992a
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	7	years	USEPA, 1992a

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose.
 USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors";
 OSWER Directive 9285.6-03.
 USEPA, 1992a. Region 6 Memorandum: Central Tendency and RME Exposure Parameters.
 USEPA, 1992b. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January 1992.
 USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)⁻¹

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

INTAKE_{-INGESTION} = $\frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365 \text{ days/yr}}$

INTAKE_{-DERMAL} = $\frac{DA_{event} \times SA \times EF \times ED}{BW \times AT \times 365 \text{ days/yr}}$

Where:
 DA_{event} = CS x AF x ABS_d x CF

Note: For noncarcinogenic effects, AT = ED.

TABLE E-6.44

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL (CENTRAL TENDENCY)
ADULT RESIDENT
NTC ORLANDO
OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] (mg/kg-day) ⁻¹	CANCER RISK INGESTION	DERMAL ABS [2]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [3] (mg/kg-day) ⁻¹	CANCER RISK DERMAL	TOTAL CANCER RISK
Tetrachloroethene	O	27	ug/kg	1.8E-09	5.2E-02	9.6E-11	0.01	3.7E-10	5.2E-02	1.9E-11	1.2E-10
Benzo(a)pyrene equivalent	O	265	ug/kg	1.8E-08	7.3E+00	1.3E-07	0.01	3.6E-09	8.0E+00	2.9E-08	1.6E-07
Aroclor-1254	O	69.4	ug/kg	4.8E-09	2.0E+00	9.5E-09	0.06	5.7E-09	2.2E+00	1.3E-08	2.2E-08
Aroclor-1260	O	25	ug/kg	1.7E-09	2.0E+00	3.4E-09	0.06	2.1E-09	2.2E+00	4.5E-09	7.9E-09
SUMMARY CANCER RISK						1E-07				5E-08	2E-07
<p>[1] Relative potency factors were applied to the CSFs for carcinogenic PAHs. Relative potency factors are derived in "Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons," USEPA, 1993. [2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November 1995). [3] Calculated from oral CSFs. ND = no data available.</p>											

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Tetrachloroethene	O	27	ug/kg	1.8E-08	1.0E-01	1.8E-07	0.01	3.7E-09	1.0E-01	3.7E-08	2.2E-07
Benzo(a)anthracene	O	260	ug/kg	1.8E-07	3.0E-02	5.9E-06	0.01	3.6E-08	2.7E-02	1.3E-06	7.3E-06
Benzo(a)pyrene	O	330	ug/kg	2.3E-07	3.0E-02	7.5E-06	0.01	4.5E-08	2.7E-02	1.7E-06	9.2E-06
Benzo(b)fluoranthene	O	630	ug/kg	4.3E-07	3.0E-02	1.4E-05	0.01	8.6E-08	2.7E-02	3.2E-06	1.8E-05
Benzo(k)fluoranthene	O	230	ug/kg	1.6E-07	3.0E-02	5.3E-06	0.01	3.2E-08	2.7E-02	1.2E-06	6.4E-06
Chrysene	O	460	ug/kg	3.2E-07	3.0E-02	1.1E-05	0.01	6.3E-08	2.7E-02	2.3E-06	1.3E-05
Indeno(1,2,3-cd)pyrene	O	200	ug/kg	1.4E-07	3.0E-02	4.6E-06	0.01	2.7E-08	2.7E-02	1.0E-06	5.6E-06
Aroclor-1254	O	69.4	ug/kg	4.8E-08	2.0E-05	2.4E-03	0.06	5.7E-08	1.8E-05	3.2E-03	5.5E-03
Aroclor-1260	O	25	ug/kg	1.7E-08	2.0E-05	8.6E-04	0.06	2.1E-08	1.8E-05	1.1E-03	2.0E-03
Aluminum	I	9740	mg/kg	6.7E-03	1.0E+00	6.7E-03	0.001	1.3E-04	2.0E-01	6.7E-04	7.3E-03
Barium	I	59.7	mg/kg	4.1E-05	7.0E-02	5.8E-04	0.001	8.2E-07	4.9E-03	1.7E-04	7.5E-04
Chromium	I	14.6	mg/kg	1.0E-05	3.0E-03	3.3E-03	0.001	2.0E-07	3.3E-04	6.1E-04	3.9E-03
Iron	I	6400	mg/kg	4.4E-03	3.0E-01	1.5E-02	0.001	8.8E-05	6.0E-03	1.5E-02	2.9E-02
Vanadium	I	4.8	mg/kg	3.3E-06	7.0E-03	4.7E-04	0.001	6.6E-08	2.1E-04	3.1E-04	7.8E-04
SUMMARY HAZARD INDEX						0.03				0.02	0.05
<p>[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November, 1995). [2] Calculated from oral RfDs.</p>											

TABLE E-6.45

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL (CENTRAL TENDENCY)
 CHILD RESIDENT
 NTC ORLANDO
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	100	mg/day	USEPA, 1996
FRACTION INGESTED	FI	100%	unitless	USEPA, 1995
ADHERENCE FACTOR	AF	0.2	mg/cm ² -event	USEPA, 1992a
AGE-SPECIFIC SURFACE AREA	SA	age-specific	cm ²	USEPA, 1989
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1995
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
BODY WEIGHT	BW	15	kg	USEPA, 1991
AGE-SPECIFIC BODY WEIGHT	BW	age-specific	kg	USEPA, 1989
EXPOSURE FREQUENCY	EF	350	days/year [1]	USEPA, 1992a
EXPOSURE DURATION	ED	2	years	USEPA, 1995
AGE-SPECIFIC EXPOSURE DURATION	ED	age-specific	years	Assumption
AGE-WEIGHTED SURFACE AREA [2]	SA _{soil/adj}	766	cm ² -year/kg	USEPA, 1992b
DOSE ABSORBED PER EVENT	DA _{event}	chemical-specific	mg/cm ² -event	USEPA, 1992b
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	2	years	USEPA, 1995

$$\text{CANCER RISK} = \text{INTAKE (mg/kg-day)} \times \text{CANCER SLOPE FACTOR (mg/kg-day}^{-1}\text{)}$$

$$\text{HAZARD QUOTIENT} = \text{INTAKE (mg/kg-day)} / \text{REFERENCE DOSE (mg/kg-day)}$$

$$\text{INTAKE-INGESTION} = \frac{\text{CS} \times \text{IR} \times \text{FI} \times \text{CF} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT} \times 365 \text{ days/yr}}$$

$$\text{INTAKE-DERMAL} = (\text{DA}_{\text{event}} \times \text{EF} / \text{AT} \times 365 \text{ days/year}) \times \text{SA}_{\text{soil/adj}}$$

Where:

$$\text{SA}_{\text{soil/adj}} = \text{SUM} (\text{SA} \times \text{ED} / \text{BW})$$

$$\text{DA}_{\text{event}} = \text{CS} \times \text{AF} \times \text{ABS} \times \text{CF}$$

[1] Units for exposure frequency are in events/year in the calculation of the dermally absorbed dose.

[2] In estimating the dermally absorbed dose for children age 1 through 6, the time-weighted, bodyweight normalized surface area exposed is calculated from surface area, exposure duration, and body weight for each of 6 age periods, age 1 through 6, per USEPA, 1992.

TABLE E-6.45

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL (CENTRAL TENDENCY)
CHILD RESIDENT
NTC ORLANDO
OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] (mg/kg-day) ⁻¹	CANCER RISK INGESTION	DERMAL ABS [2]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [1, 3] (mg/kg-day) ⁻¹	CANCER RISK DERMAL	TOTAL CANCER RISK
Tetrachloroethene	O	27	ug/kg	4.9E-09	5.2E-02	2.6E-10	0.01	5.7E-10	5.2E-02	2.9E-11	2.9E-10
Benzo(a)pyrene equivalent	O	265	ug/kg	4.8E-08	7.3E+00	3.5E-07	0.01	5.6E-09	8.0E+00	4.4E-08	4.0E-07
Aroclor-1254	O	69.4	ug/kg	1.3E-08	2.0E+00	2.5E-08	0.06	8.7E-09	2.2E+00	1.9E-08	4.5E-08
Aroclor-1260	O	25	ug/kg	4.6E-09	2.0E+00	9.1E-09	0.06	3.1E-09	2.2E+00	6.9E-09	1.6E-08
SUMMARY CANCER RISK						4E-07				7E-08	5E-07
<p>[1] Relative potency factors were applied to the CSFs of carcinogenic PAHs. Relative potency factors are derived in "Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons," USEPA, 1993. [2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November 1995). [3] Calculated from oral CSFs. ND = no data.</p>											

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2]	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Tetrachloroethene	O	27	ug/kg	1.7E-07	1.0E-01	1.7E-06	0.01	2.0E-08	1.0E-01	2.0E-07	1.9E-06
Benzo(a)anthracene	O	260	ug/kg	1.7E-06	3.0E-02	5.5E-05	0.01	1.9E-07	2.7E-02	7.1E-06	6.2E-05
Benzo(a)pyrene	O	330	ug/kg	2.1E-06	3.0E-02	7.0E-05	0.01	2.4E-07	2.7E-02	9.0E-06	7.9E-05
Benzo(b)fluoranthene	O	630	ug/kg	4.0E-06	3.0E-02	1.3E-04	0.01	4.6E-07	2.7E-02	1.7E-05	1.5E-04
Benzo(k)fluoranthene	O	230	ug/kg	1.5E-06	3.0E-02	4.9E-05	0.01	1.7E-07	2.7E-02	6.3E-06	5.5E-05
Chrysene	O	460	ug/kg	2.9E-06	3.0E-02	9.8E-05	0.01	3.4E-07	2.7E-02	1.3E-05	1.1E-04
Indeno(1,2,3-cd)pyrene	O	200	ug/kg	1.3E-06	3.0E-02	4.3E-05	0.06	8.8E-07	2.7E-02	3.3E-05	7.5E-05
Aroclor-1254	O	69.4	ug/kg	4.4E-07	2.0E-05	2.2E-02	0.06	3.1E-07	1.8E-05	1.7E-02	3.9E-02
Aroclor-1260	O	25	ug/kg	1.6E-07	2.0E-05	8.0E-03	0.01	1.8E-08	1.8E-05	1.0E-03	9.0E-03
Aluminum	I	9740	mg/kg	6.2E-02	1.0E+00	6.2E-02	0.001	7.2E-04	2.0E-01	3.6E-03	6.6E-02
Barium	I	59.7	mg/kg	3.8E-04	7.0E-02	5.5E-03	0.001	4.4E-06	4.9E-03	8.9E-04	6.3E-03
Chromium	I	14.6	mg/kg	9.3E-05	3.0E-03	3.1E-02	0.001	1.1E-06	3.3E-04	3.2E-03	3.4E-02
Iron	I	6400	mg/kg	4.1E-02	3.0E-01	1.4E-01	0.001	4.7E-04	6.0E-03	7.8E-02	2.1E-01
Vanadium	I	4.8	mg/kg	3.1E-05	7.0E-03	4.4E-03	0.001	3.5E-07	2.1E-04	1.7E-03	6.1E-03
SUMMARY HAZARD INDEX						0.3				0.1	0.4
<p>[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November 1995). [2] Calculated from oral RfDs.</p>											

TABLE E-6.46

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL (CENTRAL TENDENCY)
 OCCUPATIONAL WORKER
 NTC ORLANDO
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	50	mg/day	USEPA, 1991
FRACTION INGESTED	FI	100%	unitless	Assumption
ADHERENCE FACTOR	AF	0.2	mg/cm ² -event	USEPA, 1992a
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1995
SURFACE AREA EXPOSED	SA	2,300	cm ²	USEPA, 1992a
DOSE ABSORBED PER EVENT	DA _{event}	chemical-specific	mg/cm ² -event	USEPA, 1992b
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	250	days/year [1]	USEPA, 1995
EXPOSURE DURATION	ED	9	years	USEPA, 1992a
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	9	years	USEPA, 1992a

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose.
 USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors";
 OSWER Directive 9285.6-03.
 USEPA, 1992a. Region 6 Memorandum: Central Tendency and RME Exposure Parameters.
 USEPA, 1992b. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January 1992.
 USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.

$$\text{CANCER RISK} = \text{INTAKE (mg/kg-day)} \times \text{CANCER SLOPE FACTOR (mg/kg-day)}^{-1}$$

$$\text{HAZARD QUOTIENT} = \text{INTAKE (mg/kg-day)} / \text{REFERENCE DOSE (mg/kg-day)}$$

$$\text{INTAKE}_{\text{INGESTION}} = \frac{\text{CS} \times \text{IR} \times \text{FI} \times \text{CF} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT} \times 365 \text{ days/yr}}$$

$$\text{INTAKE}_{\text{DERMAL}} = \frac{\text{DA}_{\text{event}} \times \text{SA} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT} \times 365 \text{ days/yr}}$$

Where:

$$\text{DA}_{\text{event}} = \text{CS} \times \text{AF} \times \text{ABS} \times \text{CF}$$

Note: For noncarcinogenic effects, AT = ED

TABLE E-6.46

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL (CENTRAL TENDENCY)
 OCCUPATIONAL WORKER
 NTC ORLANDO
 OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF (mg/kg-day) ¹	CANCER RISK INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2] (mg/kg-day) ¹	CANCER RISK DERMAL	TOTAL CANCER RISK
Tetrachloroethene	O	27	ug/kg	1.7E-09	5.2E-02	8.8E-11	0.01	1.6E-10	5.2E-02	8.1E-12	9.6E-11
Benzo(a)pyrene equivalent	O	265	ug/kg	1.7E-08	7.3E+00	1.2E-07	0.01	1.5E-09	8.0E+00	1.2E-08	1.3E-07
Aroclor-1254	O	69.4	ug/kg	4.4E-09	2.0E+00	8.7E-09	0.06	2.4E-09	2.2E+00	5.3E-09	1.4E-08
Aroclor-1260	O	25	ug/kg	1.6E-09	2.0E+00	3.1E-09	0.06	8.7E-10	2.2E+00	1.9E-09	5.1E-09
SUMMARY CANCER RISK						1E-07				2E-08	2E-07
[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November 1995).											
[2] Calculated from oral CSFs.											
NE = not evaluated.											

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2]	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Tetrachloroethene	O	27	ug/kg	1.3E-08	1.0E-01	1.3E-07	0.01	1.2E-09	1.0E-01	1.2E-08	1.4E-07
Benzo(a)anthracene	O	260	ug/kg	1.3E-07	3.0E-02	4.2E-06	0.01	1.2E-08	2.7E-02	4.3E-07	4.7E-06
Benzo(a)pyrene	O	330	ug/kg	1.6E-07	3.0E-02	5.4E-06	0.01	1.5E-08	2.7E-02	5.5E-07	5.9E-06
Benzo(b)fluoranthene	O	630	ug/kg	3.1E-07	3.0E-02	1.0E-05	0.01	2.8E-08	2.7E-02	1.1E-06	1.1E-05
Benzo(k)fluoranthene	O	230	ug/kg	1.1E-07	3.0E-02	3.8E-06	0.01	1.0E-08	2.7E-02	3.8E-07	4.1E-06
Chrysene	O	460	ug/kg	2.3E-07	3.0E-02	7.5E-06	0.01	2.1E-08	2.7E-02	7.7E-07	8.3E-06
Indeno(1,2,3-cd)pyrene	O	200	ug/kg	9.8E-08	3.0E-02	3.3E-06	0.06	5.4E-08	2.7E-02	2.0E-06	5.3E-06
Aroclor-1254	O	69.4	ug/kg	3.4E-08	2.0E-05	1.7E-03	0.06	1.9E-08	1.8E-05	1.0E-03	2.7E-03
Aroclor-1260	O	25	ug/kg	1.2E-08	2.0E-05	6.1E-04	0.01	1.1E-09	1.8E-05	6.3E-05	6.7E-04
Aluminum	I	9740	mg/kg	4.8E-03	1.0E+00	4.8E-03	0.001	4.4E-05	2.0E-01	2.2E-04	5.0E-03
Barium	I	59.7	mg/kg	2.9E-05	7.0E-02	4.2E-04	0.001	2.7E-07	4.9E-03	5.5E-05	4.7E-04
Chromium	I	14.6	mg/kg	7.1E-06	3.0E-03	2.4E-03	0.001	6.6E-08	3.3E-04	2.0E-04	2.6E-03
Iron	I	6400	mg/kg	3.1E-03	3.0E-01	1.0E-02	0.001	2.9E-05	6.0E-03	4.8E-03	1.5E-02
Vanadium	I	4.8	mg/kg	2.3E-06	7.0E-03	3.4E-04	0.001	2.2E-08	2.1E-04	1.0E-04	4.4E-04
SUMMARY HAZARD INDEX						0.02				0.006	0.03
[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November 1995).											
[2] Calculated from oral RfDs.											

Harding Lawson Associates

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TABLE E-6.47

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) - NORTHERN PLUME VOC (CENTRAL TENDENCY)
 ADULT RESIDENT
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION WATER	CW	chemical-specific	ug/liter	
INGESTION RATE	IR	1.4	liters/day	USEPA, 1992
BODY WEIGHT	BW	70	kg	USEPA, 1991
CONVERSION FACTOR	CF	0.001	mg/ug	
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1991
EXPOSURE DURATION	ED	7	years	USEPA, 1992
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	7	years	USEPA, 1992
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03. USEPA, 1992. Region 6 Memorandum: Central Tendency and RME Exposure Parameters.				

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)⁻¹

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

INTAKE = $\frac{CW \times IR \times EF \times ED \times CF}{BW \times AT \times 365 \text{ days/year}}$

Note: For noncarcinogenic effects, AT = ED.

TABLE E-6.47

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) - NORTHERN PLUME VOC (CENTRAL TEN
ADULT RESIDENT
NAVAL TRAINING CENTER
ORLANDO, FLORIDA
OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	CANCER SLOPE FACTOR (mg/kg-day) ⁻¹	CANCER RISK INGESTION
Tetrachloroethene	1900	UG/LITER	3.6E-03	0.052	1.9E-04
Trichloroethene	410	UG/LITER	7.9E-04	0.011	8.6E-06
TOTAL CANCER RISK					2E-04
NE = not evaluated.					

NONCARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT INGESTION
cis-1,2-Dichloroethene	350	UG/LITER	6.7E-03	1.0E-02	6.7E-01
Tetrachloroethene	1900	UG/LITER	3.6E-02	1.0E-02	3.6E+00
Trichloroethene	410	UG/LITER	7.9E-03	6.0E-03	1.3E+00
Aluminum	4630	UG/LITER	8.9E-02	1.0E+00	8.9E-02
Barium	46	UG/LITER	8.8E-04	7.0E-02	1.3E-02
Chromium	8.4	UG/LITER	1.6E-04	3.0E-03	5.4E-02
Iron	751	UG/LITER	1.4E-02	3.0E-01	4.8E-02
Mercury	0.39	UG/LITER	7.5E-06	3.0E-04	2.5E-02
TOTAL HAZARD INDEX					6
ND = no data available.					

TABLE E-6.48

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) - NORTHERN PLUME VOC (CENTRAL TENDENCY)
 CHILD RESIDENT
 NAVAL TRAINING CENTER ORLANDO
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE	
CONCENTRATION WATER	CW	chemical-specific	ug/liter		<p>CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)⁻¹</p> <p>HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)</p> <p>INTAKE = $\frac{CW \times IR \times EF \times ED \times CF}{BW \times AT \times 365 \text{ days/year}}$</p> <p>Note: For noncarcinogenic effects, AT = ED.</p>
INGESTION RATE	IR	0.7	liters/day	USEPA, 1992	
BODY WEIGHT	BW	15	kg	USEPA, 1991	
CONVERSION FACTOR	CF	0.001	mg/ug		
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1991	
EXPOSURE DURATION	ED	2	years	USEPA, 1992	
AVERAGING TIME					
CANCER	AT	70	years	USEPA, 1991	
NONCANCER	AT	2	years	USEPA, 1992	
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03. USEPA, 1992. Region 6 Memorandum: Central Tendency and RME Exposure Parameters.					

TABLE E-6.48

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) - NORTHERN PLUME VOC (CENTRAL TENDEN
 CHILD RESIDENT
 NAVAL TRAINING CENTER ORLANDO
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	CANCER SLOPE FACTOR (mg/kg-day) ⁻¹	CANCER RISK INGESTION
Tetrachloroethene	1900	UG/LITER	2.4E-03	0.052	1.3E-04
Trichloroethene	410	UG/LITER	5.2E-04	0.011	5.8E-06
TOTAL CANCER RISK					1E-04
NE = not evaluated.					

NONCARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT INGESTION
cis-1,2-Dichloroethene	350	UG/LITER	1.6E-02	1.0E-02	1.6E+00
Tetrachloroethene	1900	UG/LITER	8.5E-02	1.0E-02	8.5E+00
Trichloroethene	410	UG/LITER	1.8E-02	6.0E-03	3.1E+00
Aluminum	4630	UG/LITER	2.1E-01	1.0E+00	2.1E-01
Barium	46	UG/LITER	2.1E-03	7.0E-02	2.9E-02
Chromium	8.4	UG/LITER	3.8E-04	3.0E-03	1.3E-01
Iron	751	UG/LITER	3.4E-02	3.0E-01	1.1E-01
Mercury	0.39	UG/LITER	1.7E-05	3.0E-04	5.8E-02
TOTAL HAZARD INDEX					14
ND = no data available.					

TABLE E-6.49

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) - SOUTHERN VOC PLUME (CENTRAL TENDENCY)
 ADULT RESIDENT
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION WATER	CW	chemical-specific	ug/liter	
INGESTION RATE	IR	1.4	liters/day	USEPA, 1992
BODY WEIGHT	BW	70	kg	USEPA, 1991
CONVERSION FACTOR	CF	0.001	mg/ug	
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1991
EXPOSURE DURATION	ED	7	years	USEPA, 1992
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	7	years	USEPA, 1992

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)⁻¹
 HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

 INTAKE = $\frac{CW \times IR \times EF \times ED \times CF}{BW \times AT \times 365 \text{ days/year}}$

Note: For noncarcinogenic effects, AT = ED.

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance:
 "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.

TABLE E-6.49

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) - SOUTHERN VOC PLUME (CENTRAL TEND
 ADULT RESIDENT
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	CANCER SLOPE FACTOR (mg/kg-day) ⁻¹	CANCER RISK INGESTION
Tetrachloroethene	110	UG/LITER	2.1E-04	0.052	1.1E-05
Trichloroethene	23	UG/LITER	4.4E-05	0.011	4.9E-07
TOTAL CANCER RISK					1E-05
NE = not evaluated.					

NONCARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT INGESTION
cis-1,2-Dichloroethene	12	UG/LITER	2.3E-04	1.0E-02	2.3E-02
trans-1,2-Dichloroethene	1.4	UG/LITER	2.7E-05	2.0E-02	1.3E-03
Tetrachloroethene	110	UG/LITER	2.1E-03	1.0E-02	2.1E-01
Trichloroethene	23	UG/LITER	4.4E-04	6.0E-03	7.4E-02
Aluminum	3780	UG/LITER	7.2E-02	1.0E+00	7.2E-02
Barium	25.2	UG/LITER	4.8E-04	7.0E-02	6.9E-03
Chromium	6.8	UG/LITER	1.3E-04	3.0E-03	4.3E-02
Iron	738	UG/LITER	1.4E-02	3.0E-01	4.7E-02
Mercury	0.1	UG/LITER	1.9E-06	3.0E-04	6.4E-03
TOTAL HAZARD INDEX					0.5
ND = no data available.					

TABLE E-6.50

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) - SOUTHERN VOC PLUME (CENTRAL TENDENCY)
 CHILD RESIDENT
 NAVAL TRAINING CENTER ORLANDO
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION WATER	CW	chemical-specific	ug/liter	
INGESTION RATE	IR	0.7	liters/day	USEPA, 1992
BODY WEIGHT	BW	15	kg	USEPA, 1991
CONVERSION FACTOR	CF	0.001	mg/ug	
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1991
EXPOSURE DURATION	ED	2	years	USEPA, 1992
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	2	years	USEPA, 1992

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance:
 "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.
 USEPA, 1995. Region IV Supplemental Guidance to RAGS, Bulletin No. 3, November.

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)⁻¹

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

INTAKE = $\frac{CW \times IR \times EF \times ED \times CF}{BW \times AT \times 365 \text{ days/year}}$

Note: For noncarcinogenic effects, AT = ED.

TABLE E-6.50

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) - SOUTHERN VOC PLUME (CENTRAL TENDEN
CHILD RESIDENT
NAVAL TRAINING CENTER ORLANDO
ORLANDO, FLORIDA
OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	CANCER SLOPE FACTOR (mg/kg-day) ⁻¹	CANCER RISK INGESTION
Tetrachloroethene	110	UG/LITER	1.4E-04	0.052	7.3E-06
Trichloroethene	23	UG/LITER	2.9E-05	0.011	3.2E-07
TOTAL CANCER RISK					8E-06
NE = not evaluated.					

NONCARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT INGESTION
cis-1,2-Dichloroethene	12	UG/LITER	5.4E-04	1.0E-02	5.4E-02
trans-1,2-Dichloroethene	1.4	UG/LITER	6.3E-05	2.0E-02	3.1E-03
Tetrachloroethene	110	UG/LITER	4.9E-03	1.0E-02	4.9E-01
Trichloroethene	23	UG/LITER	1.0E-03	6.0E-03	1.7E-01
Aluminum	3780	UG/LITER	1.7E-01	1.0E+00	1.7E-01
Barium	25.2	UG/LITER	1.1E-03	7.0E-02	1.6E-02
Chromium	6.8	UG/LITER	3.0E-04	3.0E-03	1.0E-01
Iron	738	UG/LITER	3.3E-02	3.0E-01	1.1E-01
Mercury	0.1	UG/LITER	4.5E-06	3.0E-04	1.5E-02
TOTAL HAZARD INDEX					1
ND = no data available.					

TABLE E-6.51

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) ANTIMONY PLUME (CENTRAL TENDENCY)
 ADULT RESIDENT
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION WATER	CW	chemical-specific	ug/liter	
INGESTION RATE	IR	1.4	liters/day	USEPA, 1992
BODY WEIGHT	BW	70	kg	USEPA, 1991
CONVERSION FACTOR	CF	0.001	mg/ug	
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1991
EXPOSURE DURATION	ED	7	years	USEPA, 1992
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	7	years	USEPA, 1992

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.	$\text{CANCER RISK} = \text{INTAKE (mg/kg-day)} \times \text{CANCER SLOPE FACTOR (mg/kg-day)}^{-1}$ $\text{HAZARD QUOTIENT} = \text{INTAKE (mg/kg-day)} / \text{REFERENCE DOSE (mg/kg-day)}$ $\text{INTAKE} = \frac{\text{CW} \times \text{IR} \times \text{EF} \times \text{ED} \times \text{CF}}{\text{BW} \times \text{AT} \times 365 \text{ days/year}}$ <p>Note: For noncarcinogenic effects, AT = ED.</p>
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TABLE E-6.51

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) ANTIMONY PLUME (CENTRAL TENDENC
 ADULT RESIDENT
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	CANCER SLOPE FACTOR (mg/kg-day) ⁻¹	CANCER RISK INGESTION
Tetrachloroethene	7.5	UG/LITER	1.4E-05	0.052	7.5E-07
Trichloroethene	0.88	UG/LITER	1.7E-06	0.011	1.9E-08
TOTAL CANCER RISK					8E-07
NE = not evaluated.					

NONCARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT INGESTION
Tetrachloroethene	7.5	UG/LITER	1.4E-04	1.0E-02	1.4E-02
Trichloroethene	0.88	UG/LITER	1.7E-05	6.0E-03	2.8E-03
Aluminum	170	UG/LITER	3.3E-03	1.0E+00	3.3E-03
Antimony	14.1	UG/LITER	2.7E-04	4.0E-04	6.8E-01
Barium	3.4	UG/LITER	6.5E-05	7.0E-02	9.3E-04
Chromium	0.99	UG/LITER	1.9E-05	3.0E-03	6.3E-03
Iron	28.4	UG/LITER	5.4E-04	3.0E-01	1.8E-03
TOTAL HAZARD INDEX					0.7
ND = no data available.					

TABLE E-6.52

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) ANTIMONY PLUME (CENTRAL TENDENCY)
 CHILD RESIDENT
 NAVAL TRAINING CENTER ORLANDO
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION WATER	CW	chemical-specific	ug/liter	
INGESTION RATE	IR	0.7	liters/day	USEPA, 1992
BODY WEIGHT	BW	15	kg	USEPA, 1991
CONVERSION FACTOR	CF	0.001	mg/ug	
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1991
EXPOSURE DURATION	ED	2	years	USEPA, 1992
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	2	years	USEPA, 1992

$CANCER\ RISK = INTAKE\ (mg/kg\text{-}day) \times CANCER\ SLOPE\ FACTOR\ (mg/kg\text{-}day)^{-1}$
 $HAZARD\ QUOTIENT = INTAKE\ (mg/kg\text{-}day) / REFERENCE\ DOSE\ (mg/kg\text{-}day)$
 $INTAKE = \frac{CW \times IR \times EF \times ED \times CF}{BW \times AT \times 365\ \text{days/year}}$

Note: For noncarcinogenic effects, AT = ED.

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance:
 "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.
 USEPA, 1995. Region IV Supplemental Guidance to RAGS, Bulletin No. 3, November.

TABLE E-6.52

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) ANTIMONY PLUME (CENTRAL TENDENCY)
 CHILD RESIDENT
 NAVAL TRAINING CENTER ORLANDO
 ORLANDO, FLORIDA
 OPERABLE UNIT 4

CARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	CANCER SLOPE FACTOR (mg/kg-day) ⁻¹	CANCER RISK INGESTION
Tetrachloroethene	7.5	UG/LITER	9.6E-06	0.052	5.0E-07
Trichloroethene	0.88	UG/LITER	1.1E-06	0.011	1.2E-08
TOTAL CANCER RISK					5E-07
NE = not evaluated.					

NONCARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT INGESTION
Tetrachloroethene	7.5	UG/LITER	3.4E-04	1.0E-02	3.4E-02
Trichloroethene	0.88	UG/LITER	3.9E-05	6.0E-03	6.6E-03
Aluminum	170	UG/LITER	7.6E-03	1.0E+00	7.6E-03
Antimony	14.1	UG/LITER	6.3E-04	4.0E-04	1.6E+00
Barium	3.4	UG/LITER	1.5E-04	7.0E-02	2.2E-03
Chromium	0.99	UG/LITER	4.4E-05	3.0E-03	1.5E-02
Iron	28.4	UG/LITER	1.3E-03	3.0E-01	4.2E-03
TOTAL HAZARD INDEX					2
ND = no data available.					

TABLE E-6.53

INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER (CENTRAL TENDENCY)
 ADULT RESIDENT - WADING
 NAVAL TRAINING CENTER - OPERABLE UNIT 4
 ORLANDO, FLORIDA

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION WATER	CW	chemical-specific	ug/liter	
INGESTION RATE [1]	IR	0.026	liters/day	USEPA, 1995
SURFACE AREA [2]	SA	5,000	cm ²	USEPA, 1996
EVENT FREQUENCY	EV	1	events/day	Assumption
BODY WEIGHT	BW	70	kg	USEPA, 1991
DOSE ABSORBED PER EVENT	DAevent	chemical-specific	mg/cm ² -event	Calculated
EXPOSURE TIME	ET	2.6	hours/day	Assumption
EXPOSURE FREQUENCY	EF	45	days/year	Assumption
EXPOSURE DURATION	ED	7	years	USEPA, 1992a
DIFFUSION DEPTH PER EVENT	PCevent	chemical-specific	cm/event	Calculated per USEPA, 1992b [3]
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	7	years	USEPA, 1992a
CONVERSION FACTOR	CF1	0.001	mg/ug	
CONVERSION FACTOR	CF2	0.001	liter/cm ³	

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)⁻¹

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

INTAKE-INGESTION = $\frac{CW \times IR \times EF \times ED \times CF1}{BW \times AT \times 365 \text{ days/yr}}$

INTAKE-DERMAL = $\frac{DAevent \times EV \times EF \times ED \times SA}{AT \times BW \times 365 \text{ days/yr}}$

Where:
 DAevent = PCevent x CW x CF1 x CF2

Note: For noncarcinogenic effects, AT = ED.

[1] Ingestion Rate = 0.026 l/day = 10 ml/hour x 2.6 hours/day x 0.001 l/ml
 [2] Surface area assumes lower legs, hands, and feet are exposed.
 [3] PCevent is calculated in the Dermal Guidance See Table E-6.39.

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Parameters."
 USEPA, 1992a. Region 6 Memorandum: Central Tendency and RME Exposure Parameters.
 USEPA, 1992b. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B.
 USEPA, 1995. Supplemental Guidance to RAGS: Region 4 Bulletins, Bulletin No. 3, November 1995.

TABLE E-6.53

INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER (CENTRAL TENDENCY)
 ADULT RESIDENT - WADING
 NAVAL TRAINING CENTER - OPERABLE UNIT 4
 ORLANDO, FLORIDA

CARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF (mg/kg-day) ⁻¹	CANCER RISK INGESTION	PCEVENT[1] (cm/event)	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2] (mg/kg-day) ⁻¹	CANCER RISK DERMAL	TOTAL CANCER RISK
Tetrachloroethene	19	ug/L	8.7E-08	5.2E-02	4.5E-09	1.56	2.6E-05	5.2E-02	1.4E-06	1.4E-06
Trichloroethene	57	ug/L	2.6E-07	1.1E-02	2.9E-09	0.849	4.3E-05	1.1E-02	4.7E-07	4.7E-07
Vinyl chloride	35	ug/L	1.6E-07	1.9E+00	3.0E-07	0.022	6.8E-07	ND	ND	3.0E-07
4,4'-DDT	0.03	ug/L	1.4E-10	3.4E-01	4.7E-11	6.91	1.8E-07	1.7E+00	3.1E-07	3.1E-07
SUMMARY CANCER RISK					3E-07				2E-06	2E-06
[1] This chemical-specific value has been calculated in Table E-6-39.										
[2] Calculated from oral CSFs. ND = no data available.										

NONCARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	PCEVENT[1] (cm/event)	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day) ⁻¹	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
cis-1,2-Dichloroethene	760	ug/L	3.5E-05	1.0E-02	3.5E-03	0.0327	2.2E-04	1.0E-02	2.2E-02	2.5E-02
Tetrachloroethene	19	ug/L	8.7E-07	1.0E-02	8.7E-05	1.56	2.6E-04	1.0E-02	2.6E-02	2.6E-02
Trichloroethene	57	ug/L	2.6E-06	6.0E-03	4.4E-04	0.849	4.3E-04	6.0E-03	7.1E-02	7.1E-02
Vinyl chloride	35	ug/L	1.6E-06	ND	ND	0.022	6.8E-06	ND	ND	ND
4,4'-DDT	0.03	ug/L	1.4E-09	5.0E-04	2.7E-06	6.91	1.8E-06	1.0E-04	1.8E-02	1.8E-02
Endrin ketone	0.01	ug/L	4.6E-10	3.0E-04	1.5E-06	0.303	2.7E-08	ND	ND	1.5E-06
Aluminum	538	ug/L	2.5E-05	1.0E+00	2.5E-05	0.0026	1.2E-05	2.0E-01	6.2E-05	8.6E-05
SUMMARY HAZARD INDEX					0.004				0.1	0.1
[1] This chemical-specific value has been calculated in Table E-6-39.										
[2] Calculated from oral RfDs. ND = no data available.										

TABLE E-6.54

INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER (CENTRAL TENDENCY)
 CHILD RESIDENT - WADING
 NAVAL TRAINING CENTER - OPERABLE UNIT 4
 ORLANDO, FLORIDA

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION WATER	CW	chemical-specific	ug/liter	
INGESTION RATE [1]	IR	0.13	liters/day	USEPA, 1995
AGE-SPECIFIC SURFACE AREA [2]	SA	age-specific	cm ²	USEPA, 1989
EVENT FREQUENCY	EV	1	events/day	Assumption
BODY WEIGHT	BW	15	kg	USEPA, 1991
DOSE ABSORBED PER EVENT	DA _{event}	chemical-specific	mg/cm ² -event	Calculated
EXPOSURE FREQUENCY	EF	100	days/year	Assumption
EXPOSURE DURATION	ED	2	years	USEPA, 1992a
AGE-WEIGHTED SURFACE AREA [3]	SA _{sw/adj}	766	cm ² -yr/kg	Calculated per USEPA, 1992b
DIFFUSION DEPTH PER EVENT [4]	PC _{event}	chemical-specific	cm/event	Calculated per USEPA, 1992b
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	2	years	USEPA, 1992a
CONVERSION FACTOR	CF1	0.001	mg/ug	
CONVERSION FACTOR	CF2	0.001	liter/cm ³	

[1] Ingestion Rate = 0.13 l/day = 50 ml/hour x 2.6 hours/day x 0.001 l/ml.

[2] Surface area assumes lower legs, hands, and feet are exposed.

[3] PC_{event} is calculated in the Dermal Guidance See Table E-6-39.

USEPA, 1989. Exposure Factors Handbook; EPA/600/8-89/043; May 1989.

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Parameters".

USEPA, 1992a. Region 6 Memorandum: Central Tendency and RME Exposure Parameters.

USEPA, 1992b. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B

$$\text{CANCER RISK} = \text{INTAKE (mg/kg-day)} \times \text{CANCER SLOPE FACTOR (mg/kg-day)}^{-1}$$

$$\text{HAZARD QUOTIENT} = \text{INTAKE (mg/kg-day)} / \text{REFERENCE DOSE (mg/kg-day)}$$

$$\text{INTAKE-INGESTION} = \frac{\text{CW} \times \text{IR} \times \text{EF} \times \text{ED} \times \text{CF1}}{\text{BW} \times \text{AT} \times 365 \text{ days/yr}}$$

$$\text{INTAKE-DERMAL} = \frac{\text{DA}_{\text{event}} \times \text{EV} \times \text{EF} \times \text{SA}_{\text{sw/adj}}}{\text{AT} \times 365 \text{ days/yr}}$$

Where:

$$\text{SA}_{\text{sw/adj}} = \text{Sum (SA} \times \text{ED} / \text{BW)}$$

$$\text{DA}_{\text{event}} = \text{PC}_{\text{event}} \times \text{CW} \times \text{CF1} \times \text{CF2}$$

Note: For noncarcinogenic effects, AT = ED.

TABLE E-6.54

INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER (CENTRAL TENDENCY)
 CHILD RESIDENT - WADING
 NAVAL TRAINING CENTER - OPERABLE UNIT 4
 ORLANDO, FLORIDA

CARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF	CANCER RISK INGESTION	PCEVENT [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2]	CANCER RISK DERMAL	TOTAL CANCER RISK
Tetrachloroethene	19	ug/L	1.3E-06	5.2E-02	6.7E-08	1.56	8.9E-05	5.2E-02	4.6E-06	4.7E-06
Trichloroethene	57	ug/L	3.9E-06	1.1E-02	4.3E-08	0.849	1.5E-04	1.1E-02	1.6E-06	1.6E-06
Vinyl chloride	35	ug/L	2.4E-06	1.9E+00	4.5E-06	0.022	2.3E-06	ND	4.5E-06	4.5E-06
4,4'-DDT	0.03	ug/L	2.0E-09	3.4E-01	6.9E-10	6.91	6.2E-07	1.7E+00	1.1E-06	1.1E-06

SUMMARY CANCER RISK

5E-06

7E-06

1E-05

[1] This chemical-specific value has been calculated in Table E-6-39.

ND = no data available.

NONCARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	PCEVENT [1] (cm/event)	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
cis-1,2-Dichloroethene	760	ug/L	1.8E-03	1.0E-02	1.8E-01	0.0327	8.7E-04	1.0E-02	8.7E-02	2.7E-01
Tetrachloroethene	19	ug/L	4.5E-05	1.0E-02	4.5E-03	1.56	1.0E-03	1.0E-02	1.0E-01	1.1E-01
Trichloroethene	57	ug/L	1.4E-04	6.0E-03	2.3E-02	0.849	1.7E-03	6.0E-03	2.8E-01	3.0E-01
Vinyl chloride	35	ug/L	8.3E-05	ND	ND	0.022	2.7E-05	ND	ND	ND
4,4'-DDT	0.03	ug/L	7.1E-08	5.0E-04	1.4E-04	6.91	7.3E-06	1.0E-04	7.3E-02	7.3E-02
Endrin ketone	0.01	ug/L	2.4E-08	3.0E-04	7.9E-05	0.303	1.1E-07	ND	ND	7.9E-05
Aluminum	538	ug/L	1.3E-03	1.0E+00	1.3E-03	0.0026	4.9E-05	2.0E-01	2.4E-04	1.5E-03

SUMMARY HAZARD INDEX

0.2

0.5

0.8

[1] This chemical-specific value has been calculated in Table E-6-39.

[2] Calculated from oral RfDs.

ND = no data available.

APPENDIX E-7

DERMAL ABSORPTION FROM SOIL

ABSORBED DOSE CALCULATION - DERMAL EXPOSURE TO SOIL

The absorbed dose is calculated per the USEPA *Dermal Exposure Assessment: Principles and Applications*, Interim Report, January 1992. The calculation of the estimated dermally absorbed dose per unit area per event is:

$$DA_{event} = C_{soil} \times AF \times ABS \times CF$$

where:

DA_{event} = Dose absorbed per unit area per event ($\text{mg}/\text{cm}^2\text{-event}$)

C_{soil} = Contaminant concentration in soil (mg/kg)

AF = Adherence factor of soil to skin ($\text{mg}/\text{cm}^2\text{-event}$)

ABS = Absorption fraction (dimensionless)

CF = Units conversion factor ($10^{-6} \text{ kg}/\text{mg}$)

Dermally absorbed dose for use in risk calculations is derived generally (for adults who are no longer growing) as follows:

$$DA_{adult} = DA_{event} \times EF \times ED \times SA / BW \times AT$$

For children, to account for changing surface areas and bodyweights, the dermally absorbed dose is calculated as follows:

$$DA_{child} = (DA_{event} \times EF / AT) \sum_{i=m}^n (SA_i \times ED_i / BW_i)$$

where:

EF = Exposure frequency (events/year)

AT = Averaging time (days). For noncarcinogenic effects, $AT = ED$, and for carcinogenic effects $AT = 70$ years or 25,550 days.

SA_i = Surface area exposed at age i (cm^2)

ED_i = Exposure duration at age i (years)

BW_i = Bodyweight at age i (kg)

For the typical case, USEPA recommends SA for head and hands only and for the "reasonable worst case," the SA of the head, hands, forearms, and lower legs as the SA available for contact with soil. USEPA simplifies these assumptions by saying that 25 percent of the total body surface area would be available for soil contact. For adults, using 50th and 95th percentile whole body SA values, the default SA values are 5000 cm^2 and 5800 cm^2 (Table G-1). For children, the default values for each age group would be equal to 25 percent of the 50th percentile and 95th percentile whole body SA values. Estimated bodyweights are the average of the 50th percentile female and

male weights (Table E-7.1).

Values of

$$\sum_{i=m}^n (SA_i \times ED_i / BW_i)$$

for commonly used age ranges are presented in E-7.2.

REFERENCES

USEPA, 1989, Exposure Factors Handbook; Office of Health and Environmental Assessment, Washington, DC; EPA/600/8-89/043; 1989.

USEPA, 1992, Dermal Exposure Assessment: Principles and Applications; Office of Health and Environmental Assessment, Washington, DC; EPA/600/8-91/011F; 1992.

USEPA, 1994, Supplemental Guidance to RAGS: Region IV Bulletin (Draft), Bulletin Vol. 1 No. 1; March 1994.

Table E-7.1
Exposure Parameters for Dermal Contact With Soil

Remedial Investigation
Operable Unit 4
Naval Training Center Orlando
Orlando, Florida

Age	Total Surface Area (cm ²)		SA Available for Soil Contact (cm ²) (.25 x Total Surface Area)		Body Weight (kg)			Derivation of D _A event (Dose absorbed/unit area/ event)	
	Male 50th Percentile ¹	Male 95th Percentile ¹	Male 50th Percentile	Male 95th Percentile	Male 50th Percentile ²	Female 50th Percentile ²	Average of Male and Female	50th	95th
								Percentile	Percentile
1<23	5398	6104	1350	1526	11.5	10.5	11	122.7	138.7
2<3	6030	6820	1508	1705	13.4	12.6	13	116.0	131.2
3<4	6640	7640	1660	1910	15.3	14.6	14.95	111.0	127.8
4<5	7310	8450	1828	2113	17.4	16.4	16.9	108.1	125.0
5<6	7930	9180	1983	2295	19.3	18.8	19.05	104.1	120.5
6<7	8660	10600	2165	2650	21.9	21	21.45	100.9	123.5
7<8	9360	11100	2340	2775	24.4	23.5	23.95	97.7	115.9
8<9	10000	12400	2500	3100	27.3	27.3	27.3	91.6	113.6
9<10	10700	12900	2675	3225	29.7	29.6	29.65	90.2	108.8
10<11	11800	14800	2950	3700	34.5	34.3	34.4	85.8	107.6
11<12	12300	16000	3075	4000	36.4	40	38.2	80.5	104.7
12<13	13400	17600	3350	4400	42.1	45.2	43.65	76.7	100.8
13<14	14700	18100	3675	4525	47.7	48.6	48.15	76.3	94.0
14<15	16100	19100	4025	4775	55.5	52.8	54.15	74.3	88.2
15<16	17000	20200	4250	5050	60.2	53.9	57.05	74.5	88.5
16<17	17600	21600	4400	5400	63.6	55.3	59.45	74.0	90.8
17<18	18000	20900	4500	5225	65.7	58.3	62	72.6	84.3
18<75	20000	23000	5000	5750	75.9	61.5	68.7	72.8	83.7
Child - 6 years old (Sum ages 1<7)								662.8	766.7
Child from 2 to 8 years (Sum ages 2<8)								637.8	743.8
Child from 6 to 16 years (Sum ages 6<17)								922.6	1136.3
Adult - 24 years old (18<75 multiplied by 24)								1746.7	2008.7
Adult - 30 years old (Sum Child+ Adult)								2409.5	2775.4

¹ USEPA, 1989. Exposure Factors Handbook. EPA/600/8-89/043 (Table 4B-3)

² USEPA, 1989. Exposure Factors Handbook. EPA/600/8-89/043 (Table 5A-3)

³ SAs based on equation SA = K x BW(2/3). K is calculated from age 2<3 data.

Table E-7.2
Summary of Age Adjusted, Bodyweight-Normalized Surface Area Exposed to Soil¹

Remedial Investigation
 Operable Unit 4
 Naval Training Center Orlando
 Orlando, Florida

Age Range	Duration of Exposure to Soil	Sum of terms for Average Case (50 th Percentile) (area x duration/bodyweight) (cm ² -yr/kg)	Sum of Terms for Reasonable Maximum Exposure (95 th Percentile) (area x duration/bodyweight) (cm ² -yr/kg)
1 through 6	6 years	662.8	766.7
2 through 8	6 years	637.8	743.8
6 through 16	11 years	922.6	1136.3
18 through 41	24 years	1746.7	2008.7
1 through 30	30 years	2409.5	2775.4

¹ See Table E-7.1.

APPENDIX E-8

CALCULATION OF AIR CONCENTRATIONS USING THE SHOWER MODEL

INTRODUCTION

Harding Lawson Associates (HLA) calculated concentrations of volatile organic compounds (VOCs) in groundwater that could volatilize during a shower. After reviewing the literature, the model selected by HLA to predict indoor (bathroom) concentrations is that presented by Foster and Chrostowski (1987). This theoretical approach is based on the experimental work of Andelman (1985). Andelman measured air concentrations of trichloroethylene and chloroform in a bench-scale shower assembly. Foster and Chrostowski (1987) developed a model from these experimental data. HLA modified the input parameters from the bench-scale design to be representative of a typical bathroom.

CALCULATIONS

Parameter values used in the following equations can be found in Table E-8.1.

The equation used to calculate air concentrations in the bathroom is shown below:

$$C(voc) = \frac{S}{R} \times (e^{RD_s} - 1) \times e^{-Rt}$$

where:

$C(voc)$	=	concentration of VOC in bathroom ($\mu\text{g}/\text{m}^3$)
S	=	VOC generation rate ($\mu\text{g}/\text{m}^3\text{-min}$)
R	=	air exchange rate (min^{-1})
D_s	=	duration of shower (min)
t	=	time at which concentration is

being calculated (min)

R, the air exchange rate, is calculated as the volumetric flowrate through the bathroom (m^3/min) divided by the volume of the bathroom (m^3).

S, the VOC source generation rate, is calculated based on the concentration of the contaminant in the water, emission of compound from a droplet, flowrate of water, and volume of room for dilution. S is calculated from the following series of equations:

$$S = \frac{C_{wd} \times FR}{SV}$$

where:

C_{wd}	=	concentration in water droplet ($\mu\text{g}/\text{l}$)
FR	=	flow rate in shower (l/min)
SV	=	shower volume (m^3)

C_{wd} is calculated as follows:

$$C_{wd} = C_{wo} \times [1 - e^{(-\frac{K_d \times t_d}{60d})}]$$

Table E-8.1
Empirical Constants for the Shower Model

Remedial Investigation
Operable Unit 4
Naval Training Center
Orlando, Florida

Constant	Symbol	Value	Unit	Source
Liquid-film mass transfer for CO ₂	K _l (CO ₂)	20	cm/hr	Calculated
Gas-film mass transfer for H ₂ O	K _g (H ₂ O)	3000	cm/hr	Calculated
Molar gas constant x Temperature	RT	0.024	atm-m ³ /mole	
Reference temperature	T ₁	293	K	
Temperature of shower water	T _s	318	K	Assumption
Viscosity of water at shower temperature	u _s	0.6178	cp	Calculated
Viscosity of water at reference temperature	u ₁	0.65	cp	Calculated
Shower droplet free-fall time	t _s	1.5	sec	Assumption
Droplet diameter	d	1	mm	Foster and Chrostowski, 1987
Flow rate in shower	FR	20	l/min	Assumption
Volume of shower area	SV	12	m ³	Assumption
Air exchange rate	R	0.03	min ⁻¹	Calculated
Time in shower	D _s	12	min	USEPA, 1989
Time at which concentration is being calculated	t	12	min	Assumption

Source: Foster, S.A. and Chrostowski, P.C., 1987. Inhalation Exposures to Volatile Organic Contaminants in the Shower

where:

C_{wo}	=	concentration in groundwater ($\mu\text{g/l}$)
K_{al}	=	temperature correction of the mass transfer coefficient, K_L (cm/hr)
t_s	=	shower water droplet free-fall time (sec)
d	=	droplet diameter (mm)

The term $K_{al}/60d$ combines both the rate of transfer and the available interfacial area across which volatilization can occur. The value $1/60d$ equals the specific interfacial area, $6/d$, for a spherical shower droplet of diameter d multiplied by conversion factors (hr/3600 sec and 10 mm/cm).

K_{al} is calculated according to:

where:

	K_L	=	mass-transfer coefficient (cm/hr)
	T_1	=	reference temperature (K)
	u_s	=	viscosity of water at reference temperature (cp)
	T_s	=	temperature of shower water (K)
	u_1	=	viscosity of water at shower temperature (cp)

$$K_{al} = K_L \times \left[\frac{T_1 \times u_s}{T_s \times u_1} \right]^{0.5}$$

K_L is calculated according to:

where:

	$k_l(\text{voc})$	=	chemical-specific liquid mass-transfer coefficient (cm/hr)
	$k_g(\text{voc})$	=	chemical-specific gas mass-transfer coefficient (cm/hr)
	RT	=	molecular gas constant (R) x temperature (T) (atm·m ³ /mole)
	H	=	Henry's Law Constant (atm·m ³ /mole)

$$K_L(\text{voc}) = \frac{I}{\frac{I}{k_l(\text{voc})} + \frac{RT}{H \times k_g(\text{voc})}}$$

The input values of k_l and k_g are based on the mass transfer coefficients of CO_2 and water. They are calculated for the particular compound of interest according to the following equations:

$$k_l(\text{voc}) = k_l(\text{CO}_2) \times \left[\frac{44}{MW(\text{voc})} \right]^{0.5}$$

where:

$k_l(\text{CO}_2)$ = liquid mass-transfer coefficient for carbon dioxide (cm/hr)
 $k_g(\text{H}_2\text{O})$ = gas mass-transfer coefficient for water (cm/hr)
 $\text{MW}(\text{voc})$ = molecular weight of VOC

ASSUMPTIONS

Several assumptions were made to complete this modeling effort. The more important ones involve the volume of the bathroom and the air exchange rate (see Equations 1 and 2). A bathroom volume of 12 m^3 was assumed. For the purposes of this model, it was also assumed that the air between the shower area and the rest of the bathroom was well mixed. The volumetric flowrate through the bathroom was assumed to be $0.4 \text{ m}^3/\text{min}$, which gives an effective air exchange rate of 1.8 air changes/hour. Few measurements have been done on ventilation rate in bathrooms. HLA considers this value to be a conservative estimate given that most homes have air exchange rates of 0.5 to 2.0 changes/hour. Bathrooms may have higher ventilation rates than the entire house due to the effect of local exhaust fans, if present, or the opening of windows.

Another assumption is implicit in the use of Equation 1. This equation calculates VOC concentrations at time (t), which is assumed to equal the duration of shower use (D_s). Thus, the resulting concentrations represent maximum concentrations at the end of the shower. In reality, an individual would experience an integrated exposure that would gradually increase during shower usage and decrease again after the water was turned off. HLA made the simplifying assumption that the peak concentrations would persist for the duration of exposure. This is a conservative assumption that is protective of public health.

REFERENCES

- Andelman, J.B., 1985, Inhalation Exposure in the Home to Volatile Organic Contaminants in Drinking Water; *Sci. Total Environ.*; Vol. 47, pp. 443-460.
- Foster, S.A. and Chrostowski, P.C., 1987, Inhalation Exposures to Volatile Organic Contaminants in the Shower; paper presented at the 80th Annual Meeting of the Air Pollution Control Association; New York, New York; June 1987.
- USEPA, 1989, Exposure Factors Handbook; EPA/600/8-89/043; July 1989.

APPENDIX E-9

MODEL FOR GROUNDWATER VOLATILIZATION TO INDOOR AIR

APPENDIX E-9

VAPOR MIGRATION MODEL

This appendix presents the vapor migration model used to estimate volatile emissions from groundwater sources to indoor air, the risk-based screening levels used to derive acceptable VOC concentrations in indoor air, and the final screening levels selected for each VOC.

Groundwater screening levels were developed using a three-step process. The first step used a fate and transport model to estimate VOC migration from groundwater to indoor air. The output from the model is a volatilization factor (VF) which relates the amount of VOC in groundwater to the estimated indoor air concentration. The second step was to calculate risk-based screening levels for inhalation exposures to air. The product of this step is an air concentration that corresponds to a fixed level of acceptable risk (i.e., a threshold air concentration). The final step in this process was to combine the VF from the model with the RBSLs to calculate target groundwater concentrations. The target groundwater concentrations represent VOC concentrations in those media that do correspond to fixed levels of risk to receptors exposed to air in a building overlying the groundwater source area. Target groundwater concentrations were composed to plume specific EPCs in Tables 8-10 through 8-12 to derive site-specific estimates of cancer and non-cancer risk.

The following paragraphs provide additional detail describing the modeling approach.

Step 1 - Calculate groundwater volatilization factors

The Johnson-Ettinger model, as recommended in USEPA's Soil Screening Guidance (USEPA, 1996), is the fate and transport model used in this evaluation. Two models are presented in this guidance document: one for infinite source areas, and one for finite source areas. The model for finite source areas has been used in this evaluation because it is assumed that chemicals in groundwater will degrade over time, rather than remain at a steady concentration.

The equations and theory supporting the model development are provided as an attachment to this appendix. This information was excerpted from Appendix H of the Soil Screening Guidance document (USEPA, 1996). The equations included in this attachment are specific to soil sources, and do not provide the equations used to derive the VF factor or the effective diffusion variables (used only in the *chi* parameter).

Groundwater modifications. To calculate migration from groundwater, the C_{source} variable for soil was substituted with a C_{source} value for groundwater. The C_{source} value for groundwater is equal to the Henry's Law constant multiplied by the C_{gw} (average contaminant level in groundwater). The C_{gw} was set equal to 1 g/cm^3 , consistent with the C_r for soil (1 g/g). The C_{gw} value was substituted for the C_r value used in the soil equations.

Diffusion variables. The equations used to derive the effective diffusion variables are presented in ASTM's Standard Guide for Risk-Based Corrective Action at Petroleum Release Sites (ASTM, 1995). These equations are also presented in the attachment to this appendix.

Volatilization factors. The VF equations are presented below:

For both soil and groundwater:

$$VF = 1 / C_{building}$$

$C_{building}$ is dependent upon the relationship between the exposure time (T) and the degradation time (TD):

If $T > TD$, $C_{building} = \langle E \rangle / Q_{building}$
If $T < TD$, $C_{building} = a \times C_{source} \times 1000 \text{ cm}^3 \cdot \text{kg} / \text{m}^3 \cdot \text{g}$

Model input parameters. The chemical-physical inputs to the model are both chemical- and site-specific. Chemical constants such as Henry's Law values and soil/water partition coefficients were obtained from IDEM draft RISC guidance (IDEM, 1997). Variables not presented in IDEM guidance were obtained from the USEPA SSL guidance (USEPA, 1996). Site-specific inputs to the model included soil bulk density, water content and air content in vadose zone soils, depth to groundwater sources, thickness of soil and groundwater source areas, soil porosity, vadose zone thickness, and organic carbon content. The area of building below grade was adjusted to reflat the building-on slab construction technique used in Florida (i.e., no basements). In addition it was assumed that the entire building was located over the groundwater plume. The basis of all input variables are provided in Tables E-9.3 through E-9.4. All output variables are also provided in the pages accompanying those tables.

Step 2 - Calculate RBSLs

RBSLs were calculated for commercial/industrial worker inhalation exposures to air and residential exposures to air. The RBSLs are based on the commercial/industrial worker and residential exposure parameters and cancer and non-cancer inhalation dose-response values presented in Appendix E-6-29 and E-6-31. The equations used to calculate the RBSLs, in addition to all input variables and calculated values, are presented in the RBSL spreadsheets included in Table E (commercial/industrial) and E- (residential). RBSLs for carcinogenic effects were calculated for a target cancer risk of 1×10^{-6} . RBSLs for non-cancer effects were calculated for a non-cancer risk of HI of 1.

Step 3 - Calculate groundwater target values

Target tier values for groundwater were calculated by multiplying the VF values by the RBSLs. The resulting target groundwater concentrations were then used with plume-specific EPCs to calculate plume-specific estimates of risk as shown in the following equation:

$$\frac{\text{Target Risk}}{\text{Groundwater Target Concentration}} = \frac{\text{Plume Risk}}{\text{Plume EPC}}$$

where

- Target Risk = 1×10^{-6} or HI = 1.
- Groundwater Target Concentration = calculated in model.
- Plume EPC = EPC presented in Tables 8-10 through 8-12.
- Plume Risk = calculated in this equation.

These calculations are presented in Tables E-6.29 through E-6.31.

References:

American Society for Testing and Materials, 1995; Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites, E1739-95, November.

USEPA, 1996. Soil Screening Guidance: Technical Background Document. Office of Solid Waste and Emergency Response. EPA/540/R-95/128. May.

Environmental Protection
Agency

Emergency Response
Washington, DC 20460

EPA/540/R-95/128
PB96-963502
May 1996

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Soil Screening Guidance: Technical Background Document

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APPENDIX H

**Evaluation of the Effect on the Draft SSLs of the
Johnson and Ettinger Model (EQ, 1994a)**

ENVIRONMENTAL QUALITY MANAGEMENT, INC.

MEMORANDUM

TO: Janine Dinan

DATE: October 7, 1994

SUBJECT: Evaluation of the Effect on the Draft SSLs of the Johnson and Ettinger (1991) Model for the Intrusion of Contaminant Vapors Into Buildings

FROM: Craig S. Mann

FILE: 5099-3

cc:

Under U.S. Environmental Protection Agency (EPA) Contract No. 68-D3-0035, Task order No. 0-25, Environmental Quality Management, Inc. (EQ) was directed to evaluate the effect on the draft soil screening levels (SSLs) of employing the Johnson and Ettinger (1991) model for estimating the intrusion rate of contaminant vapors from soil into buildings. This memorandum summarizes the evaluation.

Model Review:

Johnson and Ettinger (1991) is a closed-form analytical solution for both convective and diffusive transport of vapor-phase contaminants fully incorporated in soil into enclosed structures. The nondimensionalized mass balance is written as:

$$\frac{\partial \sum_i \epsilon_i C_i^*}{\partial t^*} - \left(\frac{L_P}{L_D} \right) (\nabla^* P^*) \cdot (\nabla^* C_v^*) = \nabla^* \cdot \left[\frac{D^{eff} \mu L_P}{k_v \Delta P_r L_D} \right] \nabla^* C_v^* + \sum_i R_i^* \quad (1)$$

- where
- * = Nondimensional variables
 - ϵ_i = Volume fraction of phase i, unitless
 - C_i = Concentration of contaminant in phase i, g/cm³
 - t = Time, s
 - L_P = Convection path length, cm

- L_D = Diffusion path length, cm
- P = Pressure in vapor-phase, g/cm-s²
- ∇ = Del operator, 1/cm
- C_v = Contaminant concentration in vapor phase, g/cm³
- D^{eff} = Effective diffusion coefficient, cm²/s
- μ = Vapor viscosity, g/cm-s
- k_v = Soil permeability to vapor flow, cm²
- ΔP_r = Reference indoor-outdoor pressure differential, g/cm-s²
- R_i = Formation rate of contaminant in phase i, g/cm³-s

and,

- C_i^* = C_i/C_r
- ∇^* = $L_D \nabla$
- P^* = $P/\Delta P_r$
- t^* = $t (k_v \Delta P_r / L_p L_D \mu)$
- R_i^* = $R_i L_p L_D \mu / C_r k_v \Delta P_r$

where C_r , L_p and L_D are characteristic concentration, convection pathway length, and diffusion pathway length, chosen to give the dependent concentration variable and derivatives of C_i^* and P^* magnitudes of order unity.

The mass balance solution includes the following assumptions:

1. The soil column is isotropic within any horizontal plane.
2. The effective diffusion coefficient is constant within any horizontal plane.
3. Concentration at the soil-air interface is zero (i.e., boundary layer resistance is zero).

4. No loss of contaminant occurs across the lower boundary (i.e., no leaching).
5. Source degradation and transformation are not considered.
6. Convective vapor flow near the building foundation is uniform.
7. Contaminant vapors enter the building primarily through openings in the walls and foundation at or below grade.
8. Convective velocities decrease with increasing contaminant source-building distance.
9. All contaminant vapors directly below a basement will enter the basement, unless the floor and walls are perfect vapor barriers.
10. The building contains no other contaminant sources or sinks, and the air volume is well mixed.

Therefore,

$$Q_{building} C_{building} = E \quad (2)$$

where $Q_{building}$, $C_{building}$, and E represent the volumetric flow rate or ventilation rate of the building (cm^3/s), contaminant concentration within the building (g/cm^3), and rate of contaminant entry (g/s), respectively.

Also,

$$\alpha = C_{building} / C_{source} \quad (3)$$

where C_{source} is the vapor-phase contaminant concentration within the soil at the source, and α represents the attenuation coefficient. C_{source} is written as:

$$C_{source} = \frac{H C_s \rho_b}{\theta_w + K_d \rho_b + H \theta_a} \quad (4)$$

- where
- H = Henry's law constant, unitless
 - C_s = Soil bulk concentration, g/g
 - ρ_b = Soil dry bulk density, g/cm³
 - θ_w = Soil water-filled porosity, unitless
 - K_d = Soil-water partition coefficient, cm³/g
 - θ_a = Soil air-filled porosity, unitless.

The authors derive a solution for α for both steady-state conditions (i.e., depth of contamination, $z = \infty$) and for quasi-steady-state conditions ($0 < z < L$). For steady state conditions α is written as:

$$\alpha = \left[\left[\frac{D^{eff} A_B}{Q_{building} L_T} \right] \times \exp \left(\frac{Q_{soil} L_{crack}}{D^{crack} A_{crack}} \right) \right] / \left[\exp \left(\frac{Q_{soil} L_{crack}}{D^{crack} A_{crack}} \right) + \left[\frac{D^{eff} A_B}{Q_{building} L_T} \right] + \left[\frac{D^{eff} A_B}{Q_{soil} L_T} \right] \left[\exp \left(\frac{Q_{soil} L_{crack}}{D^{crack} A_{crack}} \right) - 1 \right] \right] \quad (5)$$

- where
- D^{eff} = Effective diffusion coefficient, cm²/s
 - A_B = Area of basement, cm²
 - L_T = Source-building separation, cm

Q_{soil} = Volumetric flow rate of soil gas into the building, cm^3/s

L_{crack} = Building foundation thickness, cm

D^{crack} = Effective diffusion coefficient through crack, cm^2/s ($D^{crack} = D^{eff}$)

A_{crack} = Area of crack, cm^2

$Q_{building}$ = Building ventilation rate, cm^3/s .

For quasi-steady-state conditions the long-term average attenuation coefficient $\langle \alpha \rangle$ is:

$$\langle \alpha \rangle = \frac{\rho_b C_R \Delta H_C A_B}{Q_{building} C_{source} \tau} \left(\frac{L_T^0}{\Delta H_C} \right) [(\beta^2 + 2\psi\tau)^{1/2} - \beta] \quad (6)$$

where

ρ_b = Soil dry bulk density, g/cm^3

C_R = Average contaminant level in soil, g/g

ΔH_c = Thickness of depth over which contaminant is distributed, cm

A_B = Area of basement, cm^2

$Q_{building}$ = Building ventilation rate, cm^3/s

C_{source} = Vapor-phase soil concentration at source, g/cm^3

τ = Exposure averaging period, s

L_T^0 = Source-building separation at $t=0$, cm

and,

$$\beta = \left(\frac{D^{eff} A_B}{L_T^0 Q_{soil}} \right) \left[1 - \exp \left(- \frac{Q_{soil} L_{crack}}{D^{crack} A_{crack}} \right) \right] + 1 \quad (7)$$

$$\psi = D^{eff} C_{source} / (L_T^0)^2 \rho_b C_R \quad (8)$$

The time required to deplete a finite source (τ_D) of depth ΔH_c is given as:

$$\tau_D = \frac{[\Delta H_c / L_T^0 + \beta]^2 - \beta^2}{2\psi} \quad (9)$$

If the exposure period (τ) is greater than τ_D , the average emission rate into the building $\langle E \rangle$ is given as a simple mass balance:

$$\langle E \rangle = \rho_b C_R \Delta H_c A_B / \tau \quad (10)$$

and the average building concentration ($C_{building}$) is:

$$C_{building} = \langle E \rangle / Q_{building} \quad (11)$$

Evaluation

In order to evaluate the effects of using the model on the SSLs for volatile contaminants, a case example was constructed which best estimates a reasonable high end exposure point concentration for residential land use. Where possible, values of model variables were taken directly from Johnson and Ettinger (1991).

The case example assumes that a residential dwelling with a basement is constructed within the area of homogeneous residual contamination such that the contaminant source lies directly below the basement floor at $t = 0$. Therefore, the

diffusion and convection path lengths were set equal to the thickness of the basement slab (15 cm). Soil permeability to vapor flow from the basement floor to the bottom of contamination was set equal to $1.0 \times 10^8 \text{ cm}^2$ (1 darcy) which is representative of silty to fine sand. Soil column-building pressure differential was set equal to 1 pascal (10 g/cm-s^2) as a reasonable long-term average value (Johnson and Ettinger, 1991). Values for all other soil properties were set equal to those of the Generic SSLs in the July 1994 Technical Background Document for Draft Soil Screening Level Framework (TBD). Building variables, i.e., basement area, ventilation rate, etc., were taken from Johnson and Ettinger (1991).

In the analysis, the values for C_{building} (kg/m^3) were calculated for the 42 chemicals in the TBD for which human health benchmarks are available. Please note that the values of C_{source} and C_{building} were calculated for an initial soil concentration of 1 mg/kg instead of $1 \times 10^6 \text{ g/g}$. This was done to facilitate reverse calculation of the SSL in units of mg/kg . Therefore, these values are artificially high by a factor of 1×10^6 . The inverse of the value of C_{building} (m^3/kg) was used as the indoor volatilization factor (VF_{indoor}) and substituted into Equations 2-4 or 2-5 of the TBD as appropriate to calculate the resulting carcinogenic and noncarcinogenic inhalation SSLs. SSLs were calculated for both steady-state conditions (infinite source depth) and quasi-steady-state conditions (finite source depth). In each case where the exposure period exceeded the time required for source depletion (finite source depth), the volatilization factor was normalized to an average contaminant level in soil (C_s) of 1 mg/kg . For quasi-steady-state conditions, the depth to the bottom of contamination was set equal to 2 meters below the basement floor.

The value of the indoor SSL for each contaminant was compared to the respective SSL calculated for outdoor exposures of the same duration using the Generic SSL calculations found in the TBD. The outdoor SSLs were computed for a 30 acre square area source of emissions. Table 1 summarizes the results of this comparison. The attachment to this memorandum gives the detailed computations for this evaluation.

As can be seen from Table 1, results on a chemical-specific basis indicate a rate of change as high as three orders of magnitude between the outdoor SSL and the infinite source indoor SSLs in the case of highly volatile contaminants. For very persistent contaminants, the relative difference was considerably less, and in some cases there was no difference in SSL concentrations.

This variability is due to: 1) the variability in the human health benchmarks used to calculate the risk-based SSLs, and 2) the apparent diffusion coefficient of each compound. The apparent diffusion coefficient can be expressed as the effective diffusion coefficient through soil divided by the liquid-phase partition coefficient (Jury et al., 1983). The apparent diffusion coefficient (D_A) is given here so as not to be confused with the effective diffusion coefficient (D^{eff}) from Johnson and Ettinger (1991):

TABLE 1. SUMMARY OF INDOOR AND OUTDOOR INHALATION SSLs FOR VOLATILE CONTAMINANTS

Chemical	Indoor SSL infinite source (mg/kg)	Indoor SSL finite source (mg/kg)	Outdoor SSL infinite source (mg/kg)
Aldrin	0.4	0.4	0.5
Benzene	0.002	0.02	0.5
Bis(2-chloroethyl)ether	0.02	0.05	0.3
Bromoform	0.8	0.9	43
Carbon disulfide	0.03	0.7	11
Carbon tetrachloride	0.0007	0.01	0.2
Chlordane	51	53	54
Chlorobenzene	0.7	2	87
Chloroform	0.001	0.007	0.2
DDT	5 ^a	5 ^a	5 ^a
1,2-Dichlorobenzene	26	65	297 ^a
1,4-Dichlorobenzene	102	235 ^a	235 ^a
1,1-Dichloroethane	4	35	939
1,2-Dichloroethane	0.002	0.007	0.3
1,1-Dichloroethylene	0.0001	0.003	0.04
1,2-Dichloropropane	0.06	0.3	10
1,3-Dichloropropene	0.0007	0.004	0.1
Dieldrin	3	4	2
Ethylbenzene	21	69	257 ^a
Heptachlor	0.04	0.04	0.3
Heptachlor epoxide	1	1	1
Hexachloro-1,3-butadiene	0.03	0.05	1
Hexachlorobenzene	0.3	0.6	1
HCH-alpha(alpha-BHC)	0.5	0.6	0.9
HCH-beta(beta-BHC)	7 ^a	7 ^a	7 ^a
Hexachlorocyclopentadiene	0.06	0.07	2
Hexachloroethane	0.6	0.6	45
Methyl bromide	0.01	0.3	3
Methylene chloride	0.04	0.3	7
Nitrobenzene	9	25	100
Styrene	185	472	1439 ^a
1,1,2,2-Tetrachloroethane	0.007	0.02	0.4
Tetrachloroethylene	0.05	0.3	11
Toluene	6	28	521 ^a
Toxaphene	2	2	2 ^a
1,2,4-Trichlorobenzene	6	9	214
1,1,1-Trichloroethane	5	69	980 ^a
1,1,2-Trichloroethane	0.009	0.02	1
Trichloroethylene	0.01	0.09	3
2,4,6-Trichlorophenol	64	94	190
Vinyl acetate	5	14	351
Vinyl chloride	0.00002	0.002	0.01

^a = SSL based on C_{max}.

$$D_A = \left[(\theta_a^{10/3} D_a H + \theta_w^{10/3} D_w) / \theta_t^2 \right] / (\rho_b K_d + \theta_w + \theta_a H) \quad (12)$$

- where
- D_A = Apparent diffusion coefficient, cm^2/s
 - θ_a = Air-filled soil porosity, unitless
 - D_a = Diffusivity in air, cm^2/s
 - H = Henry's law constant, unitless
 - θ_w = Water-filled soil porosity, unitless
 - D_w = Diffusivity in water, cm^2/s
 - θ_t = Total soil porosity, unitless
 - ρ_b = Soil dry bulk density, g/cm^3
 - K_d = Soil-water partition coefficient, cm^3/g .

With all nonchemical-specific variables held constant, Figure 1 shows the exponential relationship between the apparent diffusion coefficient and the building concentration for quasi-steady-state conditions (finite source).

For nonchemical-specific variables, a sensitivity analysis was performed for soil permeability to vapor flow (k_v), soil-building pressure differential (ΔP), depth of contamination (ΔH_c), source-building separation at $t = 0$ (L_r^0), crack-to-total area ratio (η), and building ventilation rate (Q_{building}).

Table 2 shows the results of the sensitivity analysis for the quasi-steady-state condition (finite source). As can be seen from Table 2, the effect of the building ventilation rate is linear if the value of C_{sat} is not included in limiting the value of the SSL. Depth of contamination (ΔH_c) has the greatest effect for contaminants with higher apparent diffusion coefficients (e.g., benzene, chloroform, vinyl chloride, etc.), in that as ΔH_c increases, the time required for source depletion (τ_D) also increases. Therefore, with greater initial contaminant mass in the soil, these compounds are emitted for a longer period of time thus reducing the SSL. For the more persistent contaminants, an increase in k_v or ΔP produces the greatest results. This is to be expected as values of τ_D for these contaminants exceed the exposure duration. Table 2 also indicates that an order of magnitude change in values of L_r^0 and η produce same order of magnitude results. It must be remembered, however, that in the case of L_r^0 , the model assumes isotropic soil

$$D_{crack}^{eff} = \left[D^a * \frac{\theta_{acrack}^{3.33}}{\theta_T^{2.0}} \right] + \left[D^w * \frac{1}{H} * \frac{\theta_{wcrack}^{3.33}}{\theta_T^{2.0}} \right]$$

where:

- D^a = Diffusion coefficient in air [cm²/s]
- θ_{acrack} = Volumetric air content in foundation/wall cracks [cm³-air/cm³-total volume]
- θ_{wcrack} = Volumetric water content in foundation/wall cracks [cm³-H₂O/cm³-total volume]
- D_{crack}^{eff} = Effective diffusion coefficient through foundation cracks [cm²/s]

$$D_s^{eff} = \left[D^a * \frac{\theta_{ax}^{3.33}}{\theta_T^{2.0}} \right] + \left[D^w * \frac{1}{H} * \frac{\theta_{wx}^{3.33}}{\theta_T^{2.0}} \right]$$

where:

- D^a = Chemical-specific diffusion coefficient in air [cm²/s]
- θ_T = Total soil porosity in the impacted zone [cm³/cm³-soil]
- D^w = Chemical-specific diffusion coefficient in water [cm²/s]

$$D_{ws}^{eff} = (h_{cap} - h_v) * \left[\frac{h_{cap}}{D_{cap}^{eff}} + \frac{h_v}{D_s^{eff}} \right]^{-1}$$

where:

- h_{cap} = Thickness of capillary fringe [cm]
- h_v = Thickness of vadose zone [cm]
- D_{cap}^{eff} = Effective diffusion through capillary fringe [cm²/s]
- D_s^{eff} = Effective diffusion through vadose zone [cm²/s]

In Equation C-16, D_{cap}^{eff} is calculated as:

$$D_{cap}^{eff} = \left[D^a * \frac{\theta_{acap}^{3.33}}{\theta_T^{2.0}} \right] + \left[D^w * \frac{1}{H} * \frac{\theta_{wcap}^{3.33}}{\theta_T^{2.0}} \right]$$

where:

- D^a = Diffusion coefficient in air [cm²/s]
- θ_{acap} = Volumetric air content in capillary fringe soils [cm³-air/cm³-soil]
- θ_T = Total soil porosity [cm³/cm³-soil]
- D^w = Diffusion coefficient in water [cm²/s]
- H = Dimensionless form of Henry's Law constant [(cm³-H₂O)/(cm³-air)]
- θ_{wcap} = Volumetric water content in capillary fringe soils [cm³-H₂O/cm³-soil]

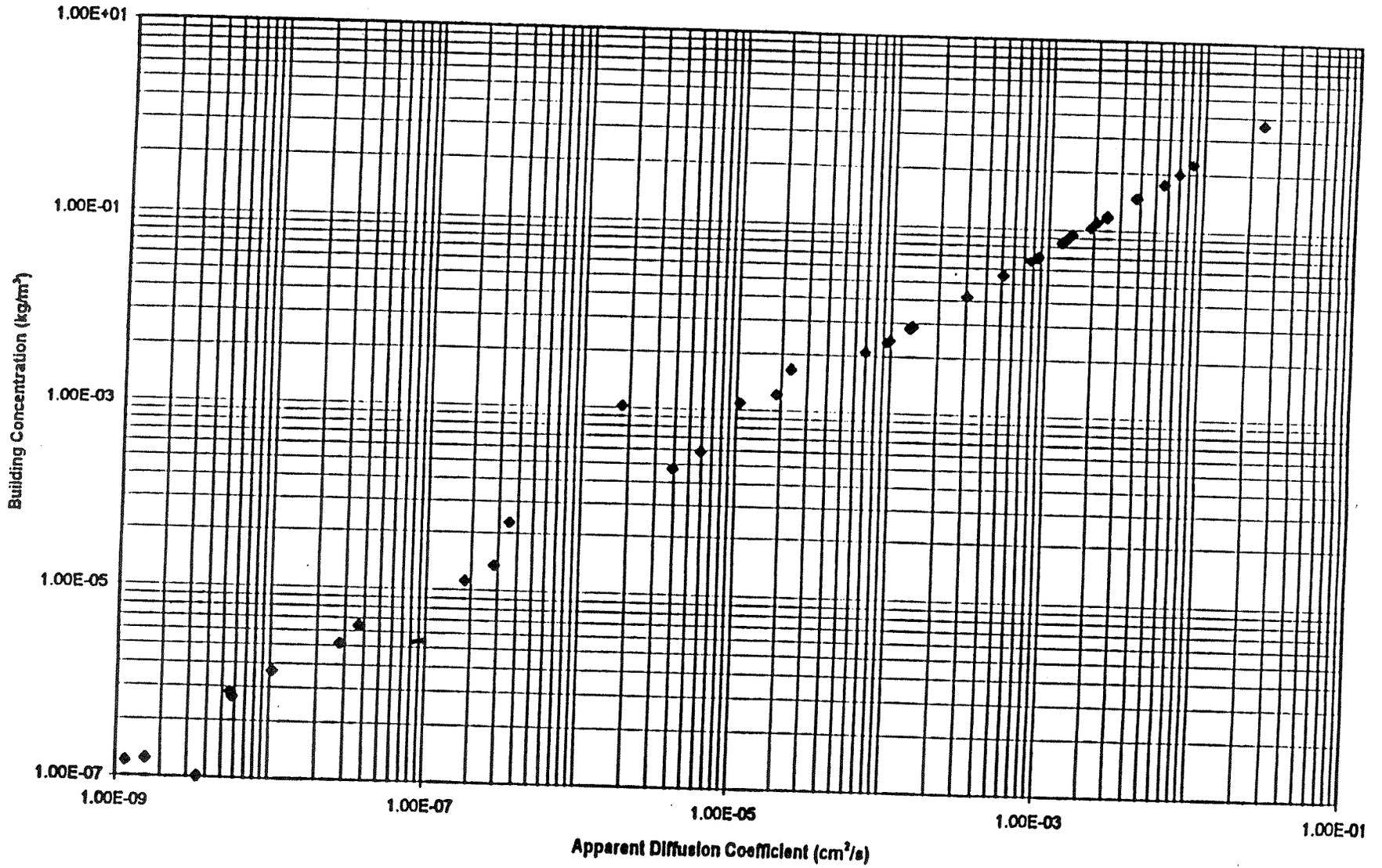


TABLE 2. MODEL SENSITIVITY TO NONCHEMICAL SPECIFIC VARIABLES

Chemical	Ratio of Variable-to-Test Condition SSL							
	Apparent diffusion coefficient, D_A (cm^2/s)	Test condition SSL, (mg/kg)	Soil vapor permeability, $k_v \times 10$	Soil-bldg. pressure differential, $\Delta P \times 10$	Depth to source lower boundary, $\Delta H_s \times 10$	Source-bldg. separation at $t=0$, $L^0 \times 10$	Inverse of crack-to-total area ratio, $1/\eta \times 10$	Bldg. ventilation rate, $Q_{outside} \times 10$
DDT	1.16E-09	5 ^a	1	1	1	1	1	1.0
Dieldrin	1.59E-09	4	0.1	0.1	1	1.2	1.5	3.4
HCH-beta(beta-BHC)	3.54E-09	7 ^a	0.8	0.8	1	1	1	1.0
Chlordane	5.63E-09	53	0.1	0.1	1	1.3	1.3	1.3
Heptachlor epoxide	5.78E-09	1	0.1	0.1	1	1.3	1.5	8.4
Aldrin	1.03E-08	0.4	0.1	0.1	1	1.2	1.5	10
HCH-alpha(alpha-BHC)	2.81E-08	0.6	0.1	0.1	1	1.2	1.5	10
Toxaphene	3.69E-08	2	0.1	0.1	1	1.1	1.1	1.1
2,4,6-Trichlorophenol	1.81E-07	94	0.1	0.1	1	1.1	1.5	10
Hexachlorobenzene	2.84E-07	0.6	0.1	0.1	1	1.1	1.5	3.2
Heptachlor	3.52E-07	0.04	0.1	0.1	1	1.3	1.5	10
Hexachloroethane	1.80E-06	0.6	0.3	0.3	1	2	1.4	10
Nitrobenzene	3.92E-06	25	0.1	0.1	1	1	1.5	10
Bis(2-chloroethyl) ether	5.94E-06	0.05	0.1	0.1	1	1	1.5	10
Hexachlorocyclopentadiene	1.06E-05	0.07	0.2	0.2	1	1.2	1.5	10
1,2,4-Trichlorobenzene	1.89E-05	9	0.1	0.1	1	1.1	1.5	10
Bromoform	2.32E-05	0.9	0.2	0.2	1	1.2	1.5	10
Hexachloro-1,3-butadiene	6.97E-05	0.05	0.1	0.1	1	1.1	1.5	10
Styrene	9.50E-05	472	0.1	0.1	1	1	1.5	3.0
1,1,2,2-Tetrachloroethane	9.89E-05	0.02	0.2	0.2	1	1	1.5	10
1,2-Dichlorobenzene	1.34E-04	65	0.2	0.2	1	1	1.5	4.5
1,4-Dichlorobenzene	1.38E-04	235 ^a	0.2	0.2	1	.1	1	1.0
1,1,2-Trichloroethane	3.04E-04	0.02	0.4	0.4	1	1	1.5	10
Chlorobenzene	5.18E-04	2	0.8	0.8	1	1	1.5	10
Vinyl acetate	7.79E-04	14	1	1	1	1	1.5	10
1,2-Dichloroethane	8.57E-04	0.007	0.9	0.9	1	1	1.5	10
Ethylbenzene	8.64E-04	69	1	1	0.8	1	1.2	3.7
1,2-Dichloropropane	1.24E-03	0.3	1	1	0.6	1	1	10
Toluene	1.25E-03	28	1	1	0.7	1	1	10
Tetrachloroethylene	1.34E-03	0.3	1	1	0.5	1	1	10
1,3-Dichloropropene	1.44E-03	0.004	1	1	0.4	1	1	10
Chloroform	1.91E-03	0.007	1	1	0.5	1	1	10
1,1-Dichloroethane	2.08E-03	35	1	1	0.4	1	1	10
Benzene	2.12E-03	0.02	1	1	0.4	1	1	10
Trichloroethylene	2.44E-03	0.09	1	1	0.3	1	1	10
Methylene chloride	2.45E-03	0.3	1	1	0.4	1	1	10
1,1,1-Trichloroethane	3.79E-03	69	1	1	0.2	1	1	10
Carbon tetrachloride	3.82E-03	0.01	1	1	0.2	1	1	10
Carbon disulfide	5.67E-03	0.7	1	1	0.2	1	1	10
1,1-Dichloroethylene	7.09E-03	0.003	1	1	0.1	1	1	10
Methyl bromide	8.56E-03	0.3	1	1	0.1	1	1	10
Vinyl chloride	2.40E-02	0.002	1	1	0.1	1	1	10

^a = SSL based C_{max} .

conditions from the point of building entry to the bottom of contamination. As L_T^0 increases, α decreases until diffusion not convection limits the rate of contaminant vapor transport. The effect of changes in the value of η decrease as values of k_v decrease such that for very permeable soils and convection-dominated vapor transport, the effect of crack size is relatively insignificant.

Conclusions

Use of the Johnson and Ettinger (1991) model to calculate SSLs based on indoor chronic exposures can have significant impacts on the values of the SSLs for contaminants with high apparent diffusion coefficients. When comparing the infinite source indoor model to the infinite source outdoor model for these contaminants, values of the SSL differ by orders of magnitude for case example conditions. Under these conditions, diffusion is the limiting transport mechanisms for all but one contaminant for both steady-state and quasi-steady-state conditions. To effect case example conditions, the following must be true:

1. The contaminant source must be relatively close or directly beneath the structure.
2. The soil between the structure and the source must be very permeable ($k_v \geq 10^8 \text{ cm}^2$).
3. The structure must be underpressurized.
4. The air within the structure must be well mixed (i.e., little or no soil-air boundary layer resistance).
5. The combination of diffusion coefficient through the cracks, area of the cracks, and building underpressurization must offer no more resistance than the soil column beneath the structure.

From this evaluation, the four most important factors affecting the average long-term building concentration and thus the SSL are building ventilation rate, source-building separation, soil permeability to vapor flow, and source depth. If the source of contamination is relatively deep and close to the building, and if the soil between the source and the building is very permeable, building concentrations of contaminants with relatively high apparent diffusion coefficients will increase dramatically.

It should be noted, however, that soil permeability, k_v , is the most variable parameter at any given site, and may vary by three orders of magnitude across a typical residential lot (Johnson and Ettinger, 1991). For this reason, the overall effective diffusion coefficient should be determined by integration across each soil type. Overall

diffusion/convection vapor transport will therefore be limited by the soil stratum offering the greatest resistance to vapor flow.

References

Johnson, Paul C., and Robert A. Ettinger. 1991. Heuristic model for predicting the intrusion rate of contaminant vapors into buildings. *Environ. Sci. Technol.*, 25(8):1445-1452.

Jury, W. A., W. J. Farmer, and W. F. Spencer. 1983. Behavior Assessment Model for Trace Organics in Soil, I, Model description. *J. Environ. Qual.*, 12:558-564.

Attachment

APPENDIX E-10
TOXICITY PROFILES

1,2-Dichloroethene. 1,2-Dichloroethene is a volatile organic compound which exists as cis- and trans-isomers. The commercially used material is usually a mixture of the two isomers. In the past, it was used as a general inhalation anesthetic. It is used most often as a solvent for dyes, perfume oils, waxes, resins, and plastics. It is also used as an intermediate in the synthesis of polymers.

1,2-Dichloroethene is absorbed by all routes of administration. Distribution is rapid and, due to its lipophilic nature, occurs to all organ systems. It is extensively metabolized to dichloroacetaldehyde and chloroacetic acids which are excreted primarily through urine.

Dermal contact to 1,2-dichloroethene may result in defatting of the skin and dermatitis. Exposure to airborne 1,2-dichloroethene causes irritation to eyes, mucous membranes and the upper respiratory tract. Systemically, the trans-isomer is believed to be more toxic than the cis-isomer. However, both have been reported to produce central nervous system depression and toxicity to liver and lungs. No data on the reproductive toxicity of 1,2-dichloroethene exists. Both isomers have tested negative for mutagenicity in vitro tests. Cancer effects have not been studied in humans or animals.

References:

Agency for Toxic Substances and Disease Registry (ATSDR), 1990. "Toxicological Profile for 1,2-Dichloroethene"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, February 1990.

Mycroft, F.J., Jones, J.R., and Olson, K.R. 1990. Environmental and Occupational Toxicology. In: Poisoning and Drug Overdose. Ed. K.R. Olson. Appleton & Lange, CT. p. 397.

Aluminum. Aluminum occurs naturally in the soil and makes up approximately 8 percent of the earth's crust. Higher soil concentrations are associated with industries which burn coal and aluminum mining and smelting. Human exposures to aluminum may occur through ingestion of foods grown in soil that contains aluminum and use of antacids, antiperspirants, and other drug store items. Aluminum in antiperspirants can cause skin rashes in some people. Factory workers who inhale large amounts of aluminum dust may develop lung problems. Aluminum has caused lower birth weights in some animals. Studies have shown that aluminum accumulates in the brains of people with Alzheimer's disease. However, any causal link between aluminum exposure and this disease is yet to be demonstrated. Both human epidemiological studies and animal experiments strongly suggest that aluminum is not a carcinogen.

References:

Agency for Toxic Substances and Disease Registry (ATSDR), 1989. "Toxicological Profile for Aluminum"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, October 1989.

Antimony. Antimony enters the environment during the mining and processing of its ores and other related compounds. Small amounts of antimony are also released into the environment by incinerators and coal burning power plants. Antimony will strongly adhere to soil which contains iron, manganese, or aluminum. Antimony was used for medicinal purposes to treat people infected with parasites. However, chronic exposure can cause eye, skin, and lung irritation, as well as heart problems, vomiting and diarrhea. The oral RfD, based on an oral drinking water study in rats, showed changes in glucose and cholesterol metabolism. Antimony has not been evaluated by the USEPA for evidence of human carcinogenic potential.

References:

Agency for Toxic Substances and Disease Registry (ATSDR), 1991. "Toxicological Profile for Antimony"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, February 1991.

Integrated Risk Information System (IRIS), 1993. United States Environmental Protection Agency.

Aroclors. Aroclors is the trade name for polychlorinated biphenyls [PCBs] produced in the United States by

Monsanto Chemical Company. PCBs are a class of compounds in which one to ten atoms are attached to the biphenyl structure. PCBs are subdivided according to the degree of chlorination. The aroclors are identified by a four-digit numbering code in which the first two digits (12) indicate that the parent molecule is biphenyl and the last digits indicate the chlorine content by weight percent. The amount of chlorination of the rings determines the specific structure, or congener, of the aroclor and, subsequently, the specific chemical, physical, and toxicological properties. The excellent dielectric properties, thermal stability, and nonflammability of aroclors has made them ideal for use in electrical transformers and capacitors. Therefore, they have been used in these applications extensively in the past. Humans may be exposed to aroclors when an aroclor-containing electrical component burns or is dismantled. Although the production of aroclors in the U.S. was banned in 1977, aroclors do not readily breakdown, and they may still be present in older electrical equipment, and environmental media.

Following dermal exposure, aroclors have caused a skin rash called chloracne. Aroclors have also produced developmental defects in humans, which have mainly consisted of behavioral abnormalities. These effects have also been observed in animals. Epidemiological studies on occupationally-exposed humans do not conclusively link exposure to aroclors with an increased incidence of cancer. However, chronic oral exposure to aroclors has produced liver cancer in laboratory animals. The potency of the carcinogenic action of aroclors appears to increase as the chlorination of the aroclors increases. Although cancer in laboratory animals has only been conclusively demonstrated for aroclors with the highest percent chlorination (aroclors-1260 and 1254), the USEPA has classified all aroclor congeners as B2, probable human carcinogens.

References:

MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, MA; September 1992.

Arsenic. Arsenic had once used in pesticide formulations and has industrial uses in tanneries, as well as the glass and wine making industries. Toxicity depends on its chemical form. Arsenic is an irritant of the skin, mucous membranes, and gastrointestinal tract. Symptoms of acute toxicity include vomiting, diarrhea, convulsions, and a severe drop in blood pressure. Subchronic effects include hyperpigmentation, sensory-motor polyneuropathy, persistent headache, and lethargy. Chronic oral exposure has caused skin lesions, peripheral vascular disease, and peripheral neuropathy. The USEPA has classified arsenic as Group A, human carcinogen, based on increased incidence of skin and lung cancer in epidemiology studies.

References:

Agency for Toxic Substances and Disease Registry (ATSDR), 1992. "Toxicological Profile for Arsenic"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, February 1992.

Barium. Barium is used in paints, soap, paper, rubber, and in the manufacture of glass. Some compounds of barium have been used as insecticides. Acute exposure to barium through ingestion can cause gastroenteritis, muscular paralysis, as well as cardiovascular effects. Chronic inhalation of barium containing dust can cause a reversible, benign pneumoconiosis. There is no evidence for carcinogenicity for barium.

References:

Amdur, Mary O., John Doull, Curtis D. Klaassen, 1991. Toxicology: The Basic Science of Poisons, 4th edition; Pergamon Press, Inc. New York.

Benzo(a)anthracene. Benzo(a)anthracene is a member of the polycyclic aromatic hydrocarbons (PAH) class of compounds which contain two or more aromatic rings. PAHs are ubiquitous in nature and are also manmade. Benzo(a)anthracene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material. It is also product of pyrolysis in tobacco smoke.

Benzo(a)anthracene has produced skin tumors in laboratory animals after dermal application. Benzo(a)anthracene produced mutations in bacteria and in mammalian cells, and transformed mammalian cells in culture. Although there are no human data that specifically link exposure to benzo(a)anthracene to human cancers, benzo(a)anthracene is a component of mixtures that have been associated with human cancer. As such, benzo(a)anthracene has been classified by USEPA as a B2, probable human carcinogen.

References:

MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, MA; September 1992.

Benzo(a)pyrene. Benzo(a)pyrene is a member of the polycyclic aromatic hydrocarbons (PAH) class of compounds which contain two or more aromatic rings. They are ubiquitous in nature and are also man made. Benzo(a)pyrene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material. Human data demonstrating a causal relationship linking benzo(a)pyrene to carcinogenicity are lacking. However, multiple animal studies in many species demonstrate benzo(a)pyrene to be carcinogenic following administration by a variety of routes. The mechanism through which benzo(a)pyrene elicits its carcinogenic potential is well understood. Benzo(a)pyrene has produced positive results in numerous genotoxicity assays. Benzo(a)pyrene has been classified by the EPA as a B2, probable human carcinogen.

References:

ATSDR, 1989. Toxicological Profile for Polycyclic Aromatic Hydrocarbons. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, October, 1989.

Clayton, George D. and Florence E. Clayton, editors, 1981. Patty's Industrial Hygiene and Toxicology, 3rd Revised Edition; John Wiley & Sons; New York.

Integrated Risk Information System (IRIS), 1993. United States Environmental Protection Agency.

Benzo(b)fluoranthene. Benzo(b)fluoranthene is a member of the polycyclic aromatic hydrocarbons (PAH) class of compounds which contain two or more aromatic rings. PAHs are ubiquitous in nature and are also manmade. Benzo(b)fluoranthene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material.

Although there are no human data that specifically link exposure to benzo(b)fluoranthene to human cancers, benzo(b)fluoranthene is a component of mixtures that have been associated with human cancer. These include coal tar, soots, coke oven emissions and cigarette smoke. Benzo(b)fluoranthene produced tumors in mice after lung implantation, intraperitoneal, or subcutaneous injection, and skin painting. Benzo(b)fluoranthene has produced positive results in several genotoxicity assays. It has been classified as a B2, probable human carcinogen, by the USEPA.

References:

MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, MA; September 1992.

Benzo(k)fluoranthene. Benzo(k)fluoranthene is a member of the polycyclic aromatic hydrocarbons (PAH) class of compounds which contain two or more aromatic rings. PAHs are ubiquitous in the environment resulting from the incomplete combustion of organic materials, whether natural or man-made. Benzo(k)fluoranthene also occurs in coal tar, and crude oil.

Although there are no human data that specifically link exposure to benzo(k)fluoranthene to human cancers,

benzo(k)fluoranthene is a component of mixtures that have been associated with human cancer. These include coal tar, soots, coke oven emissions and cigarette smoke. Benzo(k)fluoranthene produced tumors after lung implantation in mice and when administered with a promoting agent in skin-painting studies. Benzo(k)fluoranthene is mutagenic in bacteria. Benzo(k)fluoranthene has been classified by USEPA as a B2, probable human carcinogen.

References:

MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, MA; September 1992.

Beryllium. Beryllium is a trace element that is obtained by extraction from mineral ores. Most beryllium is contributed to the environment by the burning of fossil fuels which contain beryllium ore. Beryllium is generally incorporated into alloy metals that are used in jet engine parts and electrical components. Pure beryllium metal is used in parts for aircraft brakes, nuclear weapons, nuclear reactors, and precision instruments.

Available data on beryllium suggest that it is most toxic to the lung. Acute inhalation exposures to high concentrations of beryllium in the air can cause chemical pneumonitis, the symptoms of which include cough, shortness of breath, and fatigue. These symptoms can persist and even worsen after exposure to beryllium has been discontinued. Chronic inhalation exposures to low concentrations of beryllium can produce chronic beryllium disease, which results in inhibited breathing efficiency. Inhalation of beryllium has been shown to produce lung cancer in animals, and an increased incidence of lung cancer has been demonstrated in workers who are exposed to beryllium in the air. Therefore beryllium has been classified by the USEPA as a B2, probable human carcinogen.

References:

Agency for Toxic Substances and Disease Registry (ATSDR), 1991. "Toxicological Profile for Beryllium"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, February 1991.

Chromium. Chromium has been used in plating for corrosion resistance and decorative purposes, in the manufacture of alloys, and in printing, dyeing, and photography. The toxicity of chromium depends upon its valence state. Hexavalent chromium is more toxic than trivalent chromium. The effects of inhalation exposure to hexavalent chromium include ulcers of the upper respiratory tract, nasal inflammation, perforation of the nasal septa and lung cancer. Most trivalent chromium compounds are inactive in short-term genotoxicity assays. Trivalent chromium compounds have not been found to be carcinogenic by any route of exposure. There is epidemiological evidence of an association between hexavalent chromium inhalation exposure and lung cancer. The USEPA has classified hexavalent chromium as an Class A, human carcinogen, by the inhalation route.

References:

Amdur, Mary O., John Doull, Curtis D. Klaassen, 1991. Toxicology: The Basic Science of Poisons, 4th edition; Pergamon Press, Inc. New York.

Integrated Risk Information System (IRIS), 1993. United States Environmental Protection Agency.

Chrysene. Chrysene is one of the polycyclic aromatic hydrocarbons (PAH) compounds which are formed during the combustion of organic material. Although there are no human data that specifically link exposure to chrysene to human cancers, chrysene is a component of mixtures that have been associated with human cancer. These include coal tar, soots, coke oven emissions and cigarette smoke. Chrysene produced chromosomal abnormalities in hamsters and mouse germ cells after gavage exposure, positive responses in bacterial gene mutation assays, and transformed mammalian cells exposed in culture. Due to its similarities with benzo(a)pyrene and other carcinogenic PAHs, chrysene has been classified as a B2, probable human carcinogen.

References:

MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, MA; September 1992.

DDD, DDE, DDT. DDT was one of the most highly used insecticides, and is now ubiquitous in the environment. It was used extensively in World War II to control lice (applied directly to human skin), and later used as an agricultural insecticide and as a public health tool to control insects which spread typhus and malaria. DDD and DDE were contained as impurities in DDT, and are also primary metabolites of DDT, and share similar toxicological properties. DDT, DDD, and DDE are highly persistent in the environment, and thus tend to bioconcentrate in the food chain. This, combined with its toxicological properties, has been attributed to the decline in population of several predatory bird species.

DDT is absorbed to a minor extent via inhalation and dermal routes, and to a large extent by the oral route. Exposure to humans is likely greatest through ingestion of mucous that was contaminated with DDT that had been inhaled. DDT is absorbed into the lymphatic system and distributed to fats throughout the body. In both humans and animals, DDT acts as a CNS stimulant by interfering with the movement of ions within neurons. DDT acts as an estrogenic compound in animals, and this has been attributed to numerous adverse reproductive effects observed in animals exposed to DDT. DDT also causes liver hypertrophy, hepatocyte degeneration, and induces the enzyme cytochrome P450, which can effect the metabolism of other xenobiotics. There is no conclusive evidence of DDT-induced carcinogenicity in humans. However, DDT has produced liver tumors in laboratory animals. DDD, DDE, and DDT have, therefore, been placed in USEPA's weight of evidence group B2, probable human carcinogen.

References:

Agency for Toxic Substances and Disease Registry (ATSDR), 1992. "Toxicological Profile for DDD, DDE, and DDT"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, October 1992.

Dibenz(a,h)anthracene. Dibenz(a,h)anthracene is one of the polycyclic aromatic hydrocarbons (PAH) compounds which are formed during the combustion of organic material. This compound is found in tobacco smoke, food, and industrial emissions. Although there are no human data that specifically link exposure to dibenz(a,h)anthracene to human cancers, dibenz(a,h)anthracene is a component of mixtures that have been associated with human cancer. These include coal tar, soots, coke oven emissions and cigarette smoke. Dibenz(a,h)anthracene is metabolized similarly to benzo(a)pyrene, and has produced skin tumors in laboratory animals following dermal exposure. Dibenz(a,h)anthracene has also been shown to be mutagenic, producing DNA damage in human cell cultures. Due to its similarities with benzo(a)pyrene and other carcinogenic PAHs, dibenz(a,h)anthracene has been classified as a B2, probable human carcinogen.

MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, MA; September 1992.

Endrin Ketone. Endrin ketone, like endrin aldehyde, is not a commercial product, but rather an impurity in the pesticide endrin. Endrin was a commonly used agricultural insecticide/rodenticide from the early 1960s to 1986, when its production in the United States was voluntarily terminated by the manufacturer. Endrin is absorbed via inhalation, oral, and dermal exposure routes. The primary toxic manifestation resulting from endrin exposure is acute neurotoxia. Both humans and animals have exhibited uncontrolled jerking, tremors, convulsions and death following endrin exposure. The endrin concentrations required to produce these effects have not been well quantified, but it is estimated that current environmental endrin concentrations are not significant enough to induce adverse neurological effects in humans. Animal studies suggest that endrin could pose a reproductive hazard to humans, but this has not been supported by clinical findings in humans. Endrin was not mutagenic in *in vitro* assays, nor was it determined to be a causative cancer agent in epidemiologic studies.

References:

ATSDR, 1989. Toxicological Profile for Endrin and Endrin Aldehyde. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, October, 1989.

Indeno(1,2,3-cd)pyrene. Indeno(1,2,3-c,d)pyrene is one of the polycyclic aromatic hydrocarbons (PAH) compounds which are formed during the combustion of organic material and is a component of cigarette smoke and smoke stack emissions. No carcinogenicity data specifically for indeno(1,2,3-c,d)pyrene are available in humans, however, toxic effects are attributable to mixtures of PAHs. Animal studies indicate that indeno(1,2,3-c,d)pyrene can induce skin tumors in mice, and may have some immunosuppressive effects. In mammalian cell cultures, indeno(1,2,3-c,d)pyrene was found to be genotoxic. It has been classified by the USEPA as a B2 carcinogen.

References:

MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, MA; September 1992.

Iron. Iron is a metal which is required for a variety of physiological functions such as heme biosynthesis, oxidative phosphorylation and mixed-function oxidase-mediated metabolic reactions. Only divalent forms of iron are absorbed. As absorption occurs, divalent iron is biochemically converted to trivalent iron, the biologically active form. Under normal conditions, absorbed dietary iron is complexed to hemoglobin and transported to the liver for storage until needed for physiological reactions. The balance of iron is regulated only by the amount of dietary intake and the degree of intestinal absorption. Intestinal absorption tends to be low (2 - 15%) except during periods of increased iron need when absorption efficiency increases dramatically.

Acute iron toxicity has been well characterized following the accidental ingestion of iron-containing preparations by children. Shortly after ingestion, the corrosive effects of iron cause vomiting and diarrhea, often bloody. Later signs include shock, metabolic acidosis, seizures, liver and/or kidney failure, coma, and death. Chronic iron overload manifests as disturbances in liver function, diabetes mellitus, and endocrine and cardiovascular effects. Inhalation of iron containing dust or fumes in occupational settings may result in deposition of iron particles in the lungs leading to interstitial fibrosis. Autopsies of hematite miners noted an increase in lung cancer. However, the etiology of the lung cancer may be related to factors other than iron exposure such as cigarette, silica or PAH exposures.

References:

Aisen, P., Cohen, G. and Kang, J.O., 1990. Iron Toxicosis. *Int. Rev. Exp. Pathol.* 31:1-46.

Goyer, R.A., 1991. Toxic Effects of Metals. In: Casarett and Doull's Toxicology: The Basic Science of Poisons, 3rd edition. Eds. C.D. Klaassen, M.O. Amdur and J. Doull. Macmillan Publishing Co. N.Y.

Mercury. Mercury has been used in the past for medicinal purposes; however, occupational exposure to mercury can occur during mining, smelting, chloralkali production, and in the manufacturing of mercury-containing products. There are three forms in which mercury can exist: elemental, inorganic, and organic. Its chemical form determines its toxicity. Metallic mercury causes behavioral effects and other nervous system damage. Inorganic mercury salts will produce kidney damage. Organic mercury compounds target the CNS. Most organic mercury compounds that contaminate the environment produce a toxic neuroencephalopathy (paresthesias, ataxia, spasticity, tremor, mental status changes, learning defects, and neurasthenic symptoms). Some organic mercury compounds readily break down in the body to inorganic compounds and thus produce toxicity similar to that produced by organic mercury compounds. Some studies have indicated that mercury is genotoxic. It has not been classified as to carcinogenicity by the USEPA.

References:

Amdur, Mary O., John Doull, Curtis D. Klaassen, 1991. Toxicology: The Basic Science of Poisons, 4th edition; Pergamon Press, Inc. New York.

Tetrachloroethene (Perchlroethene). Tetrachloroethene is a man-made volatile chlorinated solvent that is used extensively in the textile and dry cleaning industries as a cleanser and degreaser. Tetrachloroethene is also used as a degreaser in the electronics and metal industry. Since tetrachloroethene effectively cleans and decreases without adversely affecting what is being cleansed, tetrachloroethene is used extensively in a multitude of commercially available cleansers.

Tetrachloroethene is nearly completely absorbed via the inhalation and oral routes; dermal exposure represents a minor pathway. Oral and inhalation exposure to tetrachloroethene in humans and animals indicates that the liver, kidney, and nervous system are target organs. Long-term exposures to tetrachloroethene produced proliferative changes in the mouse livers, renal nephropathy in animals and occupationally exposed workers, and irreversible nervous system damage in laboratory animals. Additionally, an increased incidence of menstrual disorders and spontaneous abortions have been observed in women occupationally exposed to tetrachloroethene in the dry cleaning business. Epidemiological data in humans is insufficient to make conclusions regarding the potential carcinogenicity of tetrachloroethene. However, tetrachloroethene has produced hepatic cancer in laboratory animals exposed orally and by inhalation. Therefore, the USEPA has placed tetrachloroethene in weight-of-evidence group B2, probable human carcinogen.

References:

Agency for Toxic Substances and Disease Registry (ATSDR), 1991. "Toxicological Profile for Tetrachloroethene"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. October, 1991.

Thallium. Thallium is a naturally-occurring soft metal that is a minor constituent in a variety of ores and is obtained as a by-product of the refining of iron, cadmium, and zinc. It is used as a catalyst, in certain alloys, jewelry, thermometers, semiconductors, dyes and pigments, and optical lenses. It has been used medically as a depilatory agent. Additionally, it is used as a rodenticide and insecticide. Thallium is efficiently absorbed from the gastrointestinal tract. Excretion occurs primarily through urine and feces. Following absorption, distribution occurs to kidney tissue to a large extent, with lesser distribution to thyroid, intestines, testes, pancreas, skin, bone, and spleen.

Thallium is one of the more toxic metals. Acute toxicity results in gastrointestinal irritation, shock, ascending paralysis, seizures, and psychic disturbances. Signs of subacute or chronic thallium poisoning include hair loss, nail dystrophy, cataracts, peripheral muscular weakness and atrophy, chorea, peripheral neuropathy, and kidney damage. Loss of vision have been related to industrial thallium exposures. No information is available which addresses the carcinogenic potential of thallium.

References:

Goyer, R.A., 1991. Toxic Effects of Metals. In: Casarett and Doull's Toxicology: The Basic Science of Poisons, 3rd edition. Eds. C.D. Klaassen, M.O. Amdur and J. Doull. Macmillan Publishing Co. N.Y.

Tweig, M., 1990. Thallium. In: Poisoning and Drug Overdose. Ed. K.R. Olson. Appleton & Lange, CT. pps. 276-7.

Trichloroethene. Trichloroethene is a man-made chlorinated solvent that is used extensively in industry as a metal degreasing agent. Trichloroethene is also used in dry cleaning and as a solvent in paints and adhesives.

Several human deaths and acute neurotoxic effects have been attributed to oral and inhalation exposure to

trichloroethene. In animals, oral and inhalation exposure to trichloroethene have produce neurotoxic effects, including behavioral changes, and renal toxicity. Additionally, inhalation and oral exposures to trichloroethene in animals have produced lung, liver, and testicular cancers. Epidemiological data in humans is insufficient to conclude whether trichloroethene is a human carcinogen. However, studies on trichloroethene metabolism suggest that it is metabolized similarly in humans and laboratory animals. Therefore, the USEPA has placed trichloroethene in weight-of-evidence group B2, probable human carcinogen.

References:

MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, MA; September 1992.

Vinyl Chloride. Most of the vinyl chloride produced in the United States is used in the manufacture of polyvinyl chloride and other vinyl polymers. Because vinyl chloride is a gas the only significant route of exposure is inhalation. It is highly flammable. Acute exposure to vinyl chloride causes CNS depression. Several epidemiologic studies have found associations between occupational exposure and impaired liver function to vinyl chloride. Symptoms of liver disease associated with occupational exposure include pain, hepatomegaly, portal hypertension, and thrombocytopenia. Carcinogenicity studies by inhalation and oral routes in rats, mice, and hamsters resulted in liver angiosarcomas in all animals tested. Vinyl chloride workers are at increased risk for developing liver angiosarcomas, brain, skin, and lung tumors, and tumors of the lymph and blood-forming systems. Vinyl chloride is classified in group A, a human carcinogen.

References:

Clayton, George D. and Florence E. Clayton, editors, 1981. Patty's Industrial Hygiene and Toxicology, 3rd Revised Edition; John Wiley & Sons; New York.

Integrated Risk Information System (IRIS), 1993. United States Environmental Protection Agency., Vol. 48, No. 5, pp. 635-547, May 1985, U.S.A.

APPENDIX E-11
DOSE-RESPONSE VALUES

TABLE 11.1
ORAL DOSE-RESPONSE DATA
FOR CARCINOGENIC EFFECTS

Compound	Chemical Group	Weight of Evidence	Oral Slope Factor (mg/kg/day) ⁻¹	Test Species	Study Type	Tumor Type	Source
BASE NEUTRAL COMPOUNDS							
Benzo(a)anthracene	B	B2	7.3E+00 **				IRIS
Benzo(a)pyrene	B	B2	7.3E+00	Mouse	Oral-diet	Forestomach	IRIS
Benzo(b)fluoranthene	B	B2	7.3E+00 **				IRIS
Benzo(k)fluoranthene	B	B2	7.3E+00 **				IRIS
Chrysene	B	B2	7.3E+00 **				IRIS
Dibenzo(a,h)anthracene	B	B2	7.3E+00 **				IRIS
Indeno(1,2,3-cd)pyrene	B	B2	7.3E+00 **				IRIS
INORGANICS/METALS							
Aluminum	I/M	ND					
Antimony	I/M	ND					
Arsenic	I/M	A	1.5E+00	Human	Oral-DW	Skin	IRIS
Barium	I/M	ND					
Beryllium	I/M	B2	4.3E+00 W3	Rat	Oral-DW	Total	IRIS
Chromium VI	I/M	ND					
Iron	I/M	ND					
Mercury (as mercuric chloride)	I/M	C					IRIS
Thallium	I/M	ND					
PESTICIDES/PCBs							
4,4'-DDT	P	B2	3.4E-01	Mouse/rat	Oral-diet	Liver	IRIS
Endrin ketone	P	ND					
Polychlorinated Biphenyls (PCBs) high risk and persistence-upper bound	P	B2	See Below *** 2.0E+00	Rat	Oral-diet	Liver	IRIS
VOLATILES							
1,2-Dichloroethene (cis)	V	D					IRIS
1,2-Dichloroethene (trans)	V	ND					
Tetrachloroethene	V	B2	5.2E-02 (W1) (N1)				NCEA HEAST
Trichloroethene	V	B2	1.1E-02 (W2) (N1)				HEAST
Vinyl Chloride	V	A	1.9E+00	Rat	Oral-diet	Lung, liver	HEAST

TABLE E-11.1
 ORAL DOSE-RESPONSE DATA
 FOR CARCINOGENIC EFFECTS

Compound	Chemical Group	Weight of Evidence	Oral Slope Factor (mg/kg/day) ⁻¹	Test Species	Study Type	Tumor Type	Source
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NOTES:

ND - Not determined/No data

DW - Drinking water

mg - milligram

kg - kilogram

IRIS - Integrated Risk Information System

HEAST - Health Effects Assessment Summary Tables

NCEA - National Center for Environmental Assessment

Sources:

IRIS as of 1/98

HEAST, 1997

NCEA, date varies.

Chemical Groups:

A - Acid extractable

B - Base neutral extractable

I/M - Inorganic/Metal

P - Pesticide

V - Volatile

W - Waste

+ - Based on IRIS for 2,4-; 2,6-Dinitrotoluene mixture

* - The value for chlordane is used as surrogate for the isomers.

** - Slope Factor for Benzo(a)Pyrene used for other carcinogenic PAHs. EPCs for other PAHs should be adjusted for B(a)P equivalent concentrations using toxicity equivalency factors: 1.0 [benzo(a)pyrene]; 1.0: [dibenz(a,h)anthracene]; 0.1 [benzo(a)anthracene, benzo(b)fluoranthene, indeno(1,2,3-c,d)pyrene]; 0.01 [benzo(k)fluoranthene]; 0.001 [chrysene].
 *** Slope factors are applicable to Aroclors 1016, 1248, 1254, and 1260.

Weight of Evidence (Route-Specific):

A - Human carcinogen

B - Probable human carcinogen

B1 - limited evidence of cancer in humans

B2 - sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans

C - Possible human carcinogen

D - Not classifiable as to human carcinogenicity

E - Evidence of lack of carcinogenicity to humans

W1 = Value was withdrawn from HEAST in FY 1992 update

W2 = Value of 1.1E-02 was withdrawn from HEAST in FY 1992 update

W3 = Value was withdrawn from IRIS April, 1998

N1 = An NCEA provisional regional support value has been provided in response to a specific request.

TABLE E-11.2
DERMAL DOSE-RESPONSE DATA
FOR CARCINOGENIC EFFECTS

Compound	CHEMICAL SOURCE	Weight of Evidence	ORAL SLOPE FACTOR (mg/kg/day) ¹		ORAL ABSORPTION EFFICIENCY	REFERENCE	DERMAL SLOPE FACTOR (mg/kg/day) ¹
BASE NEUTRAL COMPOUNDS							
Benzo(a)anthracene	B	B2	7.3E+00	**	91%	[4]	8.0E+00
Benzo(a)pyrene	B	B2	7.3E+00		91%	Hecht et al., 1979	8.0E+00
Benzo(b)fluoranthene	B	B2	7.3E+00	**	91%	[4]	8.0E+00
Benzo(k)fluoranthene	B	B2	7.3E+00	**	91%	[4]	8.0E+00
Chrysene	B	B2	7.3E+00	**	91%	[4]	8.0E+00
Dibenzo(a,h)anthracene	B	B2	7.3E+00	**	91%	[4]	8.0E+00
Indeno(1,2,3-cd)pyrene	B	B2	7.3E+00	**	91%	[4]	8.0E+00
INORGANICS/METALS							
Aluminum	I/M	ND			20%	USEPA, 1995	ND
Antimony	I/M	ND			10%	ATSDR, 1991	ND
Arsenic	I/M	A	1.5E+00		98%	Vahter, 1983	1.5E+00
Barium	I/M	ND			7%	ATSDR, 1991	ND
Beryllium	I/M	B2	4.3E+00	W3	1%	Owen, 1990	4.3E+02
Chromium VI	I/M	ND			11%	Ogawa, 1976	ND
Iron	I/M	D			2%	Goyer, 1991	ND
Mercury (as mercuric chloride)	I/M	ND			20%	Nielsen, 1992	ND
Thallium (based on thallium sulfate)	I/M	D			100%	Lie et al., 1960	ND
PESTICIDES/PCBs							
4,4'-DDT	P	B2	3.4E-01		20%	Siebert, 1976	1.7E+00
Endrin ketone	P	ND					ND
Polychlorinated Biphenyl (PCBs) high risk and persistence-upper bound	P	B2	See Below	***		Albro & Fishbein, 1972	
			2.0E+00		90%		2.2E+00
VOLATILES							
1,2-Dichloroethene (cis)	V	D			100%	[2]	ND
1,2-Dichloroethene (trans)	V	ND			100%	[2]	ND
Tetrachloroethene	V	B2	5.2E-02	(W1) (N1)	100%	Pegg et al., 1979	5.2E-02
Trichloroethene	V	B2	1.1E-02	(W2) (N1)	100%	Prout et al., 1985	1.1E-02
Vinyl Chloride	V	A	1.9E+00		100%	Watanabe et al., 1976	ND

TABLE E-11.2
DERMAL DOSE-RESPONSE DATA
FOR CARCINOGENIC EFFECTS

Compound	CHEMICAL SOURCE	Weight of Evidence	ORAL SLOPE FACTOR (mg/kg/day) ¹	ORAL ABSORPTION EFFICIENCY	REFERENCE	DERMAL SLOPE FACTOR (mg/kg/day) ¹
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NOTES:

ND - Not determined/No data
DW - Drinking water
mg - milligram
kg - kilogram
IRIS - Integrated Risk Information System
HEAST - Health Effects Assessment Summary Tables
NCEA - National Center for Environmental Assessment

Sources:

IRIS as of 1/98
HEAST, 1997
NCEA, date varies.

Chemical Groups:

A - Acid extractable
B - Base neutral extractable
I/M - Inorganic/Metal
P - Pesticide
V - Volatile
W - Waste

Weight of Evidence (Route-Specific):

A - Human carcinogen
B - Probable human carcinogen
 B1 - limited evidence of cancer in humans
 B2 - sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans
C - Possible human carcinogen
D - Not classifiable as to human carcinogenicity
E - Evidence of lack of carcinogenicity to humans

USEPA, 1995: Chemicals without specific information on absorption efficiency are assigned default values as follows:
VOCs: 80%; SVOCs and pesticides: 50%; Inorganics: 20%.

- [1] Dose-response value is based on absorbed dose; no adjustment is necessary.
- [2] Value for 1,1-dichloroethene used as surrogate, based on structural analogy.
- [3] Value for phenol used as surrogate.
- [4] Value for benzo(a)pyrene used for all PAHs without specific values.
- [5] Value for bis(2-ethylhexyl)phthalate used for all phthalate esters, based on structural analogy.
- [6] Value for DDT used for DDD and DDE, based on structural analogy.
- [7] Value used for all endosulfan compounds, based on structural analogy.
- [8] Value for heptachlor used for heptachlor epoxide, based on structural analogy.

+ - Based on IRIS for 2,4-, 2,6-Dinitrotoluene mixture

* - The value for chlordane is used as surrogate for the isomers.

** - Slope Factor for Benzo(a)Pyrene used for other carcinogenic PAHs. EPCs for other PAHs should be adjusted for B(a)P equivalent concentrations using toxicity equivalency factors: 1.0 [benzo(a)pyrene]; 1.0: [dibenz(a,h)anthracene]; 0.1 [benzo(a)anthracene, benzo(b)fluoranthene, indeno(1,2,3-c,d)pyrene]; 0.01 [benzo(k)fluoranthene]; 0.001 [chrysene].
*** Slope factors are applicable to Aroclors 1016, 1248, 1254, and 1260.

W1 = Value was withdrawn from HEAST in FY 1992 update

W2 = Value of 1.1E-02 was withdrawn from HEAST in FY 1992 update

W3 = Value was withdrawn from IRIS April, 1998

N1 = An NCEA provisional regional support value has been provided in response to a specific request.



T- 2-11.3
**INHALATION DOSE-RESPONSE DATA
 FOR CARCINOGENIC EFFECTS**

Compound	Chemical Group	Weight of Evidence	Inhalation Slope Factor* (mg/kg/day) ⁻¹	Unit Risk (µg/m ³) ⁻¹	Test Species	Study Type	Tumor Type	Source
BASE NEUTRAL COMPOUNDS								
Benzo(a)anthracene	B	B2	3.1E+00 ***	8.8E-04 ***				USEPA,1995
Benzo(a)pyrene	B	B2	3.1E+00 (W2)	8.8E-04				USEPA,1995
Benzo(b)fluoranthene	B	B2	3.1E+00 ***	8.8E-04 ***				USEPA,1995
Benzo(k)fluoranthene	B	B2	3.1E+00 ***	8.8E-04 ***				USEPA,1995
Chrysene	B	B2	3.1E+00 ***	8.8E-04 ***				USEPA,1995
Dibenzo(a,h)anthracene	B	B2	3.1E+00 ***	8.8E-04 ***				USEPA,1995
Indeno(1,2,3-cd)pyrene	B	B2	3.1E+00 ***	8.8E-04 ***				USEPA,1995
INORGANICS/METALS								
Aluminum	I/M	ND						
Antimony	I/M	ND						
Arsenic	I/M	A	1.5E+01 (W1)	4.3E-03	Human	Inhalation	Lung	IRIS
Barium	I/M	ND						
Beryllium	I/M	B2	8.4E+00	2.4E-03	Human	Inhalation	Lung	IRIS
Chromium VI	I/M	A	4.1E+01	1.2E-02	Human	Inhalation	Lung	IRIS
Iron	I/M	ND						
Mercury (as mercuric chloride)	I/M	D						IRIS
Thallium	I/M	ND						
PESTICIDES/PCBs								
4,4'-DDT	P	B2	3.4E-01	9.7E-05	Mouse	Oral-diet	Liver	IRIS
Endrin ketone	P	ND						
Polychlorinated Biphenyls (PCBs) high risk and persistence-upper bound	P	B2	See Below ** 2.0E+00		Rat	Oral-diet	Liver	IRIS
VOLATILES								
1,2-Dichloroethene (cis)	V	D						IRIS
1,2-Dichloroethene (trans)	V	ND						
Tetrachloroethene	V	B2	2.0E-03 (N1)	5.8E-07 (N1)				NCEA/HEAST
Trichloroethene	V	B2	6.0E-03 (N1)	2.0E-06 (N1)				NCEA/HEAST
Vinyl Chloride	V	A	3.0E-01	8.4E-05	Rat	Inhalation	Liver tumors	HEAST

TABLE E-11.3
 INHALATION DOSE-RESPONSE DATA
 FOR CARCINOGENIC EFFECTS

Compound	Chemical Group	Weight of Evidence	Inhalation Slope Factor* (mg/kg/day) ⁻¹	Unit Risk (µg/m ³) ⁻¹	Test Species	Study Type	Tumor Type	Source
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NOTES:

ND - Not determined/No data

DW - Drinking water

µg - microgram

mg - milligram

kg - kilogram

IRIS - Integrated Risk Information System

HEAST - Health Effects Assessment Summary Tables

NCEA - National Center for Environmental Assessment

Sources:

IRIS as of 1/98

HEAST, 1997 (including July updates)

NCEA from USEPA Region III Risk Based Concentrations, January - June, 1996.

USEPA, 1995. USEPA Region IV Human Health Risk Assessment Bulletin #2, November, 1995.

* - Source of slope factor is HEAST, 1995 unless otherwise noted.

c - Calculated by ABB-ES from unit risk [slope = ((unit risk x 70 kg)/20 m³/day) x 1000 ug/mg]

** Slope factors are applicable to Aroclors 1016, 1248, 1254, and 1260.

** - Slope Factor for Benzo(a)Pyrene used for other carcinogenic

PAHs. EPCs for other PAHs should be adjusted for B(a)P equivalent concentrations using toxicity equivalency factors: 1.0 [benzo(a)pyrene];

1.0: [dibenz(a,h)anthracene]; 0.1 [benzo(a)anthracene, benzo(b)fluoranthene, indeno(1,2,3-c,d)pyrene]; 0.01 [benzo(k)fluoranthene]; 0.001 [chrysene].

+ - Value for chlordane used for alpha- and gamma- isomers.

W1 = Value was withdrawn from HEAST in FY 1997 update

W2 = Value of 6.1E+00 was withdrawn from HEAST in FY 1993 update

W3 = Value was withdrawn from HEAST in FY 1992 update

N1 = An NCEA provisional regional support value has been provided in response to a specific request.

Chemical Groups:

A - Acid extractable

B - Base neutral extractable

IM - Inorganic/Metal

P - Pesticide

V - Volatile

W - Waste

Weight of Evidence (Route-Specific):

A - Human carcinogen

B - Probable human carcinogen

B1 - limited evidence of cancer in humans

B2 - sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans

C - Possible human carcinogen

D - Not classifiable as to human carcinogenicity

E - Evidence of lack of carcinogenicity to humans

TA 11.4
 ORAL DOSE-RESPONSE DATA
 FOR NONCARCINOGENIC EFFECTS

Compound	CHEMICAL SOURCE	CHRONIC ORAL RfD (mg/kg-day)	SUBCHRONIC ORAL RfD(1) (mg/kg-day)	STUDY TYPE	CONFIDENCE LEVEL	CRITICAL EFFECT	TEST ANIMAL	UNCERTAINTY FACTOR	SOURCE
BASE NEUTRAL COMPOUNDS									
Benzo(a)anthracene	B	ND	ND						
Benzo(a)pyrene	B	ND	ND						IRIS
Benzo(b)fluoranthene	B	ND	ND						IRIS
Benzo(k)fluoranthene	B	ND	ND						IRIS
Chrysene	B	ND	ND						IRIS
Dibenzo(a,h)anthracene	B	ND	ND						IRIS
Indeno(1,2,3-cd)pyrene	B	ND	ND						IRIS
INORGANICS/METALS									
Aluminum	I/M	1.0E+00 (N1)	ND						
Antimony	I/M	4.0E-04	4.0E-04	Oral-DW	Low	Reduced lifespan	Rat	1,000 H,A,L	NCEA
Arsenic	I/M	3.0E-04	3.0E-04	Oral-DW	Medium	Keratoses and hyperpigmentation	Human	3 H	IRIS
Barium	I/M	7.0E-02	7.0E-02	Oral-DW	Medium	Increased blood pressure	Human	3 H	IRIS
Beryllium	I/M	2.0E-03	2.0E-03	Oral-DW	Low	No effects observed	Rat	100 H,A	IRIS
Chromium VI	I/M	5.0E-03	2.0E-02	Oral-DW	Low	No effects observed	Rat	500 H,A,S	IRIS
Iron	I/M	3.0E-01 (N1)	ND						NCEA
Mercury (as mercuric chloride)	I/M	3.0E-04	3.0E-03	Oral-diet	High	Autoimmune effects	Rat	1,000 H,A,S,L	IRIS
Thallium (based on thallium sulfate)	I/M	8.0E-05	8.0E-04	Oral-gavage	Low	No effects observed	Rat	3,000 H,A,S,D	IRIS
PESTICIDES/PCBs									
4,4'-DDT	P	5.0E-04	5.0E-04	Oral-diet	Medium	Liver lesions	Rat	100 H,A	IRIS
Endrin ketone	P	3.0E-04	3.0E-04	---	---				IRIS
Polychlorinated Biphenyl (PCBs)	P	2.0E-05	5.0E-05	---	---				IRIS
VOLATILES									
1,2-Dichloroethene (cis)	V	1.0E-02	1.0E-01	Oral-gavage		Decreased hematocrit and hemoglobin	Rat	3,000	HEAST
1,2-Dichloroethene (trans)	V	2.0E-02	2.0E-01	Oral-DW	Low	Increased serum alkaline phosphatase	Mouse	1,000 H,A,S	IRIS
Tetrachloroethene	V	1.0E-02	1.0E-01	Oral-gavage	Medium	Hepatotoxicity	Mouse	1,000 H,A,S	IRIS
Trichloroethene	V	6.0E-03 (N1)	ND						NCEA
Vinyl Chloride	V	ND	ND						NCEA

TABLE E-11.4
 ORAL DOSE-RESPONSE DATA
 FOR NONCARCINOGENIC EFFECTS

Compound	CHEMICAL SOURCE	CHRONIC ORAL RfD (mg/kg-day)	SUBCHRONIC ORAL RfD ^[1] (mg/kg-day)	STUDY TYPE	CONFIDENCE LEVEL	CRITICAL EFFECT	TEST ANIMAL	UNCERTAINTY FACTOR	SOURCE
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NOTES:

ND - No data available
 W - RfD withdrawn from IRIS/HEAST
 mg - milligram
 kg - kilogram
 DW - Drinking Water
 IRIS - Integrated Risk Information System
 HEAST - Health Effects Assessment Summary Tables
 NCEA - National Center for Environmental Assessment (formerly ECAO)

[1] - Source for all subchronic RfDs is HEAST (1997) if chronic RfD is from IRIS or HEAST (1997), unless otherwise indicated.
 [2] TPH dose-response assessment performed using values developed by Massachusetts Department of Environmental Protection, per USEPA, 1995.
 * RfD for pyrene used for the aromatics EPH and VPH fractions, per MADEP 1997
 ***RfD for Aroclor 1254 used as surrogate
 ~RfD for Endosulfan used as surrogate
 ~~ RfD for Endrin used as surrogate
 ! RfD for manganese in food divided by modifying factor of 3, as recommended in IRIS
 II RfD for manganese in food divided by modifying factor of 3, as recommended in IRIS
 ' Value for chlordane used for alpha- and gamma- isomers.
 * RfD for pyrene used for the aromatics EPH and VPH fractions, per MADEP 1997
 @ Value for n-hexane used as surrogate, per MADEP, 1997
 @@ Value based on n-hexane, per MADEP, 1997

Uncertainty factors:
 H - variation in human sensitivity
 A - animal to human extrapolation
 S - extrapolation from subchronic to chronic NOAEL
 L - extrapolation from LOAEL to NOAEL
 N - NOEL not attained
 D - Lack of supporting data
 M - additional modifying factor

(H1) A drinking water standard for ammonia of 34 mg/L is available; RfD has not been calculated from this standard.
 (H2) A drinking water standard for copper of 1.3 mg/L is available; RfD has not been calculated from this standard.

W1 = Value was withdrawn from HEAST in FY 1993 update
 W2 = Value was withdrawn from HEAST in FY 1992 supplement #2 update
 W3 = Value was withdrawn from HEAST in FY 1997 update

SOURCES:
 IRIS as of 1/98; chronic RfDs
 HEAST, FY 1997; chronic and subchronic RfDs
 NCEA; RfDs
 USEPA, 1995 USEPA Region IV Human Health Risk Assessment Bulletin #2, November, 1995; RfDs.
 MADEP, 1997. Revisions to the Massachusetts Contingency Plan, 10/31/97

N1 = An NCEA provisional regional support value has been provided in response to a specific request.
 N2 = An NCEA provisional regional support value of 5E-02 has been published in Region III RBC Table
 N3 = An NCEA provisional regional support value of 1E-02 has been published in Region III RBC Table
 N4 = An NCEA provisional regional support value of 5E-03 has been published in Region III RBC Table
 USEPA Region III Risk Based Concentrations, March 17, 1997.

CHEMICAL GROUPS
 A - Acid extractable
 B - Base neutral extractable
 I/M - Inorganic/Metal
 P - Pesticide
 V - Volatile
 W - Waste
 X - Other



TABLE E-11.5
DERMAL DOSE-RESPONSE DATA
FOR NONCARCINOGENIC EFFECTS

Compound	CHEMICAL SOURCE	CHRONIC ORAL RfD (mg/kg-day)	SUBCHRONIC ORAL RfD(1) (mg/kg-day)	ORAL ABSORPTION EFFICIENCY	REFERENCE	CHRONIC DERMAL RfD (mg/kg-day)	SUBCHRONIC DERMAL RfD (mg/kg-day)
BASE NEUTRAL COMPOUNDS							
Benzo(a)anthracene	B	ND	ND	91%	[6]	ND	ND
Benzo(a)pyrene	B	ND	ND	91%	Hecht et al., 1979	ND	ND
Benzo(b)fluoranthene	B	ND	ND	91%	[6]	ND	ND
Benzo(k)fluoranthene	B	ND	ND	91%	[6]	ND	ND
Chrysene	B	ND	ND	91%	[6]	ND	ND
Dibenzo(a,h)anthracene	B	ND	ND	91%	[6]	ND	ND
Indeno(1,2,3-cd)pyrene	B	ND	ND	91%	[6]	ND	ND
INORGANICS/METALS							
Aluminum	I/M	1.0E+00 (N1)	ND	20%	USEPA, 1995	2.0E-01	ND
Antimony	I/M	4.0E-04	4.0E-04	10%	ATSDR, 1991	4.0E-05	4.0E-05
Arsenic	I/M	3.0E-04	3.0E-04	98%	Vahter, 1983	2.9E-04	2.9E-04
Barium	I/M	7.0E-02	7.0E-02	7%	ATSDR, 1991	4.9E-03	4.9E-03
Beryllium	I/M	2.0E-03	2.0E-03	1%	Owen, 1990	2.0E-05	2.0E-05
Chromium VI	I/M	5.0E-03	2.0E-02	11%	Ogawa, 1976	5.5E-04	2.2E-03
Iron	I/M	3.0E-01 (N1)	ND	2%	Goyer, 1991	6.0E-03	ND
Mercury (as mercuric chloride)	I/M	3.0E-04	3.0E-03	20%	Nielsen, 1992	6.0E-05	6.0E-04
Thallium (based on thallium sulfate)	I/M	8.0E-05	8.0E-04	100%	Lie et al., 1960	8.0E-05	8.0E-04
PESTICIDES/PCBs							
4,4'-DDT	P	5.0E-04	5.0E-04	20%	Siebert, 1976	1.0E-04	1.0E-04
Endrin ketone	P	3.0E-04	3.0E-04	~~			
Polychlorinated Biphenyl (PCBs)	P	2.0E-05	5.0E-05	90%	Albro & Fishbein, 1972	1.8E-05	4.5E-05
VOLATILES							
1,2-Dichloroethene (cis)	V	1.0E-02	1.0E-01	100%	[4]	1.0E-02	1.0E-01
1,2-Dichloroethene (trans)	V	2.0E-02	2.0E-01	100%	[4]	2.0E-02	2.0E-01
Tetrachloroethene	V	1.0E-02	1.0E-01	100%	Pegg et al., 1979	1.0E-02	1.0E-01
Trichloroethene	V	6.0E-03 (N1)	ND	100%	Prout et al., 1985	6.0E-03	ND
Vinyl Chloride	V	ND	ND	100%	Watanabe et al., 1976	ND	ND

TABLE E-11.5
DERMAL DOSE-RESPONSE DATA
FOR NONCARCINOGENIC EFFECTS

Compound	CHEMICAL SOURCE	CHRONIC ORAL RfD (mg/kg-day)	SUBCHRONIC ORAL RfD[1] (mg/kg-day)	ORAL ABSORPTION EFFICIENCY	REFERENCE	CHRONIC DERMAL RfD (mg/kg-day)	SUBCHRONIC DERMAL RfD (mg/kg-day)
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NOTES:

ND - No data available

W - RfD withdrawn from IRIS/HEAST

mg - milligram

kg - kilogram

DW - Drinking Water

IRIS - Integrated Risk Information System

HEAST - Health Effects Assessment Summary Tables

NCEA - National Center for Environmental Assessment (formerly ECAO)

Uncertainty factors:

H - variation in human sensitivity

A - animal to human extrapolation

S - extrapolation from subchronic to chronic NOAEL

L - extrapolation from LOAEL to NOAEL

N - NOEL not attained

D - Lack of supporting data

M - additional modifying factor

SOURCES:

IRIS as of 1/98; chronic RfDs

HEAST, FY 1997; chronic and subchronic RfDs

NCEA; RfDs

USEPA, 1995. USEPA Region IV Human Health Risk Assessment

Bulletin # 2, November, 1995; RfDs.

MADEP, 1997. Revisions to the Massachusetts Contingency Plan, 10/31/97

CHEMICAL GROUPS:

A - Acid extractable

B - Base neutral extractable

I/M - Inorganic/Metal

P - Pesticide

V - Volatile

W - Waste

X - Other

USEPA, 1995: Chemicals without specific information on absorption efficiency are assigned default values as follows:

VOCs: 80%; SVOCs and pesticides: 50%; Inorganics: 20%.

[1] - Source for all subchronic RfDs is HEAST (1997) if chronic RfD is from IRIS or HEAST (1997), unless otherwise indicated.

[2] TPH dose-response assessment performed using values developed by Massachusetts Department of Environmental Protection, per USEPA, 1995.

[3] Dose-response value is based on absorbed dose; no adjustment is necessary.

[4] Value for 1,1-dichloroethene used as surrogate, based on structural analogy.

[5] Value for phenol used as surrogate.

[6] Value for benzo(a)pyrene used for all PAHs without specific values.

[7] Value for bis(2-ethylhexyl)phthalate used for all phthalate esters, based on structural analogy.

[8] Value for DDT used for DDD and DDE, based on structural analogy.

[9] Value used for all endosulfan compounds, based on structural analogy.

[10] Value for heptachlor used for heptachlor epoxide, based on structural analogy.

* RfD for pyrene used for the aromatics EPH and VPH fractions, per MADEP 1997

**RfD for Aroclor 1254 used as surrogate

~RfD for Endosulfan used as surrogate

~~ RfD for Endrin used as surrogate

! RfD for manganese in food divided by modifying factor of 3, as recommended in IRIS

!! RfD for manganese in food divided by modifying factor of 3, as recommended in IRIS

' Value for chlordane used for alpha- and gamma- isomers.

* RfD for pyrene used for the aromatics EPH and VPH fractions, per MADEP 1997

@ Value for n-hexane used as surrogate, per MADEP, 1997

@@ Value based on n-hexane, per MADEP, 1997

(H1) A drinking water standard for ammonia of 34 mg/L is available; RfD has not been calculated from this standard.

(H2) A drinking water standard for copper of 1.3 mg/L is available; RfD has not been calculated from this standard.

W1 = Value was withdrawn from HEAST in FY 1993 update

W2 = Value was withdrawn from HEAST in FY 1992 supplement #2 update

W3 = Value was withdrawn from HEAST in FY 1997 update

N1 = An NCEA provisional regional support value has been provided in response to a specific request.

N2 = An NCEA provisional regional support value of 5E-02 has been published in Region III RBC Table

N3 = An NCEA provisional regional support value of 1E-02 has been published in Region III RBC Table

N4 = An NCEA provisional regional support value of 5E-03 has been published in Region III RBC Table

USEPA Region III Risk Based Concentrations, March 17, 1997.

T_a 11.6
**INHALATION DOSE-RESPONSE DATA
 FOR NONCARCINOGENIC EFFECTS**

COMPOUND	CHEMICAL GROUP	CHRONIC INHALATION RIC (mg/m ³)	SUBCHRONIC[1] INHALATION RIC (mg/m ³)	CHRONIC INHALATION RID[2] (mg/kg-day)	SUBCHRONIC INHALATION RID[2] (mg/kg-day)	STUDY TYPE	CONFIDENCE LEVEL	CRITICAL EFFECT	TEST ANIMAL	UNCERTAINTY FACTOR	SOURCE
BASE NEUTRAL COMPOUNDS											
Benzo(a)anthracene	B	ND	ND	ND	ND						
Benzo(a)pyrene	B	ND	ND	ND	ND						
Benzo(b)fluoranthene	B	ND	ND	ND	ND						
Benzo(k)fluoranthene	B	ND	ND	ND	ND						
Chrysene	B	ND	ND	ND	ND						
Dibenzo(a,h)anthracene	B	ND	ND	ND	ND						
Indeno(1,2,3-cd)pyrene	B	ND	ND	ND	ND						
INORGANICS/METALS											
Aluminum	I/M	ND	ND	ND	ND						
Antimony	I/M	ND	ND	ND	ND						
Arsenic	I/M	ND	ND	ND	ND						
Barium	I/M	5.0E-04	5.0E-03	1.0E-04 [3]	1.0E-04 [3]	Inhalation	Low	Fetotoxicity	Rat	1,000 H,A,S	HEAST
Beryllium	I/M	ND	ND	ND	ND						
Chromium VI	I/M	ND	ND	ND	ND						
Iron	I/M	ND	ND	ND	ND						
Mercury (as elemental mercury)	I/M	3.0E-04	3.0E-04	8.6E-05 [2]	8.6E-05 [2]	Inhalation	Low	Neurotoxicity	Human	30 H,D	HEAST
Thallium	I/M	ND	ND	ND	ND						
PESTICIDES/PCBs											
4,4'-DDT	P	ND	ND	ND	ND						
Endrin ketone	P	ND	ND	ND	ND						
Polychlorinated Biphenyls (PCBs)	P	ND	ND	ND	ND						
VOLATILES											
1,2-Dichloroethene (cis)	V	ND	ND	ND	ND						
1,2-Dichloroethene (trans)	V	ND	ND	ND	ND						
Tetrachloroethene	V	ND	ND	ND	ND						
Trichloroethene	V	ND	ND	ND	ND						
Vinyl Chloride	V	ND	ND	ND	ND						

TABLE E-11.6
 INHALATION DOSE-RESPONSE DATA
 FOR NONCARCINOGENIC EFFECTS

COMPOUND	CHEMICAL GROUP	CHRONIC INHALATION RIC (mg/m ³)	SUBCHRONIC ^[1] INHALATION RIC (mg/m ³)	CHRONIC INHALATION RID ^[2] (mg/kg-day)	SUBCHRONIC INHALATION RID ^[2] (mg/kg-day)	STUDY TYPE	CONFIDENCE LEVEL	CRITICAL EFFECT	TEST ANIMAL	UNCERTAINTY FACTOR	SOURCE
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-11.6
**INHALATION DOSE-RESPONSE DATA
 FOR NONCARCINOGENIC EFFECTS**

COMPOUND	CHEMICAL GROUP	CHRONIC INHALATION RfC (mg/m ³)	SUBCHRONIC[1] INHALATION RfC (mg/m ³)	CHRONIC INHALATION RfD[2] (mg/kg-day)	SUBCHRONIC INHALATION RfD[2] (mg/kg-day)	STUDY TYPE	CONFIDENCE LEVEL	CRITICAL EFFECT	TEST ANIMAL	UNCERTAINTY FACTOR	SOURCE
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NOTES:

ND - No data available
 W - RfD withdrawn from IRIS/HEAST
 mg - milligram
 kg - kilogram
 µg - microgram
 DW - Drinking Water
 IRIS - Integrated Risk Information System
 HEAST - Health Effects Assessment Summary Tables
 NCEA - National Center for Environmental Assessment

SOURCES:

IRIS as of 1/98; chronic RfCs
 HEAST, FY 1997; chronic and subchronic RfCs and RfDs
 USEPA, 1995. USEPA Region IV Human Health Risk Assessment Bulletin #2, November, 1995; RfDs
 MADEP, 1997. Revisions to the Massachusetts Contingency Plan, 10/31/97

Uncertainty factors:

H - variation in human sensitivity
 A - animal to human extrapolation
 S - extrapolation from subchronic to chronic NOAEL
 L - extrapolation from LOAEL to NOAEL
 N - NOEL not attained
 D - Lack of supporting data
 M - additional modifying factor

Chemical Group:

A - Acid extractable
 B - Base neutral extractable
 I/M - Inorganic/Metal
 P - Pesticide
 V - Volatile
 W - Waste
 X - Other

[1] Source of all subchronic RfCs is HEAST (1997)
 [2] - RfD calculated by ABB-ES from RfC as follows, per USEPA, 1995:
 $RfD (mg/kg-d) = RfC (mg/m^3) / 70 kg \times 20 m^3/d$, unless otherwise indicated
 [3] - HEAST Table 2: Alternate Methods; RfD calculated from RfC by HEAST
 [4] - There is a National Ambient Air Quality Standard for lead of 1.5 µg/m³ averaged over three months
 [5] TPH dose-response assessment performed using values developed by Massachusetts Department of Environmental Protection, per USEPA, 1995.
 ~Value for naphthalene is used as surrogate for C10-C22 aromatics fraction, per MADEP, 1997.
 -- Value for xylenes used as surrogate. For the C9-C10 aromatics VPH fraction, the value represents 20% of the xylene RfC, per MADEP, 1997.
 @@ Value for n-hexane used as surrogate, per MADEP 1997
 @@@ Value based on n-hexane, per MADEP 1997
 W1 = Value was withdrawn from HEAST in FY 1993 update
 W2 = Value was withdrawn from HEAST in FY 1993 update
 W3 = Value was withdrawn from HEAST in FY 1992 supplement #2 update
 W4 = Value was withdrawn from HEAST in FY 1993 supplement #2 update
 W5 = Value was withdrawn from HEAST in FY 1993 update