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FINAL REMEDIAL INVESTIGATION REPORT REVISION 2 FOR OPERABLE UNIT 2 (OU 2) MCCOY ANNEX LANDFILL VOLUME 1 OF 3 PART B SECTIONS 5.0 THROUGH REFERENCES NTC ORLANDO FL

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REMEDIAL INVESTIGATION REPORT

for

OPERABLE UNIT 2
McCOY ANNEX LANDFILL

Naval Training Center
Orlando, Florida

VOLUME I OF III
(TEXT)

Southern Division
Naval Facilities Engineering Command
Contract Number N62467-94-D-0888
Contract Task Order CTO-0024

MARCH 2001

5.0 INVESTIGATION RESULTS

5.1 LANDFILL BOUNDARIES AND COVER

The primary investigations to determine the locations of the landfill boundaries and the thickness of the soil cover over the landfill were performed during Phase I. Investigations were conducted during Phase II for the area to the west of the golf course and in the wooded area to the south. Additional Phase III activities were conducted on the golf course and in the wooded area to the south. The results of the investigations are presented below.

5.1.1 Extent of Landfill

The G-858 magnetometer/gradiometer and the EM31 terrain conductivity meter were used to identify areas of landfill material and define the landfill boundaries. Color-contoured maps of the total field magnetic and terrain conductivity results are presented in Figures 5-1A and 5-1B, respectively. Areas of the site that contain surface or buried metallic objects are color-contoured in shades of reds, purples, or deep blue. Shades of yellow and shades of green indicate areas where metallic objects were not detected.

The EM terrain conductivity data indicate that two types of soil are present at this site that are representative of background conditions: clean sandy soils and fill, and silty sands that contain organic materials. The terrain conductivity values for the clean sandy soils were approximately 8 to 10 millimhos per meter and are presented in shades of green (Figure 5-1B). These sandy soils and fill are present throughout the southern areas of the site. The organic-rich soils were present in the northwestern forested area of the site near golf course hole No. 9. The presence of the organic materials and silt in the soil resulted in higher values of terrain conductivity relative to the surrounding clean sandy soils and fill. The terrain conductivity of the organic-rich soils was observed to be 11 to 16 millimhos per meter. These areas are color-contoured in shades of orange and red-orange. Anomalous responses suspected to represent buried waste were observed to have a terrain conductivity data range of 14 millimhos per meter and greater. These responses are color-contoured in shades of reds and purple. The lower range of terrain conductivity values indicative of buried waste overlapped the upper range of values for natural soils with a high organic content. The terrain conductivity values representative of surface or buried metallic objects and debris are presented in shades of deep blue. The magnetic data were not affected by the presence of organic-rich soils.

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48618.8
48528.5
48477.3
48431.7
48398.8
48365.0
48338.7
48310.8
48288.2
48263.5
48243.0
48223.0
48200.5
48181.5
48159.5
48140.5
48118.5
48099.5
48077.0
48057.0
48036.5
48011.8
47989.2
47961.3
47935.0
47901.2
47868.3
47822.7
47771.5
47681.3

NanoTeslas
(nT)

8TH EXPRESS STREET

POND
SWAMP/ WOODS
AREA
MARSH
BOGGY CREEK ROAD
TRADEPORT DRIVE
LAKE GILLOOLY

300 0 300
SCALE IN FEET

5-3

CTO 0024

FIGURE 5-1A

TOTAL FIELD MAGNETIC RESULTS
McCOY ANNEX LANDFILL
REMEDIAL INVESTIGATION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

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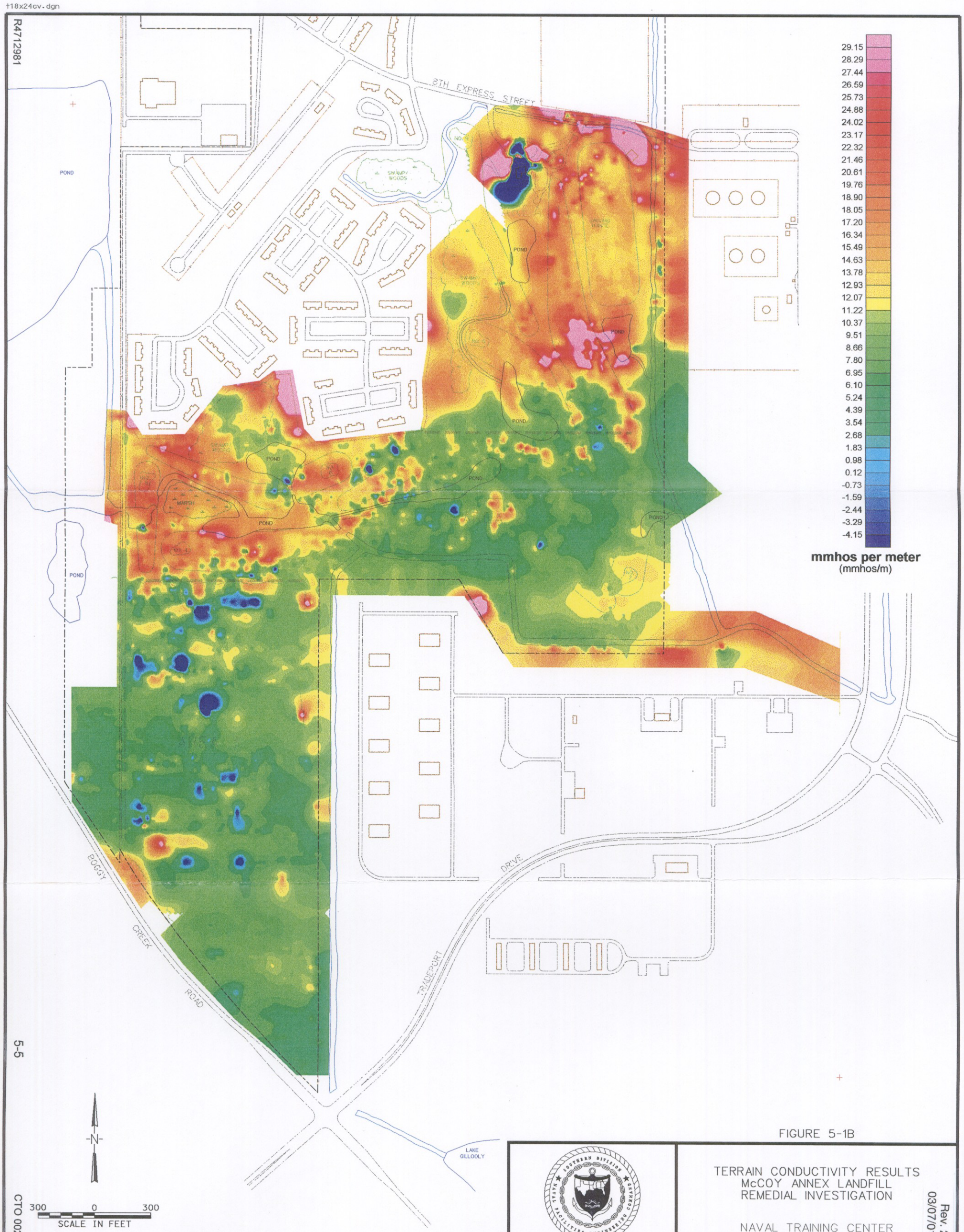

5-5

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FIGURE 5-1B

TERRAIN CONDUCTIVITY RESULTS
McCOY ANNEX LANDFILL
REMEDIAL INVESTIGATION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

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The magnetic and EM data sets provided similar results in their delineation of the presence of buried wastes and disturbed soils. However, the magnetic data provide much better definition of the boundaries of the landfill. The magnetic data sets appear to have a higher resolution and contain higher frequency responses relative to the EM data. The EM responses are generally observed to be broad, low-frequency responses. This contrast is believed to be the result of the magnetic instrumentation detecting the presence of only buried ferrous metals, while the EM equipment detected the presence of contaminated fill, disturbed soils, stratigraphic changes, and metallic debris.

Clusters of high-frequency, anomalous magnetic and EM responses were observed across much of the golf course and the northern half of the forested area. These anomalous responses are shown in shades of purple, red, and blue on Figures 5-1A and 5-1B. Two general areas of the site appear to represent regions of organized waste disposal activity, and they appear to be the areas in which a majority of the wastes were disposed. The first region is located approximately between the southern area of the driving range and the middle area of the No. 1 fairway (Figure 5-1C). The area extends to the west near the tee for hole No. 9 and the middle of the No. 8 fairway. This area appears to contain a series of east–west trending anomalies that probably represent trenches. The anomalous magnetic responses indicate that the trenches contain metallic objects or debris. The EM results suggest that these areas may also contain elevated concentrations of electrically conductive contaminants such as elevated electrolytes (e.g., chlorides, phosphates, sulfides) and/or fill that contains silty, clayey, or organic-rich fill soils. The soils map (see Figure 2-2Q) shows an area of Bassinger fine sand, depressional soils immediately west of the fairways for hole Nos. 8 and 9 (i.e., swamp/woods area of Figure 5-1A) that may have been the source of the silty, clayey, or organic-rich soil fill.

The second area of apparent trench disposal is located in the central portion of the site and south of the perimeter fence for the base housing. This area includes portions of the fairways, greens, and tees for hole Nos. 4, 5, 6, and 7 as well as the northern portions of the adjacent forested region to the south. This area also extends west of the golf course across the access road and to the eastern shore of the pond. This area appears to contain linear anomalies that represent trenches and broad anomalies that probably represent large areas of waste disposal. The EM data also suggest that this area of waste disposal may contain conductive contaminants or organic-rich fill soils. Again, the soils map (see Figure 2-2Q) shows the presence of the Bassinger fine sand, depressional soil unit in this area of the site.

Broad low-frequency anomalies in the central portion of the wooded area likely represent landfill material, but there is less evidence for well-defined trenches. The area including the southern halves of the fairways for hole Nos. 1 and 8 also is a probable landfill area, although again there is little evidence of well-defined trenches.

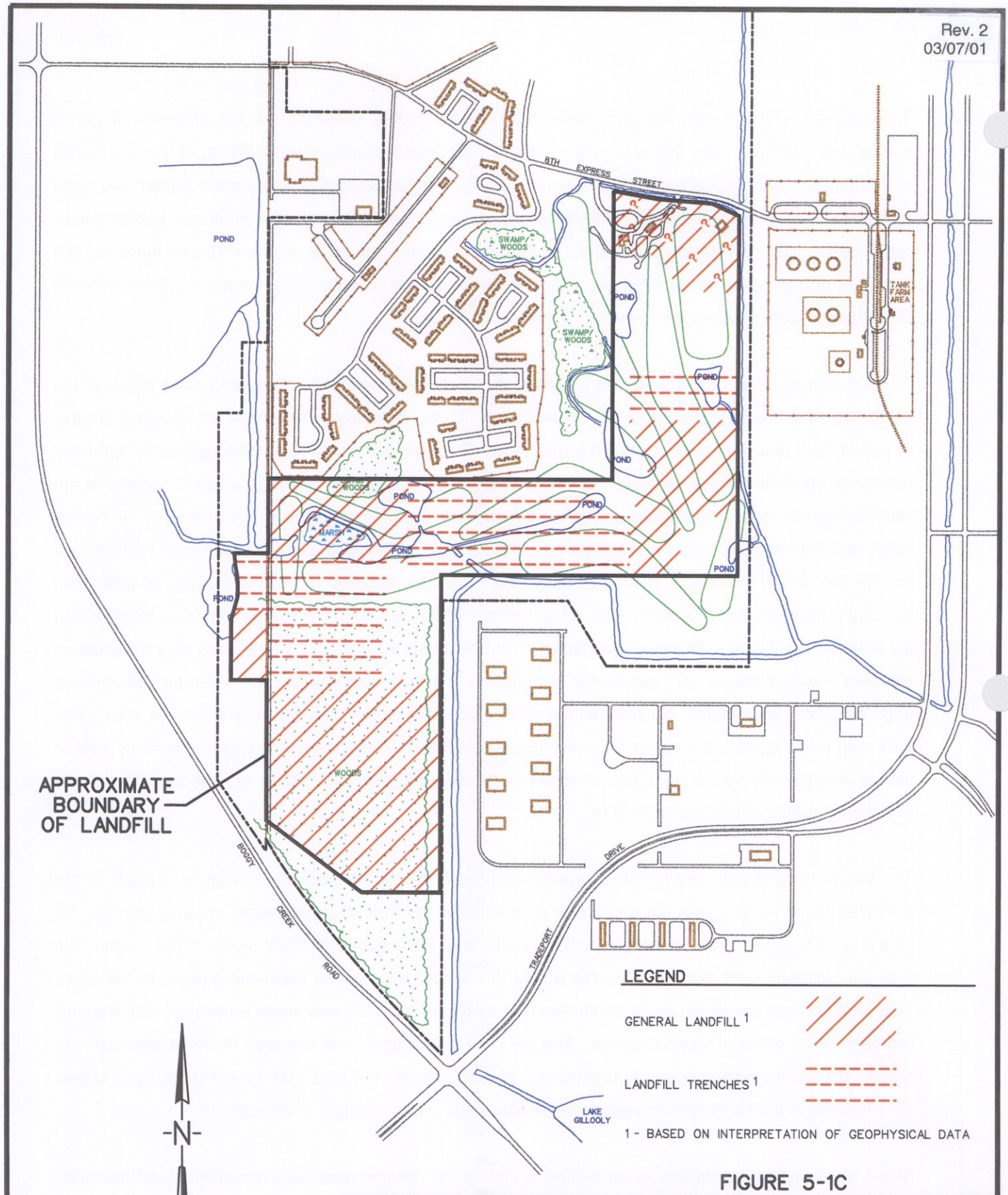

FIGURE 5-1C

LANDFILL BOUNDARIES
McCOY ANNEX LANDFILL
REMEDIAL INVESTIGATION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

5-8

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The remaining anomalous magnetic and EM responses appear to represent random localized landfilling events. These random anomalies could represent areas of natural topographic lows where wastes were disposed of or areas where soils were randomly removed for other purposes and the holes then filled with wastes.

The presence of chain-link perimeter fences and golf course buildings also resulted in anomalous responses. The fences are located between the Navy housing and the golf course and between the former ammunition bunkers located on GOAA property east of the wooded area in the southern part of the OU and the forested/golf course areas. The golf course buildings are present in the northern portion of the site. The presence of these facilities may have created anomalous responses of sufficient magnitude to mask the presence of wastes or metallic debris within a 15- to 30-foot radius.

The forested area of the site south of the No. 4 fairway appears to contain primarily surface and buried metallic objects and debris. Some features observed at the surface were hot water tanks, drums, tire rims, steel cable, and scrap sheet metal. These features are most apparent in the total field magnetic data set. It is suspected that similar metallic objects are present in the subsurface at this location.

5.1.2 Soil Cover Thickness

The GPR and hand auger data are presented as color contours of landfill cover thickness (in feet) in Figure 5-1D. The landfill cover thickness, as defined by the GPR (collected over the golf course areas, see Section 3.3.1), appears to correlate to the golf course design. The GPR data indicated that the clean fill soils applied to the golf course to obtain the final grade were often placed directly on areas of landfilled waste at this site. The interface between the waste and the landfill cover material, and the interface between the native material and the earth fill used to construct the golf course were often strong reflectors. The GPR survey indicates that the waste materials landfilled within the present golf course area are covered by soils that are typically 1 to 2.5 feet thick or greater.

Phase I, Phase II, and Phase III hand auger data were used in the undeveloped, forested areas of the site to determine landfill cover thickness (see Section 3.3.2). Generally the data indicate wastes in this area to have a fairly thick soil cover. Some borings in the forested area indicate that wastes, particularly in the northern region of the large wooded area south of hole No. 4, have only about 1 foot of cover. Note also that some areas had visible waste material at the surface. It is unknown whether this material is associated with previous authorized landfilling activities or subsequent surface dumping by unauthorized individuals.

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8TH EXPRESS STREET

POND

SWAMP/ WOODS

DRIVING RANGE

NO. 9

NO. 8

NO. 6

NO. 5

NO. 4

NO. 3

NO. 2

NO. 1

MARSH

WOODS

BOGGY CREEK ROAD

TRADEPORT DRIVE

LAKE GILLOOLY

3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3.0
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4

SURFACE COVER
(THICKNESS IN FEET)

N

300 0 300
SCALE IN FEET

5-11

CTO 0024

FIGURE 5-1D

LANDFILL COVER THICKNESS
McCOY ANNEX LANDFILL
REMEDIAL INVESTIGATION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

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03/07/01

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Fifty-three hand auger borings were advanced within the boundaries of the golf course during Phase III to confirm the geophysical data. The hand auger data corroborate areas of thin (between 0.5 and 2 feet) landfill soil cover in the southern portion of the golf course, principally in the southeastern corner, that were identified by GPR data. Generally the data indicate that waste material elsewhere at the course has a soil cover of at least 4 feet.

5.1.3 Soil Organic Vapor Survey Results

The results of the SOV survey are presented in the report prepared by W.L. Gore & Associates and provided in Appendix B. The Gore report contains a tabular printout of the VOC and SVOC detections and five contour maps of OU 2 showing the relative masses of the predominant compounds detected: benzene, toluene, ethylbenzene, and xylenes (BTEX); benzene; tetrachloroethene; chloroform; and chlorobenzene.

The SOV data provide a qualitative indication of areas where higher concentrations (i.e., "hot spots") of VOCs and SVOCs may exist. In preparing the maps, Gore set the minimum (gray) contour level for each mapped analyte at the maximum blank level observed or the method detection limit, whichever was greater. The maximum contour level was set at the maximum value observed. In most instances, the masses reported on the modules compare favorably with concentrations reported in the soil, groundwater, or both. However, due to a variety of factors, a perfect comparison between matrix data and soil gas levels can rarely be achieved.

As shown in the data tables in the Gore report (Appendix B), the BTEX compounds and chlorobenzene had the highest masses detected in modules No. 141072 (256 μg benzene, 20 μg chlorobenzene) and No. 141079 (174 μg benzene, 237 μg chlorobenzene). These modules were placed in the locations designated H2 and H9, respectively, on the contour maps. Other compounds detected include tetrachloroethene (6.68 μg in No. 141020), 1,4-dichlorobenze (3.23 µg in No. 141072), and trichloroethene (1.43 μg in No. 141084).

Distribution maps for five VOCs are provided in the Gore report (Appendix B). BTEX compounds were detected at low levels over much of the southern portion of the golf course and the adjacent wooded area to the south. Moderate levels of BTEX were found in one location in the southeastern part of the golf course and at several locations in the wooded area. The highest levels were detected in the northern part of the wooded area.

The distribution of benzene is similar to that of BTEX, with the highest levels found in the northern part of the wooded area, and sporadic low-level detections in the northeastern and western portions of the golf course and southern part of the wooded area.

A methane gas survey was performed in conjunction with the SOV survey. The locations of the sampling points, the procedures used to collect the samples, and the rationale for collection are discussed in Section 3.5. Methane gas was not detected at any of the sample locations.

5.2 SURFACE SOIL

During Phase I of the RI fieldwork, investigators collected 116 surface soil samples (see Figure 3-4B) and 12 field duplicate samples. Thirteen more surface soil samples and two field duplicates were collected during Phase II of sampling. In addition 10 samples and field duplicates were collected to evaluate the levels of pesticides and herbicides in areas of the golf course that do not overlie landfill material. Samples were analyzed at a fixed-base laboratory. Analytical parameters are detailed in Section 3.4.3. Data were validated according to established procedures as detailed in Section 4.0 and the analytical results of the investigation are presented in Appendix B. Tables 5-2A and 5-2B present detected organics and inorganics, respectively. Table 5-2C lists the minimum value, maximum value, frequency of detection, and location of the maximum for every chemical detected. Only analytes that were detected in at least one sample are presented in Tables 5-2A and 5-2B. Throughout this section tables and figures indicate concentrations that meet or exceed screening criteria; for ease of discussion these concentrations will subsequently be identified in the text as "exceeding" the criteria.

5.2.1 Volatile Organic Compounds

Seven VOCs were detected in the surface soils. Three compounds, carbon disulfide (at 3.6 J µg/kg), chloromethane (at 7.4 µg/kg), and tetrachloroethene (at 3.0 µg/kg), had only one detection each. Toluene had the maximum number of detections (17 out of 133) with concentrations ranging from 1.5 µg/kg to 14.9 J µg/kg. The majority of these detections were in the wooded area located in the southwestern portion of the site. Acetone had 15 detections (out of 56) with concentrations ranging from 24 J µg/kg to 51,400 µg/kg. Other VOCs detected include methylene chloride with nine detections ranging from 2.3 µg/kg to 16.3 µg/kg and xylenes with eight detections ranging from 2.2 µg/kg to 7.8 µg/kg. Acetone and methylene chloride are common laboratory artifacts. Each has a very high vapor pressure, so its persistence in temperate zone soils is usually brief. Table 5-2A presents detected VOCs and Table 5-2C lists the frequency of these detections. The detected chemicals were compared to State of Florida FDEP

TABLE 5-2A

SURFACE SOIL PHASES I AND II—DETECTED ORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Sample ID[a]	Screening Criteria[b]	B01	B02	B03	B04	B05	B05-D	B06	B07	B08	B09	B10	H1	H2
Sample Date		5/13/98	5/13/98	5/13/98	5/13/98	5/13/98	5/13/98	5/13/98	5/13/98	5/13/98	5/13/98	5/13/98	6/29/97	6/29/97
Volatiles (µg/kg)														
Acetone	780000					18.6								
Carbon disulfide	200000													
Chloromethane	1700													
Methylene chloride	16000													
Tetrachloroethene	8900													
Toluene	380000		4.2											
Xylenes, Total	5900000												8.7 J	
Semivolatiles (µg/kg)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Acenaphthene	1900000													
Anthracene	18000000													
Benzo(a)anthracene	1400													
Benzo(a)pyrene	100													
Benzo(b)fluoranthene	1400													
Benzo(g,h,i)perylene	2300000													
Benzo(k)fluoranthene	15000													
Chrysene	140000													
Dibenzo(a,h)anthracene	100													
Fluoranthene	2900000													
Fluorene	2200000													
Indeno(1,2,3-cd)pyrene	1500													
Phenanthrene	2000000													
Pyrene	2200000													
Pesticides/PCBs (µg/kg)		(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)
4,4'-DDD	4600													2.2
4,4'-DDE	3300													2.2
4,4'-DDT	3300													
Aldrin	70													
alpha-Chlordane[c]	3100													5.0
Aroclor-1254[c]	500													
Dieldrin	70													
Endosulfan II[c]	410000													
Endrin	21000													4.4
Endrin ketone	•													
gamma-Chlordane[c]	3100													3.9
Heptachlor	200													
Heptachlor epoxide	100													
Methoxychlor	370000													
Herbicides (µg/kg)														
Pentachlorophenol	8600													
TPH[e] (mg/kg)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Diesel-Range Organics	340												11.1	
Gasoline-Range Organics	340													NA
TPH (C8-C40)	340													
Dioxins (µg/kg)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OCDD	4.3													

TABLE 5-2A

SURFACE SOIL PHASES I AND II—DETECTED ORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Sample ID[a]	Screening Criteria[b]	H3	H4	H5	H5-D	H6	H7	H8	H9	H10	H11	H12	H13	H14
Sample Date		6/29/97	6/30/97	6/30/97	6/30/97	6/29/97	6/29/97	6/29/97	6/30/97	6/30/97	6/29/97	6/29/97	6/29/97	6/29/97
Volatiles (µg/kg)														
Acetone	780000													
Carbon disulfide	200000													
Chloromethane	1700													
Methylene chloride	16000													
Tetrachloroethene	8900													
Toluene	380000													
Xylenes, Total	5900000													
Semivolatiles (µg/kg)														
Acenaphthene	1900000													
Anthracene	18000000													
Benzo(a)anthracene	1400													
Benzo(a)pyrene	100							166		100			197 J	
Benzo(b)fluoranthene	1400													
Benzo(g,h,i)perylene	2300000													
Benzo(k)fluoranthene	15000													
Chrysene	140000													
Dibenzo(a,h)anthracene	100												152 J	
Fluoranthene	2900000												792	
Fluorene	2200000													
Indeno(1,2,3-cd)pyrene	1500													
Phenanthrene	2000000												532	
Pyrene	2200000												579 J	
Pesticides/PCBs (µg/kg)		(d)	(d)			(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)
4,4'-DDD	4600						23							2.7
4,4'-DDE	3300						39.4							
4,4'-DDT	3300						234							
Aldrin	70													
alpha-Chlordane[c]	3100						36			60 J				
Aroclor-1254[c]	500			39	22									
Dieldrin	70								4.1	9.0 J				
Endosulfan II[c]	410000													
Endrin	21000													
Endrin ketone	*													
gamma-Chlordane[c]	3100						46			66 J			2.3	
Heptachlor	200						4.2							
Heptachlor epoxide	100									6.3 J				
Methoxychlor	370000													
Herbicides (µg/kg)														
Pentachlorophenol	8600									13.5				
TPH[c] (mg/kg)														
Diesel-Range Organics	340			11.1			11			11.5	24.3		13.4	
Gasoline-Range Organics	340													
TPH (C8-C40)	340	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dioxins (µg/kg)		NA	NA			NA	NA	NA	NA	NA	NA	NA	NA	NA
OCDD	4.3			0.18J	0.13J									

TABLE 5-2A

SURFACE SOIL PHASES I AND II—DETECTED ORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Sample ID[a]	Screening Criteria[b]	H15	H15-D	H16	H17	H18	H19	H20	H21	H22	H23	H24	H25	H25-D
Sample Date		6/29/97	6/29/97	6/29/97	6/29/97	6/28/97	6/28/97	6/28/97	6/28/97	6/28/97	6/28/97	6/28/97	6/28/97	6/28/97
Volatiles (µg/kg)														
Acetone	780000											24 J		
Carbon disulfide	200000											3.6 J		
Chloromethane	1700									7.4				
Methylene chloride	16000													
Tetrachloroethene	8900													
Toluene	380000									4.5				
Xylenes, Total	5900000													
Semivolatiles (µg/kg)														
Acenaphthene	1900000													
Anthracene	18000000		716											
Benzo(a)anthracene	1400	**5750**	**1600**											
Benzo(a)pyrene	100	**5500**	**1490 J**											
Benzo(b)fluoranthene	1400	**4410**	1220 J							**127**	**311**			
Benzo(g,h,i)perylene	2300000	4420	1100 J											
Benzo(k)fluoranthene	15000	2600	802 J											
Chrysene	140000	6680	1730											
Dibenzo(a,h)anthracene	100	**1580**	**392 J**								**194**			
Fluoranthene	2900000	22300	3740								527			
Fluorene	2200000													
Indeno(1,2,3-cd)pyrene	1500	**3930**	1060 J											
Phenanthrene	2000000	11400	2890											
Pyrene	2200000	14700	2700								430			
Pesticides/PCBs (µg/kg)				(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)		(d)
4,4'-DDD	4600									13				
4,4'-DDE	3300		5.2							8.6				
4,4'-DDT	3300									188				
Aldrin	70													
alpha-Chlordane[c]	3100									14				
Aroclor-1254[c]	500													
Dieldrin	70													
Endosulfan II[c]	410000													
Endrin	21000													
Endrin ketone	-													
gamma-Chlordane[c]	3100									12				
Heptachlor	200		2.8			1.8								
Heptachlor epoxide	100													
Methoxychlor	370000													
Herbicides (µg/kg)														
Pentachlorophenol	8600	2.5												
TPH[e] (mg/kg)														
Diesel-Range Organics	340	32.1	52.9			9.59					13.0	12.2		7.26 J
Gasoline-Range Organics	340													
TPH (C8-C40)	340	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dioxins (µg/kg)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OCDD	4.3													

TABLE 5-2A

SURFACE SOIL PHASES I AND II—DETECTED ORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Sample ID[a]	Screening Criteria[b]	H26	H27	H28	H29	H30	H31	H32	H33	H34	H35	H35-D	H36	H37
Sample Date		6/28/97	6/28/97	6/28/97	6/28/97	6/28/97	6/28/97	6/28/97	6/28/97	6/28/97	6/28/97	6/28/97	6/28/97	6/28/97
Volatiles (µg/kg)														
Acetone	780000										1560	33	39.5 J	
Carbon disulfide	200000													
Chloromethane	1700													
Methylene chloride	16000													3.6
Tetrachloroethene	8900													
Toluene	380000								4.0	3.8	4.8			10.4
Xylenes, Total	5900000									2.2	3.7			5.7
Semivolatiles (µg/kg)														
Acenaphthene	1900000													
Anthracene	18000000			515										
Benzo(a)anthracene	1400			1730	603									
Benzo(a)pyrene	100			1780	565			403		166				
Benzo(b)fluoranthene	1400			1280	505									
Benzo(g,h,i)perylene	2300000			1240	420									
Benzo(k)fluoranthene	15000			1080	399									
Chrysene	140000			1800	717									
Dibenzo(a,h)anthracene	100			769	262			248		89.9				
Fluoranthene	2900000			5380	1560			1200		416				
Fluorene	2200000													
Indeno(1,2,3-cd)pyrene	1500			1210	417									
Phenanthrene	2000000			2040	994			734						
Pyrene	2200000			3740	991			793						
Pesticides/PCBs (µg/kg)		(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)			(d)	(d)
4,4'-DDD	4600			18				3.0						
4,4'-DDE	3300			26	3.9			1.8	1.9	6.3				
4,4'-DDT	3300			47				21		4.8				
Aldrin	70													
alpha-Chlordane[c]	3100			20				2.3	15	2.7				
Aroclor-1254[c]	500													
Dieldrin	70													
Endosulfan II[c]	410000													
Endrin	21000													
Endrin ketone	*			7.5										
gamma-Chlordane[c]	3100			19				3.0	13	4.7				
Heptachlor	200						2.7							
Heptachlor epoxide	100			1.4										
Methoxychlor	370000			27										
Herbicides (µg/kg)														
Pentachlorophenol	8600													
TPH[c] (mg/kg)														
Diesel-Range Organics	340			35.7	19.0		14.2	27.7	10.1	11.1	43.1	11.5	36.2	
Gasoline-Range Organics	340										0.128			
TPH (C8-C40)	340	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dioxins (µg/kg)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OCDD	4.3													

TABLE 5-2A

SURFACE SOIL PHASES I AND II—DETECTED ORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Sample ID[a]	Screening Criteria[b]	H38	H39	H40	H41	H42	H43	H44	H45	H45-D	H46	H47	H48	H49
Sample Date		6/28/97	6/28/97	6/28/97	5/13/98	5/13/98	5/13/98	5/13/98	5/13/98	5/13/98	5/13/98	5/13/98	5/13/98	5/13/98
Volatiles (µg/kg)														
Acetone	780000													
Carbon disulfide	200000													
Chloromethane	1700													
Methylene chloride	16000		4.4			3	12.4 J				16.3 J	15.5	14.3 J	4.6 J
Tetrachloroethene	8900													
Toluene	380000		3.8		2.7 J	1.5	14.9 J				3.7 J	8.6	5.4 J	
Xylenes, Total	5900000		2.8				4.8 J							
Semivolatiles (µg/kg)														
Acenaphthene	1900000													
Anthracene	18000000													
Benzo(a)anthracene	1400													
Benzo(a)pyrene	100													
Benzo(b)fluoranthene	1400													
Benzo(g,h,i)perylene	2300000													
Benzo(k)fluoranthene	15000													
Chrysene	140000													
Dibenzo(a,h)anthracene	100													
Fluoranthene	2900000													
Fluorene	2200000													
Indeno(1,2,3-cd)pyrene	1500													
Phenanthrene	2000000													
Pyrene	2200000													
Pesticides/PCBs (µg/kg)		(d)	(d)	(d)										
4,4'-DDD	4600													
4,4'-DDE	3300				3.8									
4,4'-DDT	3300													
Aldrin	70													
alpha-Chlordane[c]	3100													
Aroclor-1254[c]	500													
Dieldrin	70													
Endosulfan II[c]	410000													
Endrin	21000													
Endrin ketone	*													
gamma-Chlordane[c]	3100													
Heptachlor	200													
Heptachlor epoxide	100													
Methoxychlor	370000													
Herbicides (µg/kg)														
Pentachlorophenol	8600													
TPH[c] (mg/kg)														
Diesel-Range Organics	340	11.9	12.9		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gasoline-Range Organics	340				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TPH (C8-C40)	340	NA	NA	NA	23.8	33.6	39.8	32.6	49.6	63.4	50.7	25.2	41.5	30.4
Dioxins (µg/kg)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OCDD	4.3													

TABLE 5-2A

SURFACE SOIL PHASES I AND II—DETECTED ORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Sample ID[a]	Screening Criteria[b]	H49-D	S01	S02	S03	S04	S10	S10-D	S11	S12	S20	S21	S22	S30
Sample Date		5/13/98	5/12/98	5/12/98	5/12/98	5/12/98	6/28/97	6/28/97	6/29/97	6/30/97	6/28/97	6/29/97	6/30/97	6/28/97
Volatiles (µg/kg)														
Acetone	780000													
Carbon disulfide	200000													
Chloromethane	1700													
Methylene chloride	16000	2.3												
Tetrachloroethene	8900													
Toluene	380000										7.4			
Xylenes, Total	5900000										7.8			
Semivolatiles (µg/kg)														
Acenaphthene	1900000					1630 J								
Anthracene	18000000					2700 J								
Benzo(a)anthracene	1400			1210	547 J	7940								
Benzo(a)pyrene	100			1380	469	6320								
Benzo(b)fluoranthene	1400			1110	403 J	5470 J								
Benzo(g,h,i)perylene	2300000			1350	891	9860								
Benzo(k)fluoranthene	15000			950	272 J	4190 J								
Chrysene	140000			2500	509 J	8510								
Dibenzo(a,h)anthracene	100			461	172	1720								
Fluoranthene	2900000		191 J	600 J	1450	22400								
Fluorene	2200000					1370 J								
Indeno(1,2,3-cd)pyrene	1500			1210	846	8800								
Phenanthrene	2000000			178 J	711 J	13600								
Pyrene	2200000		145 J	528 J	966	14500								
Pesticides/PCBs (µg/kg)							(d)		(d)	(d)	(d)	(d)	(d)	(d)
4,4'-DDD	4600													5.3
4,4'-DDE	3300					178					5.2		4.4	41
4,4'-DDT	3300					274								
Aldrin	70				13									
alpha-Chlordane[c]	3100				124	219								
Aroclor-1254[c]	500													
Dieldrin	70				26	97								
Endosulfan II[c]	410000													
Endrin	21000													
Endrin ketone	-													
gamma-Chlordane[c]	3100				111	243								
Heptachlor	200				13	48								
Heptachlor epoxide	100													
Methoxychlor	370000													
Herbicides (µg/kg)														
Pentachlorophenol	8600		4.7			109								
TPH[e] (mg/kg)														
Diesel-Range Organics	340	NA	NA	NA	NA	NA	8.34		9.97 J	12.7	8.16 J			11.5
Gasoline-Range Organics	340	NA	NA	NA	NA	NA								
TPH (C8-C40)	340	37	65.3	52.7	855	896	NA	NA	NA	NA	NA	NA	NA	NA
Dioxins (µg/kg)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OCDD	4.3													

TABLE 5-2A

SURFACE SOIL PHASES I AND II—DETECTED ORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Sample ID[a]	Screening Criteria[b]	S31	S32	S40	S41	S50	S51	S52	S60	S61	S62	S70	S71	S72
Sample Date		6/29/97	6/30/97	6/28/97	6/29/97	6/28/97	6/29/97	6/30/97	6/28/97	6/29/97	6/30/97	6/28/97	6/29/97	6/30/97
Volatiles (µg/kg)														
Acetone	780000		18500 J					99 J			212 J			
Carbon disulfide	200000													
Chloromethane	1700													
Methylene chloride	16000													
Tetrachloroethene	8900													
Toluene	380000													
Xylenes, Total	5900000												9.4 J	
													6.0 J	
Semivolatiles (µg/kg)														
Acenaphthene	1900000													
Anthracene	18000000													
Benzo(a)anthracene	1400										1050 J			497 J
Benzo(a)pyrene	100				142		227	112			1030 J	123		499 J
Benzo(b)fluoranthene	1400										1090 J			
Benzo(g,h,i)perylene	2300000										1390 J			
Benzo(k)fluoranthene	15000										586 J			
Chrysene	140000										1130 J			517 J
Dibenzo(a,h)anthracene	100										353 J			200 J
Fluoranthene	2900000										1670 J			789 J
Fluorene	2200000													
Indeno(1,2,3-cd)pyrene	1500										1170 J			
Phenanthrene	2000000										571 J			
Pyrene	2200000										1240 J			562 J
Pesticides/PCBs (µg/kg)		(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)
4,4'-DDD	4600													
4,4'-DDE	3300			2.9		3.5	13		14					
4,4'-DDT	3300						9.8		9.0					
Aldrin	70													
alpha-Chlordane[c]	3100						1.3							
Aroclor-1254[c]	500													
Dieldrin	70													
Endosulfan II[c]	410000						2.2							
Endrin	21000													
Endrin ketone	*													
gamma-Chlordane[c]	3100						1.3							
Heptachlor	200				1.4		1.1						1.4	
Heptachlor epoxide	100													
Methoxychlor	370000													
Herbicides (µg/kg)														
Pentachlorophenol	8600											4.5		
TPH[c] (mg/kg)														
Diesel-Range Organics	340	9.6			9.76		31.6	9.28 J			43.6	10.5	17.7	22
Gasoline-Range Organics	340													
TPH (C8-C40)	340	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dioxins (µg/kg)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OCDD	4.3													

TABLE 5-2A

SURFACE SOIL PHASES I AND II—DETECTED ORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Sample ID[a]	Screening Criteria[b]	S80	S80-D	S81	S82	S83	S90	S91	S91-D	S92	S99	S100	S101	S102
Sample Date		6/28/97	6/28/97	6/29/97	6/30/97	7/1/97	6/28/97	6/29/97	6/29/97	6/30/97	7/1/97	6/29/97	6/29/97	6/30/97
Volatiles (µg/kg)														
Acetone	780000								4330 J					
Carbon disulfide	200000													
Chloromethane	1700													
Methylene chloride	16000													
Tetrachloroethene	8900									3.0				
Toluene	380000						5.0							
Xylenes, Total	5900000													
Semivolatiles (µg/kg)														
Acenaphthene	1900000													
Anthracene	18000000													
Benzo(a)anthracene	1400				900 J				2620					1060
Benzo(a)pyrene	100				923 J			254	2370	286 J			285	982
Benzo(b)fluoranthene	1400				676 J				2660					829
Benzo(g,h,i)perylene	2300000				876 J				1980					851
Benzo(k)fluoranthene	15000				755 J				1640					680
Chrysene	140000				919 J				2770					1080
Dibenzo(a,h)anthracene	100				398 J				654				119	294
Fluoranthene	2900000				1620 J			506	5970	692			513	1850
Fluorene	2200000													
Indeno(1,2,3-cd)pyrene	1500				810 J				1770					797
Phenanthrene	2000000								3230					1420
Pyrene	2200000				1110 J			404	4700	509 J			383	1370
Pesticides/PCBs (µg/kg)				(d)	(d)	(d)	(d)			(d)	(d)	(d)	(d)	
4,4'-DDD	4600													
4,4'-DDE	3300						2.2	1.6	1.7			2.4	9.7	1.6
4,4'-DDT	3300											7.8	6.1	
Aldrin	70													
alpha-Chlordane[c]	3100						3.1	2.3	3.5			1.7	1.7	
Aroclor-1254[c]	500													
Dieldrin	70												1.0	
Endosulfan II[c]	410000									4.5				
Endrin	21000													
Endrin ketone	*													
gamma-Chlordane[c]	3100						3.0	2.4	2.0			1.9	2.2	
Heptachlor	200												1.2	
Heptachlor epoxide	100													
Methoxychlor	370000													
Herbicides (µg/kg)														
Pentachlorophenol	8600													
TPH[c] (mg/kg)														
Diesel-Range Organics	340			8.74 J	12.9	25.9	8.5 J	8.87 J	11.7			7.45 J		24.3
Gasoline-Range Organics	340													
TPH (C8-C40)	340	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dioxins (µg/kg)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OCDD	4.3													

TABLE 5-2A

SURFACE SOIL PHASES I AND II—DETECTED ORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Sample ID[a]	Screening Criteria[b]	S102-D	S103	S104	S105	S108	S109	S110	S111	S112	S113	S114	S115	S116
Sample Date		6/30/97	7/1/97	7/1/97	7/1/97	7/1/97	7/1/97	6/28/97	6/29/97	6/30/97	7/1/97	7/1/97	7/1/97	7/1/97
Volatiles (µg/kg)														
Acetone	780000		397 J	123 J	17000							26700		51400
Carbon disulfide	200000													
Chloromethane	1700													
Methylene chloride	16000													
Tetrachloroethene	8900													
Toluene	380000													
Xylenes, Total	5900000													
Semivolatiles (µg/kg)														
Acenaphthene	1900000													
Anthracene	18000000		339											
Benzo(a)anthracene	1400	465 J	1380											
Benzo(a)pyrene	100	396	2360 J							125			105 J	
Benzo(b)fluoranthene	1400		937											
Benzo(g,h,i)perylene	2300000	380	805											
Benzo(k)fluoranthene	15000		767											
Chrysene	140000	486 J	1160											
Dibenzo(a,h)anthracene	100	116	560 J											
Fluoranthene	2900000	852 J	3000 J							427			509 J	
Fluorene	2200000													
Indeno(1,2,3-cd)pyrene	1500		753											
Phenanthrene	2000000	456	1380											
Pyrene	2200000	589 J	2080 J											
Pesticides/PCBs (µg/kg)			(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)
4,4'-DDD	4600													
4,4'-DDE	3300	2.0	22 J						4.0				1.8 J	
4,4'-DDT	3300													
Aldrin	70													
alpha-Chlordane[c]	3100													
Aroclor-1254[c]	500													
Dieldrin	70													
Endosulfan II[c]	410000													
Endrin	21000													
Endrin ketone	*		19 J											
gamma-Chlordane[c]	3100												1.9 J	
Heptachlor	200													
Heptachlor epoxide	100													
Methoxychlor	370000													
Herbicides (µg/kg)														
Pentachlorophenol	8600													
TPH[c] (mg/kg)														
Diesel-Range Organics	340	52.5	66.8	38.1					10.1					
Gasoline-Range Organics	340													
TPH (C8-C40)	340	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dioxins (µg/kg)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OCDD	4.3													

TABLE 5-2A

SURFACE SOIL PHASES I AND II—DETECTED ORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Sample ID[a]	Screening Criteria[b]	S117	S118	S119	S120	S121	S122	S123	S124	S124-D	S125	S126	S127	S128
Sample Date		7/1/97	7/1/97	7/1/97	6/28/97	6/29/97	6/30/97	7/1/97	7/1/97	7/1/97	7/1/97	7/1/97	7/1/97	7/1/97
Volatiles (µg/kg)														
Acetone	780000	28200		130 J			7620 J							
Carbon disulfide	200000													
Chloromethane	1700													
Methylene chloride	16000					12.6 J								
Tetrachloroethene	8900													
Toluene	380000									9.6 J				
Xylenes, Total	5900000									7.4 J				
Semivolatiles (µg/kg)														
Acenaphthene	1900000													
Anthracene	18000000													
Benzo(a)anthracene	1400													
Benzo(a)pyrene	100											48 J		
Benzo(b)fluoranthene	1400													
Benzo(g,h,i)perylene	2300000													
Benzo(k)fluoranthene	15000													
Chrysene	140000													
Dibenzo(a,h)anthracene	100													
Fluoranthene	2900000													
Fluorene	2200000													
Indeno(1,2,3-cd)pyrene	1500													
Phenanthrene	2000000													
Pyrene	2200000													
Pesticides/PCBs (µg/kg)		(d)	(d)	(d)	(d)	(d)	(d)	(d)			(d)	(d)	(d)	(d)
4,4'-DDD	4600													
4,4'-DDE	3300						3.4	1.3 J						
4,4'-DDT	3300													9.1 J
Aldrin	70													
alpha-Chlordane[c]	3100													
Aroclor-1254[c]	500													
Dieldrin	70													
Endosulfan II[c]	410000													
Endrin	21000													
Endrin ketone	*													
gamma-Chlordane[c]	3100													
Heptachlor	200						1.2							
Heptachlor epoxide	100													
Methoxychlor	370000													
Herbicides (µg/kg)														
Pentachlorophenol	8600													
TPH[d] (mg/kg)														
Diesel-Range Organics	340				23.0						10.5	10.4		
Gasoline-Range Organics	340													
TPH (C8-C40)	340	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dioxins (µg/kg)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OCDD	4.3													

TABLE 5-2A

SURFACE SOIL PHASES I AND II—DETECTED ORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Sample ID[a]	Screening Criteria[b]	S129	S130	S131	S132	S133	S134	S135	S137	S137-D	S138	S139	S140	S151
Sample Date		7/1/97	6/28/97	6/29/97	6/30/97	7/1/97	6/30/97	6/30/97	6/30/97	6/30/97	6/30/97	6/30/97	6/28/97	7/1/97
Volatiles (µg/kg)														
Acetone	780000													
Carbon disulfide	200000													
Chloromethane	1700													
Methylene chloride	16000													
Tetrachloroethene	8900													
Toluene	380000													
Xylenes, Total	5900000													
Semivolatiles (µg/kg)														
Acenaphthene	1900000													
Anthracene	18000000													
Benzo(a)anthracene	1400													
Benzo(a)pyrene	100													
Benzo(b)fluoranthene	1400													
Benzo(g,h,i)perylene	2300000													
Benzo(k)fluoranthene	15000													
Chrysene	140000													
Dibenzo(a,h)anthracene	100													
Fluoranthene	2900000													
Fluorene	2200000													
Indeno(1,2,3-cd)pyrene	1500													
Phenanthrene	2000000													
Pyrene	2200000													
Pesticides/PCBs (µg/kg)		(d)	(d)	(d)	(d)	(d)	(d)	(d)			(d)	(d)	(d)	(d)
4,4'-DDD	4600													
4,4'-DDE	3300	4.5 J												
4,4'-DDT	3300													
Aldrin	70													
alpha-Chlordane[c]	3100													
Aroclor-1254[c]	500													
Dieldrin	70													
Endosulfan II[c]	410000													
Endrin	21000													
Endrin ketone	•													
gamma-Chlordane[c]	3100													
Heptachlor	200			1.6				1.1 J		3.0				
Heptachlor epoxide	100													
Methoxychlor	370000													
Herbicides (µg/kg)														
Pentachlorophenol	8600													
TPH[c] (mg/kg)														
Diesel-Range Organics	340		8.09 J	9.48 J				47.8						
Gasoline-Range Organics	340													
TPH (C8-C40)	340	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dioxins (µg/kg)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OCDD	4.3													

TABLE 5-2A

SURFACE SOIL PHASES I AND II—DETECTED ORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Sample ID[a]	Screening Criteria[b]	S151-D	S152	S153	S154	S155	S156	S157	S158	S159	S160
Sample Date		7/1/97	7/1/97	7/1/97	7/1/97	6/30/97	6/30/97	7/1/97	7/1/97	7/1/97	7/1/97
Volatiles (µg/kg)											
Acetone	780000										
Carbon disulfide	200000										
Chloromethane	1700										
Methylene chloride	16000										
Tetrachloroethene	8900										
Toluene	380000										
Xylenes, Total	5900000										
Semivolatiles (µg/kg)											
Acenaphthene	1900000										
Anthracene	18000000										
Benzo(a)anthracene	1400										
Benzo(a)pyrene	100										
Benzo(b)fluoranthene	1400										
Benzo(g,h,i)perylene	2300000										
Benzo(k)fluoranthene	15000										
Chrysene	140000										
Dibenzo(a,h)anthracene	100										
Fluoranthene	2900000										
Fluorene	2200000										
Indeno(1,2,3-cd)pyrene	1500										
Phenanthrene	2000000										
Pyrene	2200000										
Pesticides/PCBs (µg/kg)		(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)
4,4'-DDD	4600										
4,4'-DDE	3300			2.1 J			3.0	3.1 J			
4,4'-DDT	3300										
Aldrin	70										
alpha-Chlordane[c]	3100										
Aroclor-1254[c]	500										
Dieldrin	70					3.0					
Endosulfan II[c]	410000										
Endrin	21000										
Endrin ketone	*										
gamma-Chlordane[c]	3100										
Heptachlor	200										
Heptachlor epoxide	100										
Methoxychlor	370000										
Herbicides (µg/kg)											
Pentachlorophenol	8600										
TPH[e] (mg/kg)											
Diesel-Range Organics	340		9.92					9.66		30.7	
Gasoline-Range Organics	340										
TPH (C8-C40)	340	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dioxins (µg/kg)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OCDD	4.3										

TABLE 5-2A

SURFACE SOIL PHASES I AND II – DETECTED ORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

"J" qualifier on analytical data indicates an estimated value.

NA - Not Analyzed.

No entry indicates chemical not detected.

Only chemicals detected in at least one sample are shown.

The complete list of analytical results is presented in Appendix B of this report.

Shaded entry indicates chemical detected at a concentration that meets or exceeds the screening criterion.

(a) "D" in sample location indicates a duplicate sample.

(b) State of Florida Soil Cleanup Target Levels for Residential Direct Exposure.

(c) Screening Criteria Substitutions – Chlordane for alpha-Chlordane and gamma-Chlordane, PCBs for Aroclor-1254, and Endosulfan for Endosulfan II.

(d) Not analyzed for PCBs.

(e) Total Petroleum Hydrocarbons.

* Screening value not available.

TABLE 5-2B

SURFACE SOIL PHASES I AND II—DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]		H1	H2	H3	H4	H5	H5-D	H6	H7	H8	H9
DATE SAMPLED	Florida SCTL[c]	NTC BGSV[d]	6/29/97	6/29/97	6/29/97	6/30/97	6/30/97	6/30/97	6/29/97	6/29/97	6/29/97	6/30/97
Metals (mg/kg)												
Aluminum	72000	4780	2880	4660	6520	3870	2510	2880	614	2870	4070	3910
Antimony	26	*										
Arsenic	0.8	1.9			0.68	1.2	0.85	0.63				
Barium	110	21.6		9.7		11.5	10.1	11.4				4.3
Cadmium	75	0.46										
Calcium	*	*	947	381	168	844	443	406	218	209	169	135
Chromium	*	33568	3.4	4.6	5.4	4.6	3.2	3.4	0.93	3.0	3.8	4.4
Cobalt	4700	7.7		0.20								
Copper	110	2.6	11.9	4.0	0.71				0.30	0.52	1.3	
Iron	23000	843	381	634	571	834 J	395 J	441 J	105	300	401	469 J
Lead	400	21.3	6.9	5.3	4.2	5.2	5.0	4.9	2.3	3.8	4.7	6.8
Magnesium	*	381	57.1	60.1	45.6	60.1	46.3	45.1		20.4	22.8	
Manganese	1600	10.8	2.3	2.0	0.78	4.3	2.2	2.0	0.58	2.1	1.3	1.6
Mercury	3.4	.05										
Nickel	110	*	1.0	1.7	1.2	1.2	1.3	1.2		0.74	1.2	1.1
Potassium	*	210	27.3	33.4	20.5	36.8	40.5	39.8		15.0	16.5	15.0
Selenium	390	1.1		0.50							0.49	
Silver	390	*										
Sodium	*	*										
Thallium	*	*										
Vanadium	15	4.9	2.6	3.8	2.6	4.3	2.3	2.8	0.43	1.6	2.0	2.0
Zinc	23000	4.6	6.2	6.8		5.3	4.4	4.0			21.6	4.8
Radiological (pCi/g)												
Gross alpha[e]	5	*	1.03	1.32	1.45	1.18	1.11	0.937	0.625	1.06	1.50	1.48
Gross beta[e]	15	*	0.421	0.598	0.459	0.635	0.526	0.462	0.226	0.753		0.491
Actinium-228	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bismuth-214	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-210	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-212	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-214	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium-208	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5-2B

SURFACE SOIL PHASES I AND II—DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]		H10	H11	H12	H13	H14	H15	H15-D	H16	H17	H18
DATE SAMPLED	Florida SCTL[c]	NTC BGSV[d]	6/30/97	6/29/97	6/29/97	6/29/97	6/29/97	6/29/97	6/29/97	6/29/97	6/29/97	6/28/97
Metals (mg/kg)												
Aluminum	72000	4780	3400	200	1010	3590	4940	2520	2890	378	1260	2000
Antimony	26	*										
Arsenic	0.8	1.9	0.52									
Barium	110	21.6	8.2				177	7.3	7.3			
Cadmium	75	0.46										
Calcium	*	*	3160		199	116	209	467	411		262	225
Chromium	*	33568	3.6	0.49	1.5	3.3	4.9	3.3	4.0	0.94	1.7	3.0
Cobalt	4700	7.7					0.33					
Copper	110	2.6			1.0	1.4	2.0	0.98	0.79	1.2	0.67	21.4
Iron	23000	843	409 J	60.1	160	407	652	327	335	474	153	289
Lead	400	21.3	9.3	2.4	5.2	5.4	7.1	7.0	6.9	2.8	3.7	6.6
Magnesium	*	381	47.0		15.5	25.2	32.7	29.3	26.0	10.2	30.8	24.3
Manganese	1600	10.8	2.9		1.6	2.1	3.8	7.7	4.8	2.0	1.5	3.5
Mercury	3.4	.05										
Nickel	110	*	1.1		0.28	1.1	1.2	0.69	0.75		0.38	0.57
Potassium	*	210	19.5		11.2	14.9	13.3	16.1	19.6		16.5	12.0
Selenium	390	1.1					0.44					
Silver	390	*						0.27	0.23			
Sodium	*	*										
Thallium	*	*										
Vanadium	15	4.9	1.9	0.22	0.66	1.6	2.2	1.3	1.6	0.33	0.72	1.2
Zinc	23000	4.6	6.0				45.8	5.2		11.9		7.2
Radiological (pCi/g)												
Gross alpha[e]	5	*	1.84	0.171	0.445	1.18	1.45	1.53	0.940 J	0.229 J	0.483 J	0.835 J
Gross beta[e]	15	*	0.642		0.212	0.453	0.421	0.520	0.452		0.378	0.377
Actinium-228	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bismuth-214	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-210	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-212	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-214	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium-208	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5-2B

SURFACE SOIL PHASES I AND II—DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]		H19	H20	H21	H22	H23	H24	H25	H25-D	H26	H27
DATE SAMPLED	Florida SCTL[c]	NTC BGSV[d]	6/28/97	6/28/97	6/28/97	6/28/97	6/28/97	6/28/97	6/28/97	6/28/97	6/28/97	6/28/97
Metals (mg/kg)												
Aluminum	72000	4780	915	3490	585	2480	2640	1470	1380	899	300	1700
Antimony	26	*										
Arsenic	0.8	1.9					1.7					
Barium	110	21.6		26.2			12.0					
Cadmium	75	0.46				0.10	0.16					
Calcium	*	*	1120	7470	121	351	1160	260	166	103	58.4	255
Chromium	*	33568	1.7	4.0	0.70	3.1	6.2	2.0	1.2	0.75	0.54	2.6
Cobalt	4700	7.7		0.26								
Copper	110	2.6	1.0	11.3	0.42	0.83	3.4					0.30
Iron	23000	843	163	560	209	835	709	160	116	92.2	102	129
Lead	400	21.3	7.9	8.8	2.8	10.6	17.1	4.2	2.8			4.3
Magnesium	*	381	21.8	318			79.8	28.8				
Manganese	1600	10.8	1.8	11.3	0.61	3.6	7.4	1.4	0.77			0.62
Mercury	3.4	.05					0.15					
Nickel	110	*	0.34	3.7	0.24	0.64	0.86	0.54	0.36	0.47	0.35	0.53
Potassium	*	210	10.8	53.8			21.4	20.0				
Selenium	390	1.1										
Silver	390	*										
Sodium	*	*										
Thallium	*	*										
Vanadium	15	4.9	0.59	1.9								
Zinc	23000	4.6		21.5		10.4	24.6					
Radiological (pCi/g)												
Gross alpha[e]	5	*	0.492 J	1.41 J	0.271 J	0.680 J	1.29 J	0.370 J	0.282 J		0.280 J	0.433 J
Gross beta[e]	15	*	0.279	0.517		0.187	0.558	0.283			0.219	0.400
Actinium-228	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bismuth-214	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-210	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-212	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-214	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium-208	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5-2B

SURFACE SOIL PHASES I AND II—DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]		H28	H29	H30	H31	H32	H33	H34	H35	H35-D	H36
DATE SAMPLED	Florida SCTL[c]	NTC BGSV[d]	6/28/97	6/28/97	6/28/97	6/28/97	6/28/97	6/28/97	6/28/97	6/28/97	6/28/97	6/28/97
Metals (mg/kg)												
Aluminum	72000	4780	804	791	1490	1290	761	873	515	998	956	1500
Antimony	26	*										
Arsenic	0.8	1.9										
Barium	110	21.6										
Cadmium	75	0.46			0.08			0.10				
Calcium	*	*	851	332	906		2340	515	360	208	192	286
Chromium	*	33568	2.9	0.96	1.8	1.5	1.6	1.9	2.6	1.3	1.2	1.8
Cobalt	4700	7.7										
Copper	110	2.6	0.93		0.93		0.31	8.7	1.3			4.4
Iron	23000	843	130	85.1	406	574	217	116	439	92.5	84.0	600
Lead	400	21.3	5.4		3.8	3.3	6.8	7.0	9.4	3.0	3.0	12.3
Magnesium	*	381	49.6	43.8	46.1		39.9	29.5				73.0
Manganese	1600	10.8	3.3	1.4	3.0	0.57	1.4	2.4	2.2	0.53		1.1
Mercury	3.4	.05							0.12			
Nickel	110	*	0.45	0.24	0.58	0.29	0.31	0.26	0.41	0.26		0.93
Potassium	*	210		14.2	19.6	11.2			10.7			44.4
Selenium	390	1.1										0.56
Silver	390	*										
Sodium	*	*										
Thallium	*	*										
Vanadium	15	4.9					2.2					
Zinc	23000	4.6	11.3		6.8			14.5	17.2			
Radiological (pCi/g)												
Gross alpha[e]	5	*	0.853 J	0.423 J	1.40	0.542 J	0.674 J	0.158 J	0.557 J	0.286 J		0.386
Gross beta[e]	15	*	0.288	0.232	0.527	0.444				0.215		0.581
Actinium-228	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bismuth-214	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-210	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-212	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-214	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium-208	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5-2B

SURFACE SOIL PHASES I AND II—DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]		H37	H38	H39	H40	H41	H42	H43	H44	H45	H45-D
DATE SAMPLED	Florida SCTL[c]	NTC BGSV[d]	6/28/97	6/28/97	6/28/97	6/28/97	5/13/98	5/13/98	5/13/98	5/13/98	5/13/98	5/13/98
Metals (mg/kg)												
Aluminum	72000	4780	1390	548	230	58.4	282	510	567	2020	863	560
Antimony	26	*									0.84	
Arsenic	0.8	1.9	0.54									
Barium	110	21.6					2.7	3.1	3.7	4.0	12.0	3.8
Cadmium	75	0.46										
Calcium	*	*		213	58.4	78.2	3 J	3 J	288 J	309 J	425 J	322 J
Chromium	*	33568	2.0	1.0	0.73	0.21						
Cobalt	4700	7.7										
Copper	110	2.6					1.7	2.1	1.8	1.9	2.8	1.0
Iron	23000	843	718	101	23.1	19.7	80.8	237	2	550	233	193
Lead	400	21.3		2.6			3.5	11.4	3.5	3.1	6.4	4.0
Magnesium	*	381					58.0	58.0	51.3	65.0	63.2	50.2
Manganese	1600	10.8	0.86				1.5			1.1		
Mercury	3.4	.05										
Nickel	110	*	0.33	0.34								
Potassium	*	210										
Selenium	390	1.1									0.31	
Silver	390	*										
Sodium	*	*										
Thallium	*	*	0.45									
Vanadium	15	4.9					0.34	0.42	0.45			0.85
Zinc	23000	4.6					4.7	3.7	3.9	7.1	4.3	3.9
Radiological (pCi/g)												
Gross alpha[e]	5	*	0.438	0.417	0.153	0.111		8.1	10.4			7.5
Gross beta[e]	15	*	0.211	0.257		0.469	6.1	6.4	4.5	3.9		
Actinium-228	*	*	NA	NA	NA	NA		0.6	0.4	0.5	0.5	
Bismuth-214	*	*	NA	NA	NA	NA	0.4				0.8	0.5
Lead-210	*	*	NA	NA	NA	NA				2.3		
Lead-212	*	*	NA	NA	NA	NA			0.2		0.2	0.2
Lead-214	*	*	NA	NA	NA	NA	0.6	1.3	0.8	1	0.8	
Thallium-208	*	*	NA	NA	NA	NA					0.2	0.1

TABLE 5-2B

SURFACE SOIL PHASES I AND II—DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]		H46	H47	H48	H49	H49-D	S01	S02	S03	S04	S10
DATE SAMPLED	Florida SCTL[c]	NTC BGSV[d]	5/13/98	5/13/98	5/13/98	5/13/98	5/13/98	5/12/97	5/12/97	5/12/97	5/12/97	6/28/97
Metals (mg/kg)												
Aluminum	72000	4780	589	832	1810	517	444	25	2820	2240	2210	2980
Antimony	26	*						0.40				
Arsenic	0.8	1.9			0.35			0.54	0.74	0.53	1.1	0.98
Barium	110	21.6	8.0	3.4	5.0	3.0	3.3	26.7	22.4	24.0	24.8	
Cadmium	75	0.46										
Calcium	*	*	334 J	286 J	338 J	252 J	247 J	2190 J	1410 J	25 J	5760 J	668
Chromium	*	33568						4.1	4.5		6.5	3.9
Cobalt	4700	7.7	0.15		0.25			0.22	0.31	0.24	0.48	
Copper	110	2.6	4.6	0.57	0.90	0.72	0.62	5.1	4.8	6.8	17.8	0.78
Iron	23000	843	132	252	395	228	196	936	485	599	1300	538
Lead	400	21.3	5.0	3.4	5.0	2.5	2.2	12.5	15.7	47.2	97.3	4.3
Magnesium	*	381	68.4	59.0	82.6	53.3	47.3	212	158	255	427	83.1
Manganese	1600	10.8						11.9	5.6	10.6	18.0	2.3
Mercury	3.4	.05										0.10
Nickel	110	*										0.96
Potassium	*	210						93.4	129	93.9	162	40.4
Selenium	390	1.1		0.30	0.54			0.56	0.37	0.66		
Silver	390	*										
Sodium	*	*									269	
Thallium	*	*										
Vanadium	15	4.9	0.64	0.63	1.6	0.60	0.53		2.2	0.18	3.0	2.2
Zinc	23000	4.6	4.6	2.9	3.9	3.3	3.5	33.8	16.4	59.7	106	
Radiological (pCi/g)												
Gross alpha[e]	5	*			8.3	3.8	5.1	5.5		4.6	5.9	1.61
Gross beta[e]	15	*	7	28	6.4	15.3			6.3	2.8	3.5	0.733
Actinium-228	*	*		0.8				0.7	1.4		1.9	NA
Bismuth-214	*	*				1.2			0.9		1.5	NA
Lead-210	*	*										NA
Lead-212	*	*	0.2	0.2	0.3		0.2	0.4	0.3	0.4	0.4	NA
Lead-214	*	*	0.6	0.5	1.1	1.4	0.6		1.3	0.9	1.3	NA
Thallium-208	*	*					0.2	0.4			0.3	NA

TABLE 5-2B

SURFACE SOIL PHASES I AND II—DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]		S10-D	S11	S12	S20	S21	S22	S30	S31	S32	S40
DATE SAMPLED	Florida SCTL[c]	NTC BGSV[d]	6/28/97	6/29/97	6/30/97	6/28/97	6/29/97	6/30/97	6/28/97	6/29/97	6/30/97	6/28/97
Metals (mg/kg)												
Aluminum	72000	4780	2080	3430	1210	3510	2030	2800	4340	2760	1560	3590
Antimony	26	*										
Arsenic	0.8	1.9	0.65		1.3	2.5	3.8	2.1	2.5	2.4	0.61	2.3
Barium	110	21.6		10.0	3.8			7.3	13.3	13.7	5.0	15.9
Cadmium	75	0.46						0.23	0.13		0.16	
Calcium	*	*	670	773	431	553	472	684	1460	480	536	825
Chromium	*	33568	2.6	3.9	2.4	3.5	2.5	4.8	4.7	3.3	2.5	4.3
Cobalt	4700	7.7		0.24				0.27	0.26	0.23		
Copper	110	2.6	0.77	1.2		0.82	1.2	4.5	4.6	1.7		1.0
Iron	23000	843	467	837	694 J	589	878	955 J	1130	1220	1240 J	374
Lead	400	21.3	3.3	5.6	2.4	3.7	3.9	13.5	6.5	4.7	9.2	4.1
Magnesium	*	381	75.4	84.5	37.1	67.0	52.4	54.9	127	63.7	39.9	116
Manganese	1600	10.8	2.1	4.1	2.2	4.4	3.5	6.9	7.6	2.5	4.2	2.7
Mercury	3.4	.05										
Nickel	110	*	0.68	1.7	0.57	1.4	1.2	1.4	1.9	2.3	0.88	0.77
Potassium	*	210	33.5	47.2	28.7	30.4	37.2	54.8	44.4	53.9	26.1	63.0
Selenium	390	1.1										
Silver	390	*										
Sodium	*	*										
Thallium	*	*										
Vanadium	15	4.9		4.8	1.9	3.5	2.8	3.0	4.7	4.2	2.2	3.1
Zinc	23000	4.6		6.1			5.7	16.5	8.9	5.8	12.8	
Radiological (pCi/g)												
Gross alpha[e]	5	*	0.855	2.33	0.785	1.63	0.936	1.10	1.95	2.37	0.669	2.01
Gross beta[e]	15	*	0.406	1.11		0.609	0.478	0.731	0.951	0.674	0.387	0.934
Actinium-228	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bismuth-214	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-210	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-212	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-214	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium-208	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5-2B

SURFACE SOIL PHASES I AND II—DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]		S41	S50	S51	S52	S60	S61	S62	S70	S71	S72
DATE SAMPLED	Florida SCTL[c]	NTC BGSV[d]	6/29/97	6/28/97	6/29/97	6/30/97	6/28/97	6/29/97	6/30/97	6/28/97	6/29/97	6/30/97
Metals (mg/kg)												
Aluminum	72000	4780	1970	3380	2720	2730	3880	2130	2650	4260	1670	2200
Antimony	26	*										
Arsenic	0.8	1.9	3.8	3.2	3.2	4.8	2.1	0.93	3.9	1.3	1.2	1.7
Barium	110	21.6		16.7	9.6	13.7	13.7		10.3			5.6
Cadmium	75	0.46								0.07		
Calcium	*	*	620	942	2980	564	868	2450	1370	656	666	3650
Chromium	*	33568	2.9	4.0	3.2	3.1	3.9	2.8	4.0	4.4	2.1	3.0
Cobalt	4700	7.7	0.25	0.21						0.25		
Copper	110	2.6	1.8	1.4	2.5		1.6	2.0		1.5	1.6	2.4
Iron	23000	843	1020	836	869	491 J	770	462	831 J	884	293	396 J
Lead	400	21.3	4.6	5.0	5.3	3.4	4.9	4.9	7.1	5.1	4.4	6.4
Magnesium	*	381	59.4	113	99.9	74.4	144	76.6	55.2	95.7	73.7	72.3
Manganese	1600	10.8	4.3	4.7	6.4	4.5	3.9	5.3	8.0	3.5	2.3	3.7
Mercury	3.4	.05										
Nickel	110	*	0.96	1.1	1.2	0.94	1.3	0.73	0.80	1.7	0.51	0.73
Potassium	*	210	51.9	52.4	47.8	43.9	61.8	40.0	41.4	35.0	43.9	30.3
Selenium	390	1.1										
Silver	390	*										
Sodium	*	*										
Thallium	*	*										
Vanadium	15	4.9	2.6	4.3	3.0	2.3	4.3	1.9	2.8	5.8	1.1	1.7
Zinc	23000	4.6	5.3	9.6	5.6			6.2	4.5	8.3		6.5
Radiological (pCi/g)												
Gross alpha[e]	5	*	1.27	1.81	1.56	0.825	1.73	1.41	1.75	2.80	1.14	1.19
Gross beta[e]	15	*	0.558	0.699	0.501	0.669	0.830	0.840	0.852	1.53	0.599	0.804
Actinium-228	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bismuth-214	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-210	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-212	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-214	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium-208	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5-2B

SURFACE SOIL PHASES I AND II—DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]		S80	S80-D	S81	S82	S83	S90	S91	S91-D	S92	S99
DATE SAMPLED	Florida SCTL[c]	NTC BGSV[d]	6/28/97	6/28/97	6/29/97	6/30/97	7/1/97	6/28/97	6/29/97	6/29/97	6/30/97	7/1/97
Metals (mg/kg)												
Aluminum	72000	4780	963	1090	2220	2060	2570	3350	893	1030	938	2530
Antimony	26	*										
Arsenic	0.8	1.9	3.3	3.4		1.9	1.8	2.2	0.93	0.89		2.6
Barium	110	21.6			12.2	10.6	6.9	12.9			5.7	3.0
Cadmium	75	0.46	0.06									
Calcium	*	*	796	1160	12700	1680	946 J	1340	529	601	593	682 J
Chromium	*	33568	3.5	6.5	3.3	2.9	3.4	4.0	2.9	3.8	2.2	3.3
Cobalt	4700	7.7										
Copper	110	2.6	2.3	3.0	2.7	3.0		2.4	2.8	3.7		
Iron	23000	843	266	342	294	246 J	254 J	291	117	140	252 J	486 J
Lead	400	21.3	3.1	3.5	7.8	5.7	3.5 J	9.5	11.2	13.1	6.5	1.7 J
Magnesium	*	381	51.3	66.3	49.1	113	75.1	165	41.1	45.5	43.6	59.8
Manganese	1600	10.8	17.1	21.2	3.2	4.8	3.0	7.3	1.0	1.3	3.0	2.4
Mercury	3.4	.05	0.13									
Nickel	110	*	0.35	0.64	0.56	0.62	0.49	0.71	0.30	0.31	0.38	0.63
Potassium	*	210	15.3	18.1	28.2	43.8	49.8	46.7	20.4	24.5	17.7	42.5
Selenium	390	1.1					0.50	0.43	0.41			
Silver	390	*	0.47	0.41	0.55	0.34						
Sodium	*	*			128							
Thallium	*	*										
Vanadium	15	4.9			1.5	1.6	1.7	2.1	0.72	0.97	0.62	3.1
Zinc	23000	4.6	6.7	6.5	8.7	5.1		9.7	5.9	6.9	6.9	
Radiological (pCi/g)												
Gross alpha[e]	5	*	0.901	0.922	2.16	1.17	1.22	2.13	1.28	0.506	0.670	1.36
Gross beta[e]	15	*	0.360	0.483	0.549	0.512	0.516	1.13			0.196	0.701 J
Actinium-228	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bismuth-214	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-210	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-212	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-214	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium-208	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5-2B

SURFACE SOIL PHASES I AND II—DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]		S100	S101	S102	S102-D	S103	S104	S105	S108	S109	S110
DATE SAMPLED	Florida SCTL[c]	NTC BGSV[d]	6/29/97	6/29/97	6/30/97	6/30/97	7/1/97	7/1/97	7/1/97	7/1/97	7/1/97	6/28/97
Metals (mg/kg)												
Aluminum	72000	4780	3680	2040	2070	1360	1410	2890	2680	2410	980	4980
Antimony	26	*										
Arsenic	0.8	1.9	0.51	1.3	1.2	0.86	0.87		3.2	2.5		3.2
Barium	110	21.6	14.0	9.6	13.6	8.0	4.4	1.9	2.7	3.6	3.0	21.5
Cadmium	75	0.46				0.08						
Calcium	*	*	1020	1110	860	686	1050 J	214 J	822 J	518 J	718 J	1850
Chromium	*	33568	4.3	3.8	3.7	2.4	2.1	3.1	3.4	3.0	3.5	6.4
Cobalt	4700	7.7										
Copper	110	2.6	1.6	2.3	6.8	5.0	2.5					1.9
Iron	23000	843	335	294	616 J	321 J	346 J	330 J	323 J	282 J	313 J	398
Lead	400	21.3	6.5	9.4	4.9	4.1	4.4 J	2.6 J	2.3 J	1.7 J	2.5 J	5.2
Magnesium	*	381	112	84.1	107	65.9	63.3	27.6	62.1	47.2	59.8	188
Manganese	1600	10.8	2.9	3.9	3.5	2.4	4.0	1.1	4.6	2.2	3.5	7.1
Mercury	3.4	.05		0.09	0.10							
Nickel	110	*	0.91	0.95	1.0	0.60	0.49	0.81	0.70	0.72		0.93
Potassium	*	210	39.6	35.4	46.3	30.7	18.1	12.8	27.7	43.3	25.3	66.9
Selenium	390	1.1				0.48					0.53	
Silver	390	*		0.26	0.79	0.83						
Sodium	*	*										
Thallium	*	*										
Vanadium	15	4.9	2.3	1.3	2.1	1.2	0.96	1.8	1.9	1.8	0.87	2.8
Zinc	23000	4.6	5.8	9.0	6.4	6.6	4.4					
Radiological (pCi/g)												
Gross alpha[e]	5	*	2.74	0.170	1.14	0.905	0.933	1.60	0.937	0.903	0.584	2.65
Gross beta[e]	15	*	1.21		0.573	0.479	0.485 J	0.640 J	0.339 J	0.586 J	0.335 J	1.31
Actinium-228	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bismuth-214	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-210	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-212	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-214	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium-208	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5-2B

SURFACE SOIL PHASES I AND II—DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]		S111	S112	S113	S114	S115	S116	S117	S118	S119	S120
DATE SAMPLED	Florida SCTL[c]	NTC BGSV[d]	6/29/97	6/30/97	7/1/97	7/1/97	7/1/97	7/1/97	7/1/97	7/1/97	7/1/97	6/28/97
Metals (mg/kg)												
Aluminum	72000	4780	3050	1630	1780	2900	2410	1690	1120	1340	1540	3340
Antimony	26	*										
Arsenic	0.8	1.9	1.5	2.8		1.2	3.8	1.6			0.86	1.1
Barium	110	21.6	17.8	5.5	3.0	6.2	7.5	3.8	2.7	3.3	3.2	
Cadmium	75	0.46										
Calcium	*	*	760	858	372 J	3140 J	4440 J	980 J	3110 J	2490 J	852 J	879
Chromium	*	33568	5.5	2.6	3.3	3.6	3.3	2.5	1.6	2.2	2.4	3.9
Cobalt	4700	7.7										
Copper	110	2.6	3.5	2.7								1.3
Iron	23000	843	492	132 J	167 J	361 J	277 J	164 J	201 J	265 J	322 J	1040
Lead	400	21.3	7.0	6.6	2.8 J	4.5 J	6.5 J	2.8 J	4.6 J	1.8 J	1.8 J	5.1
Magnesium	*	381	81.0	63.9		87.7	87.6	42.3	46.8	60.7	69.7	89.0
Manganese	1600	10.8	3.3	4.0	0.60	2.4	5.1	2.7	4.2	1.7	3.0	2.7
Mercury	3.4	.05										
Nickel	110	*	0.96	0.34		0.63	0.61	0.47	0.34	0.41	0.44	0.93
Potassium	*	210	41.3	43.0		30.5	35.6	29.4	17.7	18.9	28.2	29.1
Selenium	390	1.1				0.47	0.45					
Silver	390	*		0.37		0.24						
Sodium	*	*										
Thallium	*	*										
Vanadium	15	4.9	2.5	0.59	1.2	1.8	2.0	1.2	0.93	1.8	1.5	3.3
Zinc	23000	4.6										6.8
Radiological (pCi/g)												
Gross alpha[e]	5	*	2.80	1.19	0.808	0.912	1.61	0.632	0.641	1.16	0.556	1.13
Gross beta[e]	15	*	1.31	0.394	0.482	0.794	0.796	0.429	0.364	0.631	0.469	0.819
Actinium-228	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bismuth-214	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-210	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-212	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-214	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium-208	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5-2B

SURFACE SOIL PHASES I AND II—DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]		S121	S122	S123	S124	S124-D	S125	S126	S127	S128	S129
DATE SAMPLED	Florida SCTL[c]	NTC BGSV[d]	6/28/97	6/30/97	7/1/97	7/1/97	7/1/97	7/1/97	7/1/97	7/1/97	7/1/97	7/1/97
Metals (mg/kg)												
Aluminum	72000	4780	1360	928	1850	3400	3020	2740	1110	741	524	821
Antimony	26	*										
Arsenic	0.8	1.9	2.1	2.5	1.6	2.4	2.0	1.8	2.5	1.5	1.5	0.76
Barium	110	21.6		2.4	6.4	6.2	4.5	7.6	3.8	2.8	3.5	3.6
Cadmium	75	0.46		0.09								
Calcium	*	*	1470	841	792 J	1430 J	1560 J	4130 J	16000 J	1040 J	8250 J	939 J
Chromium	*	33568	2.5	1.5	2.9	4.3	3.9	3.6	1.9			
Cobalt	4700	7.7										
Copper	110	2.6	2.0	3.0								
Iron	23000	843	165	114 J	187 J	383 J	291 J	344 J	306 J	252 J	137 J	176 J
Lead	400	21.3	3.7	3.3	3.8 J	5.4 J	4.7 J	6.0 J	3.8 J	3.4 J	2.2 J	3.0 J
Magnesium	*	381	116	48.0	72.6	71.5	61.0	95.5	332	75.6	97.9	70.6
Manganese	1600	10.8	14.3	2.7	1.6	2.7	3.2	3.9	10.2	2.8	3.9	3.3
Mercury	3.4	.05										
Nickel	110	*	0.36		0.31	0.63	0.67	0.73	0.54			
Potassium	*	210	33.4	27.7	37.9	47.2	34.6	28.6	40.7	25.2	40.7	29.5
Selenium	390	1.1							0.45			
Silver	390	*		0.24								
Sodium	*	*										
Thallium	*	*										
Vanadium	15	4.9	0.68		1.0	2.2	2.0	3.3	1.6	0.61	0.50	0.51
Zinc	23000	4.6	5.4	8.2				4.5				
Radiological (pCi/g)												
Gross alpha[e]	5	*	0.687	0.579	0.700	1.00	1.35	1.69	0.554	0.664	0.548	0.639
Gross beta[e]	15	*	0.315	0.265	0.403	0.380	0.698	1.22		0.599	0.339	0.558
Actinium-228	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bismuth-214	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-210	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-212	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-214	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium-208	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5-2B

SURFACE SOIL PHASES I AND II—DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]		S130	S131	S132	S133	S134	S135	S137	S137-D	S138	S139
DATE SAMPLED	Florida SCTL[c]	NTC BGSV[d]	6/28/97	6/29/97	6/30/97	7/1/97	6/30/97	6/30/97	6/30/97	6/30/97	6/30/97	6/30/97
Metals (mg/kg)												
Aluminum	72000	4780	3540	1840	1680	1700	1400	1650	1830	1450	815	3180
Antimony	26	*										
Arsenic	0.8	1.9	1.2	0.89	2.5	4.8	1.3	1.2	0.92	0.58		1.4
Barium	110	21.6	10.5		6.0	3.6	2.0	3.2	2.9	2.4	2.4	4.2
Cadmium	75	0.46			0.07							
Calcium	*	*	964	1720	794	731 J	811	452	730	1680	864	583
Chromium	*	33568	3.9	2.2	2.4	2.8	1.4	1.8	2.3	2.0	1.4	4.2
Cobalt	4700	7.7										
Copper	110	2.6	1.3	1.4	4.1							
Iron	23000	843	972	637	349 J	207 J	219 J	258 J	622 J	576 J	298 J	925 J
Lead	400	21.3	4.7	3.4	4.2	3.9 J	2.5	2.6	2.4	1.7	2.3	1.6
Magnesium	*	381	122	49.1	64.4	47.9	71.0	42.5	63.7	59.2	55.9	63.2
Manganese	1600	10.8	4.0	2.8	3.5	5.9	2.8	1.0	1.4	1.7	2.0	1.0
Mercury	3.4	.05			0.12							
Nickel	110	*	1.0	0.48	0.42	0.43		0.47	0.54	0.28	0.26	0.93
Potassium	*	210	46.1	27.8	38.8	32.5	30.1	31.0	28.9	17.1	16.4	23.9
Selenium	390	1.1										
Silver	390	*			0.53							
Sodium	*	*										
Thallium	*	*										
Vanadium	15	4.9	3.4	1.7	1.3	1.1	0.62	1.6	2.2	2.0	1.3	5.7
Zinc	23000	4.6		6.3	7.7	5.8						
Radiological (pCi/g)												
Gross alpha[e]	5	*	1.19	0.792	0.434	0.744	0.460	0.601	0.695	0.697	0.509	0.995
Gross beta[e]	15	*	0.765	0.449		0.377		0.157		0.357	0.358	0.701
Actinium-228	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bismuth-214	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-210	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-212	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-214	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium-208	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5-2B

SURFACE SOIL PHASES I AND II—DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]		S140	S151	S151-D	S152	S153	S154	S155	S156	S157	S158
DATE SAMPLED	Florida SCTL[c]	NTC BGSV[d]	6/28/97	7/1/97	7/1/97	7/1/97	7/1/97	7/1/97	6/30/97	6/30/97	7/1/97	7/1/97
Metals (mg/kg)												
Aluminum	72000	4780	1690	4980	5090	1230	2170	2450	1240	2700	3110	2930
Antimony	26	*										
Arsenic	0.8	1.9	1.2	2.5	3.3		0.73	1.9	0.78	0.84	1.4	
Barium	110	21.6		18.7	14.8	3.6	6.3	4.7	4.2	6.5	8.7	5.4
Cadmium	75	0.46										
Calcium	*	*	450	610 J	545 J	1790 J	12500 J	1060 J	4300	1230	3270 J	1840 J
Chromium	*	33568	2.1	6.0	5.8	2.5	3.6	3.6	2.3	3.5	4.8	2.8
Cobalt	4700	7.7			0.22							
Copper	110	2.6	0.86			2.5	3.0	5.0			3.3	2.3
Iron	23000	843	431	584 J	734 J	312 J	458 J	362 J	552 J	500 J	645 J	246 J
Lead	400	21.3		3.0 J	3.7 J	11.6 J	3.7 J	2.2 J	5.3	7.3	7.1 J	4.4 J
Magnesium	*	381	60.6	79.0	83.0	58.5	143	68.0	86.7	75.5	86.6	64.5
Manganese	1600	10.8	4.1	1.8	2.4	5.0	5.5	5.2	3.8	5.1	8.9	2.6
Mercury	3.4	.05					0.22				0.13	
Nickel	110	*	5.4	1.2	1.4	0.34	0.65	0.68	0.47	0.96	1.1	0.67
Potassium	*	210	21.6	71.8	77.2	26.6	33.8	33.1	24.7	30.3	43.0	28.8
Selenium	390	1.1					0.47				0.54	
Silver	390	*					2.4				1.9	
Sodium	*	*										
Thallium	*	*										
Vanadium	15	4.9	2.2	6.3	6.6	0.81	2.2	2.2	2.7	3.4	2.7	1.1
Zinc	23000	4.6					9.1		4.9	7.7	9.6	
Radiological (pCi/g)												
Gross alpha[e]	5	*	0.981	2.57	2.72	0.720	1.19	1.06	0.826	0.741	2.09	0.806
Gross beta[e]	15	*	0.617	1.28 J	1.42	0.621 J	0.908	0.686	0.312	0.657	1.14	0.251
Actinium-228	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bismuth-214	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-210	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-212	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead-214	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium-208	*	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5-2B

SURFACE SOIL PHASES I AND II—DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]		S159	S160
DATE SAMPLED	Florida SCTL[c]	NTC BGSV[d]	7/1/97	7/1/97
Metals (mg/kg)				
Aluminum	72000	4780	1760	1280
Antimony	26	*		
Arsenic	0.8	1.9		2.0
Barium	110	21.6	10.5	4.6
Cadmium	75	0.46		
Calcium	*	*	1640 J	666 J
Chromium	*	33568	1.9	5.7
Cobalt	4700	7.7		
Copper	110	2.6	2.6	3.0
Iron	23000	843	299 J	297 J
Lead	400	21.3	5.7 J	4.2 J
Magnesium	*	381	36.5	50.0
Manganese	1600	10.8	2.7	35.5
Mercury	3.4	.05		
Nickel	110	*	0.28	0.38
Potassium	*	210	15.3	34.6
Selenium	390	1.1		
Silver	390	*		
Sodium	*	*		
Thallium	*	*		
Vanadium	15	4.9	0.73	0.68
Zinc	23000	4.6		4.7
Radiological (pCi/g)				
Gross alpha[e]	5	*	1.51	1.28
Gross beta[e]	15	*	0.628 J	0.754 J
Actinium-228	*	*	NA	NA
Bismuth-214	*	*	NA	NA
Lead-210	*	*	NA	NA
Lead-212	*	*	NA	NA
Lead-214	*	*	NA	NA
Thallium-208	*	*	NA	NA

TABLE 5-2B

SURFACE SOIL PHASES I AND II – DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

* Indicates that the screening criterion is not available.
NA – Not analyzed.
"J" qualifier on analytical data indicates an estimated value.
No entry indicates chemical not detected.
Only chemicals detected in at least one sample are shown.
The complete list of analytical results is presented in Appendix B of this report.
Shaded entry indicates chemical detected at a concentration that meets or exceeds screening criteria.
(a) "D" in sample location indicates a duplicate sample.
(b) For an organic analyte with an established GCTL and BGSV, the screening criterion is the greater of the GCTL or the BGSV.
(c) Groundwater Cleanup Target Level (Development of Soil Cleanup Target Levels (SCTLs) for Chapter 62-777, F.A.C., May 26, 1999).
(d) Background Screening Value Level (Background Sampling Report for NTC, Orlando, Florida; ABB Environmental Services, August 1995) for inorganics only.
(e) The screening values are estimated because the activities for the specific radionuclides in the samples have not been determined. These data are required for conversion to a dose rate and comparison to the 4 millirem/year federal and state value for water.

TABLE 5-2C

SURFACE SOIL PHASES I AND II—FREQUENCY OF DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Location of Maximum Concentration	Detection Frequency	Background Value[(a)]
Volatiles (mg/kg)						
67-64-1	Acetone	0.024 J	51.4	S116	15/56	
75-15-0	Carbon disulfide	0.0036 J	0.0036 J	H24	1/129	
74-87-3	Chloromethane	0.0074	0.0074	H22	1/133	
75-09-2	Methylene chloride	0.0023	0.0163 J	H46	9/133	
127-18-4	Tetrachloroethene	0.003	0.003	S92	1/133	
108-88-3	Toluene	0.0015	0.0149 J	H43	17/133	
1330-20-7	Xylenes, Total	0.0022	0.0078	S20	8/133	
Semivolatiles (mg/kg)						
83-32-9	Acenaphthene	1.63 J	1.63 J	S04	1/129	
120-12-7	Anthracene	0.339	2.7 J	S04	4/129	
56-55-3	Benzo(a)anthracene	0.465 J	7.94	S04	12/129	
50-32-8	Benzo(a)pyrene	0.048 J	6.32	S04	28/129	
205-99-2	Benzo(b)fluoranthene	0.403 J	5.47 J	S04	11/129	
191-24-2	Benzo(g,h,i)perylene	0.38	9.86	S04	11/129	
207-08-9	Benzo(k)fluoranthene	0.272 J	4.19 J	S04	11/129	
218-01-9	Chrysene	0.486 J	8.51	S04	12/129	
53-70-3	Dibenzo(a,h)anthracene	0.0899	1.72	S04	17/129	
206-44-0	Fluoranthene	0.191 J	22.4	S04	21/129	
86-73-7	Fluorene	1.37 J	1.37 J	S04	1/129	
193-39-5	Indeno(1,2,3-cd)pyrene	0.417	8.8	S04	11/129	
85-01-8	Phenanthrene	0.178 J	13.6	S04	12/129	
129-00-0	Pyrene	0.145 J	14.7	H15	18/129	

TABLE 5-2C

SURFACE SOIL PHASES I AND II—FREQUENCY OF DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Location of Maximum Concentration	Detection Frequency	Background Value[a]
PCBs and Pesticides (mg/kg)						
72-54-8	4,4'-DDD	0.0022	0.023	H7	7/130	
72-55-9	4,4'-DDE	0.0013 J	0.178	S04	32/130	
50-29-3	4,4'-DDT	0.0048	0.274	S04	11/130	
309-00-2	Aldrin	0.013	0.013	S03	1/130	
	alpha-Chlordane	0.0013	0.219	S04	15/130	
11097-69-1	Aroclor-1254	0.022	0.039	H5	1/23	
60-57-1	Dieldrin	0.001	0.097	S04	6/130	
33213-65-9	Endosulfan II	0.0022	0.0045	S92	2/130	
72-20-8	Endrin	0.0044	0.0044	H2	1/130	
53494-70-5	Endrin ketone	0.0075	0.019 J	S103	2/130	
5103-74-2	gamma-Chlordane	0.0013	0.243	S04	17/130	
76-44-8	Heptachlor	0.0011 J	0.048	S04	14/130	
1024-57-3	Heptachlor rpoxide	0.0014	0.0063 J	H10	2/130	
72-43-5	Methoxychlor	0.027	0.027	H28	1/130	
87-86-5	Pentachlorophenol	0.0025	0.109	S04	5/129	

TABLE 5-2C

SURFACE SOIL PHASES I AND II—FREQUENCY OF DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Location of Maximum Concentration	Detection Frequency	Background Value[a]
Inorganics (mg/kg)						
7429-90-5	Aluminum	58.4	6520	H3	129/129	4870
7440-36-0	Antimony	0.4	0.84	H45	2/129	*
7440-38-2	Arsenic	0.35	4.8	S133, S52	75/129	1.9
7440-39-3	Barium	1.9	177	H14	85/129	21.6
7440-43-9	Cadmium	0.06	0.23	S22	12/129	*
7440-70-2	Calcium	58.4	16000 J	S126	125/129	33568
7440-47-3	Chromium	0.21	6.5	S04, S80	116/129	7.7
7440-48-4	Cobalt	0.15	0.48	S04	17/129	*
7440-50-8	Copper	0.3	21.4	H18	80/129	2.6
7439-89-6	Iron	19.7	1300	S04	129/129	843
7439-92-1	Lead	1.6	97.3	S04	123/129	21.3
7439-95-4	Magnesium	10.2	427	S04	113/129	381
7439-96-5	Manganese	0.53	35.5	S160	117/129	10.8
7439-97-6	Mercury	0.09	0.22	S153	9/129	0.05
7440-02-0	Nickel	0.24	5.4	S140	104/129	*
7440-09-7	Potassium	10.7	162	S04	103/129	210
7782-49-2	Selenium	0.3	0.66	S03	20/129	1.1
7440-22-4	Silver	0.23	2.4	S153	12/129	*
7440-23-5	Sodium	128	269	S04	2/129	*
7440-28-0	Thallium	0.45	0.45	H37	1/129	*
7440-62-2	Vanadium	0.18	6.6	S151	106/129	4.9
7440-66-6	Zinc	2.9	106	S04	66/129	4.6

TABLE 5-2C

SURFACE SOIL PHASES I AND II—FREQUENCY OF DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Location of Maximum Concentration	Detection Frequency	Background Value[a]
Miscellaneous (mg/kg)						
	Diesel Range Organics	7.26 J	66.8	S103	53/116	
	Gasoline Range Organics	0.128	0.128	H35	1/116	
74-82-8	TPH (C8-C40)	23.8	896	S04	13/13	
	Total Organic Carbon	1.1	30000	S121	25/25	
Radiological (pCi/g)						
74-82-8	Actinium-228	0.4	1.9	S04	7/13	
74-82-8	Bismuth-214	0.4	1.5	S04	4/13	
74-82-8	Cesium-137	0.1	0.2	H44, S04	3/13	
	Gross alpha	0.111	10.4	H43	123/129	
	Gross beta	0.157	28	H47	111/129	
74-82-8	Lead-210	2.3	2.3	H44	1/13	
74-82-8	Lead-212	0.2	0.4	S01, S03, S04	9/13	
74-82-8	Lead-214	0.5	1.4	H49	11/13	
74-82-8	Thallium-208	0.1	0.4	S01	3/13	

"J" qualifier indicates an estimated value.
CAS – Chemical Abstracts Service.
* – Not available.
[a] Maximum concentration was observed in the field duplicate sample for G230.
Rejected values not included.
Background samples are not included.
Table 4-1 and Section 4.3.3 provide details regarding rejected results.

soil cleanup target levels (SCTLs) for Residential Direct Exposure (FDEP, 1999). Any detections that exceed these criteria are shaded in Table 5-2A. As seen on the table, there are no exceedances for VOCs; thus, the VOCs in surface soil are not a significant concern at the site.

The samples collected to specifically evaluate pesticides and herbicides (at areas of the golf course not associated with landfill materials) were also analyzed for VOCs to confirm that landfill material was not impacting these soils. The sample locations are identified as B01 through B10 on Figure 3-4B and on Table 5-2A. Acetone and toluene were each detected in one sample at low levels. These compounds are both common laboratory artifacts and the samples (SSB02 and SSB05) are considered to represent valid background locations.

5.2.2 Semivolatile Organic Compounds

Fourteen SVOCs were detected in the surface soils at the site. As indicated on Table 5-2C benzo(a)pyrene was detected most frequently with 28 detections (out of 129), followed by fluoranthene with 21 detections (out of 129). Other SVOCs with high number of detections include pyrene with 18, dibenzo(a,h)anthracene with 17, and chrysene with 12 detections. Benzo(b)fluoranthene, benzo(g,h,i)perylene, and benzo(k)fluoranthene had 11 detections each. The concentration range for benzo(a)pyrene was 48 J µg/kg to 6,320 µg/kg. The compound with maximum concentration was fluoranthene detected at a concentration level of 22,400 µg/kg. Thirteen of the 14 detected compounds had their maximum concentration detected at one location, S04. This location is west of the access road next to the golf course on the western side of the site (Figure 5-2). The soil cover is only 1 foot thick at this location (see Section 5.1.2). Pyrene was detected at its maximum concentration at H15, located about 600 feet south of S04. Relatively high concentrations of other SVOCs were also detected at this location, suggesting that areas around these locations do not have adequate clean soil cover. Other locations with multiple detections and relatively high SVOC concentrations include S62, S82, S91, S102, and S103 (Figure 5-2). These locations are in the south-central section of the golf course.

Table 5-2A presents the list of detected SVOCs and Table 5-2C lists the frequency of these detections. The detected chemicals were compared to SCTLs for Residential Direct Exposure. The detections exceeding the criteria are shaded in Table 5-2A. Figure 5-2 depicts sampling locations with detections exceeding the target levels. SVOCs with exceedances are benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene. Benzo(a)pyrene is the most prevalent SVOC with almost all detections exceeding the screening value. The presence of several SVOCs at levels that exceed the screening criteria in the western and southern portions of the site represents the most significant impact to surface soil from SVOCs.

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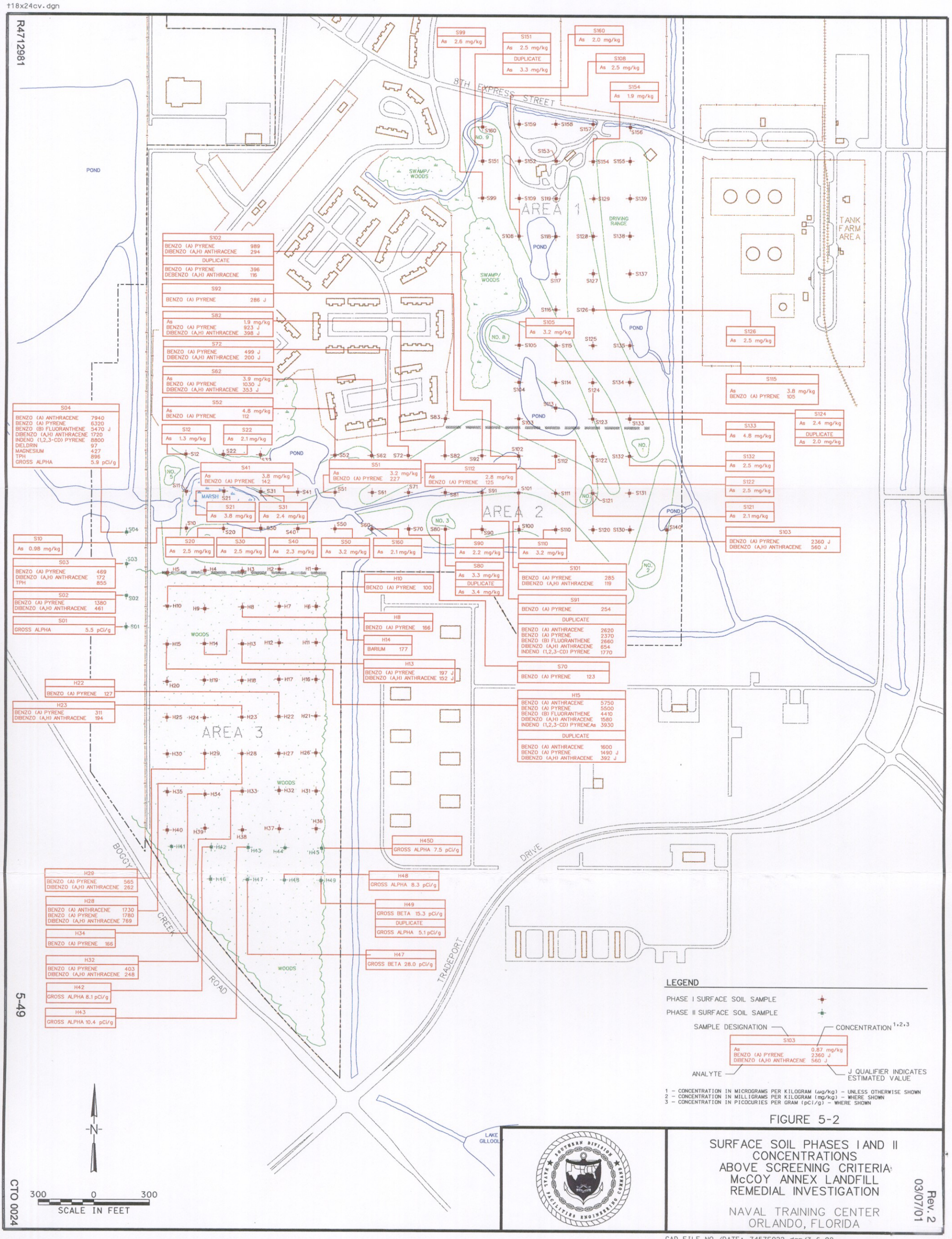
R4712981



LEGEND

PHASE I SURFACE SOIL SAMPLE

PHASE II SURFACE SOIL SAMPLE

SAMPLE DESIGNATION — CONCENTRATION[1,2,3]

S103

As	0.87 mg/kg
BENZO (A) PYRENE	2360 J
DIBENZO (A,H) ANTHRACENE	560 J

ANALYTE — J QUALIFIER INDICATES ESTIMATED VALUE

1 - CONCENTRATION IN MICROGRAMS PER KILOGRAM (ug/kg) - UNLESS OTHERWISE SHOWN
2 - CONCENTRATION IN MILLIGRAMS PER KILOGRAM (mg/kg) - WHERE SHOWN
3 - CONCENTRATION IN PICOCURIES PER GRAM (pCi/g) - WHERE SHOWN

FIGURE 5-2

SURFACE SOIL PHASES I AND II CONCENTRATIONS ABOVE SCREENING CRITERIA McCOY ANNEX LANDFILL REMEDIAL INVESTIGATION

NAVAL TRAINING CENTER ORLANDO, FLORIDA

Rev. 2 03/07/01

5-49

CTO 0024

CAD FILE NO./DATE: 7457F022.dgn/3-6-00

5.2.3 Pesticides and Polychlorinated Biphenyls

Thirteen pesticides and one PCB were detected in the surface soils at the site. 4,4'-DDE had the highest number of detections (32 out of 130), followed by gamma-chlordane (17 out of 130) and alpha-chlordane (15 out of 130). The sample collected at S04 had seven pesticides detected at maximum concentrations. The soil cover is very thin at this location. A similar observation was also made for SVOCs at this location (see the previous section), suggesting that clean soil cover is not adequate in the general area. This location is near the western boundary of the site. Other pesticides with a notable number of detections include heptachlor (14 out of 130), 4,4'-DDT (11 out of 130), and 4,4'-DDD (7 out of 130). The detected concentrations ranged from 1.3 J µg/kg to 178 µg/kg for 4,4'-DDE, 1.3 µg/kg to 243 µg/kg for gamma-chlordane, and 1.3 µg/kg to 219 µg/kg for alpha-chlordane. Aldrin, endrin, and methoxychlor had only one detection each with concentrations of 13, 4.4, and 27 µg/kg, respectively.

No pesticides were detected in any of the background samples. The sample locations are identified as B01 through B10 on Figure 3-4B and on Table 5-2A. However, data recently collected at the Main Base Golf Course (Tetra Tech NUS, 1998a) suggest that the highest levels of these chemicals may be associated with the tees and greens, with much lower levels on the fairways and the lowest levels in the rough. All of the background samples were collected in areas of the rough.

Table 5-2A presents the list of detected pesticides and Table 5-2C lists the frequency of these detections. The detected chemicals were compared to SCTLs for Residential Direct Exposure. The detections exceeding the criteria are shaded in Table 5-2A. Figure 5-2 depicts sampling locations with detections exceeding the target levels. Exceedances have occurred at only two locations, S03 and S04. The soil cover is only 1 foot thick at both of these locations.

Dieldrin and heptachlor were the only pesticides that exceeded the screening criteria. These exceedances occurred at sample location S04 for both analytes and heptachlor was detected just above the screening level at S03. PCBs were detected in one sample and its duplicate (H5 and H5-D), so dioxin analyses were performed for these samples only. Aroclor-1254 was detected at a concentration of 39 µg/kg with a duplicate sample concentration of 22 µg/kg, which are below the screening criterion for PCBs. The concentration of the dioxin octa-chlorodibenzodioxin (OCDD) was 0.18 J µg/kg with a duplicate sample concentration of 0.13 J µg/kg, which were below the screening criterion. Table 5-2A presents the list of detected PCBs and dioxins. Table 5-2C lists the frequency of these detections.

The relative absence of PCBs (and dioxins) indicates they are not a significant component of surface soil impacts at the site. The higher frequency of pesticide detections in the southwestern portion of the site,

the area near the pond west of the golf course, indicates that they were a larger component of the materials disposed in the landfill or were used on the golf course for pest control.

5.2.4 Herbicides

Pentachlorophenol was the only herbicide detected. It was detected at five locations (out of 129) with a maximum concentration of 109 µg/kg in the sample from S04. Table 5-2A presents the list of detected herbicides and Table 5-2C lists the frequency of these detections. The detected concentration of pentachlorophenol is below the screening criterion and its low frequency of detection indicates it is not a significant component of surface soil impacts.

No herbicides were detected in any of the background samples. The sample locations are identified as B01 through B10 on Figure 3-4B and on Table 5-2A. However, data recently collected at the Main Base Golf Course (Tetra Tech NUS, 1998a) suggest that the highest levels of these chemicals may be associated with the tees and greens with much lower levels on the fairways and the lowest levels in the rough. All of the background samples were collected in areas of the rough.

5.2.5 Total Petroleum Hydrocarbons

TPH (C_8-C_{40} range) were detected in all 13 samples that were analyzed. TPH concentrations ranged from 23.8 mg/kg to 896 mg/kg, with the maximum detected in a sample from S04. The diesel-range organics (DRO) were also detected at a relatively high frequency (53 out of the 116 samples), whereas the gasoline-range organics (GRO) were detected infrequently (only 1 out of the 116 samples). Table 5-2A presents the list of detected concentrations and Table 5-2C lists the frequency of these detections. Figure 5-2 depicts sampling locations with detections exceeding the target levels. At two locations, S03 and S04, the detected concentrations were above the screening criterion. The presence of TPH and SVOCs in the western portion of the golf course suggests that either landfilling of waste fuel or fuel-contaminated materials and/or burning might have taken place in this general area. The relatively high frequency of detection of TPH shows that it is a significant component of surface soil impacts in the extreme western portion of the site.

5.2.6 Inorganics

Numerous inorganic analytes were detected in the surface soil samples. Calcium, magnesium, potassium, and sodium are abundant in natural soils, have a low toxicity to humans, and have no SCTLs for Residential Direct Exposure. Therefore, these metals will not be discussed further in this section. Of the

remaining 17 inorganics detected in surface soils, 7 were detected at a high (i.e., >50% of samples) frequency (arsenic, barium, copper, manganese, nickel, vanadium, and zinc) and 3 were detected at nearly a 100% frequency (aluminum, iron, and lead). The remaining inorganics were detected at a much lower frequency (16% of samples or less). Table 5-2B presents the list of detected inorganics and Table 5-2C lists the frequency of detections along with locations at which maximum concentrations were encountered. The maximum concentrations of three metals were detected at S04; these metals are cobalt (maximum of 0.48 mg/kg), iron (maximum of 1300 mg/kg), and zinc (maximum of 106 mg/kg). This area is in the extreme western area of the site where other chemical concentrations (e.g., SVOCs) were detected at maximum concentrations.

Table 5-2B presents the summary of the inorganic detections and exceedances over the screening criterion. There is no SCTL for thallium (detected in one sample). Arsenic was the only inorganic that had exceedances of the screening criterion. No other metals exceeded the screening criteria, suggesting that the widespread detections of arsenic might be attributed to naturally occurring concentrations at the site. Inorganic background values from a previous study (ABB-ES, 1995) are presented in Tables 5-2B and 5-2C. The average background arsenic concentration is 1.9 mg/kg compared to the maximum detected value of 4.8 mg/kg. The majority of the arsenic detections, however, are around 2.0 mg/kg, again inferring that the presence of arsenic may be related to background and not contaminant sources in the landfill. Alternatively, arsenic may be associated with the past usage of pesticides and/or herbicides at the golf course. Arsenic detections above screening levels are much more common on the golf course than in the woods to the south. Figure 5-2 presents all sample locations exceeding the screening criteria.

5.2.7 Radiological

Radiological contamination was identified through gross alpha and gross beta measurements. Table 5-2B summarizes the results of the detections and exceedances over the screening criteria and Table 5-2C presents the frequency of detection information. Several gross alpha detections were found in the samples collected at various locations. The gross alpha concentrations ranged from 0.111 pCi/g to 10.4 pCi/g with the maximum detected at H43. Gross beta detections ranged from 0.157 pCi/g to 28 pCi/g with the maximum detected at H47. Detected analytes that exceeded the screening criteria are shaded in Table 5-2B. Gross alpha detections in 7 samples (out of 129) and gross beta detections in 2 samples (out of 129) were found to be above the screening criteria. These levels are thought to be associated with naturally elevated levels of radionuclides in the underlying Hawthorn Group sediments which have likely been reworked in the past and are now incorporated into the sediments of the surficial aquifer.

5.2.8 Geotechnical

Samples of the existing soil cover were collected and analyzed for geotechnical parameters to support an FS. The analyses included density, grain size, water content, Standard Proctor Test, and permeability. The procedures used to collect these samples and the analytical program are discussed in detail in Section 3.4.3. The laboratory results of the geotechnical tests are summarized in Table 5-2D and presented in full in Appendix C. In most cases, two sub-samples (A and B in Sample No. column) were collected from the same location and sent for duplicate analyses. Dry densities varied from 95.0 to 115.4 pounds per cubic foot (optimum moisture varied from 9.3 to 15.6 percent), with most samples falling within the range from 100 to 110 pounds per cubic foot. Water contents ranged from 5.4 to 18.2 percent, with typical values being around 10 percent. The saturated permeability varied by two orders of magnitude, from 8.5E-05 to 1.1E-03 centimeters per second. Particle size by sieve analysis is summarized in Table 5-2D by tabulating the percent of fines passing the No. 200 sieve, which ranged from 3.0 to 12.9.

5.2.9 Summary

The SCTLs for SVOCs, pesticides, arsenic, barium, TPH, gross alpha, and gross beta were exceeded in surface soils. The majority of the SVOC exceedances were in the western half of the site. The data suggest that landfill materials are near the surface or have impacted surface soil in the western area of the site between the golf course and the pond west of the golf course. Pesticides and TPH were also detected above screening levels in this area.

Arsenic was detected slightly above the screening level in many of the samples scattered over the golf course, with only a few detections above the screening level (and near background) in woods to the south. The arsenic may either be a background constituent or may be associated with the past use of pesticides and herbicides. Barium exceeded the screening criterion in only one sample, H14, located in the northern portion of the wooded area. Radiological detections around the southern and western perimeters of the landfill may be attributed to naturally elevated background levels.

5.3 GROUNDWATER

The groundwater assessment at OU 2 began with the Phase I and Phase II field screening of direct push groundwater samples to determine permanent monitoring well locations (see Figure 3-6A for DPT locations). The monitoring wells were then installed, sampled, and analyzed during Phases II and III to complete the assessment. Interpretation of impacts to the groundwater at the site was based on the historical use and operational practices at the site and the chemical and spatial relationship of the

TABLE 5-2D

GEOTECHNICAL TESTING RESULTS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Sample No.	Location ID	Description of Soil	ASTM D-2937			ASTM D-2216	ASTM D-5084	ASTM D-698		ASTM O-422
			Wet Density (g/cm^3)	Dry Density (g/cm^3)	Dry Density (lb/ft^3)	Water Content (%)	Coef. of Permeability (cm/s)	Maximum Dry Density (lb/ft^3)	Optimum Moisture (%)	% Passing No. 200 Sieve
NTCGTS7200B	S72	Dk Gray to Brown Quartz Fine Sand, S1 Trace Root	1.89	1.76	110.1	7.2	3.8E-03	-	-	-
NTCGTS7200A	S72	Dk Gray to Brown Quartz Fine Sand, Trace Root Fibers	1.86	1.74	108.6	6.9	3.3E-03	109.3	9.8	5.4
NTCGT12100B	S121	Dk Brown Quartz Fine Sand, Trace Colloidal Organics	1.98	1.75	109.5	12.9	1.2E-05	-	-	-
NTCGT12100A	S121	Dk Brown Quartz Fine Sand, Trace Colloidal Organics	1.90	1.66	103.9	14.2	8.1E-04	107.7	9.5	6.8
NTCGT13000B	S130	Gray to Brown Quartz Fine Sand	1.74	1.52	95.0	14.4	1.3E-03	-	-	-
NTCGT13000A	S130	Brown Quartz Fine Sand	1.80	1.58	98.4	14.2	1.1E-03	102.1	11.2	12.4
NTCGT12500B	S125	Lt Gray to Tan Quartz Fine Sand, Trace Root Fibers	1.78	1.65	102.7	8.2	1.1E-03	-	-	-
NTCGT12500A	S125	Gray to Brown Quartz Fine Sand	1.70	1.58	98.9	7.3	1.5E-03	108.5	10.0	7.5
NTCGT12300A	S123	Dk Brown Quartz Fine Sand, Trace Colloidal Organics	1.93	1.76	110.1	9.4	1.4E-04	109.7	11.4	8.2
NTCGT12300B	S123	Gray to Brown Quartz Fine Sand, Trace Colloidal Organics	1.94	1.80	112.3	7.8	4.7E-05	-	-	-
NTCGTS9200B	S92	Brown Quartz Fine Sand	1.81	1.52	95.1	18.8	1.1E-03	-	-	-
NTCGTS9200A	S92	Brown Quartz Fine Sand	1.83	1.60	100.1	14.1	1.1E-03	111.2	11.7	10.3
NTCGTH2200B	H22	Dk Brown Quartz Fine Sand, Trace Colloidal Organics	1.90	1.70	106.2	11.7	4.6E-05	-	-	-
NTCGTH2200A	H22	Dk Brown Quartz Fine Sand, Trace Colloidal Organics	1.85	1.66	103.5	11.6	5.8E-04	112.3	9.3	10.9
NTCGTH2500B	H25	Gray Quartz Fine Sand, Trace Colloidal Organics	1.75	1.60	100.1	9.1	1.2E-04	-	-	-
NTCGTH2500A	H25	Gray Quartz Fine Sand, Trace Colloidal Organics	1.80	1.68	104.9	7.1	6.4E-05	110.5	10.8	8.2
NTCGTH1900B	H19	Dk Gray to Brown Quartz Fine Sand, Trace Colloidal Organic	1.99	1.80	112.3	10.6	1.6E-05	-	-	-
NTCGTH1900A	H19	Gray to Brown Quartz Fine Sand, Some Limestone Fragments Trace Colloidal Organics	2.03	1.85	115.3	9.9	1.5E-05	110.6	9.6	8.3
NTCGTH1200B	H12	Brown Quartz Fine Sand, Trace Colloidal Organics	2.06	1.89	118.1	8.9	3.1E-04	-	-	-
NTCGTH1200A	H12	Brown Quartz Fine Sand, Trace Colloidal Organics	2.02	1.85	115.4	9.3	2.7E-05	110.3	10.2	12.9
NTCGTH0200B	H2	Tan to Brown Quartz Fine Sand, S1 Trace Colloidal Organics	1.81	1.60	100.2	12.8	8.7E-04	-	-	-
NTCGTH0200A	H2	Gray to Brown Quartz Fine Sand	1.71	1.55	97.0	10.1	1.5E-03	110.0	10.8	9.1
NTCGTH0900B	H9	Dk Brown Quartz Fine Sand, Trace Colloidal Organics	1.98	1.76	109.9	12.5	5.2E-05	-	-	-
NTCGTH0900A	H9	Dk Brown Quartz Fine Sand, Trace Colloidal Organics	2.07	1.85	115.4	12.0	5.4E-05	111.5	12.0	7.3
NTCGT10400B	S104	Tan to Brown Quartz Fine Sand	1.85	1.63	101.9	13.3	2.2E-04	-	-	-
NTCGT10400A	S104	Tan to Brown Quartz Fine Sand	1.93	1.67	104.4	15.4	8.5E-05	110.3	11.5	9.8
NTCGT15800B	S158	Brown Quartz Fine Sand, Trace Colloidal Organics	1.67	1.54	95.9	8.7	7.3E-04	-	-	-
NTCGT15800A	S158	Gray to Brown Quartz Fine Sand, Trace Colloidal Organics	1.87	1.76	109.6	6.5	1.1E-04	108.8	10.2	7.0
NTCGTH0500B	H5	Brown Quartz Fine Sand	1.91	1.72	107.4	11.0	4.6E-04	-	-	-
NTCGTH0500A	H5	Brown Quartz Fine Sand	1.89	1.67	104.3	13.1	5.6E-04	115.4	10.2	11.0
NTCGTH3900B	H39	Gray to Brown Quartz Fine Sand, Trace Colloidal Organics	1.80	1.65	102.7	9.40	3.2E-04	-	-	-
NTCGTH3900A	H39	Tan to Brown Quartz Fine Sand, Trace Colloidal Organics	1.83	1.69	105.4	8.4	1.2E-04	103.1	15.6	5.3
NTCGTH3200B	H32	Gray to Brown Quartz Fine Sand, Trace Colloidal Organics	1.75	1.59	99.0	10.4	2.2E-04	-	-	-
NTCGTH3200A	H32	Gray to Brown Quartz Fine Sand, Trace Colloidal Organics	1.78	1.64	102.2	8.7	4.0E-04	110.5	13.0	5.0
NTCGTH2900B	H29	Gray to Brown Quartz Fine Sand	1.70	1.61	100.7	5.4	4.3E-03	-	-	-

TABLE 5-2D

GEOTECHNICAL TESTING RESULTS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Sample No.	Location ID	Description of Soil	ASTM D-2937			ASTM D-2216	ASTM D-5084	ASTM D-698		ASTM O-422
			Wet Density (g/cm^3)	Dry Density (g/cm^3)	Dry Density (lb/ft^3)	Water Content (%)	Coef. of Permeability (cm/s)	Maximum Dry Density (lb/ft^3)	Optimum Moisture (%)	% Passing No. 200 Sieve
NTCGTH2900A	H29	Brown Quartz Fine Sand	1.71	1.60	99.7	7.1	4.3E-03	105.0	9.7	6.3
NTCGT15600B	S156	Brown Quartz Fine Sand	1.48	1.35	84.5	9.4	1.1E-03	-	-	-
NTCGT15600A	S156	Brown Quartz Fine Sand	1.87	1.76	109.9	6.2	2.3E-04	107.9	14.0	6.9
NTCGT11900B	S119	Brown Quartz Fine Sand	1.75	1.64	102.2	6.9	2.4E-03	-	-	-
NTCGT11900A	S119	Tan to Brown Quartz Fine Sand	1.80	1.70	106.3	5.7	1.7E-03	110.2	10.3	5.3
NTCGT15200A	S152	Tan to Brown Quartz Fine Sand	1.78	1.65	103.3	7.6	1.2E-03	-	-	-
NTCGT15200B	S152	Lt Tan to Brown Quartz Fine Sand	1.91	1.70	106.1	12.4	4.4E-04	-	-	-
NTCGT12700B	S127	Brown Quartz Fine Sand	1.87	1.71	107.0	9.1	1.9E-03	-	-	-
NTCGT12700A	S127	Brown Quartz Fine Sand	1.84	1.69	105.7	8.7	2.1E-03	108.2	11.7	7.1
NTCGT13900B	S139	Brown to Tan Quartz Fine Sand	1.99	1.79	111.9	11.0	6.7E-04	-	-	-
NTCGT13900A	S139	Brown Quartz Fine Sand	1.98	1.68	104.6	18.2	3.2E-04	-	-	10.3
NTCGTS5000B	S50	Brown Quartz Fine Sand	1.78	1.61	100.2	10.9	7.6E-05	-	-	-
NTCGTS5000A	S50	Brown Quartz Fine Sand	1.91	1.73	108.1	10.3	3.3E-04	115.3	9.5	9.9
NTCGTS2000A	S20	Brown Quartz Fine Sand	1.62	1.49	92.9	8.9	2.3E-03	109.0	12.8	9.9
NTCGTS2000B	S20	Brown Quartz Fine Sand	1.82	1.66	103.7	9.6	1.4E-03	107.4	13.0	-
NTCGTS3200B	S32	Brown Quartz Fine Sand	1.94	1.76	109.9	10.2	1.1E-03	-	-	-
NTCGTS3200A	S32	Brown Quartz Fine Sand	1.83	1.71	106.5	7.3	3.1E-04	103.3	10.9	10.2
NTCGT16000B	S160	Brown Quartz Fine Sand	2.01	1.85	115.2	8.9	2.7E-04	-	-	-
NTCGT16000A	S160	Brown Quartz Fine Sand	1.92	1.77	110.4	8.6	2.5E-04	114.3	10.5	6.1
NTCGT10100B	S101	Gray to Brown Quartz Fine Sand, S1 Trace Colloidal Organics	1.89	1.74	108.6	8.6	5.1E-03	-	-	-
NTCGT10100A	S101	Gray to Brown Quartz Fine Sand	1.92	1.77	110.8	8.2	2.2E-03	113.0	10.5	3.0
NTCGTS8000B	S80	Brown Quartz Fine Sand, 3 Inch Layer of Clayey Sand	1.99	1.72	107.6	15.5	NA	-	-	-
NTCGTS8000A	S80	Brown Quartz Fine Sand, Trace S1 Clayey Sand Layers	2.05	1.79	112.0	14.3	1.2E-05	110.2	12.1	5.6

ASTM–American Society for Testing and Materials
NA–Not Analyzed

chemicals detected in the groundwater. The chemicals detected and their distribution are presented in the following sections. Throughout this section tables and figures indicate concentrations that meet or exceed screening criteria; for ease of discussion these concentrations will subsequently be identified in the text as "exceeding" the criteria.

5.3.1 Phases I and II

A total of 48 monitoring wells were installed and sampled during Phase II (see Figure 3-6C for locations). The well locations focused on the impacted areas identified during the Phase I and Phase II DPT groundwater sampling. The groundwater analytical results for the Phase I and Phase II DPT program are presented in Tables 5-3A and 5-3B. The monitoring well locations also included upgradient and off-site (i.e., east of the canals) control points for hydrogeologic and contaminant fate and transport monitoring. Twenty-two shallow monitoring wells were screened across the water table (A wells), 22 intermediate monitoring wells were screened at the base of the surficial aquifer (B wells), and four deep wells were screened within the Hawthorn Group (C wells). The results for the Phase II monitoring well sampling program are presented in Tables 5-3C, 5-3D, and 5-3E.

5.3.1.1 Volatile Organic Compounds

Samples were collected for VOC analysis during both the DPT and monitoring well sampling programs as part of Phases I and II of the field investigation. The results are provided below.

Direct Push

Direct push groundwater sampling was conducted during Phases I and II using Geoprobe® and Strataprobe® sampling tools around the boundaries of the landfill as identified by the results of the geophysical surveys (see Section 5.1). The procedures used to collect the samples, the rationale for collection, and the analytical program are detailed in Section 3.6.1.

VOCs were detected in both shallow (water table) and intermediate (approximately 30 feet bgs) samples at several locations (Table 5-3A). Figure 5-3A presents the contaminants and concentrations detected. Fifteen VOCs were detected by the laboratory analyses. The contaminants detected, the range of concentrations, and the location and depth of the maximum concentrations are listed in Table 5-3B. A complete listing of all the analytical data is provided in Appendix B.

TABLE 5-3A

GROUNDWATER PHASES I AND II-DIRECT PUSH TECHNOLOGY DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a)(b)]	G00109	G00130	G00209	G00230	G00309	G00330	G00409	G00430	G00509	G00530	G00609	G00630	G00709	G00730	G00809
DATE SAMPLED	9/11/97	9/11/97	9/11/97	9/11/97	9/11/97	9/11/97	9/11/97	9/11/97	9/11/97	9/11/97	9/11/97	9/11/97	9/11/97	9/11/97	8/23/97
Volatiles (µg/L)															
1,1-Dichloroethane															
1,1-Dichloroethene															
1,3-Dichlorobenzene (meta)															
1,4-Dichlorobenzene (para)															
Benzene															
Chlorobenzene								16		6					
Chloromethane															
cis-1,2-Dichloroethene		9	10												
cis-1,3-Dichloropropene															
Dichlorodifluoromethane															
m- & p-Xylene															
o-Xylene															
Tetrachloroethene		5													
trans-1,2-Dichloroethene															
Trichloroethene		116	8	43		54		78		21					
Vinyl chloride		6				6									

SAMPLE LOCATION[a)(b)]	G00820	G00830	G00909	G00930	G01009	G01020	G01030	G01109	G01130	G01209	G01230	G01315	G01330	G01406	G01430
DATE SAMPLED	8/23/97	9/11/97	8/23/97	9/11/97	8/23/97	8/23/97	9/11/97	8/22/97	8/22/97	8/22/97	8/22/97	7/25/97	7/25/97	7/25/97	7/25/97
Volatiles (µg/L)															
1,1-Dichloroethane															
1,1-Dichloroethene															
1,3-Dichlorobenzene (meta)															
1,4-Dichlorobenzene (para)															
Benzene															
Chlorobenzene															
Chloromethane															
cis-1,2-Dichloroethene															
cis-1,3-Dichloropene															
Dichlorodifluoromethane															
m- & p-Xylene															
o-Xylene															
Tetrachloroethene															
trans-1,2-Dichloroethene															
Trichloroethene														59	
Vinyl chloride														12	

TABLE 5-3A

GROUNDWATER PHASES I AND II-DIRECT PUSH TECHNOLOGY DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a][b]	G01506	G01530	G01609	G01630	G01708	G01730	G01809	G01830	G01909	G01930	G02009	G02030	G02109	G02130	G02209
DATE SAMPLED	7/25/97	7/25/97	7/26/97	7/25/97	7/26/97	7/26/97	7/26/97	7/26/97	7/26/97	7/26/97	7/26/97	7/26/97	7/26/97	7/26/97	7/26/97
Volatiles (µg/L)															
1,1-Dichloroethane															
1,1-Dichloroethene															
1,3-Dichlorobenzene (meta)															
1,4-Dichlorobenzene (para)															
Benzene															
Chlorobenzene															
Chloromethane															
cis-1,2-Dichloroethene															
cis-1,3-Dichloropropene															
Dichlorodifluoromethane															
m- & p-Xylene															
o-Xylene															
Tetrachloroethene															
trans-1,2-Dichloroethene															
Trichloroethene					7										
Vinyl chloride															

SAMPLE LOCATION[a][b]	G02230	G02309	G02330	G02409	G02430	G02509	G02530	G02609	G02630	G02709	G02730	G02809	G02830	G02909	G02930
DATE SAMPLED	7/26/97	7/26/97	7/26/97	7/26/97	7/26/97	7/26/97	7/26/97	7/26/97	7/26/97	7/27/97	7/27/97	7/27/97	7/27/97	7/27/97	7/27/97
Volatiles (µg/L)															
1,1-Dichloroethane															
1,1-Dichloroethene															
1,3-Dichlorobenzene (meta)															
1,4-Dichlorobenzene (para)															
Benzene															
Chlorobenzene															
Chloromethane															
cis-1,2-Dichloroethene															6
cis-1,3-Dichloropene															
Dichlorodifluoromethane															
m- & p-Xylene															
o-Xylene															
Tetrachloroethene			57		180		18		22		5		12		6
trans-1,2-Dichloroethene															
Trichloroethene															6
Vinyl chloride															

TABLE 5-3A

GROUNDWATER PHASES I AND II-DIRECT PUSH TECHNOLOGY DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a][b]	G03009	G03030	G030A30	G03109	G03130	G03209	G03230	G03312	G03330	G03412	G03430	G03512	G03530	G03612
DATE SAMPLED	7/27/97	7/27/97	7/28/97	7/27/97	7/27/97	7/27/97	7/27/97	7/22/97	7/22/97	7/22/97	7/22/97	7/22/97	7/22/97	7/23/97
Volatiles (µg/L)														
1,1-Dichloroethane							23							
1,1-Dichloroethene														
1,3-Dichlorobenzene (meta)														
1,4-Dichlorobenzene (para)							6							
Benzene		12	9		15		17							
Chlorobenzene		12	9		13		24							
Chloromethane														
cis-1,2-Dichloroethene		9	7		12		10							
cis-1,3-Dichloropropene														
Dichlorodifluoromethane														
m- & p-Xylene		13	11		20		66							
o-Xylene														
Tetrachloroethene														
trans-1,2-Dichloroethene														
Trichloroethene							6							
Vinyl chloride							12							

SAMPLE LOCATION[a][b]	G03630	G03712	G03730	G03812	G03830	G03912	G03930	G04012	G04030	G04112	G04130	G04212	G04230	G04312
DATE SAMPLED	7/23/97	7/23/97	7/23/97	7/23/97	7/23/97	7/23/97	7/23/97	7/23/97	7/23/97	7/23/97	7/23/97	7/23/97	7/23/97	7/23/97
Volatiles (µg/L)														
1,1-Dichloroethane														
1,1-Dichloroethene														
1,3-Dichlorobenzene (meta)														
1,4-Dichlorobenzene (para)														
Benzene														
Chlorobenzene														
Chloromethane														
cis-1,2-Dichloroethene														
cis-1,3-Dichloropene														
Dichlorodifluoromethane														
m- & p-Xylene														
o-Xylene														
Tetrachloroethene														
trans-1,2-Dichloroethene														
Trichloroethene														
Vinyl chloride														

TABLE 5-3A

GROUNDWATER PHASES I AND II-DIRECT PUSH TECHNOLOGY DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a][b]	G04330	G04412	G04430	G04512	G04530	G04612	G04630	G04712	G04730	G04812	G04830	G04912	G04930	G05015	G05030
DATE SAMPLED	7/23/97	7/24/97	7/24/97	7/24/97	7/24/97	7/24/97	7/24/97	7/24/97	7/24/97	7/24/97	7/24/97	7/24/97	7/24/97	7/24/97	7/24/97
Volatiles (µg/L)															
1,1-Dichloroethane															
1,1-Dichloroethene															
1,3-Dichlorobenzene (meta)															
1,4-Dichlorobenzene (para)															
Benzene												11			
Chlorobenzene															
Chloromethane															
cis-1,2-Dichloroethene										5		47			
cis-1,3-Dichloropropene															
Dichlorodifluoromethane															
m- & p-Xylene															
o-Xylene															
Tetrachloroethene															
trans-1,2-Dichloroethene										5					
Trichloroethene															
Vinyl chloride												19			

SAMPLE LOCATION[a][b]	G05109	G05130	G05209	G05230	G05309	G05330	G05409	G05430	G05509	G05530	G05609	G05630	G05709	G05730	G05809
DATE SAMPLED	7/27/97	7/27/97	7/27/97	7/27/97	7/27/97	7/27/97	7/27/97	7/27/97	7/28/97	7/28/97	7/28/97	7/28/97	7/28/97	7/28/97	7/28/97
Volatiles (µg/L)															
1,1-Dichloroethane		7													
1,1-Dichloroethene															
1,3-Dichlorobenzene (meta)															
1,4-Dichlorobenzene (para)															
Benzene															
Chlorobenzene															
Chloromethane															
cis-1,2-Dichloroethene						5									
cis-1,3-Dichloropene		9													
Dichlorodifluoromethane															
m- & p-Xylene															
o-Xylene															
Tetrachloroethene															
trans-1,2-Dichloroethene		7				6									
Trichloroethene															
Vinyl chloride		11													

TABLE 5-3A

GROUNDWATER PHASES I AND II-DIRECT PUSH TECHNOLOGY DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a][b]	G05830	G05910	G05930	G06010	G06030	G06110	G06130	G06209	G06230	G06309	G06330	G06409	G06430	G06509	G06530
DATE SAMPLED	7/28/97	7/28/97	7/28/97	7/28/97	7/28/97	7/28/97	7/28/97	8/21/97	8/21/97	8/21/97	8/21/97	8/21/97	8/21/97	9/11/97	9/11/97
Volatiles (µg/L)															
1,1-Dichloroethane															
1,1-Dichloroethene															
1,3-Dichlorobenzene (meta)															
1,4-Dichlorobenzene (para)															
Benzene															
Chlorobenzene															
Chloromethane															
cis-1,2-Dichloroethene															
cis-1,3-Dichloropropene															
Dichlorodifluoromethane															
m- & p-Xylene															
o-Xylene															
Tetrachloroethene															
trans-1,2-Dichloroethene															
Trichloroethene															
Vinyl chloride															

SAMPLE LOCATION[a][b]	G06609	G06630	G06809	G06830	G07009	G07030	G07209	G07230	G07309	G07330	G07409	G07430	G07509	G07530	G07609
DATE SAMPLED	9/11/97	9/11/97	9/11/97	9/11/97	9/11/97	9/11/97	8/18/97	8/18/97	8/18/97	8/18/97	8/18/97	8/18/97	8/13/97	8/13/97	8/13/97
Volatiles (µg/L)															
1,1-Dichloroethane															
1,1-Dichloroethene															
1,3-Dichlorobenzene (meta)															
1,4-Dichlorobenzene (para)															
Benzene															
Chlorobenzene															
Chloromethane															
cis-1,2-Dichloroethene															
cis-1,3-Dichloropene															
Dichlorodifluoromethane															
m- & p-Xylene															
o-Xylene															
Tetrachloroethene															
trans-1,2-Dichloroethene															
Trichloroethene															
Vinyl chloride															

TABLE 5-3A

GROUNDWATER PHASES I AND II-DIRECT PUSH TECHNOLOGY DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a][b]	G07630	G07709	G07730	G07809	G07830	G07909	G07930	G08009	G08030	G08109	G08130	G08209	G08230	G08309	G08330
DATE SAMPLED	8/13/97	8/13/97	8/13/97	8/13/97	8/13/97	8/13/97	8/13/97	8/12/97	8/12/97	8/12/97	8/12/97	8/12/97	8/12/97	8/19/97	8/19/97
Volatiles (µg/L)															
1,1-Dichloroethane															
1,1-Dichloroethene															
1,3-Dichlorobenzene (meta)															
1,4-Dichlorobenzene (para)															
Benzene															
Chlorobenzene															
Chloromethane															
cis-1,2-Dichloroethene															
cis-1,3-Dichloropropene															
Dichlorodifluoromethane															
m- & p-Xylene															
o-Xylene															
Tetrachloroethene															
trans-1,2-Dichloroethene															
Trichloroethene															
Vinyl chloride															

SAMPLE LOCATION[a][b]	G08409	G08430	G08509	G08530	G08609	G08630	G08709	G08730	G08809	G08830	G08909	G08930	G09009	G09030	G09109
DATE SAMPLED	8/19/97	8/19/97	8/19/97	8/19/97	8/19/97	8/19/97	8/19/97	8/19/97	8/19/97	8/19/97	8/19/97	8/19/97	8/19/97	8/19/97	8/19/97
Volatiles (µg/L)															
1,1-Dichloroethane															
1,1-Dichloroethene															
1,3-Dichlorobenzene (meta)															
1,4-Dichlorobenzene (para)															
Benzene															
Chlorobenzene															
Chloromethane															
cis-1,2-Dichloroethene															
cis-1,3-Dichloropene															
Dichlorodifluoromethane															
m- & p-Xylene															
o-Xylene															
Tetrachloroethene															
trans-1,2-Dichloroethene															
Trichloroethene															
Vinyl chloride															

TABLE 5-3A

GROUNDWATER PHASES I AND II-DIRECT PUSH TECHNOLOGY DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a)(b)]	G09130	G09209	G09230	G09309	G09330	G09409	G09430	G09509	G09530	G09609	G09630	G09809	G09830	G09909	G09930
DATE SAMPLED	8/19/97	8/19/97	8/19/97	8/20/97	8/20/97	8/20/97	8/20/97	8/20/97	8/20/97	8/20/97	8/20/97	8/20/97	8/20/97	8/20/97	8/20/97
Volatiles (µg/L)															
1,1-Dichloroethane															
1,1-Dichloroethene															
1,3-Dichlorobenzene (meta)															
1,4-Dichlorobenzene (para)															
Benzene															
Chlorobenzene															
Chloromethane															
cis-1,2-Dichloroethene															
cis-1,3-Dichloropropene															
Dichlorodifluoromethane															
m- & p-Xylene															
o-Xylene															
Tetrachloroethene															
trans-1,2-Dichloroethene															
Trichloroethene															
Vinyl chloride															

SAMPLE LOCATION[a)(b)]	G10009	G10030	G10109	G10130	G10209	G10230	G10309	G10330	G10409	G10430	G10509	G10530	G10609	G10630	G10709
DATE SAMPLED	8/10/97	8/10/97	8/10/97	8/10/97	8/10/97	8/10/97	8/10/97	8/10/97	8/10/97	8/10/97	8/10/97	8/10/97	8/10/97	8/10/97	8/11/97
Volatiles (µg/L)															
1,1-Dichloroethane															
1,1-Dichloroethene															
1,3-Dichlorobenzene (meta)															
1,4-Dichlorobenzene (para)															
Benzene															
Chlorobenzene															
Chloromethane															
cis-1,2-Dichloroethene															
cis-1,3-Dichloropene															
Dichlorodifluoromethane															
m- & p-Xylene															
o-Xylene															
Tetrachloroethene															
trans-1,2-Dichloroethene															
Trichloroethene															
Vinyl chloride															

TABLE 5-3A

GROUNDWATER PHASES I AND II-DIRECT PUSH TECHNOLOGY DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a][b]	G10730	G10809	G10830	G10909	G10930	G11009	G11030	G11109	G11130	G11209	G11230	G11309	G11330	G11409	G11430
DATE SAMPLED	8/11/97	8/11/97	8/11/97	8/11/97	8/11/97	8/11/97	8/11/97	8/11/97	8/11/97	8/11/97	8/11/97	8/12/97	8/12/97	8/12/97	8/12/97
Volatiles (µg/L)															
1,1-Dichloroethane															
1,1-Dichloroethene															
1,3-Dichlorobenzene (meta)															
1,4-Dichlorobenzene (para)															
Benzene															
Chlorobenzene															
Chloromethane															
cis-1,2-Dichloroethene															
cis-1,3-Dichloropropene															
Dichlorodifluoromethane															
m- & p-Xylene															
o-Xylene															
Tetrachloroethene															
trans-1,2-Dichloroethene															
Trichloroethene															
Vinyl chloride															

SAMPLE LOCATION[a][b]	G11509	G11530	G11609	G11630	G11709	G11730	G11809	G11830	G11909	G11930	G12009	G12030	G12109	G12130	G12209
DATE SAMPLED	8/11/97	8/11/97	8/11/97	8/11/97	8/11/97	8/11/97	8/11/97	8/11/97	8/9/97	8/9/97	8/9/97	8/9/97	8/9/97	8/9/97	8/9/97
Volatiles (µg/L)															
1,1-Dichloroethane															
1,1-Dichloroethene															
1,3-Dichlorobenzene (meta)															
1,4-Dichlorobenzene (para)															
Benzene															
Chlorobenzene															
Chloromethane															
cis-1,2-Dichloroethene															
cis-1,3-Dichloropene															
Dichlorodifluoromethane															
m- & p-Xylene															
o-Xylene															
Tetrachloroethene															
trans-1,2-Dichloroethene															
Trichloroethene															
Vinyl chloride															

TABLE 5-3A

GROUNDWATER PHASES I AND II-DIRECT PUSH TECHNOLOGY DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a)(b)]	G12230	G12309	G12330	G12409	G12430	G12509	G12530	G12609	G12630	G12709	G12730	G12809	G12830	G12909
DATE SAMPLED	8/9/97	8/9/97	8/9/97	8/9/97	8/9/97	8/9/97	8/9/97	8/20/97	8/20/97	8/9/97	8/9/97	8/9/97	8/9/97	8/9/97
Volatiles (µg/L)														
1,1-Dichloroethane														
1,1-Dichloroethene														
1,3-Dichlorobenzene (meta)														
1,4-Dichlorobenzene (para)														
Benzene												7		24H
Chlorobenzene												9		22H
Chloromethane														
cis-1,2-Dichloroethene														
cis-1,3-Dichloropropene														
Dichlorodifluoromethane														
m- & p-Xylene														
o-Xylene														
Tetrachloroethene														
trans-1,2-Dichloroethene														
Trichloroethene														
Vinyl chloride														

SAMPLE LOCATION[a)(b)]	G12930	G13009	G13030	G13109	G13130	G13209	G13230	G13309	G13330	G13409	G13430	G13509	G13520	G13609
DATE SAMPLED	8/9/97	8/8/97	8/8/97	8/8/97	8/8/97	8/8/97	8/8/97	8/8/97	8/8/97	8/8/97	8/8/97	8/8/97	8/12/97	8/8/97
Volatiles (µg/L)														
1,1-Dichloroethane														
1,1-Dichloroethene														
1,3-Dichlorobenzene (meta)														
1,4-Dichlorobenzene (para)														
Benzene			10	8			7							
Chlorobenzene			14	10	12		9							
Chloromethane														
cis-1,2-Dichloroethene														
cis-1,3-Dichloropene														
Dichlorodifluoromethane														
m- & p-Xylene														
o-Xylene														
Tetrachloroethene														
trans-1,2-Dichloroethene														
Trichloroethene														
Vinyl chloride														

TABLE 5-3A

GROUNDWATER PHASES I AND II-DIRECT PUSH TECHNOLOGY DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a)(b)]	G13630	G14430	G13709	G13730	G13809	G13830	G13909	G13930	G14009	G14030	G14109	G14130	G14209	G14230	G14309
DATE SAMPLED	8/8/97	8/7/97	8/8/97	8/8/97	8/8/97	8/8/97	8/8/97	8/8/97	8/7/97	8/7/97	8/7/97	8/7/97	8/7/97	8/7/97	8/7/97
Volatiles (µg/L)															
1,1-Dichloroethane															
1,1-Dichloroethene															
1,3-Dichlorobenzene (meta)															
1,4-Dichlorobenzene (para)															
Benzene															
Chlorobenzene															
Chloromethane															
cis-1,2-Dichloroethene															
cis-1,3-Dichloropropene															
Dichlorodifluoromethane															
m- & p-Xylene															
o-Xylene															
Tetrachloroethene															
trans-1,2-Dichloroethene															
Trichloroethene															
Vinyl chloride															

SAMPLE LOCATION[a)(b)]	G14330	G14409	G16009	G16030	G16109	G16130	G14509	G14530	G14609	G14630	G14709	G14730	G14809	G14830	G14909
DATE SAMPLED	8/7/97	8/7/97	8/5/97	8/5/97	8/5/97	8/5/97	7/28/97	7/28/97	7/28/97	7/28/97	7/28/97	7/28/97	7/29/97	7/29/97	7/29/97
Volatiles (µg/L)															
1,1-Dichloroethane								51							
1,1-Dichloroethene															
1,3-Dichlorobenzene (meta)								33							
1,4-Dichlorobenzene (para)															
Benzene								10							
Chlorobenzene															
Chloromethane															
cis-1,2-Dichloroethene								58		12				6	
cis-1,3-Dichloropene															
Dichlorodifluoromethane															
m- & p-Xylene								32							
o-Xylene								7							
Tetrachloroethene															
trans-1,2-Dichloroethene								42							
Trichloroethene															
Vinyl chloride															

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GROUNDWATER PHASES I AND II-DIRECT PUSH TECHNOLOGY DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a][b]	G14930	G15009	G15030	G15109	G15130	G15209	G15230	G15309	G15330	G15409	G15430	G15509	G15530	G15609	G15630
DATE SAMPLED	7/29/97	7/29/97	7/29/97	7/29/97	7/29/97	7/29/97	7/29/97	7/29/97	7/29/97	7/29/97	7/29/97	7/29/97	7/30/97	7/30/97	7/30/97
Volatiles (µg/L)															
1,1-Dichloroethane															
1,1-Dichloroethene															
1,3-Dichlorobenzene (meta)															
1,4-Dichlorobenzene (para)															
Benzene															
Chlorobenzene															
Chloromethane															
cis-1,2-Dichloroethene															
cis-1,3-Dichloropropene															
Dichlorodifluoromethane															
m- & p-Xylene															
o-Xylene															
Tetrachloroethene															
trans-1,2-Dichloroethene															
Trichloroethene															
Vinyl chloride															

SAMPLE LOCATION[a][b]	G15709	G15730	G15809	G15830	G15909	G15930	G16209	G16230	G16309	G16330	G16409	G16430	G16509	G16530	G16609
DATE SAMPLED	7/30/97	8/4/97	8/4/97	8/4/97	8/4/97	8/4/97	8/5/97	8/5/97	8/5/97	8/5/97	8/6/97	8/6/97	8/6/97	8/6/97	8/6/97
Volatiles (µg/L)															
1,1-Dichloroethane															
1,1-Dichloroethene															
1,3-Dichlorobenzene (meta)															
1,4-Dichlorobenzene (para)															
Benzene															
Chlorobenzene															
Chloromethane															
cis-1,2-Dichloroethene															
cis-1,3-Dichloropene															
Dichlorodifluoromethane															
m- & p-Xylene															
o-Xylene															
Tetrachloroethene															
trans-1,2-Dichloroethene															
Trichloroethene															
Vinyl chloride															

TABLE 5-3A

GROUNDWATER PHASES I AND II-DIRECT PUSH TECHNOLOGY DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a)(b)]	G16630	G16709	G16730	G16809	G16830	G16909	G16930	G17009	G17030	G17109	G17130	G17209	G17230	G17309	G17330
DATE SAMPLED	8/6/97	8/6/97	8/6/97	8/6/97	8/6/97	8/7/97	8/7/97	8/7/97	8/7/97	8/7/97	8/7/97	9/11/97	9/11/97	9/11/97	9/11/97
Volatiles (µg/L)															
1,1-Dichloroethane															
1,1-Dichloroethene											8				
1,3-Dichlorobenzene (meta)															
1,4-Dichlorobenzene (para)															
Benzene													7		7
Chlorobenzene													5		18
Chloromethane															
cis-1,2-Dichloroethene													8		7
cis-1,3-Dichloropropene															
Dichlorodifluoromethane															
m- & p-Xylene															26
o-Xylene															5
Tetrachloroethene															
trans-1,2-Dichloroethene															
Trichloroethene															
Vinyl chloride															6

SAMPLE LOCATION[a)(b)]	G17409	G17430	G19830	G19930	G20030	G20130	G20230	G20230D	G20308	G20408	G20508	G20608	G20708	G20808	G20808D
DATE SAMPLED	9/11/97	9/11/97	4/22/98	4/22/98	4/22/98	4/22/98	4/22/98	4/22/98	4/22/98	4/22/98	4/22/98	4/22/98	4/22/98	5/5/98	5/5/98
Volatiles (µg/L)															
1,1-Dichloroethane															
1,1-Dichloroethene															
1,3-Dichlorobenzene (meta)															
1,4-Dichlorobenzene (para)															
Benzene			1.9J	5.2	1.2J										
Chlorobenzene				3.7											
Chloromethane															
cis-1,2-Dichloroethene			19	10.6			2.8	2.9			11.7				
cis-1,3-Dichloropene															
Dichlorodifluoromethane				2.6J											
m- & p-Xylene															
o-Xylene															
Tetrachloroethene					17.6		41.3	33.2			4.5				
trans-1,2-Dichloroethene															
Trichloroethene			5.4	2.3	4		3.2	3			70.2				
Vinyl chloride			2.4J	4.7J							3.5J				

TABLE 5-3A

GROUNDWATER PHASES I AND II-DIRECT PUSH TECHNOLOGY DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a][b]	G20830	G20908	G21008	G21108	G21208	G21330	G21430	G21430D	G21530	G21608	G21615	G21615D	G21620	G21625
DATE SAMPLED	4/21/98	4/21/98	4/21/98	4/15/98	4/15/98	4/15/98	4/15/98	4/15/98	4/14/98	5/4/98	5/4/98	5/4/98	5/4/98	5/4/98
Volatiles (µg/L)														
1,1-Dichloroethane														
1,1-Dichloroethene														
1,3-Dichlorobenzene (meta)														
1,4-Dichlorobenzene (para)														
Benzene														
Chlorobenzene														
Chloromethane														
cis-1,2-Dichloroethene														
cis-1,3-Dichloropropene														
Dichlorodifluoromethane														
m- & p-Xylene														
o-Xylene														
Tetrachloroethene														
trans-1,2-Dichloroethene														
Trichloroethene														
Vinyl chloride														

SAMPLE LOCATION[a][b]	G21630	G21635	G21730	G21830	G21908	G21915	G21925	G21930	G21935	G22030	G22130	G22230	G22308	G22315
DATE SAMPLED	4/14/98	5/4/98	4/14/98	4/15/98	5/5/98	5/5/98	5/5/98	4/15/98	5/5/98	4/15/98	4/15/98	4/15/98	5/5/98	5/5/98
Volatiles (µg/L)														
1,1-Dichloroethane														
1,1-Dichloroethene														
1,3-Dichlorobenzene (meta)														
1,4-Dichlorobenzene (para)														
Benzene														
Chlorobenzene														
Chloromethane														
cis-1,2-Dichloroethene														
cis-1,3-Dichloropene														
Dichlorodifluoromethane														
m- & p-Xylene														
o-Xylene														
Tetrachloroethene														
trans-1,2-Dichloroethene														
Trichloroethene														
Vinyl chloride														

TABLE 5-3A

GROUNDWATER PHASES I AND II-DIRECT PUSH TECHNOLOGY DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a)(b)]	G22325	G22330	G22335	G22430	G22530	G22630	G22730	G22830	G22930	G23008	G23008D	G23030	G23108	G23130
DATE SAMPLED	5/5/98	4/15/98	5/5/98	4/23/98	4/23/98	4/23/98	4/23/98	4/23/98	4/23/98	4/23/98	4/23/98	4/23/98	4/24/98	4/24/98
Volatiles (µg/L)														
1,1-Dichloroethane														
1,1-Dichloroethene														
1,3-Dichlorobenzene (meta)														
1,4-Dichlorobenzene (para)														
Benzene														
Chlorobenzene														
Chloromethane										2.6	4.6			
cis-1,2-Dichloroethene							1.1							
cis-1,3-Dichloropropene														
Dichlorodifluoromethane														
m- & p-Xylene														
o-Xylene														
Tetrachloroethene														
trans-1,2-Dichloroethene														
Trichloroethene														
Vinyl chloride														

SAMPLE LOCATION[a)(b)]	G23208	G23230	G23308	G23325	G23408	G23430	G23508	G23530	G23608	G23608D	G23630	G23708	G23730	G23808
DATE SAMPLED	4/24/98	4/24/98	4/24/98	4/25/98	4/25/98	4/25/98	4/25/98	4/25/98	4/25/98	4/25/98	4/25/98	4/26/98	4/25/98	4/26/98
Volatiles (µg/L)														
1,1-Dichloroethane														
1,1-Dichloroethene														
1,3-Dichlorobenzene (meta)														
1,4-Dichlorobenzene (para)														
Benzene														
Chlorobenzene														
Chloromethane														
cis-1,2-Dichloroethene														
cis-1,3-Dichloropene														
Dichlorodifluoromethane														
m- & p-Xylene														
o-Xylene														
Tetrachloroethene														
trans-1,2-Dichloroethene														
Trichloroethene														
Vinyl chloride														

TABLE 5-3A

GROUNDWATER PHASES I AND II-DIRECT PUSH TECHNOLOGY DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a][b]	G23830	G23908	G23908D	G23930	G24008	G24030	G24108	G24130	G24208	G24230	G24308	G24330	G24408	G24508
DATE SAMPLED	4/26/98	4/26/98	4/26/98	4/26/98	4/26/98	4/26/98	4/27/98	4/27/98	4/27/98	4/27/98	4/27/98	4/27/98	4/28/98	4/28/98
Volatiles (µg/L)														
1,1-Dichloroethane														
1,1-Dichloroethene														
1,3-Dichlorobenzene (meta)														
1,4-Dichlorobenzene (para)														
Benzene														
Chlorobenzene														
Chloromethane												3		
cis-1,2-Dichloroethene														
cis-1,3-Dichloropropene														
Dichlorodifluoromethane														
m- & p-Xylene														
o-Xylene														
Tetrachloroethene														
trans-1,2-Dichloroethene														
Trichloroethene														
Vinyl chloride														

SAMPLE LOCATION[a][b]	G24608	G24708	G24730	G24730D	G24808	G24830	G24908	G24930	G25030	G25108	G25130	G25160	G25170	G25218
DATE SAMPLED	4/28/98	4/28/98	4/28/98	4/28/98	4/28/98	4/28/98	5/4/98	5/4/98	5/4/98	5/5/98	5/5/98	5/5/98	5/5/98	5/6/98
Volatiles (µg/L)														
1,1-Dichloroethane														
1,1-Dichloroethene														
1,3-Dichlorobenzene (meta)														
1,4-Dichlorobenzene (para)														
Benzene					1J				1.3J		1.7J			
Chlorobenzene														
Chloromethane														
cis-1,2-Dichloroethene														
cis-1,3-Dichloropene														
Dichlorodifluoromethane														
m- & p-Xylene														
o-Xylene														
Tetrachloroethene											26.8			
trans-1,2-Dichloroethene														
Trichloroethene											511			
Vinyl chloride											9.9			

TABLE 5-3A

GROUNDWATER PHASES I AND II-DIRECT PUSH TECHNOLOGY DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a)(b)]	G25230	G25260	G25270	G25308	G25330	G25360	G25430	G25608	G25708	G25708D	G25808	G25930	G26030	G26130
DATE SAMPLED	5/6/98	5/6/98	5/6/98	5/6/98	5/6/98	5/6/98	5/6/98	5/7/98	5/7/98	5/7/98	5/7/98	5/7/98	5/7/98	5/7/98
Volatiles (µg/L)														
1,1-Dichloroethane														
1,1-Dichloroethene														
1,3-Dichlorobenzene (meta)														
1,4-Dichlorobenzene (para)														
Benzene	1.8J				3.3		1.2J					1.2J		
Chlorobenzene					4									
Chloromethane														
cis-1,2-Dichloroethene														
cis-1,3-Dichloropropene														
Dichlorodifluoromethane														
m- & p-Xylene														
o-Xylene														
Tetrachloroethene														
trans-1,2-Dichloroethene														
Trichloroethene	44.4				37.4		1.9J							
Vinyl chloride	4.8				4J									

SAMPLE LOCATION[a)(b)]	G26208	G26230	G26308	G26330	G26408	G26430	G26430D	G26508	G26530	G26608	G26630	G26708	G26730	G26808
DATE SAMPLED	5/8/98	5/8/98	5/8/98	5/8/98	5/8/98	5/8/98	5/8/98	5/8/98	5/8/98	5/8/98	5/8/98	5/8/98	5/8/98	5/8/98
Volatiles (µg/L)														
1,1-Dichloroethane														
1,1-Dichloroethene														
1,3-Dichlorobenzene (meta)														
1,4-Dichlorobenzene (para)														
Benzene				1.6J		4.4	4.1		2.3					
Chlorobenzene														
Chloromethane														
cis-1,2-Dichloroethene														
cis-1,3-Dichloropene														
Dichlorodifluoromethane														
m- & p-Xylene														
o-Xylene														
Tetrachloroethene		41.3												
trans-1,2-Dichloroethene														
Trichloroethene		1650		13.9										
Vinyl chloride		21.4												

TABLE 5-3A

GROUNDWATER PHASES I AND II-DIRECT PUSH TECHNOLOGY DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a][b]	G26830	G26908	G26908D	G26930	G27008	G27030	G27108	G27130	G27208	G27230	G27308	G27330	G27408	G27430
DATE SAMPLED	5/8/98	5/9/98	5/9/98	5/9/98	5/9/98	5/9/98	5/9/98	5/9/98	5/9/98	5/9/98	5/9/98	5/9/98	5/9/98	5/9/98
Volatiles (µg/L)														
1,1-Dichloroethane														
1,1-Dichloroethene														
1,3-Dichlorobenzene (meta)														
1,4-Dichlorobenzene (para)														
Benzene														
Chlorobenzene														
Chloromethane														
cis-1,2-Dichloroethene														
cis-1,3-Dichloropropene														
Dichlorodifluoromethane														
m- & p-Xylene														
o-Xylene														
Tetrachloroethene														
trans-1,2-Dichloroethene														
Trichloroethene														
Vinyl chloride														

SAMPLE LOCATION[a][b]	G27508	G27530	G27530D	G27608	G27630	G27708	G27730	G27808	G27830	G27908	G27930	G27930D	G30030
DATE SAMPLED	5/10/98	5/10/98	5/10/98	5/10/98	5/10/98	5/10/98	5/10/98	5/10/98	5/10/98	5/10/98	5/10/98	5/10/98	7/27/97
Volatiles (µg/L)													
1,1-Dichloroethane													
1,1-Dichloroethene													
1,3-Dichlorobenzene (meta)													
1,4-Dichlorobenzene (para)													
Benzene													
Chlorobenzene													
Chloromethane													
cis-1,2-Dichloroethene													
cis-1,3-Dichloropene													
Dichlorodifluoromethane													
m- & p-Xylene													
o-Xylene													
Tetrachloroethene													
trans-1,2-Dichloroethene													
Trichloroethene													
Vinyl chloride													

TABLE 5-3A

GROUNDWATER PHASES I AND II—DIRECT PUSH TECHNOLOGY DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

"J" qualifier on analytical data indicates an estimated value.
No entry indicates chemical not detected.
Only chemicals detected in at least one sample are listed.
The complete list of samples and analytical results is presented in Appendix B of this report.
(a) The first four digits of the sample identifier indicate the sample location and the last two digits indicate the depth of the sample.
(b) "D" at the end of the sample identifier indicates a duplicate sample.

TABLE 5-3B

DIRECT PUSH TECHNOLOGY
GROUNDWATER PHASES I AND II - CONCENTRATIONS SUMMARY
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Compound	Concentration Range (µg/L)	Location and Relative Depth of Maximum Concentration	Relative Depths Where Detected
1,1-Dichloroethane	7 to 51	G145 - Intermediate	Intermediate
1,1-Dichloroethene	8[a]	G171 - Intermediate	Intermediate
1,3-Dichlorobenzene	33[a]	G145 - Intermediate	Intermediate
1,4-Dichlorobenzene	6[a]	G32 - Intermediate	Intermediate
Benzene	1 to 24	G129 - Shallow	Shallow, Intermediate
Chlorobenzene	3.7 to 24	G32 - Intermediate	Shallow, Intermediate
Chloromethane	2.6 to 4.6[b]	G230 - Shallow	Shallow, Intermediate
cis-1,2-Dichloroethene	1.1 to 58	G145 - Intermediate	Shallow, Intermediate
trans-1,2-Dichloroethene	5 to 42	G145 - Intermediate	Shallow, Intermediate
cis-1,3-Dichloropropene	9[a]	G51 - Intermediate	Intermediate
Dichlorodifluoromethane	2.6[a]	G199 - Intermediate	Intermediate
Tetrachloroethene	4.5 to 180	G24 - Intermediate	Shallow, Intermediate
Trichloroethene	1.9 to 1650	G262 - Intermediate	Shallow, Intermediate
Vinyl chloride	2.4 to 21.4	G262 - Intermediate	Shallow, Intermediate
Xylenes	5 to 66	G32 - Intermediate	Intermediate

[a] Only one detection

[b] Maximum concentration was observed in the field duplicate sample for G230.

TABLE 5-3C

GROUNDWATER PHASE II—DETECTED ORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]	MW01A	MW01B	MW02A	MW02A-D	MW02B	MW03A	MW03B	MW04A	MW04A-D	MW04B	MW05A	MW05B	MW05B-D	MW06A
DATE SAMPLED		7/19/98	7/20/98	8/2/98	8/2/98	8/2/98	8/1/98	8/2/98	7/31/98	7/31/98	7/31/98	7/29/98	7/30/98	7/30/98	8/1/98
Volatiles (µg/L)															
1,1,2,2-Tetrachloroethane	0.2														
2-Butanone	4200														
2-Hexanone	280														
4-Methyl-2-pentanone	560														
Acetone	700										48.3 J				
Benzene	1						5.5	6.2			0.79 J				
Bromodichloromethane	0.6														
Carbon disulfide	700														
Chlorobenzene	100							19.1			1.8 J				
Chloroform	5.7														
cis-1,2-dichloroethene	70						2								
Ethylbenzene	30						4.1								
Methane	*		210	617	799	233	1310	186			372		715	525	349
Tetrachloroethene	3														
Toluene	40						8								
trans-1,2-Dichloroethene	100														
Trichloroethene	3														
Vinyl chloride	1						4.8								
Xylenes, Total	20						15.7								
Semivolatiles (µg/L)															
1,4-Dichlorobenzene	75							6.3 J							
2-Methylnaphthalene	20														
3&4-Methylphenol	4														
Butylbenzyl phthalate	140														
Di-n-butyl phthalate	700														
Diethyl phthalate	5600														
Dimethyl phthalate	70000														
Naphthalene	20							4.8 J							
Phenol	10														
Pesticides/PCBs (µg/L)		(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)
Herbicides (µg/L)															
TPH [d] (mg/L)															
TPH (C8-C40)	5						1.16	0.676							

TABLE 5-3C

GROUNDWATER PHASE II—DETECTED ORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]	MW06B	MW07A	MW07B	MW08A	MW08B	MW09A	MW09B	MW09B-D	MW10A	MW10B	MW11A	MW11A-D	MW11B	MW12A
DATE SAMPLED		8/1/98	7/29/98	7/29/98	7/28/98	7/28/98	7/22/98	7/22/98	7/22/98	7/20/98	7/21/98	8/5/98	8/5/98	8/5/98	8/4/98
Volatiles (µg/L)															
1,1,2,2-Tetrachloroethane	0.2														
2-Butanone	4200														
2-Hexanone	280														
4-Methyl-2-pentanone	560														
Acetone	700														
Benzene	1													9.2	
Bromodichloromethane	0.6														
Carbon disulfide	700														
Chlorobenzene	100													6.6	
Chloroform	5.7													2	
cis-1,2-dichloroethene	70													26.5	
Ethylbenzene	30														
Methane	*	140			740	236				58	200	88.9	71.7	1150	
Tetrachloroethene	3														
Toluene	40									1.8 J		8.1	5.8	2.6	
trans-1,2-Dichloroethene	100													7.7	
Trichloroethene	3													3.4	
Vinyl chloride	1													18.2	
Xylenes, Total	20													37.2	
Semivolatiles (µg/L)															
1,4-Dichlorobenzene	75														
2-Methylnaphthalene	20														
3&4-Methylphenol	4		3.8 J												
Butylbenzyl phthalate	140														
Di-n-butyl phthalate	700														
Diethyl phthalate	5600														
Dimethyl phthalate	70000														
Naphthalene	20														
Phenol	10														
Pesticides/PCBs (µg/L)			(c)		(c)	(c)	(c)	(c)	(c)	(c)		(c)	(c)	(c)	
Herbicides (µg/L)															
TPH [d] (mg/L)															
TPH (C8-C40)	5													0.64	

TABLE 5-3C

GROUNDWATER PHASE II—DETECTED ORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]	MW12B	MW13A	MW13B	MW14A	MW14B	MW15A	MW15B	MW16A	MW16B	MW17A	MW17B	MW18A	MW18B	MW19A
DATE SAMPLED		8/3/98	7/21/98	7/21/98	8/3/98	8/3/98	7/17/98	7/17/98	7/17/98	7/16/98	7/15/98	7/15/98	8/4/98	8/2/98	7/15/98
Volatiles (µg/L)															
1,1,2,2-Tetrachloroethane	0.2														NA
2-Butanone	4200						15.3 J								NA
2-Hexanone	280						12.9								NA
4-Methyl-2-pentanone	560						11.9								NA
Acetone	700														NA
Benzene	1	8.6													NA
Bromodichloromethane	0.6														NA
Carbon disulfide	700														NA
Chlorobenzene	100	13													NA
Chloroform	5.7													2.1	NA
cis-1,2-dichloroethene	70													62	NA
Ethylbenzene	30														NA
Methane	•	720			54.9	87.9		55		180					
Tetrachloroethene	3	2.8												64.3	NA
Toluene	40													1.6 J	NA
trans-1,2-Dichloroethene	100														NA
Trichloroethene	3													1250	NA
Vinyl chloride	1	1.5												20.3	NA
Xylenes, Total	20														NA
Semivolatiles (µg/L)															
1,4-Dichlorobenzene	75														
2-Methylnaphthalene	20							6 J							
3&4-Methylphenol	4														
Butylbenzyl phthalate	140														
Di-n-butyl phthalate	700		0.09 J												
Diethyl phthalate	5600													5 J	
Dimethyl phthalate	70000														
Naphthalene	20	6.1						23.8							
Phenol	10														
Pesticides/PCBs (µg/L)		(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)
Herbicides (µg/L)															
TPH [d] (mg/L)															
TPH (C8-C40)	5	0.718													

TABLE 5-3C

GROUNDWATER PHASE II—DETECTED ORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

PAGE 4 OF 5

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]	MW19B	MW20A	MW20B	MW21A	MW21B	MW22A	MW22B	MW23C	MW24C	MW25C	MW26C
DATE SAMPLED		7/16/98	7/18/98	7/18/98	7/19/98	7/18/98	7/30/98	7/30/98	8/6/98	7/31/98	8/6/98	8/5/98
Volatiles (µg/L)												
1,1,2,2-Tetrachloroethane	0.2		0.92 J									
2-Butanone	4200		15.3 J	13.3 J								
2-Hexanone	280		12.9	9.7 J								
4-Methyl-2-pentanone	560		10.4	8.5 J								
Acetone	700											
Benzene	1											
Bromodichloromethane	0.6											2.4
Carbon disulfide	700								33.6			11.8
Chlorobenzene	100											
Chloroform	5.7			6.3					3.7	1.8 J		12.2
cis-1,2-dichloroethene	70											
Ethylbenzene	30											
Methane	*	160		240		1300	766	168	71.2	124	113	155
Tetrachloroethene	3											
Toluene	40											
trans-1,2-Dichloroethene	100											
Trichloroethene	3											
Vinyl chloride	1											
Xylenes, Total	20											
Semivolatiles (µg/L)												
1,4-Dichlorobenzene	75											
2-Methylnaphthalene	20											
3&4-Methylphenol	4					15.3						
Butylbenzyl phthalate	140									8 J		
Di-n-butyl phthalate	700											
Diethyl phthalate	5600											
Dimethyl phthalate	70000			14.9							4.2 J	
Naphthalene	20											
Phenol	10					3.4 J						
Pesticides/PCBs (µg/L)		(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)
Herbicides (µg/L)												
TPH [d] (mg/L)												
TPH (C8-C40)	5											

TABLE 5-3C

GROUNDWATER PHASE II—DETECTED ORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

* Indicates screening value is not available.
NA – Not Analyzed
"J" qualifier indicates an estimated value.
No entry indicates chemical not detected.
Only chemicals detected in at least one sample are shown.
The complete list of analytical results is presented in Appendix B of this report.
Shaded entry indicates chemical detected at a concentration that meets or exceeds screening criterion.
(a) "D" at the end of the sample identifier indicates a duplicate sample.
(b) Groundwater Cleanup Target Levels (Development of Soil Cleanup Target Levels (SCTLs) for Chapter 62-777, F.A.C., May 26, 1999).
(c) Not analyzed for PCBs.
(d) Total Petroleum Hydrocarbons.

TABLE 5-3D

GROUNDWATER PHASE II—DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]		MW01A	MW01B	MW02A	MW02A-D	MW02B	MW03A	MW03B	MW04A	MW04A-D	MW04B	MW05A
DATE SAMPLED	Florida GCTL[c]	NTC BGSV[d]	7/19/98	7/20/98	8/2/98	8/2/98	8/2/98	8/1/98	8/2/98	7/31/98	7/31/98	7/31/98	7/29/98
Metals (µg/L)													
Aluminum	200	4067	4520 J		57400 J	46200 J	44000 J	39000 J	83700 J	100000 J	39600 J	227000 J	
Aluminum (dissolved)	200	4067	5340 J		2080 J				2430 J	4250 J	2850 J	52600 J	
Arsenic	50	5										32.9 J	
Arsenic (dissolved)	50	5											
Barium	2000	31.4								927 J	871 J	3240 J	
Barium (dissolved)	2000	31.4		483 J								804 J	
Cadmium (dissolved)	5	5.6		71.8 J									
Calcium	*	63830	10400 J	22100 J	11600 J	11500 J	38500 J	36500 J	44600 J	12800 J	14000 J	44400 J	10600 J
Calcium (dissolved)	*	36830	6140 J	20000 J	6510 J	6670 J	13700 J	29000 J	27400 J			27100 J	9480 J
Chromium	100	7.8			59.8 J	49.8 J	89.5 J	53.6 J	147 J	98.3 J		280 J	
Chromium (dissolved)	100	7.8							61.4 J			73.2 J	
Copper	1000	5.4							36.0			75.8 J	
Copper (dissolved)	1000	5.4							58.0				
Iron	300	1227	1400 J	2830 J	7300 J	6610 J	9360 J	26400 J	16000 J	10500 J		20000 J	
Iron (dissolved)	300	1227	1290 J	3020 J			3690 J	19000 J	7410 J			7340 J	
Lead	15	4.0			24.3 J	18.3 J	44.0 J	36.2 J	76.0 J	76.5 J	45.3 J	182 J	
Lead (dissolved)	15	4.0										42.4 J	
Magnesium	*	4560						13200 J	8210 J			7780 J	5830 J
Magnesium (dissolved)	*	4560						10400 J	6500 J			6710 J	5220 J
Manganese	50	17	44.2 J	41.2 J	24.7 J	22.7 J	36.9 J	194 J	54.1 J	37.4 J	28.1 J	65.6 J	
Manganese (dissolved)	50	17	34.4 J	38.4 J			25.0 J	176 J	73.5 J			56.0 J	22.2 J
Mercury	2	0.12	0.29										
Nickel	100	*										42.6 J	
Potassium	*	5400							8530 J			10600 J	
Potassium (dissolved)	*	5400							9440 J			17500 J	
Selenium	50	9.7											
Selenium (dissolved)	50	9.7											
Silver (dissolved)	100	*											20.9 J
Sodium	160000	18222	13300 J	14300 J			25300 J	25000 J	29400 J			34400 J	24700 J
Sodium (dissolved)	160000	18222	6940 J	15800 J			34400 J	23300 J	39700 J			72600 J	21400 J
Vanadium	49	20.6	52.2 J		110 J	91.7 J	114 J	103 J	222 J	154 J		330 J	
Vanadium (dissolved)	49	20.6										91.5 J	
Zinc	5000	4.0	112 J	268 J									
Zinc (dissolved)	5000	4.0	123 J	121 J									
Radiological (pCi/L)													
gross Alpha	15	13	27.9	49.0	11.9	10.9	95.5	6.9	40.3	6.3	31.4	120	7.4
gross Beta[e]	50	9.5	15.9	16.8	6.8	6.4	32.3	8.8	21.2	8.7	16.0	71.9	9.8

TABLE 5-3D

GROUNDWATER PHASE II—DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]		MW05B	MW05B-D	MW06A	MW06B	MW07A	MW07B	MW08A	MW08B	MW09A	MW09B	MW09B-D
DATE SAMPLED	Florida GCTL[c]	NTC BGSV[d]	7/30/98	7/30/98	8/1/98	8/1/98	7/29/98	7/29/98	7/28/98	7/28/98	7/22/98	7/22/98	7/22/98
Metals (ug/L)													
Aluminum	200	4067	74400 J	22400 J	35000 J	152000 J	68300 J	15400 J	56500 J	171000 J	33700 J	6220 J	5190 J
Aluminum (dissolved)	200	4067			5100 J	129000 J							
Arsenic	50	5				38.6				36.8 J			
Arsenic (dissolved)	50	5				32.7							
Barium	2000	31.4	1590 J	3700 J		3910 J	392 J	451 J	673 J	3400 J	250 J		
Barium (dissolved)	2000	31.4				3270 J	5150 J						
Cadmium (dissolved)	5	5.6											
Calcium	*	63830	18200 J	8910 J	22300 J	60000 J	10800 J	19400 J	52100 J	39700 J	21600 J	25800 J	16800 J
Calcium (dissolved)	*	36830			12700 J	44200 J			44000 J	8510 J	23000 J	18400 J	20200 J
Chromium	100	7.8	95.2 J	34.3 J	50.6 J	223 J	67.0 J		74.8 J	266 J			
Chromium (dissolved)	100	7.8				187 J							
Copper	1000	5.4	61.2 J	29.1 J		113	36.5 J	25.8 J	28.9 J	144 J			
Copper (dissolved)	1000	5.4				98.8							
Iron	300	1227	7920 J		6640 J	18900 J	4850 J		5450 J	17500 J		4680 J	
Iron (dissolved)	300	1227				12000 J							4130 J
Lead	15	4.0	93.9 J	25.6 J	60.3 J	197 J	64.5 J	17.6 J	59.3 J	237 J	28.0 J		
Lead (dissolved)	15	4.0				165 J							
Magnesium	*	4560	6360 J		8420 J	11600 J			5150 J	11400 J	6580 J		
Magnesium (dissolved)	*	4560			5500 J	7730 J					7430 J		
Manganese	50	17	31.7 J			64.5 J	21.5 J	19.8 J	66.3 J	66.5 J	20.8 J	37.3 J	20.7 J
Manganese (dissolved)	50	17	30.4 J		33.9 J	39.3 J			61.6 J	36.2 J	37.9 J	42.2 J	47.3 J
Mercury	2	0.12											
Nickel	100	*											
Potassium	*	5400			19400 J	12600 J					7260 J		
Potassium (dissolved)	*	5400			16700 J	7910 J					8620 J		
Selenium	50	9.7	55.3 J			42.0							
Selenium (dissolved)	50	9.7				33.9							
Silver (dissolved)	100	*											
Sodium	160000	18222	10600 J	8630 J	75800 J	39700 J	6140 J	7650 J	21100 J	15000 J	55100 J	25500 J	16300 J
Sodium (dissolved)	160000	18222	9180 J	8880 J	69300 J	25800 J	5060 J		11200 J	10900 J	64300 J	18600 J	
Vanadium	49	20.6	79.9 J		79.6 J	191 J	89.4 J		59.9 J	220 J			
Vanadium (dissolved)	49	20.6				162 J							
Zinc	5000	4.0											
Zinc (dissolved)	5000	4.0											
Radiological (pCi/L)													
gross Alpha	15	13	26.2	26.1	36.9	221	13.5	33.5	27.0	64.4	28.9	13.3	13.2
gross Beta[e]	50	9.5	10.9	8.4	36.7	192	7.8	10.6	25.4	33.8	34.1	5.6	7.1

TABLE 5-3D

GROUNDWATER PHASE II—DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

PAGE 3 OF 6

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]		MW10A	MW10B	MW11A	MW11A-D	MW11B	MW12A	MW12B	MW13A	MW13B	MW14A	MW14B
DATE SAMPLED	Florida GCTL[c]	NTC BGSV[d]	7/20/98	7/21/98	8/5/98	8/5/98	8/5/98	8/4/98	8/3/98	7/21/98	7/21/98	8/3/98	8/3/98
Metals (µg/L)													
Aluminum	200	4067			123000 J	126000 J	32100 J		8290 J	1360 J		94100 J	52300 J
Aluminum (dissolved)	200	4067			18300 J	25400 J	5140 J						2460 J
Arsenic	50	5											
Arsenic (dissolved)	50	5											
Barium	2000	31.4											1520 J
Barium (dissolved)	2000	31.4							1250 J				
Cadmium (dissolved)	5	5.6											
Calcium	*	63830	9030 J	27200 J	12600 J	15200 J	25600 J		29000 J	5000 J	14900 J	8090 J	43700 J
Calcium (dissolved)	*	36830	8390 J	22500 J	5750 J	7400 J	16800 J		22500 J		14000 J		23400 J
Chromium	100	7.8			160 J	163 J	43.6 J					99.7 J	92.8 J
Chromium (dissolved)	100	7.8							290 J				
Copper	1000	5.4			78.7	97.1							26.8
Copper (dissolved)	1000	5.4											
Iron	300	1227	1100 J	1670 J	10900 J	11600 J	3780 J		4490 J		1900 J	11600 J	7140 J
Iron (dissolved)	300	1227	999 J	1440 J	3990 J	4480 J			3850 J		1880 J		
Lead	15	4.0			158 J	164 J	37.0 J					70.7 J	48.9 J
Lead (dissolved)	15	4.0				21.7 J							
Magnesium	*	4560			6900 J	8440 J						6950 J	5260 J
Magnesium (dissolved)	*	4560											
Manganese	50	17	36.4 J	38.9 J	25.1 J	28.5 J		20.2 J	53.0 J	29.0 J	22.2 J	20.9 J	43.2 J
Manganese (dissolved)	50	17	33.5 J	33.8 J	41.7 J	35.7 J	31.5 J		50.6 J	26.8 J	23.4 J	25.9 J	31.9 J
Mercury	2	0.12											
Nickel	100	*											
Potassium	*	5400					24000 J						
Potassium (dissolved)	*	5400					24700 J						
Selenium	50	9.7			31.4	36.7							
Selenium (dissolved)	50	9.7											
Silver (dissolved)	100	*											
Sodium	160000	18222		11100 J		6150 J	51900 J	8100 J	12000 J	24300 J	17500 J	13200 J	45800 J
Sodium (dissolved)	160000	18222		9490 J		6430 J	55700 J	7880 J	12800 J	21100 J	17400 J	14700 J	53900 J
Vanadium	49	20.6			214 J	236 J						110 J	73.6 J
Vanadium (dissolved)	49	20.6											
Zinc	5000	4.0	132 J	53.9 J						60.2 J	55.4 J		
Zinc (dissolved)	5000	4.0	68.0 J	122 J						288 J	165 J		
Radiological (pCi/L)													
gross Alpha	15	13	4.7	11.8	50.4	39.8	21.8	3.3	8.5	8.5	17.7	3.4	68.0
gross Beta[e]	50	9.5	5.0	7.2	33.1	25.1	43.5	2.0	5.0	7.0	6.7	1.6	34.1

TABLE 5-3D

GROUNDWATER PHASE II—DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]		MW15A	MW15B	MW16A	MW16B	MW17A	MW17B	MW18A	MW18B	MW19A	MW19B	MW20A	MW20B
DATE SAMPLED	Florida GCTL[c]	NTC BGSV[d]	7/17/98	7/17/98	7/17/98	7/16/98	7/15/98	7/15/98	8/4/98	8/2/98	7/15/98	7/16/98	7/18/98	7/18/98
Metals (µg/L)														
Aluminum	200	4067		14000 J	4140 J			17800 J	28900 J	5530 J		26900 J	16400 J	
Aluminum (dissolved)	200	4067			4700 J	1290 J						2940 J		
Arsenic	50	5												
Arsenic (dissolved)	50	5												
Barium	2000	31.4		504 J				445 J				617 J	279 J	
Barium (dissolved)	2000	31.4	441 J	296 J		277 J	260 J	603 J			478 J			
Cadmium (dissolved)	5	5.6												
Calcium	*	63830	17700 J	28400 J	5710 J	23700 J	18700 J	29900 J	8700 J	16000 J	6240 J	28200 J	7950 J	39800 J
Calcium (dissolved)	*	36830	17900 J	13800 J	5780 J	28500 J	16700 J	16400 J		12400 J	6540 J	17400 J		44900 J
Chromium	100	7.8		29.2 J				37.3 J				52.2 J		
Chromium (dissolved)	100	7.8												
Copper	1000	5.4						55.4 J	27.1			57.1 J		
Copper (dissolved)	1000	5.4										69.6 J		
Iron	300	1227	1300 J	3000 J	1200 J	1960 J		4870 J	4660 J		815 J	6770 J	1740 J	3170 J
Iron (dissolved)	300	1227	1190 J	1560 J	1310 J	2190 J		2070 J				2870 J	686 J	3530 J
Lead	15	4.0		25.4 J				35.8 J	30.9 J			37.8 J	24.5 J	
Lead (dissolved)	15	4.0										8.2 J		
Magnesium	*	4560					5450 J							
Magnesium (dissolved)	*	4560												5640 J
Manganese	50	17		31.9 J	18.7 J	29.0 J		29.6 J		19.6 J	39.7 J	34.8 J	19.2 J	60.6 J
Manganese (dissolved)	50	17		21.4 J		31.8 J		40.6 J	21.2 J	33.8 J	31.3 J	38.9 J	29.6 J	69.2 J
Mercury	2	0.12												
Nickel	100	*												
Potassium	*	5400			6100 J		10000 J				5320 J			
Potassium (dissolved)	*	5400			6210 J		7910 J							
Selenium	50	9.7												
Selenium (dissolved)	50	9.7												
Silver (dissolved)	100	*												
Sodium	160000	18222	45600 J	10700 J	49000 J	14600 J	42400 J	18800 J		12700 J	10300 J	22600 J	12800 J	16300 J
Sodium (dissolved)	160000	18222	41000 J	6580 J	49000 J	15700 J	35600 J	16900 J		11900 J	7860 J	16900 J		17000 J
Vanadium	49	20.6										55.3 J		
Vanadium (dissolved)	49	20.6												
Zinc	5000	4.0	62.4 J	91.3 J	113 J	67.6 J	122 J	217 J			245 J	147 J	111 J	73.2 J
Zinc (dissolved)	5000	4.0	46.3 J	38.0 J	76.5 J	71.9 J	61.9 J	66.7 J			144 J	43.8 J	59.6 J	128 J
Radiological (pCi/L)														
gross Alpha	15	13	4.8	19.5	6.6	14.7	3.4	17.2	12.4	5.4	4.2	34.7	7.3	28.5
gross Beta[e]	50	9.5	7.2	7.8	11.9	8.5	7.2	8.2	10.1	5.0	6.9	16.7	3.1	18.6

TABLE 5-3D

GROUNDWATER PHASE II—DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]		MW21A	MW21B	MW22A	MW22B	MW23C	MW24C	MW25C	MW26C
DATE SAMPLED	Florida GCTL[c]	NTC BGSV[d]	7/18/98	7/18/98	7/30/98	7/30/98	8/6/98	7/31/98	8/6/98	8/5/98
Metals (µg/L)										
Aluminum	200	4067	2670 J		2890 J	46100 J	61200 J	9970 J	3120 J	20600 J
Aluminum (dissolved)	200	4067			13700 J		16000 J	6450 J	2780 J	11900 J
Arsenic	50	5								40.3
Arsenic (dissolved)	50	5								
Barium	2000	31.4	248 J		542 J	754 J	364 J		211 J	
Barium (dissolved)	2000	31.4		845 J			703 J	357 J		
Cadmium (dissolved)	5	5.6								
Calcium	*	63830	6940 J	15700 J	23300 J	49800 J	410000 J	43900 J	93600 J	335000 J
Calcium (dissolved)	*	36830		13500 J	9210 J	17600 J	225000 J	35400 J	95200 J	190000 J
Chromium	100	7.8				107 J	203 J	32.2 J		83.9 J
Chromium (dissolved)	100	7.8					65.5 J		23.3 J	46.5 J
Copper	1000	5.4	25.8 J			32.0 J	36.4 J			26.4 J
Copper (dissolved)	1000	5.4								
Iron	300	1227		2680 J		11900 J	64000 J	7930 J	3120 J	29700 J
Iron (dissolved)	300	1227		2180 J			22900 J	5960 J	2840 J	16800 J
Lead	15	4.0				50.1 J	71.5 J			35.5 J
Lead (dissolved)	15	4.0			47.8 J		32.6 J			
Magnesium	*	4560			7440 J	6300 J	23900 J		6530 J	14900 J
Magnesium (dissolved)	*	4560					11000 J		6750 J	9200 J
Manganese	50	17		49.8 J		51.1 J	734 J	118 J	139 J	386 J
Manganese (dissolved)	50	17	20.1 J	40.9 J	30.6 J	43.8 J	345 J	94.8 J	142 J	197 J
Mercury	2	0.12								
Nickel	100	*					61.0 J			61.2 J
Potassium	*	5400		5650 J			9860 J	10200 J		8360 J
Potassium (dissolved)	*	5400					5500 J	7480 J		
Selenium	50	9.7								
Selenium (dissolved)	50	9.7								
Silver (dissolved)	100	*								
Sodium	160000	18222	8980 J	35200 J	12400 J	12100 J	49100 J	17300 J	55500 J	28600 J
Sodium (dissolved)	160000	18222		27800 J	15900 J	14700 J	42700 J	14200 J	58800 J	22600 J
Vanadium	49	20.6				133 J	127 J			62.5 J
Vanadium (dissolved)	49	20.6								
Zinc	5000	4.0	263 J	269 J			334 J		243 J	
Zinc (dissolved)	5000	4.0	74.3 J	104 J			285 J		423 J	
Radiological (pCi/L)										
gross Alpha	15	13	17.3	70.8	100	171	25.0	5.9	2.4	10.6
gross Beta[e]	50	9.5	9.7	31.8	47.5	46.2	24.9	10.0	7.4	7.6

TABLE 5-3D

GROUNDWATER PHASE II—DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

* Indicates screening value is not available.

"J" qualifier on analytical data indicates an estimated value.

No entry indicates chemical not detected.

Only chemicals detected in at least one sample are listed.

The complete list of analytical results is presented in Appendix B of this report.

Shaded entry indicates chemical detected at a concentration that meets or exceeds the screening criteria.

(a) "D" at the end of the sample identifier indicates a duplicate sample.

(b) For an organic analyte, the screening criterion is the GCTL; for an inorganic analyte with an established GCTL and BGSV, the screening criterion is the greater of the GCTL or the BGSV.

(c) Groundwater Cleanup Target Level [Development of Soil Cleanup Target Levels (SCTLs) for Chapter 62-777, F.A.C., May 26, 1999].

(d) Background Screening Value Level (Background Sampling Report for NTC, Orlando, Florida; ABB Environmental Services, August 1995) for inorganics only.

(e) The screening value of 50 pCi/L (40 CFR 141) is referenced because the activities for specific radionuclides in the samples have not been determined. These data are required for conversion to the 4 millirem/year federal and state reference level.

TABLE 5-3E

GROUNDWATER PHASE II—FREQUENCY OF DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	CAS Number	Units	Minimum Concentration	Maximum Concentration	Location of Maximum Concentration	Detection Frequency	Background Value[a]
Volatiles							
1,1,2,2-Tetrachloroethane	79-34-5	µg/L	0.92J	0.92J	MW20A	1/47	
2-Butanone	78-93-3	µg/L	13.3J	15.3J	MW15A	3/3	
2-Hexanone	591-78-6	µg/L	9.7J	12.9	MW15A	3/47	
4-Methyl-2-pentanone	108-10-1	µg/L	8.5J	11.9	MW15A	3/47	
Acetone	67-64-1	µg/L	48.3J	48.3J	MW04B	1/1	
Benzene	71-43-2	µg/L	0.79J	9.2	MW11B	5/47	
Bromodichloromethane	75-27-4	µg/L	2.4	2.4	MW26C	1/47	
Carbon disulfide	75-15-0	µg/L	11.8	33.6	MW23C	2/47	
Chlorobenzene	108-90-7	µg/L	1.8J	19.1	MW03B	4/47	
Chloroform	67-66-3	µg/L	1.8J	12.2	MW26C	6/47	
Ethylbenzene	100-41-4	µg/L	4.1	4.1	MW03A	1/47	
Methane	74-82-8	µg/L	54.9	1310	MW03A	29/45	
Tetrachloroethene	127-18-4	µg/L	2.8	64.3	MW18B	2/47	
Toluene	108-88-3	µg/L	1.6J	8.1	MW11A	5/47	
cis-1,2-Dichloroethene	156-59-2	µg/L	2	62	MW18B	3/47	
trans-1,2-Dichloroethene	156-60-5	µg/L	7.7	7.7	MW11B	1/47	
Trichloroethene	79-01-6	µg/L	3.4	1250	MW18B	2/47	
Vinyl chloride	75-01-4	µg/L	1.5	20.3	MW18B	4/47	
Xylenes, Total	1330-20-7	µg/L	15.7	37.2	MW11B	2/47	
Semivolatiles							
1,4-Dichlorobenzene	106-46-7	µg/L	6.3J	6.3J	MW03B	1/48	
2-Methylnaphthalene	91-57-6	µg/L	6J	6J	MW15B	1/48	
3&4-Methylphenol		µg/L	3.8J	15.3	MW21B	2/47	
Butylbenzyl phthalate	85-68-7	µg/L	8J	8J	MW24C	1/48	
Di-n-butyl phthalate	84-74-2	µg/L	0.0J9	0.09J	MW13A	1/48	
Diethyl phthalate	84-66-2	µg/L	5J	5J	MW18B	1/48	

TABLE 5-3E

GROUNDWATER PHASE II—FREQUENCY OF DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	CAS Number	Units	Minimum Concentration	Maximum Concentration	Location of Maximum Concentration	Detection Frequency	Background Value[a]
Semivolatiles (Continued)							
Dimethyl phthalate	131-11-3	µg/L	4.2J	14.9	MW20B	2/48	
Naphthalene	91-20-3	µg/L	4.8J	23.8	MW15B	3/48	
Phenol	108-95-2	µg/L	3.4J	3.4J	MW21B	1/47	
Polynuclear Aromatics							
Inorganics							
Aluminum	7429-90-5	µg/L	1360J	227000J	MW04B	36/48	4067
Aluminum (dissolved)	7429-90-5	µg/L	1290J	129000J	MW06B	18/48	4067
Arsenic	7440-38-2	µg/L	32.9J	40.3	MW26C	4/48	5
Arsenic (dissolved)	7440-38-2	µg/L	32.7	32.7	MW06B	1/48	5
Barium	7440-39-3	µg/L	211J	3910J	MW06B	19/48	31.4
Barium (dissolved)	7440-39-3	µg/L	260J	5150J	MW07A	14/48	31.4
Cadmium (dissolved)	7440-43-9	µg/L	71.8J	71.8J	MW01B	1/48	5.6
Calcium	7440-70-2	µg/L	5000J	410000J	MW23C	47/48	36830
Calcium (dissolved)	7440-70-2	µg/L	5750J	225000J	MW23C	38/48	36830
Chromium	7440-47-3	µg/L	29.2J	280J	MW04B	23/48	7.8
Chromium (dissolved)	7440-47-3	µg/L	23.3J	290J	MW12B	7/48	7.8
Copper	7440-50-8	µg/L	25.8J	144J	MW08B	17/48	5.4
Copper (dissolved)	7440-50-8	µg/L	58	98.8	MW06B	3/48	5.4
Iron	7439-89-6	µg/L	815J	64000J	MW23C	39/48	1227
Iron (dissolved)	7439-89-6	µg/L	686J	22900J	MW23C	26/48	1227
Lead	7439-92-1	µg/L	17.6J	237J	MW08B	26/48	4
Lead (dissolved)	7439-92-1	µg/L	8.2J	165J	MW06B	6/48	4
Magnesium	7439-95-4	µg/L	3182.5	23900J	MW23C	19/48	4560
Magnesium (dissolved)	7439-95-4	µg/L	5220J	11000J	MW23C	11/48	4560

TABLE 5-3E

GROUNDWATER PHASE II—FREQUENCY OF DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	CAS Number	Units	Minimum Concentration	Maximum Concentration	Location of Maximum Concentration	Detection Frequency	Background Value[a]
Inorganics (Continued)							
Manganese	7439-96-5	µg/L	18.7J	734J	MW23C	40/48	17
Manganese (dissolved)	7439-96-5	µg/L	12.5975	345J	MW23C	40/48	17
Mercury	7439-97-6	µg/L	0.29	0.29	MW01A	1/48	0.12
Nickel	7440-02-0	µg/L	42.6J	61.2J	MW26C	3/48	N/A
Potassium	7440-09-7	µg/L	5320J	24000J	MW11B	13/48	5400
Potassium (dissolved)	7440-09-7	µg/L	5500J	24700J	MW11B	10/48	5400
Selenium	7782-49-2	µg/L	30.325	55.3J	MW05B	3/48	9.7
Selenium (dissolved)	7782-49-2	µg/L	33.9	33.9	MW06B	1/48	9.7
Silver (dissolved)	7440-22-4	µg/L	20.9J	20.9J	MW05A	1/48	N/A
Sodium	7440-23-5	µg/L	3157.5J	75800J	MW06A	44/48	18222
Sodium (dissolved)	7440-23-5	µg/L	4527.5J	72600J	MW04B	41/46	18222
Vanadium	7440-62-2	µg/L	40.225	330J	MW04B	20/48	20.6
Vanadium (dissolved)	7440-62-2	µg/L	91.5J	162J	MW06B	2/48	20.6
Zinc	7440-66-6	µg/L	53.9J	334J	MW23C	20/48	4
Zinc (dissolved)	7440-66-6	µg/L	38J	423J	MW25C	20/48	4
Miscellaneous							
TPH (C8-C40)		mg/L	0.64	1.16	MW03A	4/47	
Alkalinity as $CaCO_3$		mg/L	6	187	MW04B	43/48	
Biochemical Oxygen Demand		mg/L	2.2	114	MW09B	29/48	
Chemical Oxygen Demand		mg/L	1	176	MW04B	32/48	
Chloride		mg/L	1.5	300J	MW06B	35/48	
Cyanide		mg/L	0.035	0.035	MW03B	1/48	
Hardness as $CaCO_3$		mg/L	12.5	1120	MW23C	47/48	

TABLE 5-3E

GROUNDWATER PHASE II—FREQUENCY OF DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	CAS Number	Units	Minimum Concentration	Maximum Concentration	Location of Maximum Concentration	Detection Frequency	Background Value[a]
Miscellaneous (Continued)							
Nitrate, as Nitrogen		mg/L	0.1075	1.7	MW07A	14/47	
Nitrate/nitrite, as Nitrogen		mg/L	0.1J	1.7	MW07A	16/47	
Nitrite, as Nitrogen		mg/L	0.009	0.027	MW04A	5/48	
Orthophosphate		mg/L	0.09	5.4	MW13B	29/48	
Orthophosphate		mg/L	0.09	5.4	MW26C	29/48	
pH		PH units	4.6	8.9	MW06B	48/48	
Plate count, Total		CFU/mL	0	116000	MW22A	48/48	
Redox potential		MV	90.8	600	MW19A	48/48	
Sulfate		mg/L	10.7	1360	MW10A	24/48	
Total Dissolved Solids		mg/L	52	27900	MW06B	48/48	
Total Organic Carbon		mg/L	2	809	MW06B	48/48	
Total Suspended Solids		mg/L	10	10100	MW08B	48/48	
Turbidity		NTU	9	37000	MW06B	15/15	
Radiological							
Cesium-137		pCi/L	9.8	9.8	MW03A	1/1	
Cobalt-60		pCi/L	5.8	18.3	MW06B	3/3	
gross Alpha		pCi/L	2.4	221	MW06B	48/48	13
gross Beta		pCi/L	1.6	192	MW06B	48/48	9.5

CAS – Chemical Abstracts Service
"J" qualifier on analytical data indicates an estimated value.
Rejected values not included.
Table 4-1 and Section 4.3.3 provide details regarding rejected results.
[a] Background values determined only for inorganics.

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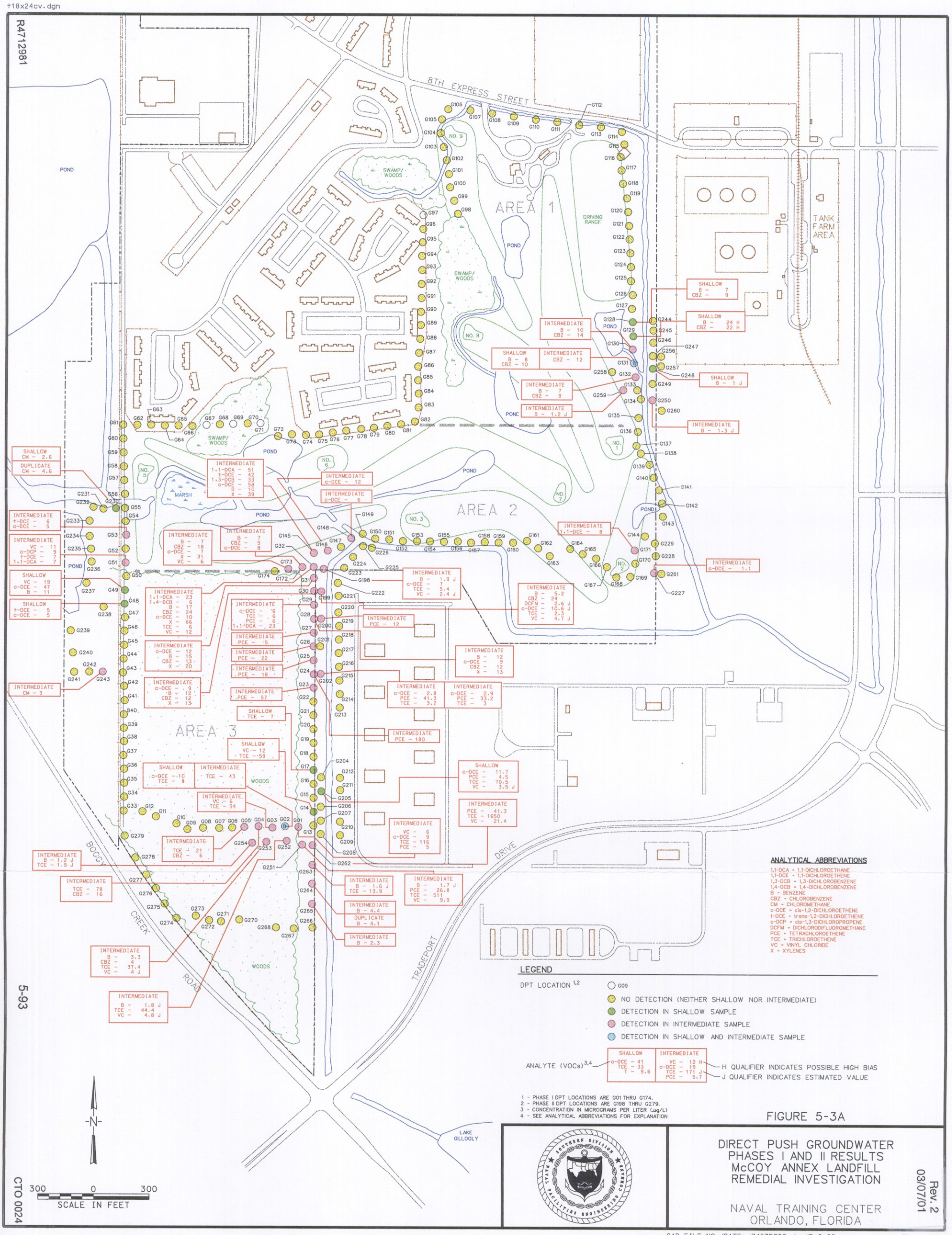
R4712981



ANALYTICAL ABBREVIATIONS

1,1-DCA = 1,1-DICHLOROETHANE
1,1-DCE = 1,1-DICHLOROETHENE
1,3-DCB = 1,3-DICHLOROBENZENE
1,4-DCB = 1,4-DICHLOROBENZENE
B = BENZENE
CBZ = CHLOROBENZENE
CM = CHLOROMETHANE
c-DCE = cis-1,2-DICHLOROETHENE
t-DCE = trans-1,2-DICHLOROETHENE
c-DCP = cis-1,3-DICHLOROPROPENE
DCFM = DICHLORODIFLUOROMETHANE
PCE = TETRACHLOROETHENE
TCE = TRICHLOROETHENE
VC = VINYL CHLORIDE
X = XYLENES

LEGEND

DPT LOCATION [1,2] G09

NO DETECTION (NEITHER SHALLOW NOR INTERMEDIATE)

DETECTION IN SHALLOW SAMPLE

DETECTION IN INTERMEDIATE SAMPLE

DETECTION IN SHALLOW AND INTERMEDIATE SAMPLE

ANALYTE (VOCs)[3,4]: SHALLOW c-DCE - 41 TCE - 33 T - 9.6 | INTERMEDIATE VC - 12 H c-DCE - 19 TCE - 171 J PCE - 5.7

H QUALIFIER INDICATES POSSIBLE HIGH BIAS

J QUALIFIER INDICATES ESTIMATED VALUE

1 - PHASE I DPT LOCATIONS ARE G01 THRU G174.
2 - PHASE II DPT LOCATIONS ARE G198 THRU G279.
3 - CONCENTRATION IN MICROGRAMS PER LITER (ug/L)
4 - SEE ANALYTICAL ABBREVIATIONS FOR EXPLANATION

FIGURE 5-3A

DIRECT PUSH GROUNDWATER
PHASES I AND II RESULTS
McCOY ANNEX LANDFILL
REMEDIAL INVESTIGATION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Rev. 2
03/07/01

5-93

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Contaminants were detected in five general areas around the boundary of the site. The first area is just south of the driving range near locations G128 through G132, G248, G250, and G259. VOCs were detected at eight locations in this area. Shallow samples from G128, G129, G131, and G248 contained benzene (maximum concentration 24 µg/L at G129). Chlorobenzene (maximum concentration 22 µg/L at G129) was detected in shallow samples from G128, G129, and G131. The intermediate samples from G130, G131, and G132 also contained chlorobenzene (maximum concentration 14 µg/L at G130). The intermediate samples from G130, G132, G250, and G259 contained benzene (maximum concentration 10 µg/L at G130). The area that includes all of these locations is immediately east of a large area of magnetic anomalies identified as probable landfill material (see Section 5.1). The northern, eastern, and southern limits of the groundwater contamination were delineated by nondetects at adjacent groundwater sampling locations. There were two trace level detections of benzene in G248 and G250 at 1 µg/L and 1.3 µg/L, respectively, on the east side of the drainage canal. Based upon past studies (Metcalf & Eddy, 1997) of the fuel storage facility located on the east side of the canal and the contamination of groundwater at the fuel storage facility, it was concluded that the trace levels of benzene contamination in G248 and G250 are associated with the fuel storage facility and not the landfill. This conclusion is strongly supported by the groundwater flow data (see Figures 2-2H and 2-2I) and the site hydrogeology that show that groundwater in the surficial aquifer flows toward and discharges into the drainage canal from all sides. The drainage canal acts as a hydraulic barrier to flow and dissolved chemicals in the groundwater are unlikely to pass beneath the canal. For this reason the Phase II monitoring well installations focused on the western side of the canal in and around the former landfill at OU 2.

The second area consists of sample locations G171 and G227. The VOC 1,1-dichloroethene (8 µg/L) was detected in the intermediate sample from G171 and cis-1,2-dichloroethene (1.1 µg/L) was detected in the intermediate sample from location G227 (Figure 5-3A). These locations are hydraulically downgradient of geophysical anomalies interpreted to represent landfill material in the hole No. 8 fairway (Figures 5-1A and 5-1B). The lateral and downgradient limits of the contamination have been determined by nondetects at nearby groundwater sampling locations.

The third area where contaminants were detected in groundwater is located at the northeastern corner of the wooded area (Figure 5-3A). This area consists of sample locations G23 through G32, G145, G146, G148, G172, G173, G198, G199, G200, and G202. The largest number of chemicals was found in this area. All of the detections were in the intermediate samples (30 feet bgs). Cis-1,2-dichloroethene was detected most frequently (in 13 of the samples) with a maximum concentration of 58 µg/L at G145. Multiple chemicals (including chlorinated solvents and fuel components) were detected in a localized area centered around G31. Tetrachloroethene (PCE) was detected in eight samples in the southern part of this area with a maximum concentration of 180 µg/L at G24. This third area of groundwater contamination is

located in the downgradient direction from two of the major areas identified as probable landfill areas (see Section 5.1). One of the landfill areas is located to the north under the golf course and the other to the west in the wooded area. The lateral and downgradient limits of the groundwater contamination in this area have been determined by nondetects in adjacent or nearby groundwater sampling locations (i.e., across the canal).

The fourth area in which VOCs were detected is located at the southeastern corner of the wooded area (Figure 5-3A). This area consists of sample locations G01 through G05, G14, G17, G205, G251 through 254, and G262 through G265. Chemicals were detected in both shallow (northern) and intermediate (southern) samples in this area. Trichloroethene (TCE) was detected in 14 samples, both shallow and intermediate. The maximum concentration was 1,650 μg/L in the intermediate sample from G262. Vinyl chloride was detected in six of the intermediate samples and two of the shallow samples. The maximum concentration was 21.4 μg/L in the intermediate sample from G262. PCE was detected in one shallow sample and in three intermediate samples with a maximum concentration of 41.3 μg/L in G262. Benzene, chlorobenzene, cis-1,2-dichloroethene, and vinyl chloride were also detected at relatively low to moderate concentrations in this area. This area is hydraulically downgradient of an area of magnetic anomalies located in the wooded area (see Section 5.1) that may be associated with past landfilling activities and downgradient of an area of former "Pits" (i.e., excavation or depression) mapped by the Soil Conservation Service (see Figure 2-2Q).

The data for the fourth area indicate groundwater contamination with the highest observed concentrations of TCE at 1,650 μg/L and 511 μg/L at G262 and G251, respectively. The southern and western limits of the groundwater contamination are bounded by the line of samples G266 through G279 and G06 through G12. The northern limit of the groundwater contamination is bounded by samples G18 through G22. The eastern, or downgradient, limit of the groundwater contamination is bounded by the drainage canal because the site hydrogeology dictates that groundwater in the surficial aquifer does not normally flow across (under) the canal (see Section 2.2.3), and the groundwater contamination in other areas has not migrated past the drainage canal. No VOCs were detected in any samples east of the canal in this area (G209 through G212). In addition, monitoring wells MW17A/B and MW19A/B that were subsequently installed during Phase II on the eastern side of the canal and southeast of the groundwater contamination do not show the presence of any organic groundwater contamination (Table 5-3C).

The fifth area of detected groundwater contamination is at the western end of the golf course. This area consists of sample locations G48, G49, G51, G53, G230, and G243. These samples are located within the area of magnetic anomalies identified as probable landfill material (see Section 5.1). VOCs were detected at low concentrations in three shallow (G48, G49, and G230) and three intermediate (G51, G53,

and G243) samples. Cis-1,2-dichloroethene was detected in three of the samples, with the maximum concentration of 47 µg/L in the shallow sample from G49. Vinyl chloride was detected in one shallow sample and one intermediate sample with a maximum concentration of 19 µg/L in G49. Benzene; chloromethane; trans-1,2-dichloroethene; 1,1-dichloroethane; and cis-1,3-dichloropropene were also detected at mostly low concentrations (i.e., <10 µg/L) in this area.

The limits of the groundwater contamination are bounded on the north, west (upgradient), and south by nondetects at nearby groundwater sampling locations. Perimeter and isolated detections of chloromethane were observed at sample locations G230 and G243, with concentrations of 4.6 and 3 µg/L, respectively. This chemical is a common laboratory contaminant and its absence within the central impacted area suggests that it may be a laboratory artifact.

The results of all of the groundwater samples collected using direct push techniques (DPT and CPT programs) were used to establish locations for permanent monitoring wells. The results of the monitoring well sampling program are discussed in the following sections.

Cone Penetrometer Samples

Groundwater samples were collected as part of Phase I during the CPT program using direct push methods. The procedures used to collect the samples, the rationale for collection, and the analytical program are detailed in Section 3.6.2. Analyses of samples collected from CPT locations were performed at a mobile laboratory and a fixed-base laboratory for selected VOCs. Two VOCs were detected in samples from location CP-1 (see Figure 3-6B). Preliminary results indicated that vinyl chloride was detected at a concentration of 220 µg/L in the 60-foot depth sample. No compounds were reported in the 70-foot depth sample. The same location (offset approximately 2 feet) was resampled (at the 60- and 70-foot intervals) about 1 month later; TCE was the only volatile compound detected (1.8 J µg/L in the 70-foot sample and 3.4 J µg/L in its duplicate sample). No chemicals were detected in any of the other samples collected during the CPT program. Appendix B contains the analytical groundwater data for all of the CPT samples.

Monitoring Wells

Nineteen VOCs were detected in 32 of the 48 monitoring well samples collected at OU 2 during Phase II. Table 5-3C lists the detections of organic chemicals. Only chemicals detected in at least one sample are presented in the summary table. Table 5-3E presents the frequency of detections for groundwater at OU 2. The analytical database for OU 2 groundwater samples is presented in Appendix B.

Ten of the 32 samples that had detections of VOCs were from wells screened across the water table, 18 samples were from wells screened at the bottom of the surficial aquifer, and 4 samples were from wells screened within the confined sand aquifer in the Hawthorn Group. The suite of VOCs is dominated by methane, petroleum-product constituents, and chlorinated compounds. Methane was the most frequently detected VOC (29 detections) and was also the VOC with the highest concentration in groundwater (1,310 µg/L at MW03A). It was detected in 29 monitoring well samples scattered across OU 2 and from all screened intervals of both the surficial and deep aquifers (Table 5-3C). Methane is a common by-product of decomposing waste in landfills. Chloroform was the next most frequently detected VOC with six detections. Benzene and toluene had five detections each, and chlorobenzene and vinyl chloride each had four detections. Four compounds (2-butanone, 2-hexanone, 4-methyl-2-pentanone, and cis-1,2-dichloroethene) had three detections each. The remaining nine VOCs detected (1,1,2,2-tetrachloroethane, acetone, bromodichloromethane, carbon disulfide, ethylbenzene, PCE, trans-1,2-dichloroethene, TCE, and xylenes) each had two or less detections.

The wells with the most VOC detections were MW11B (10 detections), MW03A (7 detections), MW18B (6 detections), and MW12B and MW20B (5 detections each). VOC detections at these wells ranged from 2.0 µg/L (chloroform) to 1,150 µg/L (methane) at MW11B, 2.0 µg/L (cis-1,2-dichloroethene) to 1,310 µg/L (methane) at MW03A, 1.6J µg/L (toluene) to 1,250 µg/L (TCE) at MW18B, 1.5 µg/L (vinyl chloride) to 720 µg/L (methane) at MW12B, and 6.3 µg/L (chloroform) to 240 µg/L (methane) at MW20B. The remaining wells with VOC detections had four or less detections.

Eight monitoring well samples contained VOC concentrations exceeding the State of Florida FDEP groundwater cleanup target levels (GCTLs) (FDEP, 1999). Two of these exceedances occurred in shallow wells, five in intermediate wells, and one in a deep well (Figure 5-3B). Monitoring wells MW11B and MW12B are located near the center of OU 2 at the northeastern corner of the wooded area. Monitoring wells MW03A and MW03B are located at the eastern edge of the golf course just south of the driving range. Well MW18B is located at the southeastern corner of the wooded area. Monitoring wells MW20A and MW20B are both located at the southern edge of the wooded area. Only one monitoring well screened within the Hawthorn Group (MW26C) contained VOCs exceeding GCTLs.

Eight VOCs (1,1,2,2-tetrachloroethane, benzene, bromodichloromethane, chloroform, PCE, TCE, vinyl chloride, and xylenes) detected in the monitoring well samples at OU 2 exceeded GCTLs. TCE was detected at the highest concentration (1,250 µg/L). Benzene exceeded GCTLs in the highest number of monitoring well samples (i.e., four wells), although its maximum concentration was only 9.2 µg/L. Vinyl

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8TH EXPRESS STREET

POND

NO. 9

SWAMP/ WOODS

AREA 1

DRIVING RANGE

TANK FARM AREA

OLD-OU2-01A

OLD-OU2-01B

OLD-OU2-02A

OLD-OU2-02B

OLD-OU2-03B

OLD-OU2-03A

OLD-OU2-03A	
BENZENE	5.5
VINYL CHLORIDE	4.8

OLD-OU2-03B	
BENZENE	6.2

OLD-OU2-04A

OLD-OU2-04B

OLD-OU2-24C

NO. 8

NO. 1

NO. 6

NO. 5

NO. 7

NO. 3

NO. 4

NO. 2

OLD-OU2-22A

OLD-OU2-22B

OLD-OU2-23C

OLD-OU2-05A

OLD-OU2-05B

MARSH

AREA 2

OLD-OU2-08B

OLD-OU2-08A

OLD-OU2-11A

OLD-OU2-09B

OLD-OU2-09A

OLD-OU2-06B

OLD-OU2-06A

OLD-OU2-07B

OLD-OU2-07A

OLD-OU2-11B	
BENZENE	9.2
TRICHLOROETHENE	3.4
VINYL CHLORIDE	18.2
XYLENES, TOTAL	37.2

OLD-OU2-11B

OLD-OU2-12B	
BENZENE	8.6
VINYL CHLORIDE	1.5

OLD-OU2-12B

OLD-OU2-12A

OLD-OU2-10A

OLD-OU2-10B

OLD-OU2-13B

OLD-OU2-13A

OLD-OU2-21B

OLD-OU2-21A

OLD-OU2-21B	
3&4 METHYLPHENOL	15.3

OLD-OU2-14A

OLD-OU2-14B

AREA 3

WOODS

OLD-OU2-15B	
NAPHTHALENE	23.8

OLD-OU2-15B

OLD-OU2-15A

OLD-OU2-26C

OLD-OU2-26C	
BROMODICHLOROETHANE	2.4
CHLOROFORM	12.2

OLD-OU2-25C

OLD-OU2-18A

OLD-OU2-17B

OLD-OU2-17A

OLD-OU2-16B

OLD-OU2-16A

OLD-OU2-18B

OLD-OU2-18B	
TETRACHLOROETHENE	64.3
TRICHLOROETHENE	1250
VINYL CHLORIDE	20.3

OLD-OU2-19A

OLD-OU2-19B

OLD-OU2-20A

OLD-OU2-20B

OLD-OU2-20A	
CHLOROFORM	6.3
DUPLICATE	
1,1,2,2-TETRACHLOROETHANE	0.92J

BOGGY CREEK ROAD

TRADEPORT DRIVE

LAKE GILLOOLY

LEGEND

SHALLOW MONITORING WELL — OLD-OU2-14A

INTERMEDIATE MONITORING WELL — OLD-OU2-17B

DEEP MONITORING WELL — OLD-OU2-26C

WELL DESIGNATION — OLD-OU2-20A

ANALYTE — CHLOROFORM 6.3

DUPLICATE — 1,1,2,2-TETRACHLOROETHANE 0.92J

J QUALIFIER INDICATES ESTIMATED VALUE

CONCENTRATION [1]

1 – CONCENTRATION IN MICROGRAMS PER LITER (ug/L)

FIGURE 5-3B

N

300 0 300

SCALE IN FEET

5-99

CTO 0024

GROUNDWATER PHASE II
ALL WELLS
ORGANICS ABOVE SCREENING CRITERIA
McCOY ANNEX LANDFILL
REMEDIAL INVESTIGATION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Rev. 2
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chloride had three exceedances, chloroform and TCE had two exceedances each, and the remaining compounds each had one exceedance. The distribution of VOCs above GCTLs is shown in Figure 5-3B.

5.3.1.2 Semivolatile Organic Compounds

Nine SVOCs were detected in 10 of 48 monitoring well samples collected at OU 2 during Phase II (see Tables 5-3C and 5-3E). Two of the wells were screened across the water table, six wells were screened at the base of the surficial aquifer, and two wells were screened within the Hawthorn Group. Naphthalene was the most frequently detected SVOC (three detections) followed by 3&4-methylphenol and dimethylphthalate with two detections each. The remaining SVOCs (1,4-dichlorobenzene, 2-methylnaphthalene, butylbenzyl phthalate, di-n-butyl phthalate, diethyl phthalate, and phenol) each had one detection. The wells with the most SVOC detections were MW03B, MW15B, and MW21B with two detections each. Groundwater samples from wells MW07A, MW12B, MW13B, MW18B, MW20B, MW24C, and MW25C each had one SVOC detection. All other groundwater samples from OU 2 did not have any positive SVOC detections. Naphthalene was the SVOC with the highest concentration and its concentrations in wells at OU 2 ranged from 4.8J µg/L at MW03B to 23.8 µg/L at MW15B. The next highest SVOC concentration was 15.3 µg/L (3&4-methylphenol at MW21B). Naphthalene and 3&4-methylphenol at these two locations were the only SVOCs to exceed the GCTLs. Figure 5-3B shows the distribution of SVOC concentrations exceeding GCTLs. Well MW15B is located on GOAA property on the east side of the drainage canal across from the wooded area and MW21B is located at the western edge of the wooded area.

5.3.1.3 Pesticides and Polychlorinated Biphenyls

There were no pesticide or PCB compounds detected in the groundwater samples collected from the monitoring wells at OU 2.

5.3.1.4 Herbicides

There were no herbicide compounds detected in the groundwater samples collected from the monitoring wells at OU 2.

5.3.1.5 Total Petroleum Hydrocarbons

TPH was detected in 4 of 47 monitoring well samples. TPH concentrations ranged from 0.64 mg/L (MW11B) to 1.16 mg/L (MW03A). All four TPH detections were in surficial aquifer wells. There were no

TPH detections in the four deep aquifer monitoring wells. No TPH concentrations were detected above the GCTL of 5 mg/L in groundwater at OU 2.

5.3.1.6 Inorganics

Table 5-3D presents the summary of inorganics detected in Phase II OU 2 groundwater samples and Table 5-3E the frequency of detections along with minimum and maximum concentrations detected. Nineteen inorganics were detected in monitoring well samples at OU 2. Inorganics were detected in all 48 groundwater samples. Several of these metals (calcium, magnesium, potassium, and sodium) are considered essential nutrients and not potential contaminants, and will not be discussed further. Total (unfiltered) and dissolved (filtered) groundwater samples were collected for inorganic analyses. Filtered samples were collected due to the high turbidities encountered during groundwater sampling activities despite the use of low-flow purging techniques. The metals detected, excluding the nutrients, were manganese (40 total and 40 dissolved detections), iron (39 total and 26 dissolved detections), aluminum (36 total and 18 dissolved detections), lead (26 total and 6 dissolved detections), vanadium (20 total and 2 dissolved detections), zinc (20 total and 20 dissolved detections), barium (19 total and 14 dissolved detections), copper (17 total and 3 dissolved detections), arsenic (4 total and one dissolved detections), nickel (3 total and no dissolved detections), selenium (3 total and one dissolved detections), silver (no total and one dissolved detection), and mercury (one total and no dissolved detections).

Nine inorganics were detected above the screening criteria in the monitoring well samples. The screening criteria for inorganics consist of a set of values compiled from the GCTLs and NTC Orlando background screening values developed by ABB-ES (1995). For aluminum, iron, and thallium the NTC Orlando background screening value is used as the screening criterion because the background value is higher than the GCTL; for all other organics the GCTL is used as the screening criterion. The exceedances occurred in the shallow, intermediate, and Hawthorn monitoring wells and are presented in Figures 5-3C, 5-3D, and 5-3E, respectively. Groundwater samples from wells MW05A, MW12A, and MW17A did not have any inorganic detections above screening criteria.

Three groundwater samples from wells at OU 2 (MW04B, MW06B, and MW08B) had seven metals that exceeded screening criteria. Three groundwater samples from wells at OU 2 (MW03B, MW22B, and MW23C) had six metals that exceeded screening criteria. Six groundwater samples from OU 2 wells (MW03A, MW05B, MW07A, MW08A, MW11A, and MW26C) had five metals that exceeded screening criteria. The remaining groundwater samples from OU 2 had four or less inorganic detections that exceeded screening criteria.

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8TH EXPRESS STREET

OLD-OU2-01A
ALUMINUM 4520J
ALUMINUM (D) 5340J
IRON 1400J
IRON (D) 1290J
VANADIUM 52.2J
GROSS ALPHA 27.9 pCi/L

OLD-OU2-02A
ALUMINUM 57400J
ALUMINUM (D) 2080J
IRON 7300J
LEAD 24.3J
VANADIUM 110J

DUPLICATE
ALUMINUM 46200J
IRON 6610J
LEAD 18.3J
VANADIUM 91.7J

OLD-OU2-03A
ALUMINUM 39000J
IRON 26400J
IRON (D) 19000J
LEAD 36.2J
MANGANESE 194J
MANGANESE (D) 176J
VANADIUM 103J

OLD-OU2-04A
ALUMINUM 100000J
ALUMINUM (D) 4250J
IRON 10500J
LEAD 76.5J
VANADIUM 154J

DUPLICATE
ALUMINUM 39600J
IRON 2850J
LEAD 45.3J
VANADIUM 31.4

OLD-OU2-05A
ALUMINUM 56500J
IRON 5450J
LEAD 59.3J
MANGANESE 66.3J
MANGANESE (D) 61.6J
VANADIUM 59.9J
GROSS ALPHA 27.0 pCi/L

OLD-OU2-06A
ALUMINUM 35000J
ALUMINUM (D) 5100J
IRON 6640J
LEAD 60.3J
VANADIUM 79.6J
GROSS ALPHA 36.9 pCi/L

OLD-OU2-07A
ALUMINUM 68300J
BARIUM (D) 5150J
IRON 4850J
LEAD 64.5J
VANADIUM 89.4J

OLD-OU2-08A
ALUMINUM 56500J
IRON 5450J
LEAD 59.3J
MANGANESE 66.3J
MANGANESE (D) 61.6J
VANADIUM 59.9J
GROSS ALPHA 27.0 pCi/L

OLD-OU2-09A
ALUMINUM 33700J
LEAD 28.0J
GROSS ALPHA 28.9 pCi/L

OLD-OU2-10A

OLD-OU2-11A
ALUMINUM 123000J
ALUMINUM (D) 18300J
CHROMIUM 160J
IRON 10900J
IRON (D) 3990J
LEAD 158J
VANADIUM 214J
GROSS ALPHA 50.4 pCi/L

DUPLICATE
ALUMINUM 126000J
ALUMINUM (D) 25400J
CHROMIUM 163J
IRON 11600J
IRON (D) 4480J
LEAD 164J
LEAD (D) 21.7J
VANADIUM 236J
GROSS ALPHA 39.8 pCi/L

OLD-OU2-12A

OLD-OU2-13A
ALUMINUM 1360J

OLD-OU2-14A
ALUMINUM 94100J
IRON 11600J
LEAD 70.7J
VANADIUM 110J

OLD-OU2-15A
IRON 1300J

OLD-OU2-16A
ALUMINUM 4140J
ALUMINUM (D) 4700J
IRON (D) 1310J

OLD-OU2-17A

OLD-OU2-18A
ALUMINUM 28900J
IRON 4660J
LEAD 30.9J

OLD-OU2-19A

OLD-OU2-20A
ALUMINUM 16400J
IRON 1740J
LEAD 24.5

OLD-OU2-21A
ALUMINUM 2670J
GROSS ALPHA 17.3 pCi/L

OLD-OU2-22A
ALUMINUM 2890J
ALUMINUM (D) 13700J
LEAD (D) 47.8J
GROSS ALPHA 100 pCi/L

AREA 1
AREA 2
AREA 3
TANK FARM AREA
DRIVING RANGE
POND
SWAMP/ WOODS
MARSH
WOODS
NO. 1
NO. 2
NO. 3
NO. 5
NO. 6
NO. 8
NO. 9
BOGGY CREEK ROAD
RADEPORT DRIVE
LAKE GILLOOLY

LEGEND

SHALLOW MONITORING WELL

WELL DESIGNATION
ANALYTE
DISSOLVED
CONCENTRATION [1,2]
J QUALIFIER INDICATES ESTIMATED VALUE

OLD-OU2-20A
ALUMINUM 16400J
IRON 1740J
IRON (D) 686J
LEAD 24.5

1 - CONCENTRATION IN MICROGRAMS PER LITER (µg/L) - UNLESS OTHERWISE SHOWN
2 - CONCENTRATION IN PICOCURIES PER LITER (pCi/L) - WHERE SHOWN

FIGURE 5-3C

GROUNDWATER PHASE II
SHALLOW WELLS
INORGANICS ABOVE SCREENING CRITERIA
McCOY ANNEX LANDFILL
REMEDIAL INVESTIGATION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

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300 0 300
SCALE IN FEET

5-103

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8TH EXPRESS STREET

POND

NO. 9

SWAMP/ WOODS

AREA 1

DRIVING RANGE

TANK FARM AREA

OLD-OU2-01B
CADMIUM (D) 71.8J
IRON 2830J
IRON (D) 3020J
GROSS ALPHA 49.0 pCi/L

OLD-OU2-02B
ALUMINUM 44000J
IRON 9360J
IRON (D) 3690J
LEAD 44.0J
VANADIUM 114J
GROSS ALPHA 95.5 pCi/L

OLD-OU2-03B
ALUMINUM 83700J
ALUMINUM (D) 24.30J
CHROMIUM 147J
IRON 16000J
IRON (D) 7410J
LEAD 76.0J
MANGANESE 54.1J
MANGANESE (D) 73.5J
VANADIUM 222J
GROSS ALPHA 40.3 pCi/L

NO. 8

OLD-OU2-22B
ALUMINUM 46100J
CHROMIUM 107J
IRON 11900J
LEAD 50.1J
MANGANESE 51.1J
VANADIUM 133J
GROSS ALPHA 171 pCi/L

OLD-OU2-05B
ALUMINUM 74400J
IRON 7920J
LEAD 93.9J
SELENIUM 55.3J
VANADIUM 79.9J
GROSS ALPHA 26.2 pCi/L

DUPLICATE
ALUMINUM 22400J
BARIUM 3700J
LEAD 25.6J
GROSS ALPHA 26.1 pCi/L

OLD-OU2-04B
ALUMINUM 227000J
ALUMINUM (D) 52600J
BARIUM 3240J
CHROMIUM 280J
IRON 20000J
IRON (D) 7340J
LEAD 182J
LEAD (D) 42.4
MANGANESE 65.6J
MANGANESE (D) 56.0J
VANADIUM 330J
VANADIUM (D) 91.5J
GROSS ALPHA 120 pCi/L
GROSS BETA 71.9 pCi/L

OLD-OU2-09B
ALUMINUM 6220J
IRON 4680J

DUPLICATE
ALUMINUM 5190J
IRON 4130J

NO. 6

NO. 5

MARSH

NO. 1

OLD-OU2-08B
ALUMINUM 171000J
BARIUM 3400J
CHROMIUM 266J
IRON 17500J
LEAD 237J
MANGANESE 66.5J
VANADIUM 220J
GROSS ALPHA 64.4 pCi/L

AREA 2

NO. 3

NO. 4

OLD-OU2-11B
ALUMINUM 32100J
ALUMINUM (D) 5140J
IRON 3780J
LEAD 37.0J
GROSS ALPHA 21.8 pCi/L

OLD-OU2-07B
ALUMINUM 15400J
LEAD 17.6J
GROSS ALPHA 33.5 pCi/L

NO. 2

OLD-OU2-06B
ALUMINUM 152000J
ALUMINUM (D) 129000J
BARIUM 3910J
BARIUM (D) 3270J
CHROMIUM 223J
CHROMIUM (D) 187J
IRON 18900J
IRON (D) 12000J
LEAD 197J
LEAD (D) 165J
MANGANESE 64.5J
VANADIUM 191J
VANADIUM (D) 162J
GROSS ALPHA 221 pCi/L
GROSS BETA 192 pCi/L

OLD-OU2-21B
IRON 2680J
IRON (D) 2180J
GROSS ALPHA 70.8 pCi/L

WOODS

OLD-OU2-13B
IRON 1900J
IRON (D) 1880J
GROSS ALPHA 17.7 pCi/L

OLD-OU2-10B
IRON 1670J
IRON (D) 1440J

OLD-OU2-12B
ALUMINUM 8290J
CHROMIUM 29.0J
IRON 4490J
IRON (D) 3850J
MANGANESE 53.0J
MANGANESE (D) 50.6J

AREA 3

OLD-OU2-14B
ALUMINUM 52300J
ALUMINUM (D) 2460J
IRON 7140J
LEAD 48.9J
VANADIUM 73.6J
GROSS ALPHA 68.0 pCi/L

WOODS

OLD-OU2-15B
ALUMINUM 14000J
IRON 3000J
IRON (D) 1560J
LEAD 25.4J
GROSS ALPHA 19.5 pCi/L

OLD-OU2-17B
ALUMINUM 17800J
IRON 4670J
IRON (D) 2070J
LEAD 35.8J
GROSS ALPHA 17.2 pCi/L

OLD-OU2-18B
ALUMINUM 5530J

OLD-OU2-16B
ALUMINUM (D) 1290J
IRON 1960J
IRON (D) 2190J

OLD-OU2-20B
IRON 3170J
IRON (D) 3530J
MANGANESE 60.6J
MANGANESE (D) 69.2J
GROSS ALPHA 28.5 pCi/L

WOODS

OLD-OU2-19B
ALUMINUM 26900J
ALUMINUM (D) 2940J
IRON 6770J
IRON (D) 2870J
LEAD 37.8J
VANADIUM 55.3J
GROSS ALPHA 34.7 pCi/L

BOGGY CREEK ROAD

TRADEPORT DRIVE

LAKE GILLOOLY

LEGEND

INTERMEDIATE MONITORING WELL

WELL DESIGNATION — OLD-OU2-16B

ALUMINUM (D) 1290J
IRON 1960J
IRON (D) 2190J

J QUALIFIER INDICATES ESTIMATED VALUE

ANALYTE

DISSOLVED

CONCENTRATION [1,2]

1 - CONCENTRATION IN MICROGRAMS PER LITER (ug/L) - UNLESS OTHERWISE SHOWN
2 - CONCENTRATION IN PICOCURIES PER LITER (pCi/L) - WHERE SHOWN

-N-

300 0 300
SCALE IN FEET

5-105

CTO 0024

FIGURE 5-3D

GROUNDWATER PHASE II
INTERMEDIATE WELLS
INORGANICS ABOVE SCREENING CRITERIA
McCOY ANNEX LANDFILL
REMEDIAL INVESTIGATION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Rev. 2
03/07/01

CAD FILE NO./DATE: 7457F013.dgn/3-6-00

t18x24cv.dgn

R4712981

8TH EXPRESS STREET

POND

SWAMP/ WOODS

NO. 9

AREA 1

DRIVING RANGE

TANK FARM AREA

POND

SWAMP/ WOODS

NO. 8

POND

OLD-OU2-23C

ALUMINUM	61200J
ALUMINUM (D)	16000J
CHROMIUM	203J
IRON	64000J
IRON (D)	22900J
LEAD	71.5J
LEAD (D)	32.6J
MANGANESE	734J
MANGANESE (D)	345J
VANADIUM	127J
GROSS ALPHA	25.0 pCi/L

OLD-OU2-23C

POND

SWAMP/ WOODS

POND

NO. 6

NO. 5

MARSH

POND

NO. 4

NO. 3

AREA 2

NO. 7

NO. 1

OLD-OU2-24C

ALUMINUM	9970J
ALUMINUM (D)	6450J
IRON	7930J
IRON (D)	5960J
MANGANESE	118J
MANGANESE (D)	94.8J

POND

NO. 2

POND

WOODS

AREA 3

WOODS

OLD-OU2-26C

ALUMINUM	20600J
ALUMINUM (D)	11900J
IRON	29700J
IRON (D)	16800J
LEAD	35.5J
MANGANESE	386J
MANGANESE (D)	197J
VANADIUM	62.5J

OLD-OU2-26C

OLD-OU2-25C

OLD-OU2-25C

ALUMINUM	3120J
ALUMINUM (D)	2780J
IRON	3120J
IRON (D)	2840J
MANGANESE	139J
MANGANESE (D)	142J

WOODS

BOGGY CREEK ROAD

TRADEPORT DRIVE

LAKE GILLOOLY

LEGEND

DEEP MONITORING WELL

WELL DESIGNATION — OLD-OU2-25C

ALUMINUM	3120J
ALUMINUM (D)	2780J
IRON	3120J
IRON (D)	2840J
MANGANESE	139J
MANGANESE (D)	142J

J QUALIFIER INDICATES ESTIMATED VALUE

ANALYTE

DISSOLVED

CONCENTRATION [1,2]

1 - CONCENTRATION IN MICROGRAMS PER LITER (ug/L) - UNLESS OTHERWISE SHOWN
2 - CONCENTRATION IN PICOCURIES PER LITER (pCi/L) - WHERE SHOWN

N

300 0 300
SCALE IN FEET

FIGURE 5-3E

GROUNDWATER PHASE II
HAWTHORN WELLS
INORGANICS ABOVE SCREENING CRITERIA
McCOY ANNEX LANDFILL
REMEDIAL INVESTIGATION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Rev. 2
03/07/01

5-107

CTO 0024

CAD FILE NO./DATE: 7457F014.dgn/3-6-00

The data demonstrate differences in the occurrence and frequency of inorganics between the different aquifer layers and units. Also, there were significant differences in the concentrations of some inorganics between the unfiltered and filtered samples. The inorganics most frequently detected above the screening criteria (aluminum, lead, iron, manganese, and vanadium) were detected in all aquifer layers and units. It was noted, however, that the frequency of exceedance was greatly reduced in the filtered samples for the shallow and intermediate well samples (i.e., both in the surficial aquifer). In the deep well samples the frequency of exceedance did not change between the unfiltered and filtered samples. This indicates that suspended particles or colloids in the shallow and intermediate well samples may have adversely affected the concentrations of some inorganic species.

Of the nine inorganics referenced above that were detected above the screening criteria in the monitoring well samples, some were detected relatively infrequently above these criteria. Cadmium and selenium were not detected in the shallow or deep wells above the criteria and were detected only once above the criteria in the intermediate wells. Chromium was detected above the criterion only once each in the shallow and deep wells, but it was detected in five samples above the criterion in the intermediate wells. Barium was detected once in the shallow wells but not at all in the deep wells above the criterion; however, it was detected above the criterion in four samples from intermediate wells.

Overall, the largest variety of inorganics and highest frequency of detection above the screening criteria occurred in the intermediate well samples (i.e., the bottom of the surficial aquifer unit). The lower portion of the surficial aquifer appears to be the interval with the most significant impact from inorganic contaminants. These findings are consistent with records indicating that the buried landfill wastes extend below the water table (up to about 10 feet based on a 15-foot burial trench depth) and the hydrogeologic data that suggest a slight downward gradient in the surficial aquifer.

5.3.1.7 Radiological

Gross alpha and gross beta were detected in all 48 monitoring well samples at OU 2 (see Table 5-3D). Gross alpha ranged from 2.4 pCi/L (MW25C) to 221 pCi/L (MW06B). Gross alpha exceeded the GCTL of 15 pCi/L in 25 well samples from OU 2. Eight of the groundwater samples were from shallow wells screened across the water table (Figure 5-3C), 16 samples were from intermediate wells screened at the bottom of the surficial aquifer (Figure 5-3D), and one sample was from a deep well (MW23C) screened within the Hawthorn Group (Figure 5-3E). Gross beta exceeded the screening criterion of 50 pCi/L in two wells (MW04B and MW06B) screened at the bottom of the surficial aquifer (Figure 5-3D).

Because of the widespread detection of gross alpha and gross beta above the groundwater screening levels, two well samples were selected for isotopic analyses to investigate the presence of naturally occurring radioactive isotopes. The samples analyzed were from shallow well MW22A, considered to be an upgradient, background location, and intermediate well MW6B, a downgradient location where the highest gross alpha and gross beta detections were observed. The results of the isotopic analyses are presented in Table 5-3F. The concentrations of radium isotopes detected in each sample exceed the screening criterion of 5 pCi/L. The data indicate that the uranium isotopes are present in concentrations that, when corrected for specific activity, are consistent with the expected ratios for these naturally occurring isotopes. The gross alpha and gross beta detected in groundwater are attributed to the presence of uranium and radium isotopes, both of which occur naturally in groundwater. Furthermore, the surficial aquifer is composed, at least in part, of reworked sediments of the Hawthorn Group that is widely known to contain phosphate minerals. Phosphate deposits are typically accompanied by elevated concentrations of naturally occurring radioactive material such as the uranium series and the thorium series. Therefore, the high turbidity of the samples and the relative abundance of phosphates in the Hawthorn Formation are considered to be the primary sources of the widespread, elevated concentrations of gross alpha and gross beta in the groundwater samples.

5.3.1.8 General Groundwater Chemistry

General groundwater chemistry data were collected from shallow, intermediate, and deep monitoring wells at OU 2 (Table 5-3G). These data serve as a baseline in determining if future consideration is given to natural attenuation as a potential remedial alternative at OU 2.

5.3.1.9 Phase I and Phase II Summary

Chemicals detected in monitoring well samples from OU 2 include 19 VOCs, 9 SVOCs, TPH, 19 metals, gross alpha, and gross beta. There were no PCB, pesticide, or herbicide compounds detected in groundwater samples from OU 2 monitoring wells. The nature of the release of chemicals at OU 2 is consistent with the known past waste disposal practices at the landfill.

Eight VOCs (1,1,2,2-tetrachloroethane, benzene, bromodichloromethane, chloroform, PCE, TCE, vinyl chloride, and xylenes) detected in eight monitoring well samples from OU 2 exceeded GCTLs. Figure 5-3B presents the distribution of these compounds. Two SVOCs (naphthalene and 3&4-methylphenol) exceeded the GCTLs at one location each.

TABLE 5-3F

GROUNDWATER PHASE II - ISOTOPIC ANALYSES
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Sample Location	MW06B	MW22A
Date Sampled	8/1/98	7/30/98
Radiological (pCi/L)		
Radium 226	147	128
Radium -228	22.6	33.6
Thorium-228	1.4	
Thorium-230	1.6	2.1
Thorium-232		
Uranium-234	88.2	31.7
Uranium-235	3.1	1.4
Uranium-238	51.2	20.4

pCi/L picocuries per liter
No entry indicates analyte not detected.

TABLE 5-3G

GROUNDWATER PHASE II - GENERAL GROUNDWATER CHEMISTRY
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Parameter	Units	MW01A	MW02A	MW02A-D	MW03A	MW04A	MW04A-D
Alkalinity	mg/L	7	29	15.5	8	5 U	5 U
Biochemical Oxygen Demand (5 day, Total)	mg/L	8.5 U	4.8	2.2	4.4	2 U	80
Carbon Dioxide (CO_2)*	mg/L	250	60	NA	330	15	NA
Chemical Oxygen Demand	mg/L	20 U	20 UJ	20 U	20 UJ	40	1
Chloride	mg/L	18	8	7.5	60	4 U	1 U
Dissolved Oxygen*	mg/L	1.8	0.4	NA	0.01	1.9	NA
Hardness, as $CaCO_3$	mg/L	26	29	28.7	146	32	35
Hydrogen Sulfide (H_2S)*	mg/L	0.5	0.01	NA	0.5	0.1	NA
Iron (Fe^{+2})*	mg/L	1.8	2.8	NA	5.2	4.2	NA
Methane	ug/L	50 U	617	799	1310	50 U	50 U
Nitrate, as Nitrogen	mg/L	0.21 U	0.11 U	0.11 U	0.11 U	0.58	0.62
Nitrate/Nitrite, as N	mg/L	0.2 U	0.1 U	0.1 U	0.1 U	0.61 J	0.62 J
Nitrite, as Nitrogen	mg/L	0.01 U	0.01 U	0.01 U	0.01 U	0.027	0.01 U
Orthophosphate	mg/L	0.1 U	0.1 U	0.13	0.1 U	0.1 U	0.1 U
Oxidation Reduction Potential[(a)]	mV	15.4	11.2	11.2	-59	46	46
pH	pH units	5.4	5.7	5.8	5.6	4.7	4.9
Plate Count, Total	CFU/mL[(c)]	30400	13000	6600	73900	20300	97200
Redox Potential vs. H_2	mV	466	308	288	310	398	418
Sulfate	mg/L	15.6	90	32	20 U	519 U	100 U
Total Dissolved Solids	mg/L	14000	110	404	1090	932	1200
Total Organic Carbon	mg/L	8.7	14.6	12.9	77.2	47.6	41
Total Suspended Solids	mg/L	1460	194	84	724	596	458
TPH (C8-C40)	mg/L	0.5 U	0.5 U	0.5 U	1.16	0.5 U	0.5 U
Turbidity*	NTU	980	345	345	59	1262	1262

TABLE 5-3G

GROUNDWATER PHASE II - GENERAL GROUNDWATER CHEMISTRY
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Parameter	Units	MW05A	MW06A	MW07A	MW08A	MW09A	MW10A
Alkalinity	mg/L	5 U	25	8	18	23.2	6
Biochemical Oxygen Demand (5 day, Total)	mg/L	5 U	5.3	4	6	27 U	25 U
Carbon Dioxide (CO_2)*	mg/L	176	130	NA	220	NA	110
Chemical Oxygen Demand	mg/L	20 UJ	60	20 UJ	25	64.4	99
Chloride	mg/L	50.5 U	60.5	5 U	52.4 U	128	9
Dissolved Oxygen*	mg/L	0.88	0.6	0.3 [(a)]	0.38	(b)	1.32
Hardness, as $CaCO_3$	mg/L	50.5	90.4	27	151	123	22.5
Hydrogen Sulfide (H_2S)*	mg/L	0.1	0.1	0.3	0.7	NA	0.3
Iron (Fe^{+2})*	mg/L	2	3	1.2	3.2	0.8	1.5
Methane	ug/L	50 U	349	50 U	740	50 U	58
Nitrate, as Nitrogen	mg/L	0.38	0.32 U	1.7	0.11 U	0.84	0.3
Nitrate/Nitrite, as N	mg/L	0.38	0.32 U	1.7	0.1 U	0.84	0.3
Nitrite, as Nitrogen	mg/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Orthophosphate	mg/L	0.1 U	0.11	0.11	0.1 U	0.1 U	0.1 U
Oxidation Reduction Potential[(a)]	mV	78.3	94	8.9	-8.8	65.5	-61
pH	pH units	4.8	5.1	5	5.2	5.9	4.8
Plate Count, Total	CFU/mL[(c)]	2600	15800	1110	8300	29000	24100
Redox Potential vs. H_2	mV	219	392	162	138	396	346
Sulfate	mg/L	18 U	37.6	100 U	60 U	199 U	1360
Total Dissolved Solids	mg/L	126	1330	476	428	58	52
Total Organic Carbon	mg/L	9	72.9	13.5	45	11.3	12.7
Total Suspended Solids	mg/L	11	137	1360	468	822	214
TPH (C8-C40)	mg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Turbidity*	NTU	59	796	1876	1921	1005	345

TABLE 5-3G

GROUNDWATER PHASE II - GENERAL GROUNDWATER CHEMISTRY
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Parameter	Units	MW11A	MW11A-D	MW12A	MW13A	MW14A	MW15A
Alkalinity	mg/L	21	14	42	15.2	32.5	26.9
Biochemical Oxygen Demand (5 day, Total)	mg/L	4.8 U	5 U	5 U	25 U	39	4.6 U
Carbon Dioxide (CO_2)*	mg/L	NA	NA	105.6	112	104	113.4
Chemical Oxygen Demand	mg/L	30	27 J	20 UJ	99	53	20 U
Chloride	mg/L	40	15	15	35	21.5	77
Dissolved Oxygen*	mg/L	4.7 [(a)]	4.7 [(a)]	2.4	0.74	11.1 [(a)]	0.98
Hardness, as $CaCO_3$	mg/L	59.9	72.7	4 U	12.5	48.8	44.2
Hydrogen Sulfide (H_2S)*	mg/L	0.7	NA	0	0.1	0.3	0.3
Iron (Fe^{+2})*	mg/L	1.8	NA	1.4	0	2.2	1.5
Methane	ug/L	88.9	71.7	50 U	50 U	54.9	50 U
Nitrate, as Nitrogen	mg/L	0.11 U	0.11 U	0.11 U	0.21 U	0.11 U	0.21 U
Nitrate/Nitrite, as N	mg/L	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	0.2 U
Nitrite, as Nitrogen	mg/L	0.013	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Orthophosphate	mg/L	0.1 U	0.1 U	0.1 U	0.4	0.1 U	0.1 U
Oxidation Reduction Potential[(a)]	mV	28.4	28.4	105.9	90	97.8	-27.1
pH	pH units	4.9	4.9	4.6	5	4.8	6.1
Plate Count, Total	CFU/mL[(c)]	30000	30800	4200	10200	2070	19200
Redox Potential vs. H_2	mV	383	366	254	415	237	424
Sulfate	mg/L	141	148	16.1	16	37.9	29.4
Total Dissolved Solids	mg/L	3720	3040	77	97	82	170
Total Organic Carbon	mg/L	13.4	16.5	4.5	26.7	50.6	32.2
Total Suspended Solids	mg/L	628	315	10	77	1170	760
TPH (C8-C40)	mg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Turbidity*	NTU	1606	1606	4	140	39	1888

TABLE 5-3G

GROUNDWATER PHASE II - GENERAL GROUNDWATER CHEMISTRY
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Parameter	Units	MW16A	MW17A	MW18A	MW19A	MW20A	MW21A
Alkalinity	mg/L	81.6	50.7	17	5 U	9	5 U
Biochemical Oxygen Demand (5 day, Total)	mg/L	8	4.3	10 U	6.1	15	23 U
Carbon Dioxide (CO_2)*	mg/L	106	106	192	12	110	140
Chemical Oxygen Demand	mg/L	24.8	79.4	31	20 U	20 U	20 U
Chloride	mg/L	27	77	4.5 U	48	14	7
Dissolved Oxygen*	mg/L	1.14	NA	10.4 [(a)]	(b)	0.1	0.5
Hardness, as $CaCO_3$	mg/L	14.3	69.1	21.7	15.6	19.9	17.3
Hydrogen Sulfide (H_2S)*	mg/L	0.1	NA	0	2.3	5	4.5
Iron (Fe^{+2})*	mg/L	1.4	NA	2.8	3.2	3.8	2.8
Methane	ug/L	50 U	50 UR	50 U	50 UR	50 U	50 U
Nitrate, as Nitrogen	mg/L	1.5	0.21 U	0.25 U	0.35	0.22	0.21 U
Nitrate/Nitrite, as N	mg/L	1.5	0.2 U	0.26 U	0.35	0.22	0.2 U
Nitrite, as Nitrogen	mg/L	0.01 U	0.01 U	0.01	0.01 U	0.01 U	0.01 U
Orthophosphate	mg/L	0.1 U	0.1 U	0.29	0.1 U	0.12	0.1 U
Oxidation Reduction Potential[(a)]	mV	117.2	NA	124.1	-11.5	-60.4	35.6
pH	pH units	4.9	5.8	4.8	4.8	5.6	5.1
Plate Count, Total	CFU/mL[(c)]	31400	9760	38600	7920	32500	1170
Redox Potential vs. H_2	mV	546	433	414	600	462	389
Sulfate	mg/L	36.7	10 U	20 U	10 U	10 U	10.7
Total Dissolved Solids	mg/L	170	269	546	70	80	630
Total Organic Carbon	mg/L	9	48.8	8.4	5.8	4.7	2
Total Suspended Solids	mg/L	172	31	292	57	840	88
TPH (C8-C40)	mg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Turbidity*	NTU	1881	119	1095	1402	911	9

TABLE 5-3G

GROUNDWATER PHASE II - GENERAL GROUNDWATER CHEMISTRY
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Parameter	Units	MW22A	MW01B	MW02B	MW03B	MW04B	MW05B
Alkalinity	mg/L	7	22.9	31	11	187	11
Biochemical Oxygen Demand (5 day, Total)	mg/L	35	25 U	2.3	3.8	4.4	30.5
Carbon Dioxide (CO_2)*	mg/L	110	92.6	108	266	0.8	164
Chemical Oxygen Demand	mg/L	20 U	74.3	25	46 J	176	102 J
Chloride	mg/L	2 UJ	24	3.4 U	21	2 U	13.5 U
Dissolved Oxygen*	mg/L	0.9	1.3	0.01	0.7	0.01	1.18
Hardness, as $CaCO_3$	mg/L	88.8	55.2	96.1	145	143	71.6
Hydrogen Sulfide (H_2S)*	mg/L	0	0.1	0.6	0.3	22.2	1
Iron (Fe^{+2})*	mg/L	1.6	3.4	2.4	1.0	0.6	2.4
Methane	ug/L	766	210	233	186	372	715
Nitrate, as Nitrogen	mg/L	0.17	0.21 U	0.11 U	0.11 U	0.2 U	0.16
Nitrate/Nitrite, as N	mg/L	0.17 J	0.2 U	0.1 U	0.1 U	0.11 J	0.16 J
Nitrite, as Nitrogen	mg/L	0.01 U	0.01 U	0.01 U	0.01 U	0.1 U	0.01 U
Orthophosphate	mg/L	0.22	1.9	0.37	0.36	0.48	0.1 U
Oxidation Reduction Potential[a]	mV	46.2	33.7	-41	-48	-103	2.5
pH	pH units	4.9	5.7	5.9	5.9	6.3	5.2
Plate Count, Total	CFU/mL[c]	116000	26200	13600	4300	11300	38700
Redox Potential vs. H_2	mV	413	370	149	285	247	162
Sulfate	mg/L	373 U	1150	46.1	14	195 U	10 U
Total Dissolved Solids	mg/L	4830	813	1500	562	4380	516
Total Organic Carbon	mg/L	298	5.2	31.4	77.1	522	62.4
Total Suspended Solids	mg/L	3570	848	692	1030	6140	618
TPH (C8-C40)	mg/L	0.5 U	0.5 U	0.5 U	0.676	0.5 UJ	0.5 U
Turbidity*	NTU	1782	885	1260	777	1866	221

TABLE 5-3G

GROUNDWATER PHASE II - GENERAL GROUNDWATER CHEMISTRY
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Parameter	Units	MW05B-D	MW06B	MW07B	MW08B	MW09B	MW09B-D
Alkalinity	mg/L	8	14	11	40	17.2	18.2
Biochemical Oxygen Demand (5 day, Total)	mg/L	31.5	41.2	35.5	8.4	27 U	114
Carbon Dioxide (CO_2)*	mg/L	NA	NA	94	144	10	NA
Chemical Oxygen Demand	mg/L	20 UJ	20 U	20 UJ	46 J	20 U	34.7
Chloride	mg/L	1.6 U	300 J	3 U	22.9 U	117	92
Dissolved Oxygen*	mg/L	1.18	0.5 [(a)]	0.04	1.84	3.4	NA
Hardness, as $CaCO_3$	mg/L	22.2	198	48.4	146	67.3	55.4
Hydrogen Sulfide (H_2S)*	mg/L	NA	2	0.7	2	0.7	NA
Iron (Fe^{+2})*	mg/L	NA	0.01	2	1	3.6	NA
Methane	ug/L	525	140	50 U	236	50 U	50 U
Nitrate, as Nitrogen	mg/L	0.14	0.2 U	0.14	0.11	0.11 U	0.16
Nitrate/Nitrite, as N	mg/L	0.14 J	0.1 U	0.14	0.11	0.1 U	0.16
Nitrite, as Nitrogen	mg/L	0.01 U	0.1 U	0.01 U	0.01 U	0.01 U	0.01 U
Orthophosphate	mg/L	0.13	2.5	0.39	0.1 U	0.11	0.18
Oxidation Reduction Potential[(a)]	mV	2.5	-275	-8.2	-72.3	-42	-42
pH	pH units	5.2	8.9	5	5.7	5.6	5.4
Plate Count, Total	CFU/mL[(c)]	14500	13700	2090	4000	2300	3800
Redox Potential vs. H_2	mV	132	92.6	127	102	160	161
Sulfate	mg/L	20 U	29.3	10 U	40 U	13 U	16 U
Total Dissolved Solids	mg/L	392	27900	146	940	219	214
Total Organic Carbon	mg/L	28.3	809	5.6	37.8	2.9	2.9
Total Suspended Solids	mg/L	1290	4930	350	10100	154	4 U
TPH (C8-C40)	mg/L	0.5 U	5 UR	0.5 U	0.5 U	0.5 U	0.5 U
Turbidity*	NTU	221	294	381	510	135	135

TABLE 5-3G

GROUNDWATER PHASE II - GENERAL GROUNDWATER CHEMISTRY
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Parameter	Units	MW10B	MW11B	MW12B	MW13B	MW14B	MW15B
Alkalinity	mg/L	62.6	12.5	8.5	36.4	5 U	16.9
Biochemical Oxygen Demand (5 day, Total)	mg/L	25 U	6.1	3.2	25 U	5 U	2 U
Carbon Dioxide (CO_2)*	mg/L	123.8	103.2	101.2	89.8	92	89.4
Chemical Oxygen Demand	mg/L	59.4	25 J	20 UJ	44.6	97 J	39.7
Chloride	mg/L	40	5.5	15.5	45	9.5	67
Dissolved Oxygen*	mg/L	(b)	0.1	4.1 [(a)]	9.1 [(a)]	3.7 [(a)]	(b)
Hardness, as $CaCO_3$	mg/L	67.9	63.9	72.4	37.2	131	70.9
Hydrogen Sulfide (H_2S)*	mg/L	0.7	2	0	0.5	0.7	5
Iron (Fe^{+2})*	mg/L	1.8	2.6	1.3	2	2.6	2.5
Methane	ug/L	200	1150	720	50 U	87.9	55
Nitrate, as Nitrogen	mg/L	0.21 U	0.11 U	0.11 U	0.21 U	0.11 U	0.21 U
Nitrate/Nitrite, as N	mg/L	0.2 U	0.1 U	0.1 U	0.2 U	0.1 U	0.2 U
Nitrite, as Nitrogen	mg/L	0.01 U	0.025	0.01 U	0.01 U	0.01 U	0.01 U
Orthophosphate	mg/L	0.1 U	4.3	0.58	5.4	0.32	0.22
Oxidation Reduction Potential[(a)]	mV	-68	-109.2	98.1	-35.2	4.1	-56
pH	pH units	5.8	6	5.5	5.8	5.9	5.7
Plate Count, Total	CFU/mL[(c)]	5500	30000	4000	2700	26000	48200
Redox Potential vs. H_2	mV	202	208	90.8	190	148	415
Sulfate	mg/L	37	113	17.8	43	163	10 U
Total Dissolved Solids	mg/L	104	372	144	129	286	94
Total Organic Carbon	mg/L	7.3	17.6	15.2	5.1	24.1	6.5
Total Suspended Solids	mg/L	313	737	155	221	1680	314
TPH (C8-C40)	mg/L	0.5 U	0.64	0.718	0.5 U	0.5 U	0.5 U
Turbidity*	NTU	510	850	8	358	1470	880

TABLE 5-3G

GROUNDWATER PHASE II - GENERAL GROUNDWATER CHEMISTRY
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Parameter	Units	MW16B	MW17B	MW18B	MW19B	MW20B	MW21B
Alkalinity	mg/L	61.7	18.9	14.5	18.9	61.7	60.7
Biochemical Oxygen Demand (5 day, Total)	mg/L	5 U	32	5 U	34.5	36	18.8
Carbon Dioxide (CO_2)*	mg/L	104.2	106.6	133	126	103.4	138.6
Chemical Oxygen Demand	mg/L	29.8	24.8	46 J	29.8	59.5	84.3
Chloride	mg/L	37	52	11	45	21	34
Dissolved Oxygen*	mg/L	(b)	0.44	0.1	(b)	1.06	0.9
Hardness, as $CaCO_3$	mg/L	59.2	74.7	40	70.4	99.4	39.2
Hydrogen Sulfide (H_2S)*	mg/L	2	2	5	2	0.3	5
Iron (Fe^{+2})*	mg/L	3	2	1.8	3.5	2.4	3
Methane	ug/L	180	50 UR	50 U	160	240	1300
Nitrate, as Nitrogen	mg/L	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U
Nitrate/Nitrite, as N	mg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Nitrite, as Nitrogen	mg/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Orthophosphate	mg/L	0.52	0.28	0.38	0.63	0.13	0.46
Oxidation Reduction Potential[(a)]	mV	-127.2	-51.3	-33.5	-30.8	-50.6	30.2
pH	pH units	6.2	5.5	5.4	5.6	6.1	6.4
Plate Count, Total	CFU/mL[(c)]	5320	6780	4400	9600	48200	12000
Redox Potential vs. H_2	mV	154	358	95.5	318	369	357
Sulfate	mg/L	10 U	10 U	10 U	10 U	43.7	12.1
Total Dissolved Solids	mg/L	190	154	134	252	210	3880
Total Organic Carbon	mg/L	8.7	8.6	7	15.1	40.8	16.3
Total Suspended Solids	mg/L	710	482	41	553	10000	1880
TPH (C8-C40)	mg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Turbidity*	NTU	1410	1360	36	1850	810	970

TABLE 5-3G

GROUNDWATER PHASE II - GENERAL GROUNDWATER CHEMISTRY
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Parameter	Units	MW22B	MW23C	MW24C	MW25C	MW26C
Alkalinity	mg/L	41	28.5	103	43	10.5
Biochemical Oxygen Demand (5 day, Total)	mg/L	5 U	4 U	16.8	6.6	2.5
Carbon Dioxide (CO_2)*	mg/L	166	110	152	85	74
Chemical Oxygen Demand	mg/L	20 UJ	20 UJ	27	21 J	94 J
Chloride	mg/L	3.5 U	1.5	16.5 U	1.5	2.5 U
Dissolved Oxygen*	mg/L	1.62	0.1	0.41	0.45	0.52
Hardness, as $CaCO_3$	mg/L	150	1120	110	261	898
Hydrogen Sulfide (H_2S)*	mg/L	1	0.1	6.5	0.6	2
Iron (Fe^{+2})*	mg/L	2.2	1.5	3.5	2	0.1
Methane	ug/L	168	71.2	124	113	155
Nitrate, as Nitrogen	mg/L	0.11 U	0.11 U	0.17	0.11 U	0.11 U
Nitrate/Nitrite, as N	mg/L	0.1 J	0.1 U	0.17 J	0.1 U	0.1 U
Nitrite, as Nitrogen	mg/L	0.01 U	0.018	0.01 U	0.01 U	0.01 U
Orthophosphate	mg/L	0.69	0.33	0.8	0.1 U	5.4
Oxidation Reduction Potential[(a)]	mV	-16.8	-48	-2.6	-50	-42
pH	pH units	5.6	7.5	6.4	7.2	7.1
Plate Count, Total	CFU/mL[(c)]	2900	0	28100	0	30000
Redox Potential vs. H_2	mV	157	231	256	243	246
Sulfate	mg/L	18 U	100 U	3010 U	54.9	30
Total Dissolved Solids	mg/L	112	536	197	441	595
Total Organic Carbon	mg/L	25.5	5.7	23.8	9	6.4
Total Suspended Solids	mg/L	1590	1900	63	122	335
TPH (C8-C40)	mg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Turbidity*	NTU	1881	152	1028	540	520

TABLE 5-3G

GROUNDWATER PHASE II - GENERAL GROUNDWATER CHEMISTRY
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

* Measurement acquired using field-test equipment (unless otherwise noted).

(a) Measurement acquired using flow-through cell.

(b) Value from flow-through cell out of reasonable range. No test kit value.

(c) Colony-forming units per milliliter.

NA - Not Analyzed.

Nine inorganic metals (aluminum, barium, cadmium, chromium, iron, lead, manganese, selenium, and vanadium) exceeded the screening criteria in groundwater at OU 2. The distribution of inorganic exceedances in the shallow, intermediate, and Hawthorn wells is presented in Figures 5-3C, 5-3D, and 5-3E, respectively. Gross alpha and gross beta were detected in all 48 groundwater samples. Gross alpha exceeded its screening criterion in 26 samples and gross beta in two groundwater samples. The distribution of gross beta and gross alpha exceedances above screening criteria are presented in Figures 5-3C, 5-3D, and 5-3E.

5.3.2 Phase III

Phase III groundwater sampling was conducted between late June and late September 1999. The initial round of sampling occurred between late June and early August; subsequently, wells with high turbidity were revisited during September when additional measures to reduce turbidity (i.e., redevelopment, insertion of microwells) were attempted. The sample from well MW14A was inadvertently not analyzed for inorganics; therefore, an additional sample for inorganic analysis only was collected at well MW14A in February 2000. The Phase III investigation was performed to address data gaps and uncertainties identified during the evaluation and interpretation of Phase I and Phase II monitoring well data. The scope and rationale for the investigation were discussed in Section 3.6.5.

5.3.2.1 Groundwater

Forty-six of the 48 groundwater monitoring wells at OU 2 were sampled during the Phase III investigation. Twenty-nine of the wells sampled are located on Navy property within the boundaries of OU 2; 17 of the wells sampled are "off-site" wells located on GOAA property that lies immediately east of OU 2. The off-site wells are separated from OU 2 by drainage canals that run approximately north to south along the eastern perimeter of OU 2. Wells MW5A and MW12A, both on-site shallow wells screened in the surficial aquifer, were not sampled because they did not contain concentrations of any chemicals above the screening criteria during the Phase II sampling. The wells sampled and the analyses performed were summarized in Table 3-1. The Phase III groundwater analytical results are presented in Tables 5-3H and 5-3I. Summary statistics for the results are presented in Table 5-3J. Discussion of the chemicals detected, their distribution, and interpretation of the results are presented in the following sections. Figure 5-3F shows the locations of all OU 2 monitoring wells and provides the groundwater concentrations of all chemicals that exceeded the screening criteria during the Phase III sampling event.

TABLE 5-3H

GROUNDWATER PHASE III - DETECTED ORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION	SCREENING	MW03A	MW03B	MW11B	MW12B	MW15B	MW18B	MW20A	MW21B	MW26C
DATE SAMPLED	CRITERIA [a]	7/29/99	7/29/99	9/22/99	7/29/99	7/27/99	7/16/99	7/21/99	7/27/99	8/2/99
Volatiles (µg/L)						NA				
Benzene	1		3.4 J	7.6	1.3					
Carbon disulfide	700				1.4			0.87 J		
Chlorobenzene	100		23	4				0.16 J		
Chloromethane	2.7							0.19 J		
Cis-1,2-dichloroethene	70			39	0.26 J		66 J			
Tetrachloroethene	3				5.1 J		34 J			
Toluene	40			1.2						
Trans-1,2-dichloroethene	100			12						
Trichloroethene	3			1.2	0.71 J		1200 J			
Vinyl chloride	1			16	0.64 J		20 J			
Xylenes, Total	20			11						
PAHs (µg/L)		NA	NA	NA	NA		NA	NA		NA
1-Methylnaphthalene	20					2.5				
2-Methylnaphthalene	20					3.7				
Naphthalene	20					13				
Semivolatiles (µg/L)		NA	NA	NA	NA		NA	NA		NA

NA Indicates not analyzed.
"J" qualifier on analytical data indicates an estimated value.
No entry indicates chemical not detected.
Only chemicals detected in at least one sample are listed.
The complete list of analytical results is presented in Appendix B of this report.
Shaded entry indicates chemical detected at a concentration that meets or exceeds screening criterion.
[a]State of Florida Groundwater Cleanup Target Levels, per Chapter 62-777, May 1999.

TABLE 5-3I

GROUNDWATER PHASE III - DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING	MW01A	MW01A-D	MW01B	MW01B-D	MW02A	MW02B	MW03A	MW03B	MW04A	MW04B
DATE SAMPLED	CRITERIA[b]	9/21/99	9/21/99	7/14/99	7/14/99	7/13/99	7/28/99	7/29/99	7/29/99	9/23/99	9/23/99
Inorganics (µg/L)											
Aluminum	4067[c]	19400 J	15100 J			981	608 J	467	965	105000 J	560000 J
Antimony	6										
Arsenic	50					2.9				5.6	27.1 J
Barium	2000	36.5 J	34.2 J				22.2	91.6	41.5	420 J	2270 J
Beryllium	4										10.3 J
Calcium	*	5740 J	12200 J	13200	13200	11700	17300 J	31700	41500	9580 J	44600 J
Chromium	100	18.6 J	15.3 J							81.2 J	449 J
Cobalt	420							5.2	2.4		39 J
Copper	1000	0.8						1.4	1.1	12.2	33.9 J
Iron	1227[c]	3330 J	2800 J	1470	1460	3760	3940	23700	15500	11000 J	52200 J
Lead	15	6.8 J	6.1 J							44.5 J	284 J
Magnesium	*	1320 J	1270 J	1300	1280	4200	3330	2850	8570	3140 J	15400 J
Manganese	50	7.1 J	6.3 J				12.1	616	38.3	39.1 J	164 J
Mercury	2									0.26	3.5
Nickel	100							16.8		50.6 J	288 J
Potassium	*	1580	1590				1340	895	2960	1720	20900
Selenium	50		3.5							11.7	31.8
Sodium	160000	6600	6770				19100	11500	34100	4850	29300
Thallium	3.8[c]										1.8
Vanadium	49	67.3 J	62.6 J					6.2	7.4	132 J	668 J
Zinc	5000							126		47.9 J	178 J
Radionuclides (pCi/L)											
gross Alpha	15	5.2	5.3	1.8	1.2		3.4		4.2	30.5	80.8
gross Beta[d]	50	4.2	3.7	2.7	3.1		4.6 J		4.7	14.3	52.8

TABLE 5-3I

GROUNDWATER PHASE III - DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING	MW05B	MW06A	MW06B	MW07A	MW07B	MW08A	MW08B	MW09A	MW09B	MW10A
DATE SAMPLED	CRITERIA[b]	7/13/99	7/29/99	9/22/99	9/22/99	7/20/99	9/23/99	7/15/99	7/16/99	7/16/99	6/27/99
Inorganics (µg/L)											
Aluminum	4067[c]	1070	2490	1110000 J	48700 J	1050	4500 J	507	754	1290	2300
Antimony	6										
Arsenic	50		6.9	121	3.5			2.7			2.6
Barium	2000	59.4	137	12400 J	161 J	20.3	52.5 J	17.7	35.2	27.8	
Beryllium	4			55.9 J							
Calcium	*		10600	179000 J	4600 J	3550	74700 J	4000	10500	16100	
Chromium	100			1490 J	38.5 J						
Cobalt	420		1.3								
Copper	1000			363	9.7						
Iron	1227[c]	1130	2990	127000 J	4290 J	696	327 J	1620 J	255 J	3340 J	
Lead	15			724 J	24.1 J						
Magnesium	*	1700	3910	57000 J	2360 J	677	4090 J	2530	4880	2990	
Manganese	50			368 J	11 J		11.8 J			7.3	
Mercury	2			5.6	0.13						
Nickel	100			188 J	15.5 J						
Potassium	*		15100	61500	1500	522	4060	1260	9130	1280	
Selenium	50			87.2							
Sodium	160000		78700	82000	6900	5570	15300	9900	60600	24400	
Thallium	3.8[c]			4.2							
Vanadium	49		22.2	1120 J	49.8 J		7.4 J		25.6		
Zinc	5000			224 J							
Radionuclides (pCi/L)											
gross Alpha	15	5.2	7	140		6	11.7	1.9	12.4		2
gross Beta[d]	50	4.7	21.8	79.9		5.2	15.4	2.8	12.25		4.9

TABLE 5-3I

GROUNDWATER PHASE III - DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING	MW10B	MW11A	MW11B	MW12B	MW13A	MW13B	MW14A	MW14B	MW15A	MW15B
DATE SAMPLED	CRITERIA[b]	6/27/99	7/31/99	9/22/99	7/29/99	6/26/99	6/26/99	2/15/00	7/15/99	7/27/99	7/27/99
Inorganics (µg/L)											
Aluminum	4067[c]		1740 J	21400 J	581	887	395		832	764 J	375 J
Antimony	6						2.4				
Arsenic	50		2.2								
Barium	2000		31.2	260 J	8.4	24.6			17.6	45.4	
Beryllium	4										
Calcium	*	16300	2780	24700 J	13100	11200	9410	3030	10500	3710 J	9090 J
Chromium	100			25.5 J							
Cobalt	420										
Copper	1000		1.7	6.7							
Iron	1227[c]	1590	1770	5290 J	2640		1210	1540 J	2520 J	422	868
Lead	15			12 J							
Magnesium	*	1630	2310	4320 J	1370		1540	2910	2110	1030	1380
Manganese	50			21 J	23.3				7.7		
Mercury	2										
Nickel	100		1.9								
Potassium	*		541 J	11400	1600	5620 J		634	1320	6700	1030
Selenium	50										
Sodium	160000		7330	22400	9110	24500 J			9500	40400	6110
Thallium	3.8[c]										
Vanadium	49			25.8 J	3.1						
Zinc	5000			1550 J							
Radionuclides (pCi/L)											
gross Alpha	15	0.6	1.5	9.7		14.1	0.5	3.9	1.5	7.2	0.5
gross Beta[d]	50	3.3	2.7	19		9.2	2.4	1.8	3.1	13.8 J	2.6 J

TABLE 5-3I

GROUNDWATER PHASE III - DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING	MW16A	MW16A-D	MW16B	MW17A	MW17B	MW18A	MW18B	MW19A	MW19B	MW20A
DATE SAMPLED	CRITERIA[b]	6/30/99	6/30/99	6/28/99	6/29/99	6/29/99	7/16/99	7/16/99	6/29/99	6/29/99	7/21/99
Inorganics (µg/L)											
Aluminum	4067[c]	912	862	4160	2500		527	565	847	466	251
Antimony	6			2.3	3				2.5		
Arsenic	50							5.2			
Barium	2000	30.7	29.9	76.3			103	26.3	24.2	23.5	
Beryllium	4										
Calcium	*			12400	26500	9850	5400	9350		13500	3170
Chromium	100			7.8							
Cobalt	420										
Copper	1000									5.4	
Iron	1227[c]	546	553	2380	333	886	215 J	1580 J	850	2190	544
Lead	15										
Magnesium	*	2210	2150	1480	8320	2330	1740	1520	2560	3020	1570
Manganese	50							3.6			
Mercury	2										
Nickel	100										
Potassium	*	9070 J	8800 J		10700 J		1100	1290			608
Selenium	50										
Sodium	160000	54100 J	52600 J		51700 J		2080	7490			6270
Thallium	3.8[c]										
Vanadium	49										37.1
Zinc	5000										
Radionuclides (pCi/L)											
gross Alpha	15	7.3	6.6	10.5	1.9	1			12.2	1.3	
gross Beta[d]	50	15.5	14.8	9.7	12.4	2.7			2.1	3.7	

TABLE 5-3I

GROUNDWATER PHASE III - DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING	MW20B	MW21A	MW21B	MW22A	MW22A-D	MW22B	MW23C	MW24C	MW25C	MW26C
DATE SAMPLED	CRITERIA[b]	7/21/99	7/27/99	7/27/99	9/23/99	9/23/99	7/30/99	8/1/99	8/2/99	8/2/99	8/2/99
Inorganics (ug/L)											
Aluminum	4067[c]	1100	307 J	347 J	798 J	925 J					
Antimony	6										
Arsenic	50				5.3	3.5				2.7	
Barium	2000	16.8			30 J	30.7 J	13	26.4	23.4	31.5	15.3
Beryllium	4										
Calcium	*	10500	851 J	12900 J	11200 J	10800 J	11600	75600	15300	98300	97100
Chromium	100							19.8			13.5
Cobalt	420										
Copper	1000										
Iron	1227[c]	1150	1140	2500	1740 J	1800 J	1750	1910	1920	3340	4670
Lead	15										
Magnesium	*	1140	1590	1730	3340 J	3370 J	1460	4140	2170	5240	5030
Manganese	50			6.5	5.7 J	5.8 J		56.2	26.6	98	46.4
Mercury	2										
Nickel	100							10.5	2.2	3.4	2
Potassium	*	1230		5360	1620	1650	1250	2630 J	3160 J	2360 J	
Selenium	50										
Sodium	160000	6990	2440	10300	13800	13900	11800	26600	10600	10300	12300
Thallium	3.8[c]										
Vanadium	49				20.6 J	21.4 J	3				
Zinc	5000	50.8			86.7 J	92.1 J					
Radionuclides (pCi/L)											
gross Alpha	15	3	2.4	0.4	5.7	4.6	1.5				
gross Beta[d]	50	5.5	0.9 J	4.8 J	5.3	3	2.5	4.1 J	4.4 J		

TABLE 5-3I

GROUNDWATER PHASE III – DETECTED INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

* Indicates that the criteria are not available.
"J" qualifier on analytical data indicates an estimated value.
No entry indicates chemical not detected.
Only chemicals detected in at least one sample are listed.
The complete list of analytical results is presented in Appendix B of this report.
Shaded entry indicates chemical detected at a concentration that meets or exceeds the screening criterion.
(a) "D" at the end of the ID indicates a duplicate sample.
(b) Groundwater Cleanup Target Level [Development of Soil Cleanup Target Levels (SCTLs) for Chapter 62-777, F.A.C., May 26, 1999].
(c) Background Screening Value Level (Background Sampling Report for NTC, Orlando, Florida; ABB Environmental Services, August 1995 for inorganics only, except as noted.
(d) The screening value of 50 pCi/L (40 CFR 141) is referenced because the activities for specific radionuclides in the samples have not been determined. These data are required for conversion to the 4 millirem/year federal and state reference level.

TABLE 5-3J

GROUNDWATER PHASE III - FREQUENCY OF DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Parameter	Minimum	Maximum	Number of Detections	Number of Exceedances
Volatile Organic Compounds (7[a]) (µg/L)				
Benzene	1.3	7.6	3	3
Carbon Disulfide	0.87	1.4	2	0
Chlorobenzene	0.16	23	3	0
Chloromethane	0.19	0.19	1	0
cis-1,2-dichloroethene	0.26	66	3	0
Tetrachloroethene	5.1	34	2	2
Toluene	1.2	1.2	1	0
Trans-1,2-dichloroethene	12	12	1	0
Trichloroethene	0.71	1200	3	1
Vinyl Chloride	0.64	20	3	2
Xylenes, Total	11	11	1	0
Semivolatile Organic Compounds (2[a]) (µg/L)				
Naphthalene	13	13	1	0
1-methylnaphthalene	2.5	2.5	1	0
2-methylnaphthalene	3.7	3.7	1	0
Inorganics (46[a]) (µg/L)				
Aluminum	251	1110000 / 4500	38 / 32	8 / 2
Antimony	2.3	3 / 3	4 / 4	0 / 0
Arsenic	2.2	121 / 6.9	12 / 8	1 / 0
Barium	8.4	12400 / 137	35 / 29	2 / 0
Beryllium	10.3	55.9 / ND	2 / 0	2 / 0
Calcium	851	179000 / 98300	42 / 36	NA / NA
Chromium	7.8	1490 / 19.8	9 / 3	2 / 0
Cobalt	1.3	39 / 5.2	4 / 3	0 / 0
Copper	0.8	363 / 5.4	10 / 4	0 / 0
Iron	215	127000 / 23700	44 / 38	29 / 23
Lead	1.9	724 / 1.9	7 / 1	4 / 0
Magnesium	677	57000 / 8570	44 / 38	NA / NA
Manganese	3.6	616 / 616	20 / 14	5 / 3
Mercury	0.13	5.6 / ND	4 / 0	2 / 0
Nickel	1.9	288 / 16.8	11 / 7	2 / 0
Potassium	364	61500 / 15100	34 / 28	NA / NA
Selenium	3.5	87.2 / ND	4 / 0	1 / 0
Sodium	2080	82000 / 78700	36 / 30	NA / NA
Thallium	1.8	4.2 / ND	2 / 0	1 / 0
Vanadium	3	1120 / 37.1	16 / 10	5 / 0
Zinc	48.9	1550 / 126	7 / 3	0 / 0
Radiological (36[a]) (pCi/L)				
Gross alpha	0.4	140 / 14.1	36 / 33	3 / 0
Gross beta	0.9	79.9 / 21.8	36 / 33	2 / 0

Exceedances are results that exceed the State of Florida Groundwater Cleanup Target Levels or the NTC Background Screening Value, whichever is greater (see Table 5-3I).
Not detected results not used in the analysis.
37 / 31 Shows count with/without six turbid samples included in data set.
ND - Not Detected
NA - Not Analyzed
Rejected values not included.
Table 4-1 and Section 4.3.3 provide details regarding rejected results.
[(a)] Number of samples analyzed (maximum of duplicate used).

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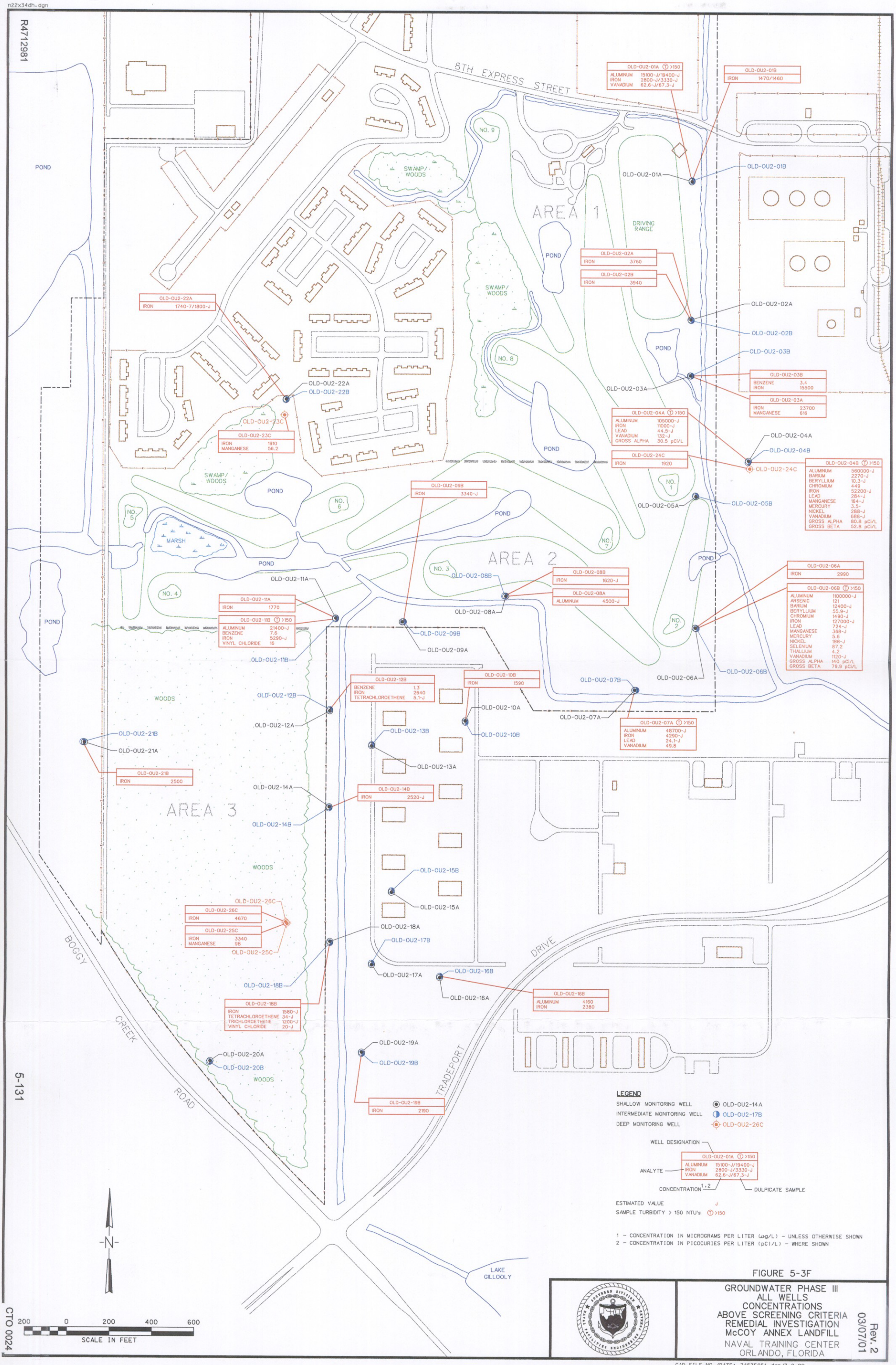

LEGEND

SHALLOW MONITORING WELL — OLD-OU2-14A

INTERMEDIATE MONITORING WELL — OLD-OU2-17B

DEEP MONITORING WELL — OLD-OU2-26C

WELL DESIGNATION

OLD-OU2-01A ⓣ >150
ALUMINUM 15100-J/19400-J
IRON 2800-J/3330-J
VANADIUM 62.6-J/67.3-J

ANALYTE

CONCENTRATION [1,2]

DULPICATE SAMPLE

ESTIMATED VALUE J

SAMPLE TURBIDITY > 150 NTU's ⓣ >150

1 - CONCENTRATION IN MICROGRAMS PER LITER (ug/L) - UNLESS OTHERWISE SHOWN
2 - CONCENTRATION IN PICOCURIES PER LITER (pCi/L) - WHERE SHOWN

FIGURE 5-3F

GROUNDWATER PHASE III
ALL WELLS
CONCENTRATIONS
ABOVE SCREENING CRITERIA
REMEDIAL INVESTIGATION
McCOY ANNEX LANDFILL
NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Rev. 2
03/07/01

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5.3.2.2 Sample Turbidity

The primary goal of the Phase III groundwater sampling effort was to obtain samples with turbidity levels of 10 NTUs or less. Microflow purging and sampling techniques (i.e., flow rate 100 mL/min or less, drawdown less than 0.3 feet and stable) were utilized to achieve this objective. Table 5-3K summarizes the Phase III well purge rate, drawdown, and turbidity results and includes the Phase II turbidity results for comparison. As can be seen in the table, the microflow methods were successful in reducing the sample turbidity for most samples; 13 of 20 shallow wells, 16 of 22 intermediate wells, and 3 of 4 Hawthorn wells equal to or less than 10 NTUs. Four shallow wells, three intermediate wells, and one Hawthorn well had turbidity levels between 10 and 51 NTUs; one shallow well (MW1A) and one intermediate well (MW11B) had turbidity of 159 and 320, respectively. The turbidity could not be reduced in two shallow and two intermediate wells (MW4A, MW4B, MW6B, and MW7A) even when sampling was conducted via microwells containing very-fine grain size filter packs that were installed inside the existing 2-inch-diameter wells (see Section 3.6.5).

The success in reducing turbidity is attributed to a combination of factors: (1) drawdown less than 0.3 foot was achieved in most wells, (2) flow rates were generally 100 mL/min or less, and (3) use of a peristaltic pump and small diameter down-hole tubing caused minimal disturbance to the water column and any accumulated well-bottom sediments. The four wells in which turbidity could not be controlled are all located along the eastern perimeter of OU 2 (i.e., southeast corner of the golf course); two shallow wells are on-site and one well pair is off-site. The reason for the high turbidity in these wells could not be determined. Some possible causes are (1) pockets of natural high-turbidity groundwater (e.g., high levels of natural colloids) where the wells are located; (2) unknown well construction defects (e.g., displaced filter pack due to heaving formation) that allows loosely consolidated, very-fine grained sediments to come into contact with the well screen; or (3) over-development of the wells that compromised the filter pack integrity and resulted in a condition similar to item (2) above.

The impact of turbidity on the chemical characteristics of the groundwater samples is discussed in the following sections.

5.3.2.3 Volatile Organic Compounds

The Phase III sampling effort included analysis of only seven well samples for VOCs. The samples analyzed were from the only wells that contained an exceedance of the GCTLs for VOCs during the Phase II sampling. Table 5-3H presents the detections for these wells and summary statistics are provided in Table 5-3J. The Phase III analytical database of OU 2 groundwater samples is presented in Appendix B.

TABLE 5-3K

GROUNDWATER PHASE III - SAMPLE COLLECTION PARAMETERS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Well Number	Purge Rate (mL/min)	Well Drawdown (feet)	Sample Turbidity (NTU)	
	1999	1999	1998	1999
SHALLOW WELLS				
1A	100	-0.03	980	159
2A	140	0.63	345	9.09
3A	100	-0.34	59	10
4A	120	-0.05	1262	> 1100
6A	100	0.39	796	9
7A	100	-0.04	1876	> 1100
8A	90	-0.12	1921	21
9A	100	-0.05	1005	9.7
10A	100	-0.05	345	44.3
11A	80	-0.23	1606	0
13A	150	-0.03	140	3.1
14A	140	-0.07	39	6.97
15A	85	-0.02	1888	1.4
16A	145	-0.05	1881	2.28
17A	125	-0.07	119	30.7
18A	140	-0.12	1095	1.1
19A	150	-0.07	1402	9.05
20A	80	-0.04	911	2.5
21A	85	-0.08	9	0.4
22A	95	-0.20	1782	10
INTERMEDIATE WELLS				
1B	150	-0.22	885	0.85
2B	100	-0.06	1260	4.4
3B	100	-0.09	777	10
4B	120	-0.39	1866	> 1100
5B	125	-1.19	221	10.1
6B	105	-1.8	294	> 1100
7B	100	-0.03	381	10
8B	145	-0.2	510	6.55
9B	100	-0.23	135	19
10B	120	-0.25	510	2.95
11B	100	-0.16	850	320
12B	100	-0.11	8	6
13B	110	-0.05	358	1.72
14B	145	-0.12	1470	9.94
15B	120	-0.04	880	1
16B	100	-0.5	1410	50.3
17B	130	-0.14	1360	1.02
18B	155	-0.83	35	6.2
19B	110	-0.11	1850	1.42
20B	90	-0.49	810	10
21B	100	-0.24	970	0.35
22B	90	-0.16	1881	1
HAWTHORN WELLS				
23C	120	-4.57	152	11.9
24C	200	-8.57	1028	10
25C	80	-2.51	540	9.89
26C	400	-4.23	520	10.03

NTU - Nephelometric Turbidity Unit

Two shallow wells, four intermediate wells, and one Hawthorn well were analyzed for VOCs. All of the wells analyzed for VOCs are located on Navy property. VOCs were detected in one shallow well and four intermediate wells (Table 5-3H); no VOCs were detected in the Hawthorn well. Table 5-3J shows that 11 VOCs were detected. The wells with the most detections were MW11B (eight detections) and MW12B (six detections). Benzene, chlorobenzene, cis-1,2-dichloroethene, TCE, and vinyl chloride were the chemicals most frequently detected (three detections each).

Four of the seven monitoring well samples contained VOC concentrations that exceeded GCTLs for the following chemicals: benzene, PCE, TCE, and vinyl chloride. All of these exceedances occurred in intermediate-depth wells on Navy property. Three of the wells, MW11B, MW12B, and MW18B, are located along the eastern perimeter of the wooded area in the southern portion of OU 2 (see Figure 5-3F). One well, MW3B, is located along the eastern perimeter of the golf course in the northern portion of OU 2. All four of these wells are located adjacent to drainage canals where the shallow and intermediate groundwater flowing beneath OU 2 discharges along the canals (see Section 2.2.3.1).

Table 5-3L provides a comparison of the VOC exceedances during the Phase II and Phase III sampling events. Both sampling events occurred during the mid-summer seasons. The table shows that turbidity of the samples was reduced for all wells where exceedances of the GCTLs occurred. The table also shows that there was a general decrease in the number of exceedances and in the concentrations of the VOCs detected between the two sampling events. One exception occurred at well MW18B where the chemicals detected and their concentrations remained relatively consistent. Only one VOC exceedance occurred in Phase III that did not occur during the Phase II sampling event (i.e., 5.1 μg/L of PCE at well MW12B).

The reduction in VOC concentrations in several of the wells between the Phase II and Phase III sampling events appears to be related to reductions in sample turbidity (e.g., wells MW3A, MW20A, MW21B, and MW26C). Because organic chemicals may be sorbed to organic matter and/or clay materials in the aquifer matrix, the acid preservation and subsequent analysis of samples with high turbidity (i.e., suspended matrix material) may have resulted in a high bias for VOCs in the Phase II sample results. The reduction in turbidity achieved by the Phase III sampling, therefore, has resulted in a more representative, although synoptic, characterization of the VOC content of the groundwater flowing beneath OU 2.

The Phase III sampling data, coupled with the Phase II sampling and direct push sampling conducted in 1997, confirm that VOC contamination in groundwater is present at relatively low concentrations with one exception (MW18B). Three localized areas of VOCs in groundwater are widely spaced across the Navy property: MW3B in the northeast, MW11B and MW12B in the central area, and MW18B in the

TABLE 5-3L

GROUNDWATER PHASES II AND III - EXCEEDANCES OF ORGANIC CHEMICALS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Well Number	Turbidity (NTUs)		Chemical Detected[a]	Concentration (µg/L)	
	Phase II	Phase III		Phase II	Phase III
SHALLOW WELLS					
MW3A	59	5	benzene	5.5	--
			vinyl chloride	4.8	--
MW20A	911	3	chloroform	6.3	--
			1,1,2,2-tetrachloroethane	0.92 J	--
INTERMEDIATE WELLS					
MW3B	777	9	benzene	6.2	3.4
MW11B	850	320	benzene	9.2	7.6
			xylenes	37.2	--
			trichloroethene	3.4	--
			vinyl chloride	18.2	16
MW12B	8	2	benzene	8.6	1.3
			vinyl chloride	1.5	--
			tetrachloroethene	--	5.1 J
MW15B[b]	880	1	naphthalene	23.8	--
MW18B	35	6	tetrachloroethene	64.3	34 J
			trichloroethene	1250	1200 J
			vinyl chloride	20.3	20 J
MW21B	970	0	3&4-methylphenol	15.3	--
HAWTHORN WELLS					
MW26C	520	10	bromodichloroethane	2.4	--
			chloroform	12.2	--

All wells on Navy property except as noted.

-- Chemical not detected above State of Florida Groundwater Cleanup Target Levels.

J - Qualifier indicates estimated concentration.

[a] Concentrations of these chemicals exceed the Groundwater Cleanup Target Levels per Chapter 62-777, May 1999.

[b] Well located on GOAA property.

southern area of OU 2. All of the well samples with detections and exceedances of the GCTLs were from the bottom portion of the surficial aquifer (i.e., intermediate wells), and all of these wells are located adjacent to canals where groundwater discharges to surface water. Thus it is likely that contaminated groundwater from this zone is discharging to the drainage canals as described in Section 2.2.3.1.

5.3.2.4 Semivolatile Organic Compounds

Two intermediate wells, MW15B and MW21B, were analyzed for SVOCs. Well MW21B is located on Navy property along the western perimeter of the wooded area in the southern portion of OU 2; well MW15B is located southeast of MW21B across the canal on GOAA property that lies east of OU 2 (Figure 5-3F). Well MW15B is located approximately 200 feet east of the drainage canal where the groundwater and surface water interface (see Section 2.2.3.1). The samples were from the only wells that contained an exceedance of the GCTLs for SVOCs during the Phase II sampling. Table 5-3H presents the detections for these wells and summary statistics are provided in Table 5-3J. The Phase III analytical database of OU 2 groundwater samples is presented in Appendix B.

SVOCs were detected in only well MW15B (Table 5-3H). The chemicals detected were naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene. None of the SVOC concentrations exceeded the GCTLs.

Table 5-3L provides a comparison of the SVOC exceedances during the Phase II and Phase III sampling events. Both sampling events occurred during the mid-summer seasons. The table shows that the turbidity reduction in the samples from wells MW15B and MW21B was relatively high. The table also shows that there was a corresponding decrease in the concentration of SVOCs detected between the two sampling events. The reduction in chemical concentrations in the wells, coupled with the similar reduction in VOCs in groundwater (see above discussion), appears to be a result of reductions in sample turbidity.

5.3.2.5 Pesticides and Polychlorinated Biphenyls

These chemicals were not detected above the GCTLs during the Phase II sampling and no analyses were performed during the Phase III sampling.

5.3.2.6 Herbicides

These chemicals were not detected above the GCTLs during the Phase II sampling and no analyses were performed during the Phase III sampling.

5.3.2.7 Total Petroleum Hydrocarbons

These chemicals were not detected above the GCTLs during the Phase II sampling and no analyses were performed during the Phase III sampling.

5.3.2.8 Inorganics

The Phase III sampling effort included analysis of samples from 46 of the 48 wells at OU 2 for inorganic analytes. Two wells were not sampled because they did not contain concentrations of any organic analytes above the screening levels during the Phase II sampling. Table 5-3I presents the detections for the wells sampled and summary statistics are provided in Table 5-3J. The Phase III analytical database of OU 2 groundwater samples is presented in Appendix B.

Samples from 20 shallow wells, 22 intermediate wells, and 4 Hawthorn wells were analyzed for inorganics during the Phase III sampling event. The number of on-site and off-site wells for each of the aquifer intervals is summarized below:

Aquifer interval	Typical well depth (ft)	On-site locations	Off-site location
Surficial (Shallow)	16	12	8
Surficial (Intermediate)	35	14	8
Hawthorn	63	3	1

Inorganics Detected in Groundwater

Inorganics were detected in each of the wells sampled (Table 5-3I). Table 5-3J shows that 21 inorganic analytes were detected and provides the range of concentrations detected for each analyte. Calcium, iron and magnesium were the most frequently detected analytes (>40 detections each) followed by aluminum, barium, potassium, and sodium (>30 detections each).

Table 5-3J also contains supplemental statistics for the groundwater data set when the results for six turbid well samples (NTUs >100) are not included. This information is presented because sample turbidity can contribute inorganic species to groundwater samples and may be exacerbated by sample preservation (i.e., acidification). Inorganic materials can occur in natural formation water as cations, anions, complex ions, and undissociated molecules. In addition, they can occur in the form of colloids and as suspended matter. The analysis of unfiltered groundwater samples will reflect the presence of inorganics from all these sources. Because clay-sized particles in the aquifer matrix may contain a wide variety of minerals, the acid preservation and subsequent analysis of samples with high turbidity

(i.e., suspended material) may have resulted in a high bias for certain inorganic chemicals. As demonstrated by Table 5-3M, the wells with the most detections were MW4B (20 detections), MW6B (19 detections), MW4A (17 detections), and MW7A (15 detections). However, the samples from these four wells were noted to have contained levels of turbidity greater than 1100 NTUs (Table 5-3K). Wells MW1A, MW3A, and MW11B contained the next highest level of detections (13 each); wells MW1A and MW11B were also noted to contain relatively high levels of sample turbidity (159 and 320 NTUs, respectively). As shown in Table 5-3M, there is an observable decrease in the frequency of inorganic detections when sample turbidity drops below 50 NTUs.

Off-Site vs. On-Site Concentrations

The monitoring wells sampled at OU 2 include eight surficial aquifer well pairs and one Hawthorn well located on the east side of the canal (i.e., off-site) that forms the eastern perimeter of the Navy property. The hydrogeologic regime described in Section 2.2.3.1 indicates that the groundwater east of the canal is hydraulically separated from the groundwater flowing beneath OU 2 by the canal which acts as a local discharge boundary for the aquifer. For this reason the wells located east of the canal are considered to represent upgradient (i.e., local background) conditions. Comparison of the on-site well results with the off-site well results, therefore, provides an opportunity to evaluate the impact of the former landfill activities at OU 2 on current groundwater conditions. In addition, both water table (shallow) and bottom of the aquifer (intermediate) depth wells were sampled in the surficial aquifer. Because the depth of the former landfill resulted in some materials being placed in direct contact with the upper portion of the surficial aquifer, the results were independently evaluated for each surficial aquifer depth. The focus of the following discussion is to determine if the former landfill is currently impacting the surficial aquifer groundwater at OU 2.

An off-site vs. on-site well comparison was not performed for the Hawthorn confined aquifer because of the small number of wells in this aquifer (three on-site and one off-site wells). In addition, several groundwater quality parameters measured in the Hawthorn wells are consistent with the hydrogeologic data (see Section 2.2.3.1) which concludes that groundwater in the Hawthorn aquifer is genetically different than groundwater in the surficial aquifer (i.e., the clay at the top of the Hawthorn formation prevents significant groundwater inflow from the surficial aquifer). For example, the average pH during purging for the Hawthorn wells was 6.8 whereas the average pH for the shallow and intermediate wells was 5.0 and 5.4, respectively (see Sampling/Purging field forms in Appendix B). The concentration of calcium in the Hawthorn wells is noticeably higher than in the surficial aquifer wells (Table 5-3I). Consequently, the magnesium-to-calcium ratio is much lower in the Hawthorn wells (0.12) compared to the surficial aquifer wells (0.85 and 0.34 for shallow and intermediate wells, respectively). These data

TABLE 5-3M

GROUNDWATER PHASE III - EFFECTS OF SAMPLE TURBIDITY ON INORGANIC DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Well	Aluminum	Antimony	Arsenic	Barium	Beryllium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Sodium	Thallium	Vanadium	Zinc	Number of Detects	Number of Exceedances
SHALLOW WELLS																							
MW04A	X		X	X		X	X		X	X	X	X	X	X	X	X	X	X		X	X	17	4
MW07A	X		X	X		X	X		X	X	X	X	X	X	X	X		X		X		15	4
MW01A[a]	X			X		X	X		X	X	X	X	X			X	X	X		X		13	3
MW03A	0			0		0		0	0	0		0	0		0	0		0		0	0	13	2
MW22A[a]	0		0	0		0				0		0	0			0		0		0	0	11	1
MW06A	0		0	0		0		0		0		0				0		0		0		10	1
MW11A	0		0	0		0			0	0		0			0	0		0				10	1
MW14A	0			0		0				0	0	0			0	0		0		0		10	1
MW08A	1			1		1				1		1	1			1		1		1		9	1
MW09A	0			0		0				0		0				0		0		0		8	0
MW15A	0			0		0				0		0				0		0				7	0
MW17A	1	1				1				1		1				1		1				7	0
MW18A	0			0		0				0		0				0		0				7	0
MW20A	0					0				0		0				0		0		0		7	0
MW16A[a]	0			0						0		0				0		0				6	0
MW02A	0		0			0				0		0										5	1
MW13A	0			0		0										0		0				5	0
MW19A	0	0		0						0		0										5	0
MW21A	0					0				0		0						0				5	0
MW10A	1		1																			2	0
INTERMEDIATE WELLS																							
MW04B	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	20	10
MW06B	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	19	13
MW11B	X			X		X	X		X	X	X	X	X			X		X		X	X	13	2
MW03B	0			0		0		0	0	0		0	0			0		0		0		11	1
MW12B	0			0		0				0		0	0			0		0		0		9	1
MW18B	0		0	0		0				0		0	0			0		0				9	1
MW02B	0			0		0				0		0	0			0		0				8	1
MW08B	0		0	0		0				0		0				0		0				8	1
MW09B	1			1		1				1		1	1			1		1				8	1
MW14B	0			0		0				0		0	0			0		0				8	1
MW20B	0			0		0				0		0				0		0			0	8	0
MW07B	0			0		0				0		0				0		0				7	0
MW16B	1	1		1		1	1			1		1										7	2
MW21B	0					0				0		0	0			0		0				7	1
MW22B				0		0				0		0				0		0		0		7	1
MW15B	0					0				0		0				0		0				6	0
MW19B	0			0		0			0	0		0										6	1
MW13B	0	0				0				0		0										5	0
MW05B	0			0						0		0										4	0
MW01B[a]						0				0		0										3	1
MW10B						0				0		0										3	1
MW17B						0				0		0										3	0
HAWTHORN WELLS																							
MW23C				1		1	1			1		1	1		1	1		1				9	2
MW25C			0	0		0				0		0	0		0	0		0				9	2
MW24C				0		0				0		0	0		0	0		0				8	1
No. of Exceed.	8	0	1	2	2	*	2	0	0	29	4	*	5	2	2	*	1	0	1	5	0		

* No screening value available.

"0" indicates analyte was detected; sample turbidity <10 NTUs.

"1" indicates analyte was detected; sample turbidity 10< NTUs <150

"X" indicates analyte was detected; sample turbidity >150 NTUs.

Shaded cell indicates exceedance of GCTLs or NTC Background, whichever is greater.

No entry indicates chemical not detected.

[a] Maximum of duplicate sample results used in table.

indicate that the groundwater in the Hawthorn aquifer is strongly influenced by Hawthorn sediments, including limestone and dolomite, that are not influential in the surficial aquifer. Because the source and flowpaths of groundwater in the aquifers are genetically different, it is concluded that the NTC background concentrations (ABB-ES, 1995) are not necessarily applicable to the Hawthorn aquifer. Collectively, the groundwater flow patterns and chemical concentrations observed at OU 2 do not indicate that the confined aquifer in the Hawthorn formation has been impacted by site activities. Further discussion regarding the fate and transport of contaminants is provided in Section 8.0.

Table 5-3N provides summary statistics for each of the on-site and off-site surficial aquifer depths described above. The results of the six samples with turbidity greater than 50 NTUs are not included in this table. The table shows that many of the inorganic analytes were not detected or were detected at a relatively low frequency (e.g., three or less samples) in both the on-site and off-site wells. In the shallow wells, aluminum, barium, calcium, iron, magnesium, potassium, and sodium were the most frequently detected inorganics. The statistics show that higher mean concentrations were calculated for the on-site wells for aluminum, barium, calcium, and iron; but higher means were calculated for the off-site wells for magnesium, potassium, and sodium. A graphical representation demonstrating the range of concentrations for each of the data sets is provided in Figures B-1 through B-16 in Appendix B. Wells that contained the extreme maximum concentrations (i.e., data that appear to be outliers) are identified on the plot for each of the analytes plotted. Plots were not created for analytes that were not detected (i.e., beryllium, cadmium, chromium, mercury, selenium, silver, and thallium). The extreme maximum concentrations could represent contaminant releases or they could represent the extreme range of the underlying background population. A t-Test was used to evaluate which of the extreme data points are statistically different from the combined shallow well data set (i.e., off-site and on-site wells together). The results of this analysis infer that only the on-site maximum concentrations of arsenic, lead, and manganese are statistical outliers (at the 5 percent significance level) when the shallow well data are assumed to be lognormally distributed (Appendix B).

For the combined intermediate well data set, the analysis infers that the maximum concentrations of aluminum, arsenic, iron, magnesium, and potassium are statistical outliers for lognormally distributed data. Because the maximum intermediate well concentration for aluminum occurred in off-site well MW16B, it is considered to be an extreme value within the background range. All other shallow and intermediate outliers occurred in on-site wells.

Historical information for OU 2 suggests that releases from the former landfill could result in higher concentrations of inorganic analytes in the on-site shallow wells than in the off-site wells. The Student t-Test was used to examine this hypothesis by evaluating the significance of the difference between the

TABLE 5-3N

GROUNDWATER PHASE III - SUMMARY STATISTICS BY AQUIFER ZONE
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

PARAMETER	SHALLOW WELLS							
	OFF-SITE WELLS (7)[a]				ON-SITE WELLS (10)			
	No. Detects	Minimum	Maximum	Mean	No. Detects	Minimum	Maximum	Mean
Aluminum	7	754	2,500	1,281	10	251	4,500	1,324
Antimony	2	2.5	3.0	2.8	0			
Arsenic	1	2.6	2.6	2.6	4	2.2	6.9	4.3
Barium	5	24.2	45.4	32.0	7	22.4	137	66.9
Beryllium	0				0			
Cadmium	0				0			
Calcium	4	3,710	26,500	12,978	10	851	74,700	15,513
Chromium	0				0			
Cobalt	0				2	1.3	5.2	3.3
Copper	0				2	1.4	1.7	1.6
Iron	5	255	850	483	10	215	23,700	3,779
Lead	0				1			
Magnesium	5	1,030	8,320	3,800	10	1,570	4,200	2,854
Manganese	0				3	5.8	616	211
Mercury	0				0			
Nickel	0				3	1.9	16.8	7.2
Potassium	5	5,620	10,700	8,244	8	364	15,100	3,040
Selenium	0				0			
Silver	0				0			
Sodium	5	24,500	60,600	46,260	9	2,080	78,700	17,013
Thallium	0				0			
Vanadium	1	25.6	25.6	25.6	5	6.2	37.1	18.9
Zinc	0				3	3.9	126	74
	INTERMEDIATE WELLS							
	OFF-SITE WELLS (7)				ON-SITE WELLS (12)			
	No. Detects	Minimum	Maximum	Mean	No. Detects	Minimum	Maximum	Mean
Aluminum	5	375	4,160	1,337	10	347	1,100	763
Antimony	2	2.3	2.4	2.4	0			
Arsenic	0				2	2.7	5.2	4.0
Barium	3	23.5	76.3	42.5	10	8.4	59.4	24.3
Beryllium	0				0			
Cadmium	0				0			
Calcium	7	9,090	16,300	12,379	11	3,550	41,500	13,409
Chromium	1	7.8	7.8	7.8	0			
Cobalt	0				1	2.4	2.4	2.4
Copper	1	5.4	5.4	5.4	1	1.1	1.1	1.1
Iron	7	868	3,340	1,781	12	696	15,500	3,041
Lead	0				0			
Magnesium	7	1,380	3,020	2,053	12	677	8,570	2,286
Manganese	1	7.3	7.3	7.3	6	3.6	38.3	15.3
Mercury	0				0			
Nickel	0				0			
Potassium	2	1,030	1,280	1,155	10	522	5,360	1,813
Selenium	0				0			
Silver	0				0			
Sodium	2	6,110	24,400	15,255	10	5,570	34,100	12,386
Thallium	0				0			
Vanadium	0				3	3.0	7.4	4.5
Zinc	0				1	50.8	50.8	50.8

Units are all µg/L

Maximum of duplicate sample results used in the analysis.

Results of turbid samples (wells MW1A, MW4A, MW4B, MW6B, MW7A, and MW11B) not used in the analysis.

No entry indicates chemical not detected; non-detect results not used in the analyses.

(a) Number of wells shown in parentheses.

off-site and on-site data sets (Appendix B). As a starting point, the data were assumed to be lognormally distributed and the log-transformed concentrations were considered first. The t-Test was formulated to determine the probability that the off-site and on-site samples are likely to come from the same underlying population, and the probability was determined for each inorganic analyte. Because the test hypothesis stipulates that a release is indicated by a higher on-site concentration, only the results of analytes for which the on-site mean was greater than the off-site mean were evaluated. A critical probability, P, value of 0.05 was used in the analysis; a finding of P = 0.05 or less infers that the two data sets are different. The results of this analysis infer that there is no statistical difference in the inorganic concentrations between the off-site or on-site shallow-depth wells with the exception of iron and manganese (P = 0.00 and 0.03, respectively; see Appendix B). The maximum concentrations of iron and manganese occur in on-site well MW3A that is located in an area of OU 2 that has demonstrated VOC impacts (i.e., benzene in well MW3B). It was noted that the probabilities for arsenic, barium, and magnesium were relatively low (P = 0.06, 0.18, and 0.16, respectively). The data plot, Figure B-3, shows that arsenic in on-site well MW6A is a statistical outlier. Furthermore, the maximum concentration of barium occurs in well MW6A. Collectively, these data suggest that iron and manganese have either been released from the former landfill or changes in the groundwater chemistry due to the landfill have increased the material solubility of these analytes, and that arsenic and barium are suspect. The data plot for magnesium, Figure B-10, on the other hand, shows that the maximum concentration occurs in an off-site well and suggests that background conditions account for the statistical difference between the off-site and on-site wells. The results of the t-Test on the non-transformed data infer that there is no statistical difference between the two data sets for any of the detected inorganic analytes; however, relatively low probabilities were similarly observed for each of the above identified analytes except magnesium.

A similar analysis to the above was performed for the intermediate well results. As shown in Table 5-3N, aluminum, barium, calcium, iron, magnesium, potassium, and sodium were the most frequently detected inorganics. As observed for the shallow wells, the mean concentrations for the on-site wells were not always higher than the off-site wells. The concentration data are graphically presented in Figures B-1 through B-16 in Appendix B. The Student t-Test was used to examine the significance of the difference between the off-site and on-site data sets (Appendix B) for both the log-transformed and non-transformed data. A critical probability, P, value of 0.05 was used in the analysis; a finding of P = 0.05 or less infers that the two data sets are different. The results of this analysis infer that there is no statistical difference in the inorganic concentrations between the off-site on on-site intermediate-depth wells (Appendix B). However, it was noted that the probabilities for arsenic and zinc were relatively low (P = 0.12 and 0.07, respectively). The data plot for arsenic, Figure B-3, shows that the maximum concentration of arsenic in on-site well MW18B is a statistical outlier. Additionally, arsenic was suspected as a contaminant in the shallow portion of the aquifer and well MW18B is located in an area of OU 2 that is impacted by VOC

contamination (i.e., TCE, PCE, and vinyl chloride in well MW18B). For these reasons, arsenic in the deeper portion of the surficial aquifer is suspected to be the result of a release from the former landfill (or change in the groundwater chemistry). The data plot for zinc, Figure B-16, indicates that the concentration of zinc typically ranges higher in the shallow wells than in the intermediate wells. However, zinc was not identified as a contaminant in the shallow aquifer at OU 2. The maximum intermediate well concentration of zinc occurs in well MW20B that is located along the far southern perimeter of OU 2 where no other impacts have been observed. For these reasons, zinc is not considered to be a result of a release from the former landfill. The results of the t-Test on the non-transformed data inferred the same relationship between the two data sets (i.e., relatively low probabilities for arsenic and zinc).

Contaminant Plume Evaluation

The former landfill at OU 2 penetrated the water table; therefore, the site conceptual model suggests that inorganic analytes (i.e., iron) may have been released to the shallow groundwater (or concentrations increased due to changes in groundwater chemistry). Because different portions of the landfill that are 28 to 40 years old were closed between 1972 and 1978 without an engineered cover (i.e., no low permeability cap), it is reasonable to assume that a contaminant plume, if present, has migrated with groundwater flow. The hydrogeologic setting indicates that shallow groundwater beneath the landfill, away from the canals, flows downward within the surficial aquifer (i.e., recharge area), and then laterally toward the canals where it then flows upward to a point of discharge along the canal streambed (i.e., discharge area). Groundwater flow to the underlying confined aquifer in the Hawthorn Group and the transport of chemicals to this aquifer from the surficial aquifer is not supported by the observed chemical concentrations and flow patterns. This conceptual model of the transport of contaminants via the groundwater pathway provides several scenarios that may occur at the site, as follows:

1. If an active inorganic groundwater plume exists, then shallow on-site wells should show the highest overall concentrations of the released contaminants.

2. If only the remnant of a detached inorganic plume exists, then the intermediate on-site wells should show the highest overall concentrations of the released contaminants.

3. If no plume exists, or if the plume has been discharged to surface water, then there should be no statistical difference between the inorganic concentrations between on-site and off-site wells or between the shallow and intermediate on-site wells.

Data presented previously indicated that a statistical difference exists between the shallow on-site and off-site groundwater concentrations for iron and manganese. Arsenic and barium in the shallow groundwater and arsenic in the deeper groundwater were identified as suspected contaminants. This finding suggests that Scenario 1 above is the appropriate conceptual model. To further investigate this scenario, the on-site concentrations of iron, manganese, arsenic, and barium in the shallow- and intermediate-depth data sets were compared to one another. Data plots 2 and 4 on Figures B-3, B-4, B-8, and B-10 provide a graphic comparison of the two on-site data sets. The Student t-Test was used to examine the difference between the shallow and intermediate on-site data sets (Appendix B) for both the log-transformed and non-transformed data. A critical probability, P, value of 0.05 was used in the analysis; a finding of P = 0.05 or less infers that the two data sets are different. The results of this analysis infer that there is no difference in the inorganic concentrations between the shallow- and intermediate-depth wells. However, it was noted that the probabilities for arsenic and barium were relatively low (P = 0.15 and 0.07, respectively) suggesting that the concentrations may be different.

Collectively, the data analysis suggests that the former landfill has resulted in a statistically significant increase in the concentrations of iron and manganese in the shallow portion of the surficial aquifer. Arsenic and barium in the shallow portion and arsenic in the lower portion of the surficial aquifer appear to be related to a release from the landfill. The concentrations of all these analytes were found to be statistically the same for the on-site shallow- and intermediate-depth wells, although the statistical probability was relatively low for arsenic and barium. However, the mean and maximum concentrations for each of these analytes were greater for the shallow portion of the aquifer (Table 5-3N). Scenario 1 described above appears to represent the site conditions, that is, a groundwater plume of inorganic analytes exists at OU 2 but migration of chemicals to the lower portion of the surficial aquifer has not resulted in an identifiable increase above the range of local background concentrations.

As indicated by Table 5-3M, detections of iron and barium are widely distributed across OU 2 and the GOAA property (i.e., off-site) and across all aquifer layers sampled. Arsenic and manganese were only occasionally detected, arsenic predominantly in the shallow portion of the surficial aquifer and manganese in the lower portion of the surficial aquifer and in the Hawthorn aquifer. Both arsenic and manganese were most frequently detected in on-site wells.

Concentrations of Inorganics Above Screening Criteria

Twenty-nine of the 45 monitoring well samples analyzed contained at least one inorganic analyte at a concentration that exceeded the screening criteria. Table 5-3J shows that 13 inorganic analytes exceeded the GCTLs. Figure 5-3F shows the location of each well and lists the analytes that exceeded

the screening criteria. Aluminum and/or iron were the inorganics that were most frequently exceeded (8 and 29 wells, respectively).

Excluding aluminum and iron, only 8 of the 45 wells contained inorganic concentrations that exceeded the screening criteria (Table 5-3M). Other than aluminum and iron, the most frequently exceeded analytes were manganese and vanadium (five each); lead (four); barium, beryllium, chromium, mercury, and nickel (two each); and arsenic, selenium, and thallium (one each). If the results of the six samples with the highest turbidity are excluded, in addition to aluminum and iron, then only one shallow well and two Hawthorn wells (MW3A, MW23C, and MW25C) contain an exceedance of only one analyte - manganese (Table 5-3M).

Figure 5-3G shows the location and concentrations of exceedances of the screening criteria when the results of the six turbid well samples are censored.

5.3.2.9 Radiological

The Phase III sampling effort included gross alpha and gross beta analysis of samples from 36 of the 48 wells at OU 2. The samples analyzed included all off-site wells on GOAA property (i.e., local background) and all on-site wells that contained an exceedance of the screening criteria for either gross alpha/beta or inorganic chemicals during the Phase II sampling event. Samples from 13 wells were not analyzed because they did not meet any of these criteria. Table 5-3I presents the detections for the wells sampled and summary statistics are provided in Table 5-3J. The Phase III analytical database of OU 2 groundwater samples is presented in Appendix B.

Fifteen shallow wells, 19 intermediate wells, and 2 Hawthorn wells were analyzed for gross alpha/beta during the Phase III sampling event. The number of on-site and off-site wells for each of the aquifer intervals is summarized below:

Aquifer interval	On-site locations	Off-site locations
Surficial – Shallow	7	8
Surficial – Intermediate	11	8
Hawthorn	1	1

n22x34dh.dgn

R4712981

8TH EXPRESS STREET

POND

SWAMP/ WOODS

NO. 9

AREA 1

DRIVING RANGE

OLD-OU2-01B
IRON 1470/1460

OLD-OU2-01A

OLD-OU2-01B

OLD-OU2-02A
IRON 3760

OLD-OU2-02B
IRON 3940

OLD-OU2-02A

OLD-OU2-02B

OLD-OU2-03A
IRON 23700
MANGANESE 616

OLD-OU2-03B
BENZENE 3.4
IRON 15500

OLD-OU2-03B

OLD-OU2-03A

OLD-OU2-22A
IRON 1740-7/1800-J

OLD-OU2-22A

OLD-OU2-22B

OLD-OU2-23C

OLD-OU2-23C
IRON 1910
MANGANESE 56.2

OLD-OU2-04A

OLD-OU2-04B

OLD-OU2-24C

OLD-OU2-24C
IRON 1920

NO. 8

NO. 6

NO. 5

NO. 1

NO. 7

NO. 4

NO. 3

NO. 2

MARSH

OLD-OU2-05A

OLD-OU2-05B

OLD-OU2-09B
IRON 3340-J

AREA 2

OLD-OU2-08B

OLD-OU2-08B
IRON 1620-J

OLD-OU2-08A
ALUMINUM 4500-J

OLD-OU2-08A

OLD-OU2-06A
IRON 2990

OLD-OU2-11A

OLD-OU2-11A
IRON 1770

OLD-OU2-11B
BENZENE 7.6
VINYL CHLORIDE 16

OLD-OU2-11B

OLD-OU2-09B

OLD-OU2-09A

OLD-OU2-06A

OLD-OU2-06B

OLD-OU2-12B
BENZENE 1.3
IRON 2640
TETRACHLOROETHENE 5.1-J

OLD-OU2-10B
IRON 1590

OLD-OU2-07B

OLD-OU2-07A

OLD-OU2-12B

OLD-OU2-12A

OLD-OU2-10A

OLD-OU2-10B

OLD-OU2-13B

OLD-OU2-13A

OLD-OU2-21B

OLD-OU2-21A

OLD-OU2-21B
IRON 2500

OLD-OU2-14A

OLD-OU2-14B

OLD-OU2-14B
IRON 2520-J

AREA 3

OLD-OU2-15B

OLD-OU2-15A

OLD-OU2-26C

OLD-OU2-26C
IRON 4670

OLD-OU2-25C
IRON 3340
MANGANESE 98

OLD-OU2-25C

OLD-OU2-18A

OLD-OU2-17B

OLD-OU2-17A

OLD-OU2-16B

OLD-OU2-16A

OLD-OU2-16B
IRON 2380

OLD-OU2-18B

OLD-OU2-18B
IRON 1580-J
TETRACHLOROETHENE 34-J
TRICHLOROETHENE 1200-J
VINYL CHLORIDE 20-J

OLD-OU2-19A

OLD-OU2-19B

OLD-OU2-19B
IRON 2190

OLD-OU2-20A

OLD-OU2-20B

WOODS

BOGGY CREEK ROAD

TRADEPORT DRIVE

LAKE GILLOOLY

N

200 0 200 400 600
SCALE IN FEET

LEGEND

SHALLOW MONITORING WELL — OLD-OU2-14A
INTERMEDIATE MONITORING WELL — OLD-OU2-17B
DEEP MONITORING WELL — OLD-OU2-26C

WELL DESIGNATION — OLD-OU2-01B
ANALYTE — IRON 1470/1460
CONCENTRATION 1,2 — DULPICATE SAMPLE

ESTIMATED VALUE J

1 – CONCENTRATION IN MICROGRAMS PER LITER (ug/L) – UNLESS OTHERWISE SHOWN
2 – CONCENTRATION IN PICOCURIES PER LITER (pCi/L) – WHERE SHOWN

NOTE:
SAMPLES WITH TURBIDITY >150 NTUs HAVE BEEN REMOVED.

FIGURE 5-3G

GROUNDWATER PHASE III
ALL WELLS CENSORED DATA
CONCENTRATIONS
ABOVE SCREENING CRITERIA
REMEDIAL INVESTIGATION
McCOY ANNEX LANDFILL
NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Rev. 2
03/07/01

5-147

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CAD FILE NO./DATE: 7457F054.dgn/3-8-00

Gross Alpha/Beta Detected in Groundwater

Gross alpha/beta were detected in each of the wells sampled. Table 5-3J also contains supplemental statistics for the groundwater data set when the results for five turbid well samples (NTUs >150) are not included. This information is presented because sample turbidity can contribute radiological species to groundwater samples and may be exacerbated by sample preservation (i.e., acidification). Radionuclides can occur in natural formation water as cations, anions, complex ions, and undissociated molecules. In addition, they can occur in the form of colloids and as suspended matter. The analysis of unfiltered groundwater samples will reflect the presence of radionuclides from all these sources. Because clay-sized particles in the aquifer matrix may contain a wide variety of minerals, the acid preservation and subsequent analysis of samples with high turbidity (i.e., suspended material) may have resulted in a high bias for certain radionuclides.

Results of Isotopic Analyses

Samples from the two wells with the highest concentrations of gross alpha and gross beta, MW4B and MW6B, were selected for isotopic analyses to investigate the presence of naturally occurring radioactive isotopes. Both wells are intermediate-depth wells completed in the lower portion of the surficial aquifer and both contained high levels of turbidity (Table 5-3O). The sample from off-site well MW4B, because it is located east of the canal, is considered to be an upgradient, background location; on-site well MW6B is in a downgradient location. The results of the isotopic analyses are presented in Table 5-3P. The concentrations of radium isotopes detected in each sample exceed the screening criteria of 5 pCi/L. The data indicate that the uranium isotopes are present at specific activities that are consistent with the expected ratios for these naturally occurring isotopes. The gross alpha and gross beta detected in groundwater are attributed to the presence of uranium and radium isotopes, both of which occur naturally in groundwater. Furthermore, the surficial aquifer is composed, at least in part, of reworked sediments of the Hawthorn Group that is widely known to contain phosphate minerals. Phosphate deposits are typically accompanied by elevated concentrations of naturally occurring radioactive material such as the uranium series and the thorium series. Therefore, the high turbidity of the samples and the relative abundance of phosphates in the Hawthorn Formation are considered to be the primary sources of the elevated concentrations of gross alpha and gross beta in the turbid groundwater samples.

5.3.2.10 General Groundwater Chemistry

General groundwater chemistry data were collected from four monitoring wells at OU 2 (representing approximately 10 percent of the total sample program during Phase III). Two shallow monitoring wells

TABLE 5-30

GROUNDWATER PHASE III- EFFECTS OF SAMPLE TURBIDITY ON RADIOLOGICAL DETECTIONS OPERABLE UNIT 2

NAVAL TRAINING CENTER ORLANDO, FLORIDA

WELL	TURBIDITY	GROSS ALPHA[a]			GROSS BETA[a]		
LOCATION	NTUs	pCi/L	> BG	> MCL	pCi/L	> BG	> SV
Shallow Wells							
MW04A	>1100	30.5	X	X	14.3	X	
MW01A[b]	159	5.3			4.2		
MW10A	44.3	2			4.9		
MW17A	30.7	1.9			12.4	1	
MW08A	21	11.7			15.4	1	
MW22A[b]	10	5.7			5.3		
MW09A	9.7	12.4			12.3	0	
MW19A	9.05	12.2			2.1		
MW06A	9	7			21.8	0	
MW14A	6.97	3.9			1.8		
MW13A	3.1	14.1	0		9.2		
MW16A[b]	2.28	7.3			15.5	0	
MW15A	1.4	7.2			13.8	0	
MW21A	0.4	2.4			0.9		
MW11A	0	1.5			2.7		
Intermediate Wells							
MW04B	>1100	80.8	X	X	52.8	X	X
MW06B	>1100	140	X	X	79.9	X	X
MW11B	320	9.7			19	X	
MW16B	50.3	10.5			9.7	1	
MW05B	10.1	5.2			4.7		
MW03B	10	4.2			4.7		
MW07B	10	6			5.2		
MW20B	10	3			5.5		
MW14B	9.94	1.5			3.1		
MW08B	6.55	1.9			2.8		
MW02B	4.4	3.4			4.6		
MW10B	2.95	0.6			3.3		
MW13B	1.72	0.5			2.4		
MW19B	1.42	1.3			3.7		
MW17B	1.02	1			2.7		
MW15B	1	0.5			2.6		
MW22B	1	1.5			2.5		
MW01B[b]	0.85	1.8			3.1		
MW21B	0.35	0.4			4.8		
Hawthorn Wells							
MW23C02	11.9	1.1			4.1		
MW24C02	10	0.5			4.4		

"0" indicates result exceeded critera; sample turbidity <10 NTUs.
"1" indicates result exceeded criteria; sample turbidity 10< NTUs <150.
"X" indicates result exceeded criteria; sample turbidity >150 NTUs.
No entry indicates result did not exceed background or MCL.
SV = Screening value
[a] Gross alpha background (BG) = 13 pCi/L, MCL = 15 pCi/L; Gross beta background (BG) = 9.5 pCi/, LSV = 50 pCi/L.
[b] Maximum of duplicate samples used.

TABLE 5-3P

GROUNDWATER PHASE III - ISOTOPIC ANALYSES
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Sample Location	MW04B	MW06B
Date Sampled	1/25/00	1/25/00
Radiological (pCi/L)		
gross Alpha	74.24	84.39
gross Beta	66.38	108.11
Radium-226	50.75	51.75
Radium -228	NA	NA
Thorium-227	0.22 U	0.09 U
Thorium-228	0.009 U	0.05 U
Thorium-230	0.01	0.08 U
Thorium-232	0.10 U	0.04
Uranium-234	7.89	7.0
Uranium-235	0.06 U	0.02 U
Uranium-238	3.27	3.74
Americium-241	<1.01	<1.41
Cesium-134	<0.74	<0.77
Cesium-137	<0.60	<0.54
Cobalt-60	<0.60	<0.91
Potassium-40	<14.2	<12.1

pCi/L picocuries per liter
"U" qualifier indicates analyte not detected at the 95% confidence level.
"<" indicates less than the minimum detectable activity.
NA Not Analyzed

(MW11A and MW13A), one intermediate well (MW01B), and one deep monitoring well (MW23C) were sampled for hardness, TDS, TSS, and alkalinity (Table 5-3Q). In general, hardness and alkalinity levels in the shallow and intermediate groundwater zones were considerably lower than in the deeper Hawthorn aquifer. TDS concentrations were also lower in the shallow aquifer. TSS concentrations did not differ appreciably among the wells and correlate with the low levels of turbidity present in the groundwater during purging and sampling (ranging from 1 to 17 NTU). Phase II results, which had higher levels of turbidity, corresponded to higher levels of TSS.

5.3.2.11 Phase III Summary

The Phase III groundwater sampling effort was successful in reducing sample turbidity; of the 46 wells sampled, 32 had less than 10 NTUs and 8 had less than 50 NTUs of turbidity. However, turbidity could not be controlled in six wells (three shallow and three intermediate depth wells). The Phase II and Phase III results were expected to be similar because the age of the landfill (portions closed between 28 and 40 years) and the hydrogeologic setting (i.e., low groundwater velocity) suggest that the groundwater plume should be chemically stable. And, the Phase II and Phase III groundwater sampling events were performed during the same seasons (one year apart) and under similar site conditions. Therefore, the widespread reductions in chemical concentrations and in the frequency of exceedances of the screening criteria observed in the Phase III data, across all analytical fractions, is attributed primarily to the reduction in the groundwater sample turbidity. Considering only the Phase III groundwater results, the deleterious effects of the six samples that contained high turbidity are clearly illustrated in Tables 5-3J, 5-3M, and 5-3O.

Phase II samples from nine wells (two shallow, six intermediate, and one Hawthorn depth) were found to have exceedances of the groundwater screening criteria for eight VOCs and two SVOCs (Table 5-3L). The Phase III results for these nine wells, however, show that neither the shallow nor the Hawthorn depth wells contain an exceedance of the groundwater screening criteria. In addition, although naphthalenes were detected at one location (MW15B), there are no exceedances of SVOCs in the Phase III results. The Phase III data confirm that VOC contamination in groundwater is present at relatively low concentrations with one exception (on-site well MW18B). Three localized areas of VOCs in groundwater above the screening criteria are widely spaced across the Navy property: MW3B in the northeast, MW11B and MW12B in the central area, and MW18B in the southern area of OU 2. All of the wells demonstrating detections and exceedances of the screening criteria were completed in the bottom portion of the surficial aquifer (i.e., intermediate wells), and all are located adjacent to canals where groundwater discharges to surface water.

TABLE 5-3Q

GROUNDWATER PHASE III - GENERAL GROUNDWATER CHEMISTRY
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Parameter	Units	MW01B	MW11A	MW13A	MW23C
Hardness $CaCO_3$	mg/L	33	33	26	200
Total Dissolved Solids	mg/L	120	140	140 J	320
Total Suspended Solids	mg/L	21	4 U	7 J	16
Total Alkalinity	mg/L	25	5 U	5 U	200
Turbidity[(a)]	NTU	1	17	3	12

NTU - Nephelometric Turbidity Units

[(a)] Measurement acquired in the field using flow-through cell.

Phase III sampling included 46 of the 48 wells for inorganic analyses. The data suggest that the former landfill has resulted in a release of iron and manganese to the shallow portion of the surficial aquifer. Arsenic and barium in the shallow portion and arsenic in the lower portion of the surficial aquifer also appear to be related to a release from the landfill. Detections of iron and barium are widely distributed across OU 2 and the GOAA property (i.e., off-site) and across all aquifer layers sampled. Arsenic and manganese were only occasionally detected, arsenic predominantly in the shallow portion of the surficial aquifer and manganese in the lower portion of the surficial aquifer and in the Hawthorn aquifer. Both arsenic and manganese were most frequently detected in on-site wells. Collectively, the data indicate that a groundwater plume of inorganic analytes exists at OU 2 but migration of chemicals to the lower portion of the surficial aquifer has not resulted in an identifiable increase above the range of local background concentrations. Migration of contaminants to the Hawthorn aquifer is not indicated, and the concentration range and distribution of inorganics in this aquifer zone indicate that significantly different background conditions exist (compared to the surficial aquifer) and that hydraulic communication between the aquifer zones is poor.

Aluminum and/or iron were the inorganics that most frequently exceeded the groundwater screening criteria (8 and 28 wells, respectively). Excluding aluminum and iron, only 8 of the 45 wells contained inorganic concentrations that exceeded the screening criteria (Table 5-3M). If the results of the six Phase III samples with the highest turbidity are excluded, in addition to aluminum and iron, then only one shallow well and two Hawthorn wells (MW3A, MW23C, and MW25C) contain an exceedance of only one analyte - manganese (Table 5-3M). Surficial aquifer well MW3A is located in an area impacted by VOCs (i.e., benzene in well MW3B), and its manganese concentration of 616 μg/L is an outlier in the shallow well data set. Concentrations of manganese in the Hawthorn aquifer range between 26.6 and 98 μg/L and are attributed to background conditions for that aquifer zone that are different than the surficial aquifer.

The Phase III sampling effort included gross alpha and gross beta analysis of samples from 36 of the 48 wells at OU 2. The data show that only 3 of 36 wells sampled (MW4A, MW4B, and MW6B) contained a concentration of gross alpha and/or gross beta that exceeded the screening criteria. However, the three wells in which the exceedances occurred were the only well samples that contained extreme turbidity (i.e., >1100 NTUs). There were no exceedances of the screening criteria for gross alpha or gross beta in the remaining 18 on-site wells sampled or in the 15 off-site wells sampled when turbidity was 320 NTUs or less. Isotopic analysis results show a similar pattern in that the highest concentrations were observed in the samples with high turbidity. In addition, wells MW4A and MW4B are off-site wells located on GOAA property that is hydraulically separated from flow beneath the former landfill by the drainage canal that acts as a discharge area for the surficial aquifer. For these reasons, the relatively high gross alpha, gross

beta, and isotopic concentrations observed in wells MW4A, MW4B, and MW6B are attributed to sample turbidity and no radiological impacts on groundwater are attributed to the former landfill at OU 2.

5.3.3 Additional Direct Push Groundwater Sampling

All samples collected during the additional DPT sampling events were analyzed for VOCs. The DPT equipment used, collection procedures, the rationale for collection, and the analytical program are detailed in Section 3.6.6.

VOCs were detected in both shallow (water table) and intermediate (28 to 30 feet bgs) samples at several locations (Table 5-3R). As discussed previously, the mobile laboratory analytical results for the first event were deemed invalid, but the duplicate samples (analyzed by a fixed-base laboratory) are valid and are included in Table 5-3R. Figures 5-3H and 5-3I present the contaminants and the concentrations detected. Nine VOCs were detected by laboratory analysis. A complete listing of all the analytical data is provided in Appendix B.

Contaminants were detected in three general areas within the interior of Area 3. The first area is immediately south and east of the southernmost landfill trenches, and west of the southern portion of the third area of VOC contamination described in Section 5.3.1.1 (Figure 5-3H). DPT locations associated with this area include P01 through P14 (Lines 1 and 2). Shallow samples from P01, P02, P03, P06, P07, and P09 contained benzene (maximum concentration 26 µg/L at P06). Chlorobenzene (maximum concentration 114 µg/L at P06) was detected in shallow samples from P01, P02, P03, P05, P06, P07, P08, and P09. The analyte cis-1,2,-dichloroethene (maximum concentration 28 µg/L at P05) was detected in shallow samples from P01, P05, and P09. PCE (maximum concentration 6 µg/L at P07) was detected in shallow samples from P05 and P07. Dichloroethene (DCE) and trans-1,2-dichloroethene were detected in the shallow sample from P09 at concentrations of 0.27 µg/L (J) and 0.34 µg/L (J), respectively. Vinyl chloride (maximum concentration 209 µg/L at P05) was detected in shallow samples from P05, P06, and P09.

Intermediate samples from P01, P02, P03, P05, P06, P07, P08, P09, P10, P12, P13, and P14 contained benzene (maximum concentration 52 µg/L at P07). Chlorobenzene (maximum concentration 77 µg/L at P07) was detected in intermediate samples from P01, P02, P03, P04, P05, P06, P07, P08, P09, P10, P11, P12, and P14. Cis-1,2,-dichloroethene (maximum concentration 38 µg/L at P03) was detected in intermediate samples from P01, P02, P03, P04, P05, P07, P08, P10, P11, and P12. 1,4-dichlorobenzene

TABLE 5-3R

ADDITIONAL DIRECT PUSH TECHNOLOGY DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a][b]	P0114D	P0114	P0128	P0214	P0228	P0316	P0330	P0416	P0430	P0516	P0530
DATE SAMPLED	9/20/00	9/20/00	9/20/00	9/20/00	9/20/00	9/21/00	9/21/00	9/20/00	9/20/00	9/20/00	9/20/00
Volatiles (µg/L)											
1,1-Dichloroethane											
1,2-Dibromoethane											
1,3-Dichlorobenzene (meta)											
1,4-Dichlorobenzene (para)					23		20		10		
Benzene	0.64 J		13	2 J	37	11	31		38		45
Chlorobenzene	21	25	22	13	42	23	34		48	11	50
Chloromethane											
cis-1,2-Dichloroethene	.078 J		15		11		38		18	28	9
cis-1,3-Dichloropene											
Dibromochloromethane											
m- & p-Xylene*			26		36		40				
o-Xylene*			4 J		7		9				
Tetrachloroethene											
trans-1,2-Dichloroethene											
Trichloroethene								5	5	7	5 J
Vinyl chloride			9		9		12		13	209	10

SAMPLE LOCATION[a][b]	P0616	P0630	P0716	P0728D	P0730	P0816	P0830	P0916	P0916D	P0930	P1016
DATE SAMPLED	9/21/00	9/21/00	9/21/00	7/26/00	9/21/00	9/21/00	9/21/00	9/21/00	9/21/00	9/21/00	9/22/00
Volatiles (µg/L)											
1,1-Dichloroethane											
1,2-Dibromoethane											
1,3-Dichlorobenzene (meta)											
1,4-Dichlorobenzene (para)											
Benzene	26	24	20	34	52		40		1	41	
Chlorobenzene	114	15	43	49	77	6	44	6	4.9	30	
Chloromethane											
cis-1,2-Dichloroethene		5	3 J	4.4 J	6		5	7	6.7		
cis-1,3-Dichloropene											
Dibromochloromethane											
m- & p-Xylene*					9 J						
o-Xylene*											
Tetrachloroethene			6								
trans-1,2-Dichloroethene									0.27 J		
Trichloroethene	2 J	5 J	10		5				0.34 J		
Vinyl chloride	40	6			11		8	11	7		

TABLE 5-3R

ADDITIONAL DIRECT PUSH TECHNOLOGY DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a][b]	P1028D	P1030	P1116	P1130	P1216	P1230	P1316	P1330	P1416	P1430	P1514D	P1514
DATE SAMPLED	7/26/00	9/22/00	9/22/00	9/22/00	9/21/00	9/21/00	9/22/00	9/22/00	9/22/00	9/22/00	7/27/00	9/22/00
Volatiles (µg/L)												
1,1-Dichloroethane												
1,2-Dibromoethane												
1,3-Dichlorobenzene (meta)												
1,4-Dichlorobenzene (para)												
Benzene	2.5	6				36		4 J		22	0.12 J	
Chlorobenzene	25	32		15		37				58	0.2 J	
Chloromethane												
cis-1,2-Dichloroethene	10	7		4 J		2 J						
cis-1,3-Dichloropene												
Dibromochloromethane												
m- & p-Xylene*										7 J		
o-Xylene*												
Tetrachloroethene	6			4 J								
trans-1,2-Dichloroethene												
Trichloroethene	2.6			5								
Vinyl chloride	8.1	7		4 J		5 J		3 J		7		

SAMPLE LOCATION[a][b]	P1528	P1614	P1628	P1628D	P1714	P1728	P1814	P1828	P1914	P1928	P1928D	P2014D
DATE SAMPLED	9/22/00	9/22/00	9/22/00	9/22/00	9/22/00	9/22/00	9/22/00	9/22/00	9/22/00	9/22/00	9/22/00	9/22/00
Volatiles (µg/L)												
1,1-Dichloroethane												
1,2-Dibromoethane												
1,3-Dichlorobenzene (meta)												
1,4-Dichlorobenzene (para)												
Benzene												
Chlorobenzene												
Chloromethane												
cis-1,2-Dichloroethene				0.29 J								
cis-1,3-Dichloropene												
Dibromochloromethane												
m- & p-Xylene*												
o-Xylene*												
Tetrachloroethene												
trans-1,2-Dichloroethene												
Trichloroethene												
Vinyl chloride												

TABLE 5-3R

ADDITIONAL DIRECT PUSH TECHNOLOGY DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a][b]	P2014	P2028	P2114	P2128	P2214	P2228	P2314	P2328	P2414	P2428	P2428D	P2914
DATE SAMPLED	9/22/00	9/22/00	9/23/00	9/23/00	9/23/00	9/23/00	9/19/00	9/19/00	9/22/00	9/22/00	9/22/00	9/20/00
Volatiles (µg/L)												
1,1-Dichloroethane												
1,2-Dibromoethane												
1,3-Dichlorobenzene (meta)												
1,4-Dichlorobenzene (para)												
Benzene												
Chlorobenzene												10
Chloromethane												
cis-1,2-Dichloroethene												1 J
cis-1,3-Dichloropene												
Dibromochloromethane												
m- & p-Xylene*												
o-Xylene*												
Tetrachloroethene		4 J		4 J		20		5 J				5 J
trans-1,2-Dichloroethene												
Trichloroethene				3 J		9	4 J	7				27
Vinyl chloride												

SAMPLE LOCATION[a][b]	P2928	P3014D	P3014	P3028	P3114	P3128	P3128D	P3214	P3228	P3228D	P3314	P3328
DATE SAMPLED	9/20/00	9/20/00	9/20/00	9/20/00	9/20/00	9/20/00	7/28/00	9/20/00	9/20/00	7/28/00	9/19/00	9/19/00
Volatiles (µg/L)												
1,1-Dichloroethane												
1,2-Dibromoethane					5 J							
1,3-Dichlorobenzene (meta)												
1,4-Dichlorobenzene (para)												
Benzene		0.74 J					2.3			1.8 J		
Chlorobenzene	11			12		2 J	1.5 J			1 J		
Chloromethane												
cis-1,2-Dichloroethene				3 J		8	6.3		16	15	9	
cis-1,3-Dichloropene												
Dibromochloromethane					5 J							
m- & p-Xylene*												
o-Xylene*												
Tetrachloroethene	5 J			5		5	0.75 J		8	4.1 J	4 J	4 J
trans-1,2-Dichloroethene							0.39 J					
Trichloroethene	30		5 J	50	5 J	134	38 J	5	360	200	76	66
Vinyl chloride				4 J		9	4.4		12	8.3		

TABLE 5-3R

ADDITIONAL DIRECT PUSH TECHNOLOGY DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a][b]	P3328D	P3414	P3428	P3428D
DATE SAMPLED	9/19/00	9/19/00	9/19/00	9/19/00
Volatiles (µg/L)				
1,1-Dichloroethane				
1,2-Dibromoethane				
1,3-Dichlorobenzene (meta)				
1,4-Dichlorobenzene (para)				
Benzene	1.3 J			0.36 J
Chlorobenzene	0.73 J		16	14
Chloromethane				
cis-1,2-Dichloroethene	2.3		1 J	0.76 J
cis-1,3-Dichloropene				
Dibromochloromethane				
m- & p-Xylene*	0.99 J			
o-Xylene*				
Tetrachloroethene	0.78 J		5	1.9
trans-1,2-Dichloroethene				
Trichloroethene	32	6	37	25
Vinyl chloride	1.8			0.32 J
SAMPLE LOCATION[a][b]				
DATE SAMPLED				
Volatiles (µg/L)				
1,1-Dichloroethane				
1,2-Dibromoethane				
1,3-Dichlorobenzene (meta)				
1,4-Dichlorobenzene (para)				
Benzene				
Chlorobenzene				
Chloromethane				
cis-1,2-Dichloroethene				
cis-1,3-Dichloropene				
Dibromochloromethane				
m- & p-Xylene*				
o-Xylene*				
Tetrachloroethene				
trans-1,2-Dichloroethene				
Trichloroethene				
Vinyl chloride				

TABLE 5-3R

ADDITIONAL DIRECT PUSH TECHNOLOGY DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

"J" qualifier on analytical data indicates an estimated value.
No entry indicates chemical not detected.
Only chemicals detected in at least one sample are listed.
The complete list of samples and analytical results is presented in Appendix B of this report.
(a) The first three digits of the sample identifier indicate the sample location and the last two digits indicate the depth of the sample.
(b) "D" at the end of the sample identifier indicates a duplicate sample.
* The FDEP GCTL for total xylenes (M, P, & O) is 20 μg/L.

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LEGEND

DPT LOCATION [1,2,3]

- NO DETECTION (NEITHER SHALLOW NOR INTERMEDIATE)
- DETECTION IN SHALLOW SAMPLE
- DETECTION IN INTERMEDIATE SAMPLE
- DETECTION IN SHALLOW AND INTERMEDIATE SAMPLE

DPT DESIGNATION — P6 — 16 FT. — SAMPLE DEPTH

ANALYTE (VOCs)[4,5]	
B	26
CBZ	114
TCE	2-J
VC	40

J QUALIFIER INDICATES ESTIMATED VALUE

1 - ADDITIONAL DPT LOCATIONS ARE P1 THRU P33.
2 - PHASE I DPT LOCATIONS ARE G01 THRU G174.
3 - PHASE II DPT LOCATIONS ARE G198 THRU G279.
4 - CONCENTRATION IN MICROGRAMS PER LITER (ug/L)
5 - SEE ANALYTICAL ABBREVIATIONS FOR EXPLANATION

ANALYTICAL ABBREVIATIONS

DBCE = DIBROMOCHLOROETHANE
1,2-DBE = 1,2-DIBROMOETHANE
B = BENZENE
CBZ = CHLOROBENZENE
c-DCE = cis-1,2-DICHLOROETHENE
t-DCE = trans-1,2-DICHLOROETHENE
PCE = TETRACHLOROETHENE
TCE = TRICHLOROETHENE
VC = VINYL CHLORIDE
X = XYLENES

SWAMP/ WOODS
POND
POND
POND
WOODS
WOODS
WOODS
BOGGY CREEK
ROAD

P9 16 FT.		DUPLICATE	
B	ND	B	1
CBZ	6	CBZ	4.9
c-DCE	7	c-DCE	6.7
t-DCE	ND	t-DCE	.27-J
TCE	ND	TCE	.34-J
VC	11	VC	7

P1 14 FT.	
B	ND
CBZ	25
c-DCE	ND
DUPLICATE	
B	.64-J
CBZ	21
c-DCE	.078-J

P8 16 FT.	
CBZ	6

P7 16 FT.	
B	20
CBZ	43
c-DCE	3-J
PCE	6
TCE	10

P6 16 FT.	
B	26
CBZ	114
TCE	2-J
VC	40

P2 14 FT.	
B	2-J
CBZ	13

P3 16 FT.	
B	11
CBZ	23

P4 16 FT.	
TCE	5

P5 16 FT.	
CBZ	11
c-DCE	28
TCE	7
VC	209

P29 14 FT.	
CBZ	10
c-DCE	1-J
PCE	5-J
TCE	27

P30 14 FT.	
B	ND
TCE	5-J
DUPLICATE	
B	.74-J
TCE	ND

P31 14 FT.	
1,2-DBE	5-J
DBCE	5-J
TCE	5-J

P32 14 FT.	
TCE	5

P33 14 FT.	
PCE	4
TCE	76
c-DCE	9

P23 14 FT.	
TCE	4-J

G66 G67 G68 G69 G70 G71 G72 G73 G74 G149 G148 G150 G151 G145 G147 G146 G32 G152 G226 G224 G225 G173 G223 G174 G172 G31 G198 G30 G199 G222 G29 G221 G28 G220 G200 G27 G219 G201 G26 G218 G25 G217 G24 G216 G202 G23 G215 G22 G214 G21 G213 G20 G19 G18 G204 G17 G212 G22 G211 G16 G205 G15 G206 G14 G207 G13 G210 G251 G209 G208 G262 G263 G264 G265 G266 G267 G268 G270 G271 G272 G273 G274 G275 G276 G277 G278 G279 G254 G253 G252 G51 G50 G49 G48 G47 G46 G45 G44 G43 G42 G41 G40 G39 G38 G37 G36 G35 G34 G33 G12 G11 G10 G09 G08 G07 G06 G05 G04 G03 G02 G01 G236 G237 G238 G239 G240 G241 G242 G243 P1 P2 P3 P4 P5 P6 P7 P8 P9 P10 P11 P12 P13 P14 P15 P16 P17 P18 P19 P20 P21 P22 P23 P24 P25 P26 P27 P28 P29 P30 P31 P32 P33 P34 B

-N-

200 0 200
SCALE IN FEET

FIGURE 5-3H

ADDITIONAL DIRECT-PUSH TECHNOLOGY
GROUNDWATER RESULTS
SHALLOW AQUIFER
McCOY ANNEX LANDFILL
REMEDIAL INVESTIGATION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Rev. 2
03/07/01

5-161

CTO 0024

CAD FILE NO./DATE: 7457F064.dgn/3-7-01

n11x17vb.dgn

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LEGEND

DPT LOCATION [1,2,3]
- NO DETECTION (NEITHER SHALLOW NOR INTERMEDIATE)
- DETECTION IN SHALLOW SAMPLE
- DETECTION IN INTERMEDIATE SAMPLE
- DETECTION IN SHALLOW AND INTERMEDIATE SAMPLE

DPT DESIGNATION — P6 — 16 FT. — SAMPLE DEPTH

ANALYTE (VOCs) [4,5]	
B	26
CBZ	114
TCE	2-J
VC	40

J QUALIFIER INDICATES ESTIMATED VALUE

1 - ADDITIONAL DPT LOCATIONS ARE P1 THRU P33.
2 - PHASE I DPT LOCATIONS ARE G01 THRU G174.
3 - PHASE II DPT LOCATIONS ARE G198 THRU G279.
4 - CONCENTRATION IN MICROGRAMS PER LITER (ug/L)
5 - SEE ANALYTICAL ABBREVIATIONS FOR EXPLANATION

ANALYTICAL ABBREVIATIONS

1,4-DCB = 1,4-DICHLOROBENZENE
B = BENZENE
CBZ = CHLOROBENZENE
c-DCE = cis-1,2-DICHLOROETHENE
t-DCE = trans-1,2-DICHLOROETHENE
PCE = TETRACHLOROETHENE
TCE = TRICHLOROETHENE
VC = VINYL CHLORIDE
X = XYLENES

SWAMP/ WOODS
POND
POND
POND
WOODS
BOGGY CREEK
ROAD

P1 28 FT.	
B	13
CBZ	22
c-DCE	15
X	30
VC	9
DUPLICATE	
B	.645
CBZ	21
c-DCE	.078-J

P2 28 FT.	
1,4-DCB	23
B	37
CBZ	42
c-DCE	11
X	43
VC	9

P3 28 FT.	
1,4-DCB	20
B	31
CBZ	31
c-DCE	38
X	49
VC	12

P4 28 FT.	
1,4-DCB	10
B	38
CBZ	48
c-DCE	18
X	5
VC	13

P5 30 FT.	
B	45
CBZ	50
c-DCE	9
TCE	5-J
VC	10

P6 30 FT.	
B	24
CBZ	15
c-DCE	5
TCE	5-J
VC	6

P7 30 FT.	
B	52
CBZ	77
c-DCE	6
X	9-J
TCE	5
VC	11
DUPLICATE 28 FT.	
B	34
CBZ	49
c-DCE	4.4-J
X	ND
TCE	ND
VC	ND

P8 30 FT.	
B	40
CBZ	44
c-DCE	5
VC	8

P9 30 FT.	
B	41
VC	30

P10 30 FT.		DUPLICATE 28 FT.	
B	6	B	2.5
CBZ	32	CBZ	25
c-DCE	7	c-DCE	10
VC	7	PCE	6
		TCE	2.6
		VC	8.1

P11 30 FT.	
CBZ	15
c-DCE	4-J
PCE	4-J
TCE	5
VC	4-J

P12 30 FT.	
B	36
CBZ	37
c-DCE	2-J
VC	5-J

P13 30 FT.	
B	4-J
VC	3-J

P14 30 FT.	
B	22
CBZ	58
X	7-J
VC	7

P16 28 FT. DUPLICATE	
c-DCE	.29-J

P20 28 FT.	
PCE	4-J

P21 28 FT.	
PCE	4-J
TCE	3-J

P22 28 FT.	
PCE	20
TCE	9

P23 28 FT.	
PCE	5-J
TCE	7

P29 28 FT.	
CBZ	11
PCE	5-J
TCE	30

P30 28 FT.	
CBZ	12
c-DCE	3-J
PCE	5
TCE	50
VC	4-J

P31 28 FT.		DUPLICATE	
B	ND	B	2.3
CBZ	2-J	CBZ	1.5-J
c-DCE	8	c-DCE	6.3
PCE	5	PCE	.75-J
t-DCE	ND	t-DCE	.38-J
TCE	134	TCE	38-J
VC	9	VC	4.4

P32 28 FT.		DUPLICATE	
B	ND	B	1.8-J
CBZ	ND	CBZ	1-J
c-DCE	16	c-DCE	15
PCE	8	PCE	4.1-J
TCE	360	TCE	200
VC	12	VC	8.3

P33 28 FT.		DUPLICATE	
B	ND	B	1.3-J
CBZ	ND	CBZ	.73-J
c-DCE	ND	c-DCE	2.3
X	ND	X	.99-J
PCE	4-J	PCE	.78-J
TCE	66	TCE	32
VC	ND	VC	1.8

P34 28 FT.		DUPLICATE	
B	ND	B	.36-J
CBZ	16	CBZ	14
c-DCE	1-J	c-DCE	.76-J
PCE	5	PCE	1.9
TCE	37	TCE	25
VC	ND	VC	.32-J

5-163

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200 0 200
SCALE IN FEET

FIGURE 5-31

ADDITIONAL DIRECT-PUSH TECHNOLOGY
GROUNDWATER RESULTS
INTERMEDIATE AQUIFER
McCOY ANNEX LANDFILL
REMEDIAL INVESTIGATION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

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(maximum concentration 23 µg/L at P02) was detected in intermediate samples from P02, P03, and P04. M-, P-, & O-xylenes (maximum concentration 49 µg/L at P03) was detected in intermediate samples collected from P01, P02, P03, P07, and P14. PCE (maximum concentration 6 µg/L at P10) was detected in intermediate samples from P10 and P11. DCE (maximum concentration 6 µg/L at P10) was detected in the intermediate samples from P04, P05, P06, P07, P10, and P11. Vinyl chloride (maximum concentration 13 µg/L at P04) was detected in intermediate samples from P01, P02, P03, P04, P05, P06, P07, P08, P09, P10, P11, P12, P13, and P14.

The second area consists of sample locations P20 through P22 (the eastern end of Line 3) and P23 (part of Line 4). This area is located north and west of the fourth area of VOC contamination described in Section 5.3.1.1 (Figure 5-3H). PCE was detected in all intermediate samples from this area (maximum concentration of 20 µg/L at P22). DCE was detected in the shallow sample from P23, and in intermediate samples from P21, P22, and P23 (maximum concentration 9 µg/L at P22).

The third area of detected VOC groundwater contamination is located west and south of the fourth area described in Section 5.3.1.1 (Figure 5-3H). It consists of sample locations P29 through P33 (Line 5), and location P34 of Line 4. VOCs were detected in both shallow and intermediate samples collected in this area. VOCs detected in the shallow samples include benzene (P30 at 0.074 µg/L), chlorobenzene (P29 at 10 µg/L), cis-1,2,-dichloroethene (P29 and P33 at 1J ug/L and 9 ug/L, respectively), PCE (P29 and P33 at 5J µg/L and 4J µg/L, respectively), and DCE (P29, P30, P31, P32, P33, and P34 at 27 µg/L, 5J µg/L, 5J µg/L, 5 µg/L, 76 µg/L, and 6 µg/L, respectively). VOCs detected in intermediate samples include benzene (P31, P32, P33, and P34 at 2.3 µg/L, 1.8J µg/L, 1.3J µg/L, and 0.36J µg/L, respectively), chlorobenzene (P29, P30, P31, P32, P33, and P34 at 11 µg/L, 12 µg/L, 2J µg/L, 1.8J µg/L, 1.3J µg/L, and 0.36J µg/L, respectively), cis-1,2,-dichloroethene (P29, P30, P31, P32, P33, and P34 at 1J µg/L, 3J µg/L, 8 µg/L, 16 µg/L, 2.3 µg/L, and 0.76J µg/L, respectively), PCE (P29, P30, P31, P32, P33, and P34 at 5J µg/L, 5 µg/L, 5 µg/L, 8 µg/L, 4J µg/L, and 5 µg/L, respectively), DCE (P29, P30, P31, P32, P33, and P34 at 30 µg/L, 50 µg/L, 134 µg/L, 360 µg/L, 66 µg/L, and 37 µg/L, respectively), and vinyl chloride (P30, P31, P32, P33, and P34 at 4J µg/L, 9 µg/L, 12 µg/L, 1.8 µg/L, and 0.32J µg/L, respectively). For samples that have field laboratory and fixed-base laboratory (duplicate) analyses, the higher concentration is listed (see Table 5-3R).

The analytical results of the additional DPT groundwater sampling substantiate the presence of two contaminant plumes of differing compositions at the study area. A northern plume is defined by the third and fifth areas discussed in Section 5.3.1.1 (Figure 5-3H) and the first area described in this section. Its composition is predominantly of petroleum hydrocarbon constituents. Benzene (20 exceedances, maximum concentration 45 µg/L) and vinyl chloride (19 exceedances, maximum concentration 209 µg/L)

are the principal contaminants present at concentrations meeting or exceeding the screening criteria. Xylenes (3 exceedances, maximum concentration 49 µg/L), chlorobenzene (1 exceedance, concentration 114 µg/L), PCE (4 exceedances, maximum concentration 6 µg/L), and DCE (7 exceedances, maximum concentration 10 µg/L) were also detected at concentrations meeting or exceeding the screening criteria. These contaminants were present in the shallow (water table) and intermediate (30 feet bgs) zones of the aquifer at P02 through P07 and at P09 (Line 1). There were no shallow detections in P10 through P14 (Line 2), but intermediate samples from each location contained detections. The additional DPT groundwater data (contaminant type, contaminant concentrations, and location within the aquifer) correlate well with results from the third and fifth areas as identified by Phase I and Phase II, and are consistent with the hydrologic model.

The southern plume area is defined by the fourth area of groundwater contamination discussed in Section 5.3.1.1 (Figure 5-3H) and the second and third areas described in this section. PCE (13 exceedances, maximum concentration 20 µg/L) and TCE (20 exceedances, maximum concentration 360 µg/L) are the principal contaminants at concentrations meeting or exceeding GCTLs, and account for 33 of 44 exceedances. Other contaminants exceeding the GCTLs include vinyl chloride (6 exceedances, maximum concentration 12 µg/L), benzene (3 exceedances, maximum concentration 2.3 µg/L), 1,2-dibromomethane (1 exceedance, concentration 5J µg/L), and dibromochloromethane (1 exceedance, concentration 5J µg/L). Of these exceedances, 10 were shallow zone detections (P23 and P29-P34), and the remaining 34 were intermediate zone detections (P20-P23 and P29-P34). There were no VOC detections in either zone at locations P15 through P19 and P24. Additional DPT groundwater data from the southern plume correlate well, although at lower concentrations, with results from the fourth area as identified by Phase I and Phase II DPT groundwater sampling, and are consistent with the hydrologic model.

The differing compositions of the two groundwater plumes, and the relative occurrence of certain contaminants within the plumes, suggests that biogenic processes attenuating the plumes differ as well. In the northern plume there is an abundance of vinyl chloride 918 detections) and TCE (11 detections), daughter products of the biogenic degradation of PCE, and a small amount of PCE (3 detections). This implies a low oxygen or anoxic subsurface environment because oxygen is needed for the microbes to complete the breakdown of the PCE by converting the vinyl chloride to carbon dioxide. Additionally, the microbes degrading chlorinated VOCs must compete with any degrading petroleum VOCs for oxygen that does enter the environment. Comparison of the amount of benzene (21 detections) with xylenes (5 detections) in the plume indicates the probability of biogenic degradation of petroleum VOCs.

The southern plume is predominantly composed of PCE (16 detections) and TCE (20 detections) with a small amount of vinyl chloride (7 detections). This indicates that biogenic degradation of chlorinated VOCs is occurring in this plume, but not to the extent observed in the northern plume. This could be due to a variety of reasons, such as the plume's source being in place for a shorter period of time, or that the subsurface environment may normally be low in oxygen and unable to promote the growth of a large population of microbes.

5.4 SURFACE WATER

Samples were collected during Phases I and II to identify impacts to surface water and sediment in the drainage canals and ponds at OU 2. Subsequently the canals were cleaned and dredged during maintenance operations by county personnel, thereby reducing the usefulness of the original surface water and sediment samples collected in Phase II. Thus, the canals were resampled in Phase III. In addition samples were collected at upstream and off-site locations upgradient from the landfill to assist in isolating impacts due to the landfill from those with other causes. The locations of the sampling points, the procedures used to collect the samples, and the rationale for collection are discussed in Section 3.4. The chemicals detected and their distribution are presented in the following sections. Throughout this section, tables and figures indicate concentrations that meet or exceed screening criteria; for ease of discussion these concentrations will subsequently by identified in the text as "exceeding" the criteria.

5.4.1 Phases I and II

Twenty-two surface water samples, plus three field duplicates and one resample, were collected at OU 2 (Figure 5-4A) and analyzed at a fixed-base laboratory. Analytical parameters are detailed in Section 3.4.1. Data were validated according to established procedures as detailed in Section 4.3, and the analytical results of the investigation are presented in Appendix B. The samples were collected during July, August, and September 1998, which are historically in the wet season in Orange County, Florida.

Six organic chemicals, 18 inorganic chemicals, and two radiological parameters were detected in the surface water samples (Table 5-4A). Only chemicals that were detected in at least one sample are presented on the summary table. Table 5-4B presents the minimum value, maximum value, frequency of detection, and location of the maximum for each chemical detected. The detected chemicals were compared to Florida Freshwater Surface Water Criteria (FSWC) (FDEP, 1999). The screening criteria are identified in Table 5-4A. Detected analytes that exceeded these screening criteria are shaded in Table 5-4A and appear in Figure 5-4A. Calcium, magnesium, potassium, and sodium are abundant in

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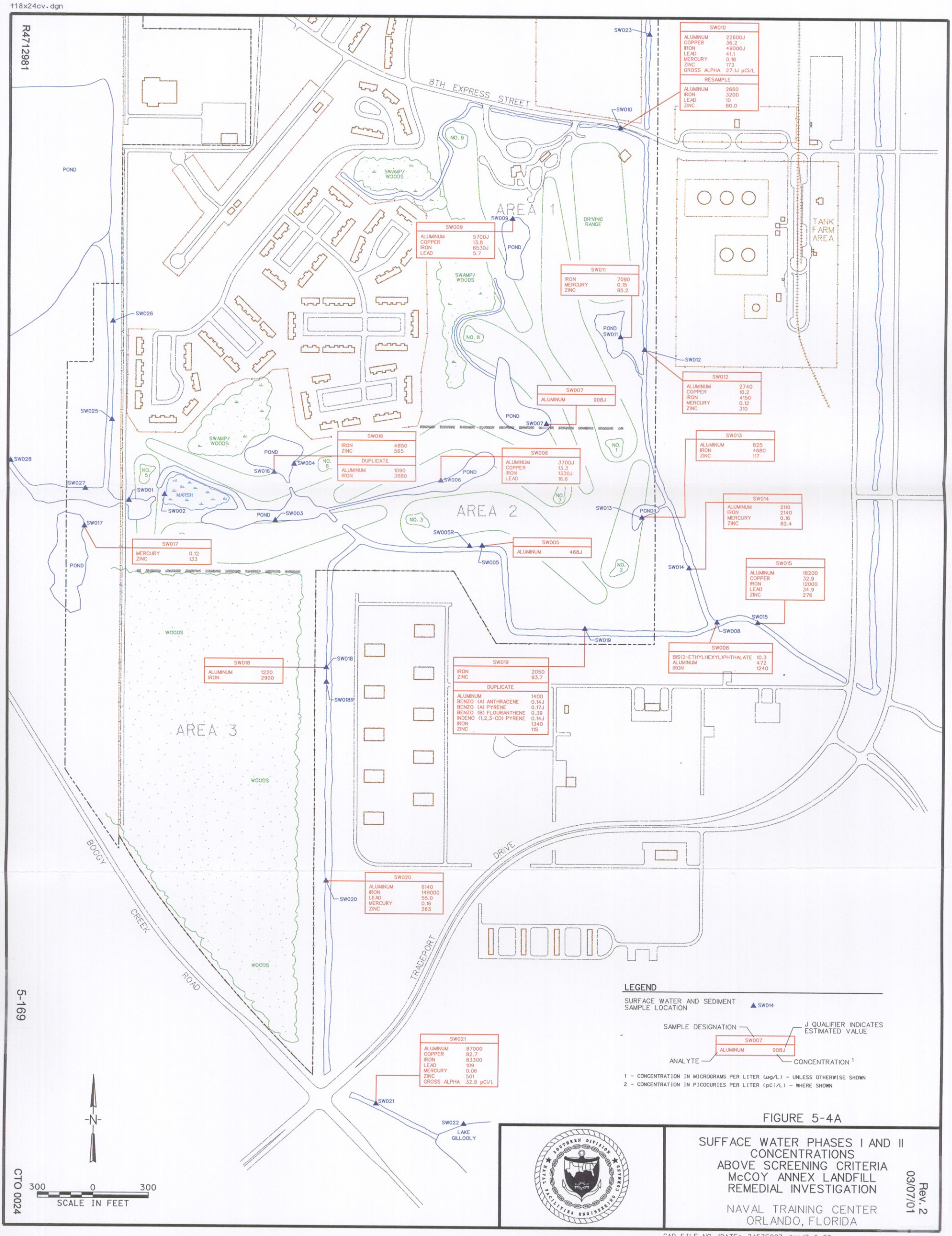

FIGURE 5-4A

SUFFACE WATER PHASES I AND II
CONCENTRATIONS
ABOVE SCREENING CRITERIA
McCOY ANNEX LANDFILL
REMEDIAL INVESTIGATION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

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TABLE 5-4A

SURFACE WATER PHASES I AND II—DETECTED ORGANICS AND INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]	SW001	SW002	SW003	SW004	SW005	SW006	SW006-D	SW007	SW008	SW009	SW010	SW1002	SW011	SW012
SAMPLE DATE		7/1/97	7/1/97	7/1/97	7/1/97	7/1/97	7/2/97	7/2/97	7/2/97	7/18/97	7/2/97	7/2/97	9/24/97	8/25/98	8/25/98
Volatiles (µg/L)															
Toluene	475													16.3	
Semivolatiles (µg/L)															
Benzo(a)anthracene	0.031														
Benzo(a)pyrene	0.031														
Benzo(b)fluoranthene	0.031														
bis(2-ethylhexyl)phthalate	0.02									10.3					
Indeno(1,2,3-cd)pyrene	0.031														
Pesticides/PCBs (µg/L)		(c)	(c)	(c)	(c)	(c)			(c)	(c)	(c)	(c)	(c)	(c)	(c)
Hebicides (µg/L)															
TPH[d] (mg/L)															
Metals (µg/L)															
Aluminum	13					468 J	3700 J		908 J	472	5700 J	22600 J	2600		2740
Arsenic	50						5.0		5.4		7.0	18.4			
Barium	**			10.6	11.6	11.1	26.9	15.9	11.8	12.2	43.0	118		11.5	53.5
Calcium	*	10400	10400	10500	9460	10300	14700	12100	10100	12500	11900	41000	25800	11900	24900
Chromium	151.99[e]						6.6		2.2		11.2	29.2			
Cobalt	*											12.4			
Copper	8.57[e]			3.9		2.8	13.3				13.8	36.2		5.8	10.2
Iron	1000	272 J	292 J	324 J	606 J	288 J	1330 J	146 J	588 J	1240	6530 J	49000 J	3200	7090	4150
Lead	1.97[e]						16.6				5.7	41.1	10		
Magnesium	*	1090	1100	1350	731	1230	3360	3380	3310	1200	4130	8240	10300	2710	4350
Manganese	*	6.5 J	9.3 J	14.7 J			55.0 J	24.4 J	57.7 J	6.4	31.6 J	1360 J	50	49.9	54.3
Mercury	0.012											0.18		0.15	0.12
Nickel	114.60[e]										2.9	9.2			
Potassium	*	1850	1860	2020	341	1780	3800	3190	2640	1160	2830	3240	5000		1020
Selenium	5											4.0			
Sodium	*	7520	5860	6370	2680	6470	16100	14300	16400	5370	20700	13400	22500	5130	14100
Vanadium	*						9.0	2.0	4.5		15.0	272			12.0
Zinc	77[e]						27.8			11.10	37.9	173	80.00	95.2	310
Radiological (pCi/L)															
gross Alpha	15			1.07 J		1.25 J	7.32 J	3.03 J		5.33	13.7 J	27.1 J	11.0		
gross Beta[f]	50	1.52	2.21	1.34			6.06	3.69	1.19	2.39	7.53	11.5	7.43		
Miscellaneous (mg/L)															
Hardness as CaCO3	*	34.4	28.6	32.5	43.9	51.6	61.1	42	45.8		59.2	155			
Total Alkalinity	*	23.9	24.9	24.4	20.5	21.4	24.4	30.2	19.9	61.3	17.1	64.4			
Total Dissolved Solids	*	106	169	153	122	104	223	159	365	90	166	67			
Total Suspended Solids	*	9	23		11		120	31	85	42	100	725			
Total Organic Carbon	*													25.7	13.1

TABLE 5-4A

SURFACE WATER PHASES I AND II—DETECTED ORGANICS AND INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]	SW013	SW014	SW015	SW016	SW016-D	SW017	SW018	SW019	SW019-D	SW020	SW021	SW022
SAMPLE DATE		8/25/98	8/26/98	8/26/98	8/25/98	8/25/98	8/25/98	8/27/98	8/25/98	8/25/98	8/27/98	8/26/98	8/26/98
Volatiles (µg/L)													
Toluene	475												
Semivolatiles (µg/L)													
Benzo(a)anthracene	0.031									0.14 J			
Benzo(a)pyrene	0.031									0.17 J			
Benzo(b)fluoranthene	0.031									0.39			
bis(2-ethylhexyl)phthalate	0.02												
Indeno(1,2,3-cd)pyrene	0.031									0.14 J			
Pesticides/PCBs (µg/L)		(c)	(c)	(c)	(c)	(c)	(c)	(c)		(c)	(c)		(c)
Hebicides (µg/L)													
TPH[d] (mg/L)													
Metals (µg/L)													
Aluminum	13	825	2110	18200		1090		1220		1400	6140	87000	
Arsenic	50										13.6	18.3	
Barium	**	67.4	49.0	117	16.7	16.7	23.8	16.9	26.7	31.6	85.5	524	20.5
Calcium	*	16400	20200	23400	19600	20500	74500	13100	16000	14400	20700	73100	13200
Chromium	151.99[e]											74.2	
Cobalt	*												
Copper	8.57[e]	5.7	6.5	32.9	4.2	5.8	5.6	8.2	3.9	6.4	4.6 J	82.7	1.8
Iron	1000	4680	2140	12000	4850	3680		2900	2050	1340	149000	83300	732
Lead	1.97[e]			34.9							55.0	109	
Magnesium	*	4510	4210	3200	1370	1520	12600	1320	1690	1960	2270	5910	1660
Manganese	*	77.9		47.7	14.9		16.7		18.8	16.4	419	367	16.6
Mercury	0.012		0.16				0.12				0.16	0.06	
Nickel	114.60[e]											17.7	
Potassium	*	6070	1190	1430			18800	741	1250	1180	673 J	863	1500
Selenium	5												
Sodium	*	30300	14600	8040	5370	5590	20800	6640	7890	7910	8200	11500	7690
Vanadium	*			33.3							24.9	77.9	
Zinc	77[e]	117	82.4	276	565	61.7	133	64.2	93.7	115	263	501	69.2
Radiological (pCi/L)													
gross Alpha	15	1.9	4.9	5.5				1.4		7.7	12.4	32.9	4
gross Beta[f]	50	10.7	2	4.1			18.5	1.6	2.6	5.6	6.1	17	
Miscellaneous (mg/L)													
Hardness as CaCO3	*												
Total Alkalinity	*												
Total Dissolved Solids	*												
Total Suspended Solids	*												
Total Organic Carbon	*	58.9	16.7	30.5	12.6	15.4	7.6	23.4	12.8	22.5	108	75.9	6.3

TABLE 5-4A

SURFACE WATER PHASES I AND II-DETECTED ORGANICS AND INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

* Screening value not available.
** Not greater than 10 percent above background.
"J" qualifier indicates an estimated value.
No entry indicates chemical not detected.
Only chemicals detected in at least one sample are shown.
The complete list of samples and analytical results is presented in Appendix B of this report.
Shaded entry indicates chemical detected at a concentration exceeding screening criteria.

(a) "D" in sample location indicates a duplicate sample.
(b) Surface Water Cleanup Target Level (Development of Soil Cleanup Target Levels Chapter 62-777, F.A.C., May 26, 1999).
(c) Not analyzed for PCBs
(d) Total Petroleum Hydrocarbons
(e) Hardness dependent per Chapter 62-3-2, F.A.C.
(f) The screening value of 50 pCi/L (40 CFR 141) is referenced because the activities for specific radionuclides in the samples have not been determined. These data are required for conversion to the 4 millirem/year federal and state reference level.

TABLE 5-4B

SURFACE WATER PHASE I AND PHASE II—FREQUENCY OF DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	CAS Number	Minimum Concentration	Maximum Concentration	Location of Maximum Concentration	Detection Frequency
Volatiles (µg/L)					
Toluene	108-88-3	16.3	16.3	SW011	1/20
Semivolatiles (µg/L)					
Benzo(a)anthracene	56-55-3	0.14J	0.14J	SW019	1/20
Benzo(a)pyrene	50-32-8	0.17J	0.17J	SW019	1/20
Benzo(b)fluoranthene	205-99-2	0.245	0.39	SW019	1/20
Bis(2-ethylhexylphthalate	117-81-7	10.3	10.3	SW008	1/20
Indeno(1,2,3-cd)pyrene	193-39-5	0.14J	0.14J	SW019	1/20
PCBs and Pesticides (µg/L)					
Inorganics (µg/L)					
Aluminum	7429-90-5	468J	87000	SW021	15/21
Arsenic	7440-38-2	3.625	18.4	SW010	6/21
Barium	7440-39-3	10.6	524	SW021	19/21
Calcium	7440-70-2	9460	74500	SW017	21/21
Chromium	7440-47-3	2.2	74.2	SW021	5/21
Cobalt	7440-48-4	12.4	12.4	SW010	1/21
Copper	7440-50-8	1.8	82.7	SW021	17/21
Iron	7439-89-6	146J	149000	SW020	20/21
Lead	7439-92-1	5.7	109	SW021	7/21
Magnesium	7439-95-4	731	12600	SW017	21/21
Manganese	7439-96-5	9.3J	1360J	SW010	17/21
Mercury	7439-97-6	0.06	0.18	SW010	7/21
Nickel	7440-02-0	2.9	17.7	SW021	3/21
Potassium	7440-09-7	341	18800	SW017	19/21
Selenium	7782-49-2	4	4	SW010	1/21
Sodium	7440-23-5	2680	30300	SW013	21/21
Vanadium	7440-62-2	2	272	SW010	8/21
Zinc	7440-66-6	15.425	565	SW016	16/21

TABLE 5-4B

SURFACE WATER PHASE I AND PHASE II—FREQUENCY OF DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	CAS Number	Minimum Concentration	Maximum Concentration	Location of Maximum Concentration	Detection Frequency
Miscellaneous (mg/L)					
Alkalinity as C_aCO^3		17.1	64.4	SW010	8/8
Hardness as C_aCO^3	7440-66-6	28.6	202	SW017	20/20
Total dissolved solids		67	365	SW007	8/8
Total organic carbon		6.3	108	SW020	12/12
Total suspended solids		11	725	SW010	6/8
Radiological (pCi/L)					
Gross alpha		1.07J	32.9	SW021	15/22
Gross beta		1.19	18.5	SW017	16/22

"J" Qualifier indicates an estimated value.
Rejected values not included.
Table 4-1 and Section 4.3.3 provide details regarding rejected results.
Background samples not included.

natural soils, have a low toxicity to humans, and have no FSWC screening values. Therefore, these metals are not discussed further in this section.

5.4.1.1 Volatile Organic Compounds

Only one VOC (toluene) was detected in surface water at the site. Toluene was detected once at SW011 which is located in the pond at the southern end of the driving range. The concentration was 16.3 µg/L, which does not exceed the FSWC of 475 µg/L. Toluene is a common laboratory artifact.

5.4.1.2 Semivolatile Organic Compounds

Five SVOCs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, bis(2-ethylhexyl)phthalate, and indeno(1,2,3-cd)pyrene] were each detected only once in surface water at the site. Bis(2-ethylhexyl)phthalate was detected at location SW008 at a concentration of 10.3 µg/L, which exceeds the FSWC value of 0.02 µg/L. Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene were all detected in sample SW019-D (the duplicate of SW019) at concentrations of 0.14J, 0.17J, 0.39, and 0.14J µg/L, respectively. All of these SVOCs exceeded the FSWC values by 4.5 to 12.5 times (Table 5-4A). Surface water sampling points SW008 and SW019 are located in the same general area, that is, along the downstream reaches of the drainage canal that runs along the southern boundary of the golf course (Figure 5-4A). The SVOCs detected in these samples were not detected at surface water sampling points immediately upstream (i.e., samples SW014 and SW005) or downstream (i.e., sample SW015). Table 5-3C shows that the groundwater in the surficial aquifer immediately upgradient of these surface water sample locations also did not contain any of the detected SVOCs (see wells MW5A/B, MW6A/B, MW7A/B, and MW8A/B). The surface soil data, however, show exceedances of the screening criteria for several of these SVOCs at locations on the north side of the hole No. 3 fairway (see samples S91 and S101 on Figure 5-2). These surface soil sample locations are approximately 300 feet from the drainage canal.

5.4.1.3 Pesticides and Polychlorinated Biphenyls

No pesticides or PCBs were detected in surface water at OU 2.

5.4.1.4 Herbicides

No herbicides were detected in surface water at OU 2.

5.4.1.5 Total Petroleum Hydrocarbons

No TPH was detected in surface water at OU 2.

Inorganics

Eighteen metals were detected in surface water at OU 2. Metals that exceeded the FSWC values by an order of magnitude, or more, include aluminum, copper, iron, lead, and mercury. There are no screening criteria for barium (detected in 19 out of 22 samples), cobalt (detected in 1 out of 22 samples), manganese (detected in 17 out of 21 samples), or vanadium (detected in 8 out of 22 samples). Table-5-4B shows the frequency of detection and the minimum and maximum values and locations for all detected chemicals.

Iron (detected in 20 out of 22 samples), barium (detected in 19 out of 22 samples), and manganese (detected in 17 out of 22 samples) were detected most frequently. The samples collected at locations SW010 and SW021 contained the largest number of metals at concentrations above the screening criteria. These locations are much closer to paved streets than any of the other sampling locations. Sample SW010 located just north of the driving range was resampled on September 24, 1997, and labeled SW1002. The results for sample SW1002 showed significantly reduced concentrations for all metals that exceeded the FSWC. No upgradient sample exists for SW010; however, sample SW012 is located downgradient and shows similar metals that exceed the FSWC. Although the cultural features in the area of SW010 (e.g., buildings, maintenance equipment, and fences) complicated the interpretation of the geophysical data, comments from golfers that had been using the course for a long time indicate that landfilling activities occurred in the area. The sample from SW010 also contained the highest concentrations of suspended solids and the highest alkalinity, thereby suggesting a localized source of impact to surface water (Table 5-4B).

Sample SW021 is located southeast of the site, south of Tradeport Road. Sampling data from locations upstream of SW021 show lower concentrations for most metals indicating a source (i.e., runoff from Tradeport Drive and/or Boggy Creek Road) located between samples SW020 and SW021. Sampling data from the furthest downstream location, SW022, did not show any exceedance of the FSWC. Sample location SW022 is located in Lake Gillooly downstream of SW021 where some dilution and more settling

could occur, but this sample was obtained near the inlet of the lake. The downstream sample suggests that the elevated metal concentrations at SW021 are reduced to acceptable levels prior to reaching the lake.

5.4.1.6 Radiological

Gross alpha and gross beta were measured in all of the surface water samples. Only gross alpha was detected above its screening criterion. The sample from location SW010 exceeded the FSWC by 1.8 times and the sample from location SW021 exceeded the FSWC by 2.2 times. Sample location SW010 was subsequently resampled for confirmation purposes. The sample was designated SW1002 (Table 5-4A). Gross alpha was not detected above its screening criterion in the confirmation sample; therefore, isotopic analysis for specific radionuclides was not performed. Samples upstream and downstream of location SW021 showed no exceedances of the FSWC for gross alpha. As was noted for the inorganics, these two sampling locations are nearer to paved streets than any other surface water sampling locations. Table 5-4B shows that the sample from SW010 also contained the highest concentrations of suspended solids and total alkalinity.

5.4.1.7 Phase I and Phase II Summary

Phase I and Phase II surface water results at OU 2 show exceedances of the FSWC for SVOCs, metals, and radiological parameters. Bis(2-ethylhexyl)phthalate was detected in the sample from SW008 above the screening value; however, this chemical is a common laboratory contaminant and it was not found in any of the other surface water samples. Therefore, this low-level detection is considered to be an artifact of the laboratory. Radiological parameters do not greatly exceed the FSWC. Sampling data show exceedances of FSWC at many of the sample locations for metals. Metals with the greatest exceedances of the FSWC values are aluminum, iron, and lead. Because the surficial aquifer was shown to contain relatively high concentrations of metals (see Figures 5-3C and 5-3D) and because this aquifer discharges into the canal, the detection of metals in the surface water is consistent with the local hydrogeologic system.

5.4.2 Phase III

Seventeen surface water samples (6 upstream locations and 11 resampled locations), plus two field duplicates, one MS/MSD, and one trip blank were collected at OU 2 and analyzed at a fixed-base laboratory. Analytical parameters are detailed in Section 3.4.1. Data were validated according to established procedures and the analytical results are presented in Appendix B. The samples were

collected during mid-August 1999, which is historically in the wet season for Orange County, Florida. However, water levels in the canals were low, indicating that base flow conditions existed.

Nine organic chemicals, 17 inorganic chemicals, and 2 radiological parameters were detected in the surface water (Table 5-4C). Table 5-4D presents the minimum and maximum values, frequency of detection and location of the maximum for each chemical detected. The detected chemicals were compared to the Florida FWSC (FDEP, 1999) identified in Table 5-4C. Detected analytes that exceeded those screening criteria are shaded in Table 5-4C and the distribution of exceedances appears in Figure 5-4B.

5.4.2.1 Volatile Organic Compounds

Only the six upstream surface water samples were analyzed for VOCs during Phase III. VOCs were detected at three of the upstream locations. All of the detected VOCs were at low concentrations and none exceeded the FWSC values.

Acetone, chloroform, and toluene were detected in surface water during Phase III sampling at the site (Table 5-4C). Chloroform was detected (0.32J μg/L) at the northeastern upstream location SW024. Toluene (0.31J μg/L) was detected in western-most upstream location SW027, while both acetone (12 μg/L) and toluene (0.36J μg/L) were detected in the western upstream location SW028. Acetone, toluene, and chloroform are highly volatile chemicals and they are common laboratory contaminants; the low levels detected may not be indicative of environmental pollutants.

5.4.2.2 Semivolatile Organic Compounds

All Phase III surface water samples were analyzed for SVOCs. One SVOC, bis(2-ethylhexyl)phthalate, exceeded the screening criterion (0.02 μg/L) at all five locations (SW012, SW014, SW019, SW026, and SW028) where it was detected during Phase III (Table 5-4C). Two of the locations (SW026 and SW028) were the most upstream stations west of the landfill area at OU 2. Bis(2-ethylhexyl)phthalate is a component of many plastic materials and is a common laboratory contaminant; the low levels detected (max = 6.6J μg/L) may not be indicative of environmental pollutants.

5.4.2.3 Polycyclic Aromatic Hydrocarbons

All Phase III surface water samples were analyzed for PAHs. Naphthalene was the only PAH detected, and only at one location (SW019) in the southeast corner of the golf course near the tee for hole No. 3 at a concentration of 0.43J μg/L which is below its screening level.

TABLE 5-4C

SURFACE WATER PHASE III - DETECTED ORGANICS AND INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE ID[a]	SCREENING	SW001	SW005	SW008	SW010	SW012	SW014	SW015	SW018	SW019	SW020
SAMPLE DATE	CRITERIA[b]	8/11/99	8/11/99	8/12/99	8/12/99	8/11/99	8/11/99	8/12/99	8/12/99	8/11/99	8/12/99
Volatiles (µg/L)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acetone	1692										
Chloroform	470.8										
Toluene	175										
Semivolatiles (µg/l)											
bis(2-ethylhexyl)phthalate	0.02					6.6 J	4.9 J			4.3 J	
Naphthalene	26									0.43 J	
Pesticides/PCBs (µg/l)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aldrin	0.00014										
Endosulfan I	0.056										
Endrin Aldehyde	*										
Herbicides (µg/l)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dicamba	195										
Inorganics (µg/l)											
Aluminum	13	5500			638	569	819		15300 J		
Antimony	160										
Arsenic	50	4.8									
Barium	*	39.9	13.7	18.8	18.6	24	28.1	21.9	45.7	15.2	15.2
Calcium	*	17600	14200	13500	14000	30400	28200	16600	12700	13700	14500
Chromium	168.28[c]	7.9							14.5		
Copper	9.53[c]	12.4			0.91	1.4	4.3		3.3		
Iron	1000	5010		288	1700	1180	1510	899	2340		277
Lead	2.31[c]	12.4			1.2				7.3		
Magnesium	*	1390	1490	1590	2850	3390	3560	2140	1800	1570	1440
Manganese	*	159				12.5	19.7	11.7	10.9		4.7
Mercury	0.012	0.00341	0.00286	0.00124	0.00268	0.00837	0.00283	0.0028	0.00462	0.00095	0.00158
Nickel	127.31[c]	3.4					2.2			5.7	
Potassium	*				1830		1440		1180		
Sodium	*	9450 J	8420 J	8150 J	7010 J	9470 J	14500 J	8860 J	11100 J	8260 J	7410 J
Vanadium	*	11.5			8.1	6.5	5		11		
Zinc	85.56[c]	53.4			6.5		11.4	11.7	17.9		
General Chemistry (mg/L)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Alkalinity	*										
Hardness as $CaCO_3$	*										
Total Alkalinity	*										
Total Dissolved Solids	*										
Total Suspended Solids	*										
Radionuclides (pCi/L)											
Gross alpha	15	18.1	5	1.2	2.8	12.7	2.2	0.5	9.6	1.8	1.4
Gross beta[d]	50	14.2	3.5	2.2	4.1	7.4	2.7		7	2.3	2.2

TABLE 5-4C

SURFACE WATER PHASE III - DETECTED ORGANICS AND INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE ID[a]	SCREENING	SW020-D	SW021	SW023	SW023-D	SW024	SW025	SW026	SW027	SW028
SAMPLE DATE	CRITERIA[b]	8/12/99	8/12/99	8/10/99	8/10/99	8/10/99	8/10/99	8/11/99	8/10/99	8/10/99
Volatiles (µg/L)		NA	NA							
Acetone	1692									12 J
Chloroform	470.8					0.32 J				
Toluene	175								0.31 J	0.36 J
Semivolatiles (µg/l)										
bis(2-ethylhexyl)phthalate	0.02							4.5 J		4.4 J
Naphthalene	26									
Pesticides/PCBs (µg/l)		NA	NA		(e)	(e)	(e)	(e)	(e)	(e)
Aldrin	0.00014						0.033 J			0.018 J
Endosulfan I	0.056									0.015 J
Endrin Aldehyde	*			0.1 J						
Herbicides (µg/l)		NA	NA							
Dicamba	195					0.59 J				
Inorganics (µg/l)										
Aluminum	13	1810 J		295 J	712 J			645	1890 J	916 J
Antimony	160								5.4	
Arsenic	50									
Barium	*	19.7	15.6	27.6	29.3	25.4	15.9	15.2	20.6	14.8
Calcium	*	14100	14500	41000	40200	36100	14600	14200	30800	30300
Chromium	168.28[c]									
Copper	9.53[c]		5.7	0.92	3	1.1	1		2.5	2.2
Iron	1000	397		968	1070	1290	769	486	523	540
Lead	2.31[c]									
Magnesium	*	1450	1640	3630	3580	3450	1150	1160	1320	1540
Manganese	*	4.9		72.3	56	78.3	86.7	14.1		
Mercury	0.012	0.0017	0.00092	0.00913	0.0108	0.00859	0.00177	0.00814	0.00233	0.0124
Nickel	127.31[c]									
Potassium	*			1150 J	1130 J	1220 J	918 J		1040 J	1450 J
Sodium	*	7280 J	9020 J	10100	10200	10000	4920	5620 J	5120	5470
Vanadium	*									
Zinc	85.56[c]		23.1							
General Chemistry (mg/L)		NA	NA							
Alkalinity	*			NA	NA	(a)	(a)	31	(a)	(a)
Hardness as $CaCO_3$	*			130	120	120	48	42	50	81
Total Alkalinity	*			81	77	74	29	(a)	42	57
Total Dissolved Solids	*			170	170	150	71	86	77	120
Total Suspended Solids	*			7				5		28
Radionuclides (pCi/L)										
Gross alpha	15	0.7	0.9		1.9	1.9	0.8	1.6	1.4	2.7
Gross beta[d]	50	2	2.2	2.6	3.4	3.2	2.1	2.6	2.1	3.4

TABLE 5-4C

SURFACE WATER PHASE III – DETECTED ORGANICS AND INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

* Screening value not available.
"J" qualifier indicates an estimated value.
NA – Not Analyzed.

Shaded entry indicates chemical detected at a concentration that meets or exceeds the screening criterion.
No entry indicates chemical not detected.
[a] "D" in sample number indicates a duplicate sample.
[b] Surface Water Cleanup Target Levels (Development of Soil Cleanup Target Levels Chapter 62-777, F.A.C., May 26, 1999).
[c] Screening Criteria are hardness dependent; based on 1999 hardness average of 77.7 mg/L at 6 upstream locations.
[d] The screening value of 50 pCi/L (40 CFR 141) is referenced because the activities for specific radionuclides in the samples have not been determined. These data are required for conversion to the 4 millirem/year federal and state reference level.
[e] PCBs not analyzed.

TABLE 5-4D

SURFACE WATER PHASE III - FREQUENCY OF DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Parameter	CAS Number	Minimum Concentration	Maximum Concentration	Location of Maximum Detection	Detection Frequency
Volatiles (µg/L)					
Acetone	67-64-1	12J	12J	SW028	1/6
Chloroform	67-66-3	0.32J	0.32J	SW024	1/6
Toluene	108-88-3	0.31J	0.36J	SW028	2/6
Semivolatiles (µg/L)					
bis(2-ethylhexyl)phthalate	117-81-7	4.3J	6.6J	SW012	5/17
PAHs (ug/L)					
Naphthalene	91-20-3	0.43J	0.43J	SW019	1/17
Pesticides/PCBs (µg/L)					
Aldrin	309-00-2	0.018J	0.033J	SW025	2/6
Endosulfan I	959-98-8	0.015J	0.015J	SW028	1/5
Endrin Aldehyde	7421-93-4	0.1J	0.1J	SW023	1/5
Herbicides (µg/L)					
Dicamba	1918-00-9	0.59J	0.59J	SW024	1/6
Inorganics (µg/L)					
Aluminum	7429-90-5	295J	15300J	SW018	10/17
Antimony	7440-36-0	5.4	5.4	SW027	1/17
Arsenic	7440-38-2	4.8	4.8	SW001	1/17
Barium	7440-39-3	13.7	45.7	SW018	17/17
Calcium	7440-70-2	12700	41000	SW023	17/17
Chromium	7440-47-3	7.9	14.5	SW018	2/17
Copper	7440-50-8	0.91	12.4	SW001	11/17
Iron	7439-89-6	277	5010	SW001	14/17
Lead	7439-92-1	1.2	12.4	SW001	3/17
Magnesium	7439-95-4	1150	3630	SW023	17/17
Manganese	7439-96-5	4.7	159	SW001	10/17
Mercury	7439-97-6	0.00092	0.0124	SW028	17/17
Nickel	7440-02-0	2.2	5.7	SW019	3/17
Potassium	7440-09-7	918J	1830	SW010	8/17
Sodium	7440-23-5	4920	14500J	SW014	17/17
Vanadium	7440-62-2	5	11.5	SW001	5/17
Zinc	7440-66-6	6.5	53.4	SW001	6/17
General Chemistry (mg/L)					
Alkalinity		31	31	SW026	1/1
Hardness as $CaCO_3$		42	130	SW023	6/6
Total Alkalinity		29	81	SW023	5/5
Total Dissolved Solids		71	170	SW023-D, SW023	6/6
Total Suspended Solids		5	28	SW028	3/6
Radiological (pCi/L)					
gross Alpha		0.5	18.1	SW001	17/17
gross Beta		2	14.2	SW001	16/17

Resample Data 1999 were used in statistical analysis.
If a duplicate sample was taken at a location, the average of the two was used for statistical purposes.
"J" qualifier indicates an estimated value.
Rejected values not included.
Table 4-1 and Section 4.3.3 provide details regarding rejected results.

5.4.2.4 Pesticides and Polychlorinated Biphenyls

Only the six upstream surface water samples were analyzed for pesticides during Phase III. Three pesticides (aldrin, endosulfan, and endrin aldehyde) were detected at three upstream locations (SW028, SW025, and SW023) (Table 5-4C). Levels of aldrin at SW028 (0.018J μg/L) and at SW025 (0.033J μg/L) exceeded the surface water screening value (0.00014 μg/L). One upstream sample (SW023) was analyzed for PCBs but they were not detected. Neither pesticides nor PCBs were detected during Phase I or Phase II sampling.

5.4.2.5 Herbicides

Only the six upstream surface water samples were analyzed for herbicides during Phase III. One herbicide (dicamba) was detected (0.59J μg/L) at SW024 but did not exceed the screening value (195 μg/L). No herbicides were detected during Phase I and Phase II sampling of surface water.

5.4.2.6 Total Petroleum Hydrocarbons

TPH was not detected in any of the six upstream surface water samples that were analyzed for TPH during Phase III. TPH was not detected at any of the downstream locations sampled during Phases I and II.

5.4.2.7 Inorganics

Inorganic chemicals were detected in each of the 17 surface water samples analyzed during Phase III (Table 5-4C). Metals that exceeded the FWSC values include aluminum at 10 locations, iron at 7 locations, copper at 1 location, lead at 2 locations, and mercury (sampled and analyzed using ultra-clean methods) at 1 location. There are no screening criteria for barium (detected in 17 out of 17 samples), manganese (detected in 10 out of 17 samples), or vanadium (detected in 5 out of 17 samples).

A sample collected at location SW001 contained the largest number of inorganics at concentrations exceeding screening criteria (aluminum, copper, iron, and lead). During Phase I and Phase II sampling, exceedances were most prevalent at locations SW010 and SW021. Contrary to previous sampling, mercury exceeded screening criteria (0.012 µg/L) at only one upstream location (SW028 = 0.0124 µg/L) during Phase III. The reduction in mercury concentrations is attributed to special precautions taken during sampling and the use of an ultra-clean laboratory for the analyses.

5.4.2.8 Radiological

Gross alpha and gross beta were detected in each of the 17 Phase III surface water samples except gross alpha in SW023 and gross beta in SW015 (Table 5-4C). Gross alpha exceeded the screening criterion (15 pCi/L) at only one location (18.1 pCi/L at SW001). The concentrations of gross beta did not exceed the screening criterion.

Isotopic analysis was performed on sample SW001 because the screening criterion for gross alpha was exceeded. This analysis was performed to investigate the presence of naturally occurring radioactive isotopes that may be the source for the elevated gross alpha detections. Sample SW001 is located along the far western perimeter of the golf course on the west side of the water hazard for hole No. 5. SW001 is also downstream of sediment samples SD025 and SD026 that contained exceedances of gross alpha (see Section 5.5.2.8). The results of the isotopic analyses are presented in Table 5-4E. The naturally occurring radium isotopes, particularly radium-226 that is an alpha emitter, are relatively low and did not exceed the screening criterion of 5 pCi/L in water (FDEP, 1999) for combined radium-226 and -228. The concentrations of the uranium and thorium isotopes detected were also relatively low. Because the uranium isotope concentrations are low and some are estimated (i.e., "J" values), the isotopic ratios could not be directly computed. However, the concentrations of the uranium isotopes, when corrected for specific activity, appear to be consistent with the expected ratios for these naturally occurring isotopes. The data suggest that naturally occurring radioactive isotopes are responsible for the gross alpha concentrations that exceeded the screening criteria.

5.4.2.9 Phase III Summary

Figure 5-4B shows the locations of exceedances of the surface water screening criteria at OU 2. The map shows the most recent results at each location (combined Phases I, II, and III data). None of the VOCs detected in surface water exceeded the screening criteria. As shown in Figure 5-4B, one SVOC [bis(2-ethylhexyl)phthalate] exceeded the surface water criterion at three downstream (SW012, SW014, and SW019) and two upstream locations (SW026 and SW028).

During Phase II, four PAHs in surface water exceeded screening criteria at SW019 (duplicate sample only) located near the southeastern corner of the golf course. However, during Phase III no PAHs exceeded the surface water screening criteria (Figure 5-4B).

n22x34dh.dgn

R4712981

8TH EXPRESS STREET

POND

SWAMP/ WOODS

NO. 9

AREA 1

DRIVING RANGE

NO. 8

NO. 5

NO. 6

NO. 4

NO. 3

NO. 2

NO. 1

NO. 7

MARSH

AREA 2

AREA 3

WOODS

BOGGY CREEK ROAD

TRADEPORT DRIVE

LAKE GILLOOLY

SW001 - SURFACE WATER
ALUMINUM 5500
COPPER 12.4
IRON 5010
LEAD 12.4
GROSS ALPHA 18.1 pCi/L
SD001 - SEDIMENT
COPPER 25.9
LEAD 33.2
ZINC 143
GROSS ALPHA 5.6 pCi/G

SW002

SW003

SW004

SW005

SW005R

SW006 - SURFACE WATER
ALUMINUM 3700-J
COPPER 13.3
IRON 1330-J
LEAD 16.6

SW007 - SURFACE WATER
ALUMINUM 908-J

SW008

SW009 - SURFACE WATER
ALUMINUM 5700-J
COPPER 13.8
IRON 6530-J
LEAD 5.7

SW010 - SURFACE WATER
ALUMINUM 638
IRON 1700
SD010 - SEDIMENT
4,4-DDE 3.4 µg/Kg
GAMMA-CHLORDANE 5.4-J µg/Kg

SW011 - SURFACE WATER
IRON 7090
MERCURY 0.15
ZINC 95.2
SD011 - SEDIMENT
GROSS ALPHA 7.7 pCi/G

SW012 - SURFACE WATER
ALUMINUM 569
BIS(2-ETHYLHEXYL)PHTHALATE 6.6-J
IRON 1180

SW013 - SURFACE WATER
ALUMINUM 825
IRON 4680
ZINC 117
SD013 - SEDIMENT
GROSS ALPHA 5.9 pCi/G

SW014 - SURFACE WATER
ALUMINUM 819
BIS(2-ETHYLHEXYL)PHTHALATE 4.9-J
IRON 1510
SD014 - SEDIMENT
GROSS ALPHA 15.0 pCi/G

SW015

SW016 - SURFACE WATER
ALUMINUM - /1090
IRON 4850/3680
ZINC 565
SD016 - SEDIMENT
4,4'-DDD 4.5 µg/Kg

SW017 - SURFACE WATER
MERCURY 0.12
ZINC 133
SD017 - SEDIMENT
4,4'-DDE 3.5-J µg/Kg
GROSS ALPHA 7.3 pCi/G

SW018 - SURFACE WATER
ALUMINUM 15300-J
IRON 2340
LEAD 7.3
SD018 - SEDIMENT
GROSS ALPHA 6.4 pCi/G

SW018R

SW019 - SURFACE WATER
BIS(2-ETHYLHEXYL)PHTHALATE 4.3-J
SD019 - SEDIMENT
GROSS ALPHA 7.9 pCi/G

SW020 - SURFACE WATER
ALUMINUM - /1810-J

SW021

SW022

SD022 - SEDIMENT
GROSS ALPHA 7.5 pCi/G

SW023 - SURFACE WATER
ALUMINUM 295-J/712-J
IRON *968/1070

FROM SW024 461 FT. DUE NORTH OF SW023

SW024 - SURFACE WATER
IRON 1290

SW025 - SURFACE WATER
ALDRIN 0.033-J
SD025 - SEDIMENT
BENZO(A)PYRENE 640 µg/Kg
GROSS ALPHA 7.2 pCi/G

SW026 - SURFACE WATER
ALUMINUM 645
BIS(2-ETHYLHEXYL)PHTHALATE 4.5-J
SD026 - SEDIMENT
GROSS ALPHA 5.1 pCi/G

SW027 - SURFACE WATER
ALUMINUM 1890-J

SW028 - SURFACE WATER
ALDRIN 0.018-J
ALUMINUM 916-J
BIS(2-ETHYLHEXYL)PHTHALATE 4.4-J
MERCURY 12.4 ng/L

OLD-OU2-01A
OLD-OU2-01B
OLD-OU2-02A
OLD-OU2-02B
OLD-OU2-03A
OLD-OU2-03B
OLD-OU2-04A
OLD-OU2-04B
OLD-OU2-05A
OLD-OU2-05B
OLD-OU2-06A
OLD-OU2-06B
OLD-OU2-07A
OLD-OU2-07B
OLD-OU2-08A
OLD-OU2-08B
OLD-OU2-09A
OLD-OU2-09B
OLD-OU2-10A
OLD-OU2-10B
OLD-OU2-11A
OLD-OU2-11B
OLD-OU2-12A
OLD-OU2-12B
OLD-OU2-13A
OLD-OU2-13B
OLD-OU2-14A
OLD-OU2-14B
OLD-OU2-15A
OLD-OU2-15B
OLD-OU2-16A
OLD-OU2-16B
OLD-OU2-17A
OLD-OU2-17B
OLD-OU2-18A
OLD-OU2-18B
OLD-OU2-19A
OLD-OU2-19B
OLD-OU2-20A
OLD-OU2-20B
OLD-OU2-21A
OLD-OU2-21B
OLD-OU2-22A
OLD-OU2-22B
OLD-OU2-23C
OLD-OU2-24C
OLD-OU2-25C
OLD-OU2-26C

LEGEND

SURFACE WATER AND SEDIMENT SAMPLE LOCATION — SW002
SHALLOW MONITORING WELL — OLD-OU2-14A
INTERMEDIATE MONITORING WELL — OLD-OU2-17B
DEEP MONITORING WELL — OLD-OU2-26C

SURFACE WATER SAMPLE DESIGNATION — SW023 - SURFACE WATER
ANALYTE — ALUMINUM 295-J/712-J; IRON *968/1070
CONCENTRATION 1,2,3 — DUPLICATE SAMPLE

SEDIMENT SAMPLE DESIGNATION — SD001 - SEDIMENT
ANALYTE — COPPER 25.9; LEAD 33.2; ZINC 14.3; GROSS ALPHA 5.6 pCi/G
CONCENTRATION 4,5,6

ESTIMATED VALUE J

1 - CONCENTRATION IN MICROGRAMS PER LITER (µg/L) - UNLESS OTHERWISE SHOWN
2 - CONCENTRATION IN PICOCURIES PER LITER (pCi/L) - WHERE SHOWN
3 - CONCENTRATION IN NANOGRAMS PER LITER (ng/L) - WHERE SHOWN
4 - CONCENTRATION IN MILLIGRAMS PER KILOGRAM (mg/Kg) - UNLESS OTHERWISE SHOWN
5 - CONCENTRATION IN PICOCURIES PER GRAM (pCi/G) - WHERE SHOWN
6 - CONCENTRATION IN MICROGRAMS PER KILOGRAM (µg/Kg) - WHERE SHOWN
* - FDEP THRESHOLD VALUE IS 1000 µg/L.

FIGURE 5-4B

SURFACE WATER AND SEDIMENT PHASES I, II, AND III CONCENTRATIONS ABOVE SCREENING CRITERIA REMEDIAL INVESTIGATION McCOY ANNEX LANDFILL
NAVAL TRAINING CENTER ORLANDO, FLORIDA

Rev. 2 03/07/01

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TABLE 5-4E

SURFACE WATER PHASE III - ISOTOPIC ANALYSES
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Sample Location	SW001
Date Sampled	2/5/00
Radiological (pCi/L)	
Gross Alpha	30.29
Gross Beta	22.35
Radium 226	1.88
Radium -228	2.41
Thorium-227	0.13 U
Thorium-228	2.20
Thorium-230	0.06 U
Thorium-232	0.16
Uranium-234	0.26
Uranium-235	0.03 U
Uranium-238	0.20
Americium-241	<1.32
Cesium-134	<0.76
Cesium-137	<0.58
Cobalt-60	<1.01
Potassium-40	<13.5

pCi/L picocuries per liter.
"U" qualifier indicates analyte not detected at the 95 percent confidence level.
"<" indicates less than the minimum detectable activity.

PCBs were not detected in the surface water samples analyzed during Phase III (SW023), Phase II (SW019 and SW020) or Phase I (SW006). One pesticide, aldrin, exceeded surface water screening criteria at two upstream locations (SW025 and SW028) during Phase III (Figure 5-4B). However, no pesticides were detected at downstream surface water locations during Phases I, II, or III.

Assuming bis(2-ethylhexyl)phthalate is a laboratory contaminant, organic contamination is not prevalent in surface water at locations within the OU 2 boundary. Mercury, analyzed using ultra-clean methods during Phase III, marginally exceeded the FSWC at one upstream location (SW028). These results indicate that the widespread distribution (exceedances in 7 interior locations of 22) observed during Phases I and II was not representative of site conditions. Inorganic exceedances in surface water were mostly limited to aluminum, copper, iron, and lead during all phases of sampling (Figure 5-4B). Groundwater, locally high in aluminum and iron, discharges to the canals and may contribute to the presence of inorganic contamination of surface water.

5.5 SEDIMENT

During Phases I and II, sediment samples were collected at the same locations as the surface water samples to identify impacts to sediments in the drainage canals and ponds. Subsequently the canals were cleaned and dredged during maintenance operations by county personnel, thereby reducing the usefulness of the original surface water and sediment samples. Thus, the canals were resampled in Phase III. In addition samples were collected at upstream and off-site locations upgradient from the landfill to assist in isolating impacts due to the landfill from those with other causes. The locations of the sampling points, the procedures used to collect the samples, and the rationale for collection are discussed in Section 3.4. The chemicals detected and their distribution are presented in the following sections. The detected chemicals were compared to Florida Sediment Evaluation Values (FSEVs) (FDEP, 1994). If no FSEVs were available, USEPA Region 4 Sediment Screening Values (SSVs) (USEPA, 1995a) were used, if available. Throughout this section, tables and figures indicate concentrations that meet or exceed screening criteria; for ease of discussion these concentrations will subsequently be identified in the text as "exceeding" the criteria.

5.5.1 Phases I and II

A total of 22 sediment samples, plus 3 field duplicates, were collected during Phase I and Phase II sampling events. Sediment samples were collected at the same locations from which surface water samples were collected (Figure 5-5), and the sample location corresponds to both sediment and surface water samples. For example, sediment sample SD001 corresponds to surface water sample location

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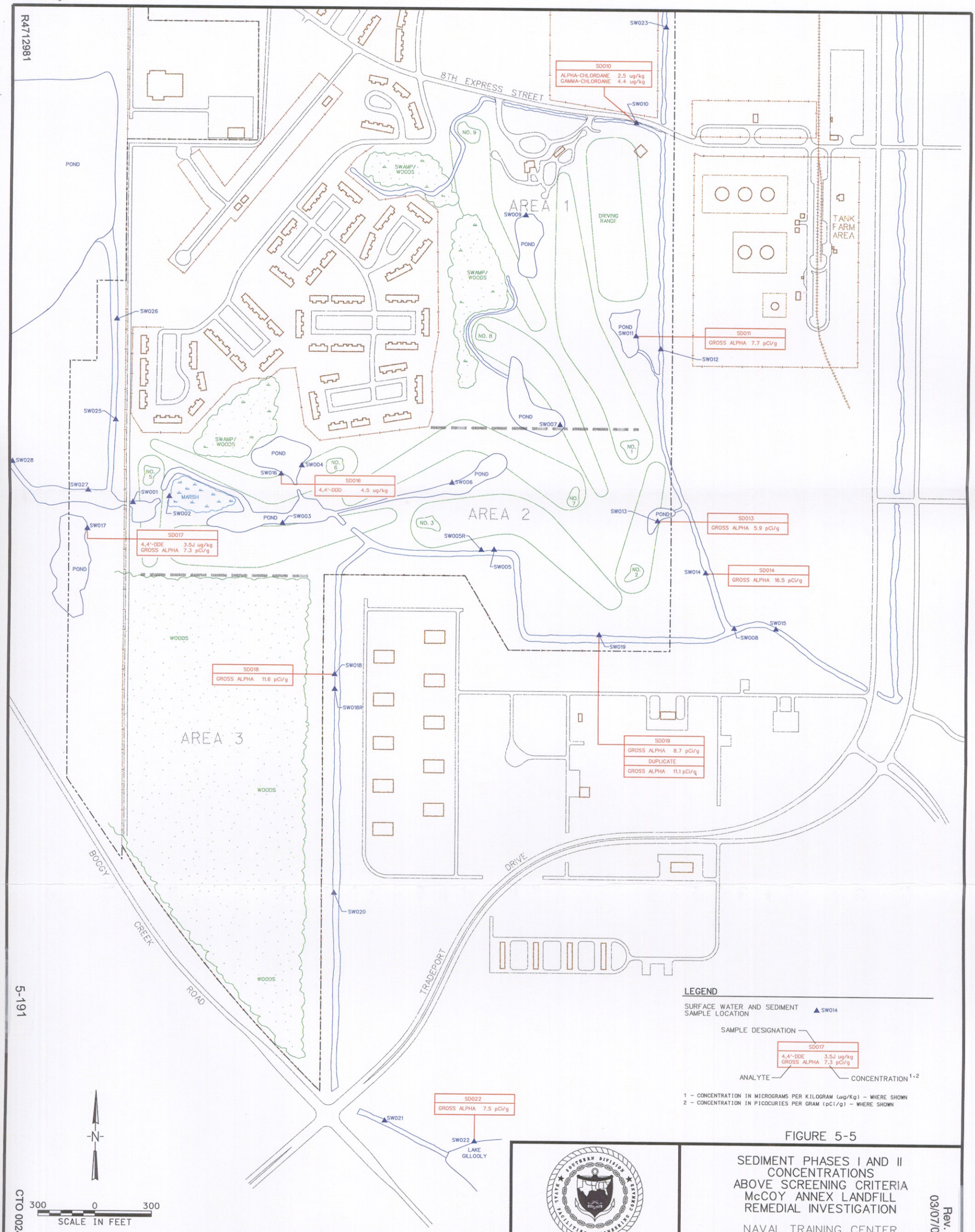

LEGEND

SURFACE WATER AND SEDIMENT SAMPLE LOCATION ▲SW014

SAMPLE DESIGNATION

SD017
4,4'-DDE 3.5J ug/kg
GROSS ALPHA 7.3 pCi/g

ANALYTE — CONCENTRATION [1,2]

1 - CONCENTRATION IN MICROGRAMS PER KILOGRAM (ug/Kg) - WHERE SHOWN
2 - CONCENTRATION IN PICOCURIES PER GRAM (pCi/g) - WHERE SHOWN

FIGURE 5-5

SEDIMENT PHASES I AND II
CONCENTRATIONS
ABOVE SCREENING CRITERIA
McCOY ANNEX LANDFILL
REMEDIAL INVESTIGATION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

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03/07/01

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SW001. Samples were analyzed at a fixed-base laboratory. Analytical parameters are described in Section 3.4.2.

Data were validated according to established procedures as described in Section 4.3, and the analytical results of the investigation are presented in Appendix B. Table 5-5A lists the detections of various chemicals and Table 5-5B presents the frequency of these detections. Only chemicals that were detected in at least one sample are presented on the summary table (Table 5-5A).

5.5.1.1 Volatile Organic Compounds

VOCs detected in sediment samples include benzene, carbon disulfide, ethylbenzene, toluene, and xylenes. Benzene (concentration 4.1 µg/kg), ethylbenzene (concentration 4.2 µg/kg), and xylenes (concentration 5.9 µg/kg) were detected in only one sample (SD008). Carbon disulfide (concentration 73.8 µg/kg) was detected in only one sample (SD011). Toluene was detected in five samples with a maximum concentration of 59.09 µg/kg in sample SD014. All detections of toluene occurred at sampling locations along the eastern portion of the site. Tables 5-5A and 5-5B present the detections and their frequencies, respectively. There are no screening criteria for any of the detected VOCs. The low frequency of detections and low concentrations of VOCs suggest that VOCs have not significantly impacted sediment at this site.

5.5.1.2 Semivolatile Organic Compounds

The only SVOC detected in sediment was 3&4-methylphenol at a concentration of 223 µg/kg in the duplicate sample for SD019 (Table 5-5A). There is no screening criterion (FSEV or SSV) for 3&4-methylphenol. The single detection of SVOCs demonstrates that SVOCs have not significantly impacted sediment at the site.

5.5.1.3 Pesticides and Polychlorinated Biphenyls

Five pesticides (4,4'-DDD, 4,4'-DDE, alpha-chlordane, gamma-chlordane, and heptachlor) were each detected once in sediment. Alpha-chlordane, gamma-chlordane, and heptachlor were detected in sample SD010 at concentrations of 2.5 µg/kg, 4.4 µg/kg, and 1.3 µg/kg, respectively. 4,4-DDD was detected in sample SD016 at a concentration of 4.5 µg/kg, whereas 4,4-DDE was detected at a concentration of 3.5 µg/kg at SD017. Table 5-5A presents the summary of these detections and exceedances over the screening criteria. Table 5-5B lists the frequency of detections.

TABLE 5-5A

SEDIMENT PHASES I AND II—DETECTED ORGANICS AND INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]	SD001	SD002	SD003	SD004	SD005	SD006	SD006-D	SD007	SD008	SD009	SD010	SD011	SD012
SAMPLE DATE		7/1/97	7/1/97	7/1/97	7/1/97	7/1/97	7/2/97	7/2/97	7/2/97	7/18/97	7/2/97	7/2/97	8/25/98	8/25/98
Volatiles (mg/kg)														
Benzene	*									4.1				
Carbon disulfide	*												73.8	
Ethylbenzene	*									4.2				
Toluene	*												3.8	2.6 J
Xylenes (Total)	*									5.9				
Semivolatiles (mg/kg)														
3&4-Methylphenol	*													
Pesticides/PCBs (mg/kg)		(c)	(c)	(c)	(c)	(c)			(c)	(c)	(c)	(c)	(c)	(c)
4,4'-DDD	1.22													
4,4'-DDE	2.07													
alpha-Chlordane	2.26											2.5		
gamma-Chlordane	2.26											4.4		
Heptachlor	*											1.3		
Herbicides (mg/kg)														
TPH[d] (mg/kg)														
TPH (C8-C40)	*													
Metals (mg/kg)														
Aluminum	*	409 J	852 J	233 J	788 J	3640 J	4010 J	1310 J	2460 J	2800	1230 J	1230 J	6460	664
Arsenic	7.24				0.82		0.58				0.07			
Barium	*	2.2	5.3	4.1	1.7	12.8	19.2	6.8	11.8	10.8	2.1	5.4	21.5	20.2
Calcium	*	186	210	42.6	92.7	175	530	408	467	188	73.8	227		584
Chromium	52.3	0.76	1.2	0.63	1.8	4.3	5.9	2.0	3.5	2.2	1.6	1.6	6.1	1.7
Cobalt	*										0.29			
Copper	18.7	0.71	0.48	0.34	0.82	2.1	0.74	1.6	0.79	0.74	0.60	1.1		2.1
Iron	*	137	307	37.1	1750	177	234	191	161	266	594	241	728	710
Lead	30.2	1.2	1.2	1.2	1.2	5.4	2.8	2.5	4.8	2.9	0.86	2.1		2.4
Magnesium	*		68.6				99.3	47.8	66.6	62.8				
Manganese	*	0.58	0.74				2.5	1.5	1.6	0.84		1.1	2.2	4.6
Mercury	0.13													
Nickel	15.9		0.24		0.32	0.57	0.48		0.40	1.1	0.47	0.31		
Potassium	*	20.8	28.9	13.2	26.2	48.3	69.2	29.4	28.4	45.9	20.0	20.5		
Selenium	*					1.0	0.81			0.52		0.66		
Sodium	*													573
Vanadium	*	0.64	1.2	0.30	7.4	3.5	2.2	1.0	1.5	2.8	2.9	24.9	8.5	3.2
Zinc	124	2.7			27.8					1.7		1.7	8.5 J	74.7 J
Radiological (pCi/g)														
Gross alpha[e]	5	0.495	1.34	0.186	0.201	2.22	0.940	1.30	2.58	1.49	1.23	0.735	7.7	
Gross beta[e]	15		0.655 J			1.33 J	0.346 J	0.762 J	1.68 J	0.679	0.543 J	0.319 J		
Actinium-228	*													1.2
Bismuth-214	*													1
Lead-212	*												0.3	0.3
Lead-214	*												0.8	0.4
Potassium-40	*													
hallium-208	*													

TABLE 5-5A

SEDIMENT PHASES I AND II—DETECTED ORGANICS AND INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE LOCATION[a]	SCREENING CRITERIA[b]	SD013	SD014	SD015	SD016	SD016-D	SD017	SD018	SD019	SD019-D	SD020	SD021	SD022
SAMPLE DATE		**8/25/98**	**8/26/98**	**8/26/98**	**8/25/98**	**8/25/98**	**8/25/98**	**8/27/98**	**8/25/98**	**8/25/98**	**8/27/98**	**8/26/98**	**8/26/98**
Volatiles (mg/kg)													
Benzene	•												
Carbon disulfide	•												
Ethylbenzene	•												
Toluene	•		59.9	9					8.6				
Xylenes (Total)	•												
Semivolatiles (mg/kg)													
3&4-Methylphenol	•									223 J			
Pesticides/PCBs (mg/kg)		(c)	(c)	(c)	(c)	(c)		(c)		(c)	(c)	(c)	(c)
4,4'-DDD	1.22				4.5								
4,4'-DDE	2.07						3.5 J						
alpha-Chlordane	2.26												
gamma-Chlordane	2.26												
Heptachlor	•												
Herbicides (mg/kg)													
TPH[d] (mg/kg)													
TPH (C8-C40)	•						21.6			20			
Metals (mg/kg)													
Aluminum	•	537	3910	816	328	2180	1210	4310	9350	1890	7170	2240	4640
Arsenic	7.24												
Barium	•	6	154	5.7	5.6	4.2	9.1	19.7	191	12	72.5	11.7	17.4
Calcium	•	282	499	374	397	453	1340	348	925	444	403	693	314
Chromium	52.3		6.7	1.9		3	4.4	5.1	10.6	3.3	7.1	3	4.7
Cobalt	•												
Copper	18.7	1.3	5.9	1.5			2.5	2.1	10	2.4	1.8	2.2	2.5
Iron	•	111	837	202	478	1570	288	219	657	471	606	344	272
Lead	30.2	0.86	7.8	5.6	1.2	1.9	19.2	4.1	7.6	4.3	4.8	2.7	3.5
Magnesium	•		208					123	186	80.1	204	108	147
Manganese	•						3.1		1.9	1.7		1.6	
Mercury	0.13		0.06		0.05		0.1		0.02				
Nickel	15.9		2.1						2		1.2		
Potassium	•												71.9
Selenium	•												
Sodium	•	340	93.2		324	41.9	412					89	44.9
Vanadium	•	1.8	6.5			6.5	2	2.9	26.1	1.9	5.6	1.7	4.4
Zinc	124	5.2 J	12.6 J	14.2 J	7.1 J	15.2 J	20.5 J	16.3 J	17.9 J	15.9 J	8.5 J	14.1 J	9 J
Radiological (pCi/g)													
Gross alpha[e]	5	5.9	16.5		4.7	3.1	7.3	11.6	8.7	11.1	4.1	4.5	7.5
Gross beta[e]	15												
Actinium-228	•	0.6	1.6		1.2		1.2	1.8		1.6	0.8	0.4	1.2
Bismuth-214	•		1.4	0.6		0.6	1.3	2.5			0.9		
Lead-212	•	0.2	0.6		0.3	0.3	0.6	0.6	0.7	0.6	0.2	0.2	0.4
Lead-214	•	0.6	1.4	1.1	0.9	0.8	1.7	2	1.4	1	0.9	0.6	0.9
Potassium-40	•					3.3							
Thallium-208	•	0.5	0.3		0.5					0.3		0.2	0.5

TABLE 5-5A

SEDIMENT PHASES I AND II-DETECTED ORGANICS AND INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

"J" qualifier on analytical data indicates an estimated value.
NA – Not Analyzed.
No entry indicates chemical not detected.
Only chemicals detected in at least one sample are listed.
Shaded entry indicates chemical detected at a concentration that meets or exceeds screening criterion.
The complete list of analytical results is presented in Appendix B of this report.
(a) "D" at the end of the sample number indicates a duplicate sample.
(b) The screening criterion is either the state of Florida Sediment Evaluation Values or the USEPA Region 4 Sediment Screening Value, whichever is applicable.
(c) Not analyzed for PCBs.
(d) Total Petroleum Hydrocarbons.
(e) The screening value is estimated because the activities for specific radionuclides in the samples have not been determined. These data are required for conversion to a dose rate and comparison to the 4 millirem/year federal and state reference value for water.
* Screening value not available.

TABLE 5-5B

SEDIMENT PHASE I AND II- DETECTIONS, FREQUENCY, MINIMUM AND MAXIMUM CONCENTRATIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	CAS Number	Minimum Concentration	Maximum Concentration	Location of Maximum Concentration	Detection Frequency
Volatiles (mg/kg)					
Benzene	71-43-2	0.0041	0.0041	SD008	1/21
Carbon disulfide	75-15-0	0.0738	0.0738	SD011	1/21
Ethylbenzene	100-41-4	0.0042	0.0042	SD008	1/21
Toluene	108-88-3	0.0026J	0.0599	SD014	5/21
Xylenes (Total)	133-20-7	0.0059	0.0059	SD008	1/21
Semivolatiles (mg/kg)					
3&4-Methylphenol		0.223J	0.223J	SD019	1/21
Pesticides/PCBs (mg/kg)					
4,4'-DDD	72-54-8	0.0045	0.0045	SD016	1/21
4,4'-DDE	72-55-9	0.0035J	0.0035J	SD017	1/21
alpha-Chlordane	5103-71-9	0.0025	0.0025	SD010	1/21
gamma-Chlordane	5103-74-2	0.0044	0.0044	SD010	1/21
Heptachlor	76-44-8	0.0013	0.0013	SD010	1/21
Herbicides (mg/kg)					
TPH (c8-c40)	TPH	20	21.6	SD017	2/12
Metals (mg/kg)					
Aluminum	7429-90-5	233J	9350	SD019	21/21
Arsenic	7440-38-2	0.07	0.82	SD004	3/21
Barium	7440-39-3	1.7	191	SD019	21/21
Calcium	7440-70-2	42.6	1340	SD017	20/21
Chromium	7440-47-3	0.63	10.6	SD019	20/21
Cobalt	7440-48-4	0.29	0.29	SD009	1/21
Copper	7440-50-8	0.34	10	SD019	19/21
Iron	7439-89-6	37.1	1750	SD004	21/21
Lead	7439-92-1	0.86	19.2	SD017	20/21
Magnesium	7439-95-4	47.8	208	SD014	10/21
Manganese	7439-96-5	0.74	4.6	SD012	10/21
Mercury	7439-97-6	0.02	0.1	SD017	4/21
Nickel	7440-02-0	0.24	2.1	SD014	11/21
Potassium	7440-09-7	13.2	71.9	SD022	10/21
Selenium	7782-49-2	0.52	1	SD005	4/21
Sodium	7440-23-5	41.9	573	SD012	7/21
Vanadium	7440-62-2	0.3	26.1	SD019	20/21
Zinc	7440-66-6	1.7	74.7J	SD012	15/21
Radiological (pCi/g)					
Actinium-228		0.4	1.8	SD018	10/12
Bismuth-214		0.6	2.5	SD018	7/12
Gross alpha		0.186	16.5	SD014	19/21
Gross beta		0.319J	1.68J	SD007	7/21
Lead-212		0.2	0.7	SD019	11/12
Lead-214		0.4	2	SD018	12/12
Potassium-40		3.3	3.3	SD016	1/12
Thallium-208		0.2	0.5	SD013,SD016, SD022	6/12

"J" qualifier indicates an estimated value.
Rejected values not included.
Table 4-1 and Section 4.3.3 provide details regarding rejected results.

Alpha-chlordane, gamma-chlordane, 4,4'-DDD, and 4,4'-DDE were all detected above the screening criteria. There is no screening criterion for heptachlor. No other pesticides were detected above the screening criteria. The locations at which the detections exceeded the screening criteria are also shown in Figure 5-5. 4,4'-DDD and 4,4'-DDE were only detected in the sediment samples from ponds located along the golf course (SD016 and SD017), whereas alpha-chlordane, gamma- chlordane, and heptachlor were only detected at the most upstream sediment location (SD010).

No PCBs were detected in either phase of the investigation. Dioxin analysis was not performed because no PCBs were detected.

5.5.1.4 Herbicides

No herbicides were detected in sediment during either phase of the investigation.

5.5.1.5 Total Petroleum Hydrocarbons

There were only two detections of TPH in sediment. Sample SD017 had a concentration of 21.6 mg/kg and the duplicate sample for SD019 had 20 mg/kg. There is no screening criterion (FSEV or SSV) for TPH. The sampling results are summarized in Table 5-5A. No other VOCs or SVOCs were detected at these two locations with the exception of 3&4-methylphenol at SD019. The low frequency of detection suggests that TPH has not significantly impacted sediments at this site.

5.5.1.6 Inorganics

Many inorganic analytes were detected in the sediment samples. Aluminum, calcium, iron, and magnesium were detected in all sediment samples. Calcium and magnesium are considered essential nutrients and not contaminants, and will not be discussed further. Table 5-5A presents the summary of the detections and exceedances over the screening criteria. Table 5-5B presents the frequency of detections and shows that many of the inorganics were ubiquitous in the sediment sampling and consistent with the surface water and groundwater results. Several inorganics, arsenic, cobalt, mercury, and selenium, were detected at a relatively low frequency and low concentrations in the sediment. Arsenic was only detected in pond samples.

There are no screening criteria for barium (detected in all samples), cobalt (detected in one sample), manganese (detected in 11 samples), selenium (detected in four samples), or vanadium (detected in all

samples except for one). Also, there were no exceedances for any of the inorganics for which screening criteria are available.

5.5.1.7 Radiological

Radiological contamination was identified through gross alpha and gross beta measurements. Several gross alpha detections were found in the sediment samples collected at various locations. The gross alpha concentrations ranged from 0.186 to 16.5 pCi/g with the maximum detected at SD014. Gross beta detections ranged from 0.319 pCi/g to 1.68 pCi/g with the maximum detected at SD007. Table 5-5A summarizes the results of the detections and exceedances over the screening criteria and Table 5-5B provides the frequency of detection. Detected analytes that exceeded the screening criteria are shaded in Table 5-5A and shown in Figure 5-5. Gross alpha detections in seven samples were found to be above the screening criterion of 5 pCi/g; however, these levels are thought to be associated with naturally elevated levels of radionuclides in the underlying Hawthorn Group sediments which have likely been reworked by geologic processes in the past and are now incorporated in the sediments of the unit above.

Because the screening criteria for gross alpha were exceeded, isotopic analyses were performed on the two sediment samples containing the highest gross alpha concentrations. This analysis was performed to investigate the presence of naturally occurring radioactive isotopes that may be the source for the elevated gross alpha detections. Sample SD14, located in the canal near the southeast corner of the golf course (Figure 5-5), is in close proximity to well MW6B that contained relatively high gross alpha concentrations in groundwater. Sample SD18, located in the canal near the northeast corner of the southern wooded area, is in close proximity to wells MW11B and MW12B where VOCs were detected in groundwater. The results of the isotopic analyses are presented in Table 5-5C. The naturally occurring radium isotopes, particularly radium-226 which is an alpha emitter, were inadvertently not analyzed. The concentrations of the uranium and thorium isotopes detected were relatively low. Because the uranium isotope concentrations are low and estimated (i.e., "J" qualifier) the isotopic ratios could not be directly computed. However, the concentrations of the uranium isotopes, when corrected for specific activity, appear to be consistent with the expected ratios for these naturally occurring isotopes. The data suggest that naturally occurring radioactive isotopes are responsible for the gross alpha concentrations that exceeded the screening criteria.

5.5.1.8 Phase I and Phase II Summary

Volatile and semivolatile organics were infrequently detected in sediments at OU 2 but none of these chemicals exceeded the available sediment screening criteria. This finding is consistent with the surface

TABLE 5-5C

SEDIMENT PHASE II - ISOTOPIC ANALYSES
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Sample Location	SD014	SD018
Date Sampled	8/26/98	8/27/98
Radiological (pCi/g)		
Radium-226	NA	NA
Radium-228	NA	NA
Thorium-228	0.9 J	0.3 J
Thorium-230	1.3 J	0.6 J
Thorium-232	0.6 J	0.3 J
Uranium-234	0.2 J	0.4 J
Uranium-235	0.1 J	
Uranium-238	0.6 J	0.3 J

pCi/g picocuries per gram
"J" qualifier indicates an estimated concentration.
No entry indicates analyte not detected.
NA Not Analyzed

water results that showed infrequent and relatively low concentrations (<20 µg/L) of VOCs and SVOCs in surface water. Inorganics, on the other hand, were nearly ubiquitous in sediment as they were in surface water and shallow groundwater that discharges through the sediments into the canals. However, there were no exceedances of the available inorganic sediment screening criteria.

The screening criteria for pesticides and gross alpha were exceeded in sediment samples in and adjacent to this site. Pesticides were found above screening criteria in the pond west of the site, the pond north of the No. 6 fairway, and in the canal north of the driving range. The gross alpha exceedances occurred in both pond and samples located along the eastern, western, and southern margins of the site.

5.5.2 Phase III

Seventeen sediment samples (6 upstream locations and 11 resampled locations), plus two field duplicates, and one MS/MSD were collected at OU 2 and analyzed at a fixed-base laboratory. Analytical parameters are detailed in Section 3.4.2. Data were validated according to established procedures and the analytical results are presented in Appendix B.

Ten organic compounds, 18 inorganic chemicals, TPH, and 2 radiological parameters were detected in the sediment (Table 5-5D). Table 5-5E presents the minimum and maximum values, frequency of detection, and location of the maximum for each chemical detected. The detected chemicals were compared to screening criteria identified in Table 5-5D. Analytes that exceed screening criteria are shaded in Table 5-5D and shown in Figure 5-4B.

5.5.2.1 Volatile Organic Compounds

Only the six upstream sediment samples were analyzed for VOCs during Phase III. VOCs were detected at four locations (SD023, SD025, SD027, and SD028). Acetone (6.3J µg/kg) and PCE (0.39J µg/kg) were detected in an upstream sample (SD023) approximately 600 feet north of the Driving Range near the location of the former waste water treatment plant. Acetone was detected at a range of 4.3J to 10J µg/kg at the other upstream sample locations (SD025, SD027, and SD028) located west of the golf course. No VOCs exceeded sediment screening criteria.

5.5.2.2 Semivolatile Organic Compounds

Only the six upstream sediment samples were analyzed for SVOCs during Phase III. No SVOCs (other than PAHs) were detected (Table 5-5D).

TABLE 5-5D

SEDIMENT PHASE III - DETECTED ORGANICS AND INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE ID[a]	SCREENING	SD001	SD005	SD008	SD010	SD012	SD014	SD015	SD018	SD019	SD020
SAMPLE DATE	CRITERIA[b]	8/11/99	8/11/99	8/12/99	8/11/99	8/11/99	8/11/99	8/12/99	8/12/99	8/11/99	8/12/99
Volatiles (µg/kg)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acetone	*										
Tetrachloroethene	*										
Semivolatiles (µg/kg)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	88.8										
Fluoranthene	113										
Pyrene	153										
Pesticides/PCBs (µg/kg)		(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)
4,4'-DDE	2.07		8.2		3.4						
alpha-Chlordane[d]	2.26							1.1 J			
Endosulfan I	*	2.6 J		2.1 J				1.3 J			
gamma-Chlordane[d]	2.26				5.4 J			2 J			
Herbicides (µg/kg)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dalapon	*										
Inorganics (mg/kg)											
Aluminum	*	11400	1220	827 J	2070	909	5860	415 J	6490 J	5970	6260 J
Antimony	12							0.3			
Arsenic	7.24	5.3						0.29	0.8		0.47
Barium	*	52.2	4.8	4	7.1	4.6	30.1	2	16.3	19.5	30.4
Beryllium	*						0.81				
Calcium	*	4820	272		2820	253	367			291	
Chromium	52.3	18.9	2		3.8		8.6		6.7 J	7	6.4 J
Copper	18.7	25.9	0.61		4.2	2.8	4.3		3.6	8.3	
Iron	*	5130 J	138 J	199 J	666 J	393 J	1200 J	176 J	296 J	684 J	519 J
Lead	30.2	33.2	2.8	1.5 J	10.7	2.6	6.1	0.61 J	4.9 J	7.3	4.7 J
Magnesium	*	214			93.2		228			58	168
Manganese	*	37.6		7	8.9		1.4			1.3	
Mercury	0.13								0.06		0.04
Nickel	15.9	5.7					3.6				
Selenium	*	2	0.46							0.87	
Silver	0.733										
Vanadium	*	19	1.3	0.82	27.1	2.4	7.6		4.8	17.6	5.1
Zinc	124	143	1.4		17.9	2.9	2			9	
Petroleum Hydrocarbons (mg/kg)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TPH C8-C40	*										
Radionuclides (pCi/g)											
gross Alpha[e]	5	5.6	3.3		3.7	2.5	15	2.2	6.4	7.9	3.1
gross beta[e]	15	3	3.1		3.6		5.7		3.2	2.6	2.2

TABLE 5-5D

SEDIMENT PHASE III - DETECTED ORGANICS AND INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

SAMPLE ID[a]	SCREENING	SD020-D	SD021	SD023	SD023-D	SD024	SD025	SD026	SD027	SD028
SAMPLE DATE	CRITERIA[b]	8/12/99	8/12/99	8/10/99	8/10/99	8/10/99	8/10/99	8/11/99	8/10/99	8/10/99
Volatiles (µg/kg)		NA	NA							
Acetone	*			6.3 J			10 J		8.8 J	4.3 J
Tetrachloroethene	*			0.39 J						
Semivolatiles (µg/kg)		NA	NA							
Benzo(a)pyrene	88.8			83 J			640			
Fluoranthene	113			26	36		37		8.3	6.1 J
Pyrene	153			4.3 J	7.1					
Pesticides/PCBs (µg/kg)		(c)	(c)		(c)	(c)	(c)	(c)	(c)	(c)
4,4'-DDE	2.07									
alpha-Chlordane[d]	2.26									
Endosulfan I	*							1.3 J		
gamma-Chlordane[d]	2.26									
Herbicides (µg/kg)		NA	NA							
Dalapon	*				12 J	7.3 J				8.8 J
Inorganics (mg/kg)										
Aluminum	*	1420 J	726 J	759	489	148	3590	1690	2130	696
Antimony	12									
Arsenic	7.24			0.32			0.76		0.43	
Barium	*	7.1	3.2	3.9	2.3	2.2	12.1	4.5	14.5	5.2
Beryllium	*									
Calcium	*								2150 J	
Chromium	52.3	1.8 J		1.7			4.8	2.3	2.8	1.8
Copper	18.7			1.6	2.2		3.4	0.69	2	
Iron	*	156 J	245 J	140	208	111	396	179 J	357	1360
Lead	30.2	1.3 J	0.97 J	2.1 J	6.4 J		5.4 J	3.4	14.4 J	1.5 J
Magnesium	*					43.5	78.7		73.7	
Manganese	*									
Mercury	0.13	0.02		0.03 J	0.04 J					
Nickel	15.9									
Selenium	*						0.9			
Silver	0.733			0.29						
Vanadium	*	1.3	0.7	1.5			2.6	1.1	2.3	3.9
Zinc	124				4.6	6.3		2.7	15.7	11.2
Petroleum Hydrocarbons (mg/kg)		NA	NA							
TPH C8-C40	*			19 J	43 J			40	30	24
Radionuclides (pCi/g)										
gross Alpha[e]	5	4.5					7.2	5.1		2.4
gross beta[e]	15	1.9			2.6		3.3	2.9		2.2

TABLE 5-5D

SEDIMENT PHASE III—DETECTED ORGANICS AND INORGANICS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

* Screening value is not available.
NA – Not Analyzed.
"J" qualifier on analytical data indicates an estimated value.
Empty cells indicate chemical not detected.
Only chemicals detected in at least one sample are listed.
The complete list of analytical results is presented in Appendix B of this report.
Shaded entry indicates chemical detected at a concentration that meets or exceeds the screening criteria.

(a) "D" at the end of the ID indicates a duplicate sample.

(b) The screening criteria is either the State of Florida Sediment Evaluation Value or the USEPA Region 4 Sediment Screening Value, whichever is applicable.

(c) PCBs not analyzed.

(d) Screening criteria substitution – chlordane for alpha-chlordane and gamma-chlordane.

(e) The screening value of 50 pCi/L (40 CFR 141) is referenced because the activities for specific radionuclides in the samples have not been determined. These data are required for conversion to the 4 millirem/year federal and state reference level.

TABLE 5-5E

SEDIMENT PHASE III - FREQUENCY OF DETECTIONS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Parameter	CAS Number	Minimum Concentration	Maximum Concentration	Location of Maximum Concentration	Detection Frequency
Volatiles (ug/kg)					
Acetone	67-64-1	4.3J	10J	SD025	4/6
Tetrachloroethene	127-18-4	0.39J	0.39J	SD023	1/6
PAHs (ug/kg)					
Benzo(a)pyrene	50-32-8	83J	640	SD025	2/6
Fluoranthene	206-44-0	6.1J	37	SD025	4/6
Pyrene	129-00-0	4.3J	7.1	SD023-D	1/6
Pesticides/PCBs (ug/kg)					
4,4'-DDE	72-55-9	3.4	8.2	SD005	2/15
Alpha-Chlordane	5103-71-9	1.1J	1.1J	SD015	1/14
Endosulfan I	959-98-8	1.3J	2.6J	SD001	4/15
Gamma-Chlordane	5103-74-2	2J	5.4J	SD010	2/15
Herbicides (ug/kg)					
Dalapon	75-99-0	7.3J	12J	SD023-D	3/6
Inorganics (mg/kg)					
Aluminum	7429-90-5	148	11400	SD001	17/17
Antimony	7440-36-0	0.3	0.3	SD015	1/17
Arsenic	7440-38-2	0.29	5.3	SD001	7/17
Barium	7440-39-3	2	52.2	SD001	17/17
Beryllium	7440-41-7	0.81	0.81	SD014	1/17
Calcium	7440-70-2	253	4820	SD001	7/17
Chromium	7440-47-3	1.7	18.9	SD001	12/17
Copper	7440-50-8	0.61	25.9	SD001	11/17
Iron	7439-89-6	111	5130J	SD001	17/17
Lead	7439-92-1	0.61J	33.2	SD001	16/17
Magnesium	7439-95-4	43.5	228	SD014	8/17
Manganese	7439-96-5	1.3	37.6	SD001	5/17
Mercury	7439-97-6	0.02	0.06	SD018	3/17
Nickel	7440-02-0	3.6	5.7	SD001	2/17
Selenium	7782-49-2	0.46	2	SD001	4/17
Silver	7440-22-4	0.29	0.29	SD023	1/17
Vanadium	7440-62-2	0.7	27.1	SD010	15/17
Zinc	7440-66-6	1.4	143	SD001	11/17
Petroleum Hydrocarbons (mg/kg)					
TPH C8-C40		19J	43J	SD023-D	4/6
Radionuclides (pCi/g)					
Gross alpha		2.2	15	SD014	12/17
Gross beta		1.9	5.7	SD014	11/17

If a duplicate sample was taken at a location, the average of the two was used for statistical purposes.
"J" qualifier indicates an estimated value.
Rejected values not included.
Resample Data 1999 were used in statistical analysis.
Table 4-1 and Section 4.3.3 provide details regarding rejected results.

5.5.2.3 Polycyclic Aromatic Hydrocarbons

The six upstream sediment samples were analyzed for PAHs during Phase III. PAHs were detected in four (SD023, SD025, SD027, and SD028) of these samples. Fluoranthene was detected most frequently (at all four locations). Only benzo(a)pyrene (640 µg/kg) exceeded sediment screening values (88.8 µg/kg) in sediment at a western upstream location (SD025).

No PAHs were detected in sediments during Phases I and II.

5.5.2.4 Pesticides and Polychlorinated Biphenyls

Pesticides were detected in 6 out of 17 locations in Phase III sediment sampling, mostly in interior locations. Detected pesticides include 4,4-DDE at SD005 and SD010; alpha-chlordane at SD015; endosulfan I at SD001, SD008, SD015, and SD026; and gamma-chlordane at SD010 and SD015. Sediment screening criteria were exceeded at two locations: at SD005 for 4,4-DDE (8.2 µg/kg) and at SD010 for gamma-chlordane (5.4J µg/kg) and 4,4-DDE (3.4 µg/kg).

During Phase I and Phase II sediment sampling, pesticides were detected and exceeded screening values in 3 out of 22 locations (SD010, SD016, and SD017). SD010 was resampled during Phase III (see above).

During Phase III, only one upstream sample (SD023) was analyzed for PCBs; none were detected.

5.5.2.5 Herbicides

Only the six upstream sediment samples were analyzed for herbicides during Phase III. Dalapon was the only herbicide detected and it was found at only two upstream locations (SD023-D and SD024). No herbicides were detected during Phase I and Phase II sampling.

5.5.2.6 Total Petroleum Hydrocarbons

Only the six upstream sediment samples were analyzed for TPH during Phase III. TPH (C8-C40) was detected (Table 5-5D) at four locations including SD023 (19J/43J mg/kg), SD026 (40 mg/kg), SD027 (30 mg/kg), and SD028 (24 mg/kg). There are no state or federal screening criteria for TPH in sediments. No related VOCs or SVOCs were detected in sediments at these locations; however, PAHs were detected at SD023, SD027, and SD028.

5.5.2.7 Inorganics

Inorganics were detected at all 17 sediment locations sampled during Phase III. Aluminum, barium, and iron were detected at all of the locations. These metals with beryllium, calcium, magnesium, manganese, selenium, and vanadium have no state or federal sediment screening criteria. Chromium, copper, lead, and zinc were detected at more than half of the sample locations. Arsenic was detected at seven locations, in both ponds (SD001 and SD027) and canals (SD015, SD018, SD020, SD023, and SD025). Mercury was detected at two canal locations east of the wooded area (SD018 and SD020) and one upstream location (SD023). Sediment screening criteria for copper, lead, and zinc were exceeded at only 1 of 17 locations, SD001.

5.5.2.8 Radiological

Samples for gross alpha and gross beta analysis were collected at each of the 17 Phase III sediment locations. Gross alpha exceeded sediment screening criteria (5 pCi/g) at four on-site downstream locations including SD001 (5.6 pCi/g), SD014 (15 pCi/g), SD018 (6.4 pCi/g), and SD019 (7.9 pCi/g) and at two upstream locations, SD025 (7.2 pCi/g) and SD026 (5.1 pCi/g). Gross beta did not exceed its screening criterion in any of the Phase III samples.

Because the screening criterion for gross alpha was exceeded, isotopic analyses were performed on two selected sediment samples. This analysis was performed to investigate the presence of naturally occurring radioactive isotopes that may be the source for the elevated gross alpha detections. Sample SD014, which contained the highest gross alpha concentration during both Phase II and Phase III sampling, is located in the canal near the southeast corner of the golf course (Figure 5-5). Sample SD014 lies in close proximity to well MW6B that contained high turbidity and high gross alpha concentrations in groundwater during Phase III sampling, similar to the Phase II results. Sample SD026 is an upstream sampling location that was only sampled during Phase III. Sample SD026 is located northwest of the golf course, in a canal upstream of the water hazard for hole No. 5. The results of the isotopic analyses are presented in Table 5-5F. The activities of naturally occurring radium isotopes, particularly radium-226 that is an alpha emitter, are relatively low but exceed the screening criteria of 5 pCi/g. The activities of the uranium and thorium isotopes detected were also relatively low. Because the uranium isotope activities are low and some are estimated (i.e., "J" values), the isotopic ratios could not be directly computed. However, the concentrations of the uranium isotopes, when corrected for specific activity, appear to be consistent with the expected ratios for these naturally occurring isotopes.

TABLE 5-5F

SEDIMENT PHASE III - ISOTOPIC ANALYSES
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Sample Location	SD014	SD026
Date Sampled	1/25/00	1/25/00
Radiological (pCi/g)		
Gross Alpha	14.86	7.28
Gross Beta	9.28	5.31
Radium-226	3.85	0.85
Radium-228	0.89	<0.05
Thorium-227	0.01 U	0.05 U
Thorium-228	0.36	0.12
Thorium-230	0.01 U	0.04 U
Thorium-232	0.29	0.06
Uranium-234	0.11	0.11
Uranium-235	0.01 U	0.01 U
Uranium-238	0.14	0.05
Americinium-241	<0.03	<0.01
Cesium-134	<0.01	<0.008
Cesium-137	0.03	0.02
Cobalt-60	<0.004	<0.002
Potassium-40	0.64	<0.08

pCi/g picocuries per gram
"U" qualifier indicates analyte not detected at the 95 percent confidence level.
"<" indicates less than the minimum detectable activity.

The data suggest that naturally occurring radioactive isotopes are responsible for the gross alpha concentrations that exceeded the screening criteria.

5.5.2.9 Phase III Summary

Figure 5-4B shows the locations of exceedances of sediment screening criteria at OU 2. The map shows the most recent results at each location (combined Phase I, II, and III data). None of the VOCs, SVOCs, herbicides, or TPH detected in sediment samples exceeded the screening criteria.

One PAH was detected at a concentration that exceeded its screening criterion (see Figure 5-4B) at upstream location SD025 (northwest of the golf course). PAHs were not detected in any samples during Phases I and II. No herbicides were detected during Phases I, II, or III at concentrations exceeding screening criteria. TPH was not detected above screening criteria during Phases I, II, or III.

Figure 5-4B shows that pesticides 4,4-DDD; 4,4-DDE; alpha chlordane; and gamma chlordane were found in sediments at concentrations exceeding screening criteria (SD005, SD010, SD016, and SD017). Possible on-site sources for these locations are the Golf Course Maintenance Shop near SD010 and several ponds (SD017 and SD016) where sediments exceeding criteria for 4,4-DDD or 4,4-DDE were found during Phases I and II that are upstream of SD005. PCBs were not detected at any sediment location sampled during Phases I, II or III.

Figure 5-4B shows that the screening criteria for inorganics were exceeded (copper, lead, and zinc) at only one location, SD001, in a pond near the road on the western OU 2 boundary.

Figure 5-4B shows the gross alpha exceeded screening criteria at nine locations. Samples containing exceedances include upstream, downstream, and pond locations. Isotopic analyses indicate that the gross alpha exceedances are the result of naturally occurring radioactive material. Gross beta was not detected above its screening criterion.

The frequency of dredging of the canal sediments is unknown. Dredging does not appear to have a significant effect on the levels of contaminants in the sediments. VOCs were not detected above criteria before or after dredging. SVOCs were not detected above criteria prior to dredging; therefore, the canal samples were not analyzed for SVOCs following dredging. Pesticides were found above criteria at SD010 before and after dredging. At location SD005 no pesticides were detected before dredging while one pesticide was found above criteria following dredging. No herbicides were detected prior to dredging;

therefore, the canal samples were not analyzed for herbicides during Phase III. TPH was not found above criteria either before or after dredging. Inorganics were not detected above criteria prior to dredging and were found above criteria in only one sample after dredging. The screening criterion for gross alpha was exceeded in several samples both before and after dredging. In summary, dredging of canal sediments does not appear to play a significant role in maintaining low levels of constituents.

5.6 RADIONUCLIDE OCCURRENCE AND IMPACTS

The nature and extent of radionuclides (and, importantly, the patterns and distribution of radionuclides) detected in the environmental media were discussed in Sections 5.2.7, 5.3.1.7, 5.3.2.9, 5.4.1.6, 5.4.2.8, 5.5.1.7, and 5.5.2.8. The cited narrative consistently states that radionuclide levels present are a function of naturally occurring conditions and, for groundwater, turbidity. Based on the data available to date, it is unlikely that the radionuclides detected in surface water are a result of the landfill or landfill processes for the following reasons.

1. Section 5.3.2.8 Contaminant Plume Evaluation suggests that "inorganic analytes (i.e., iron) may have been released to the shallow groundwater (or concentrations increased due to changes in groundwater chemistry)". While radioactive isotopes may be expected to behave similarly to metals in groundwater, there is no direct evidence that radioactive wastes were disposed in the landfill. The statement regarding inorganics was based primarily on the fact that iron is a common component of landfill debris and because the geophysical surveys performed indicated the presence of metallic materials in the landfill. It is unlikely that landfill processes have caused radioactive isotopes to become soluble in groundwater and mobile.

2. If radioactive wastes were disposed in the landfill, and behave similar to inorganics, Section 8.4 demonstrates that the migration of inorganic species via groundwater flow is very slow due to retardation in the aquifer. The calculations indicate that it would take several hundred years for metals, and thus radionuclides, to reach the canals. Although the pathway exists, it is unlikely that there has been any discharge of radionuclides to surface water from the landfills via groundwater at this point in time; potential impacts are far in the future if a radionuclide source exists in the landfill.

3. The presence of radionuclides was detected in a high percentage of groundwater, surface water, and sediment samples based on the analyses of gross alpha and gross beta activity. However, concentrations that exceeded background or screening criteria were relatively few. Therefore, few isotopic analyses were performed. For Phase III groundwater results (i.e., low-flow sampling), there were no exceedances of the NTC background for gross alpha except in the highly turbid wells, MW4A, -4B, and -6B. Wells MW4A and -4B are located immediately east of the canal and have no

hydraulic connection to groundwater beneath the landfills. Therefore, the data do not suggest that the high alpha concentrations are a result of landfill materials or processes.

The only exceedances of surface water screening criteria for gross alpha occurred at locations SW001, SW010, and SW021. SW001 and SW010 are located along the far western side of OU 2 (near hole No. 5) and to the north of OU 2 along 8th Express Street, respectively. Both of these sampling locations are upgradient of both groundwater and surface water flow with respect to the landfills at OU 2. Location SW021 is downgradient of the landfill area, with respect to surface water flow; however, the data from SW001 and SW010 suggest that downstream impacts are at least partially due to sources upgradient of the landfills.

Numerous exceedances of the sediment screening criteria for gross alpha occurred at both upgradient and downgradient sampling locations, with respect to both groundwater and surface water flow at OU 2. The concentration range for 9 out of 10 samples that contained an exceedance of gross alpha was 5.1 to 7.9 pCi/L. This narrow range and the concentration distribution indicate there is no increase of gross alpha in sediment at the downgradient locations due to landfill materials or processes. The maximum sediment concentration of gross alpha occurred at sampling location SD014 (15.0 pCi/L); however, this sample location is immediately downgradient of wells MW4A, -4B, and -6B where anomously high gross alpha was detected in conjunction with highly turbid groundwater. Thus, the high gross alpha concentration in sediment at SD014, if related to groundwater discharge, is at least partially due to off-site groundwater conditions not related to landfill materials or processes.

4. The NTC background value of 13 pCi/L for gross alpha was found to be lower than the maximum gross alpha concentration reported in the FDEP Ambient Monitoring Program data set for the Surficial Aquifer in Orlando County (i.e., 18 pCi/L). Therefore, because several wells located immediately downgradient of the landfill areas (i.e., MW5A, -5B, -8A, -8B, -11A, -11B, -12A, and -12B) contain gross alpha concentrations below NTC background, it can be stated that the water quality downgradient of the landfill is consistent with gross alpha groundwater concentrations for the Orlando area. Only highly turbid groundwater located in wells near the canals (MW4A, -4B, and -6B; see item 3 above) may have impacts on surface water quality, but the data from off-site wells MW4A and -4B suggest that the impacts are not related to landfill materials or processes.

The majority of radionuclide isotopes detected in groundwater, surface water, and sediment samples consist of alpha emitters (radium-226, thorium and uranium series, americium-241). Collectively, the RFI sampling data indicate that the occurrence and distribution of gross alpha in environmental media at OU 2 are due to background conditions (i.e., naturally occurring isotopes and upgradient/off-site conditions) and are not related to landfill materials or processes. If radionuclide sources exist in the landfill materials, the

analysis of groundwater contaminant transport at OU 2 suggests that no impacts have occurred at this point in time, and that downgradient surface water bodies such as Lake Gillooly have not been adversely impacted. This is supported by the in-stream surface water and sediment samples that also show no differential, downstream impacts that can be attributed to the discharge of groundwater into surface water.

6.0 HUMAN HEALTH RISK ASSESSMENT

An HHRA has been conducted as part of the RI for OU 2. The purpose of the HHRA is to characterize the risks to humans associated with the potential exposures to chemicals in surface soil, groundwater, surface water, and sediment. Subsurface soil was not evaluated because no excavation activities into the subsurface soil resulting in long-term exposure are expected to take place on the site because of deed restrictions based on the site status as a former landfill. This HHRA is conducted in accordance with applicable USEPA and FDEP guidance documents.

The methodology for the HHRA consists of the following five steps:

- Data evaluation
- Selection of chemicals of potential concern (COPCs)
- Exposure assessment
- Toxicity assessment
- Risk characterization (including uncertainty analysis)

Collectively, these components are used to identify site-related contaminants, known as COPCs, and estimate the potential magnitude of exposure and risk associated with these contaminants.

The location, physical description, history, and environmental setting associated with Site OU 2 are described in Sections 1.0 and 2.0 of this report. During Phase I of the RI, surface soil, surface water, sediment, and groundwater samples were collected from OU 2. During Phase II of the RI, surface soil, surface water, and sediment samples were collected from additional locations. Also during Phase II, monitoring wells were installed and groundwater was sampled in the surficial aquifer and the underlying Hawthorn Group sands. During Phase III, samples were collected at locations previously sampled in Phase I or Phase II. Two IRAs were completed after Phase III work. Two areas were excavated and a soil cover was installed over a portion of the southern end of OU 2. These IRAs are discussed further in Section 3.0. The investigation methodology, sampling locations, and the sampling rationale are also presented in Section 3.0. The quality of the data is discussed in Section 4.0. A discussion of the nature and extent of contamination based on the analytical results is presented in Section 5.0. Appendix E provides supporting HHRA information and calculations. Note that tables in Appendix E are numbered in accordance with the requirements of *Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk*

Assessments) (USEPA, 1998a) and therefore are not necessarily referred to in sequential order in this section.

6.1 DATA EVALUATION

The data evaluation involves numerous activities, including sorting the data by medium, evaluating the quality of data with respect to qualifiers and codes, and developing a data set for use in risk assessment.

Data for this HHRA consisted of analytical results for surface soil, surface water, sediment, and groundwater samples collected during Phases I, II, and III of the RI. As described in Section 3.0, additional surface water, sediment, and groundwater samples were collected at OU 2 and analyzed during the second half of 1999. This additional Phase III investigation was performed to mitigate uncertainties and data gaps identified during preparation of the Draft RI Report issued in January 1999 (Tetra Tech NUS, 1999). The scope and rationale for the investigation were discussed in Section 3.0. A sediment sample was collected at each surface water sampling location. For groundwater, unfiltered samples were collected and analyzed during Phase I. Filtered and unfiltered groundwater samples were collected and analyzed during Phase II. Unfiltered samples were collected and analyzed during Phase III. Only the unfiltered groundwater sample data were used in the HHRA. The DQOs for collecting environmental samples and conducting laboratory analyses are described in the RI/FS Work Plan (B&R Environmental, 1998b). Sample collection and analysis followed documented quality assurance (QA)/QC procedures as described in the approved Project Operations Plan (ABB-ES, 1997).

Risk was evaluated for the groundwater data from Phases I and II, as in the Draft RI Report. Because of the difference in sampling methods, risk was evaluated separately for the groundwater data from Phase III as follows: Analytical results from Phase III resampling replaced any previous data for each well and fraction analyzed. For any well not resampled in Phase III, the data from Phases I and II were retained for that well. In addition, for any fraction of analytes not analyzed in a well that was resampled in Phase III, the data for that fraction from Phases I and II were retained.

Following the Phase I and Phase II collection of surface water and sediment samples along the canal that borders the eastern perimeter of the Navy property, the canal was dredged by local authorities. This action removed sediments that were sampled during the RI field investigation. The dredging also had the potential to expose sediments that are not represented by the previous sampling. Consequently, surface water quality may be changed. Therefore, surface water and sediment samples collected from the dredged locations during Phases I and II were no longer representative of the conditions at the site and both sediment and surface water were resampled at those locations in Phase III. As for groundwater,

analytical results from Phase III resampling replaced any previous data for each location and fraction analyzed. For surface water and sediment locations not resampled in Phase III, the data from Phases I and II were retained for that location. All dredged sample locations were resampled. In addition, for any fraction of analytes not analyzed for a location that was resampled in Phase III, the data for that fraction from Phases I and II were retained. Risk was evaluated for both the surface water data from Phases I and II, as in the Draft RI Report, and for the combined Phase III surface water data set. Because sediments were removed, only the risk from the combined Phase III data set for sediment was evaluated.

Two surface soil locations, NTCSSS91 and NTCSS103, were excavated by Bechtel Jacobs Company LLC based on high concentrations of benzo(a)pyrene and were backfilled with clean soil. Data from these two locations were removed from the surface soil data set. In addition, South Carolina Research Authority (SCRA) – Environmental Enterprise Group (EEG) installed a 2-foot soil cover over a portion of the former landfill in the formerly wooded area south of the golf course. Twenty-eight surface soil sample locations were covered by the soil cover which was composed of 6 inches of soil from the NTC Main Base golf course under 18 inches of soil from a clean source (EEG, 2000). The 28 covered sample locations were NTCSSS02, NTCSSS03, NTCSSS04, NTCSSH002, NTCSSH003, NTCSSH004, NTCSSH005, NTCSSH007, NTCSSH008, NTCSSH009, NTCSSH010, NTCSSH012, NTCSSH013, NTCSSH014, NTCSSH015, NTCSSH017, NTCSSH018, NTCSSH019, NTCSSH020, NTCSSH022, NTCSSH023, NTCSSH024, NTCSSH027, NTCSSH028, NTCSSH029, NTCSSH032, NTCSSH033, and NTCSSH034. Data from these covered samples were removed from the surface soil data set.

Chemical analyses were performed in accordance with SW-846 methodologies. The analytical results were evaluated, using the National Functional Guidelines (USEPA, 1994a, b) to assess the laboratory's compliance with the analytical methodology. The analytical data were reviewed, validated, and evaluated using the criteria specified in the DQOs. All validated data with qualifiers are presented in Appendix B. All unqualified positive detections and "J" qualified detections (estimated values) were considered as detected concentrations for this HHRA. All nondetects (indicated with a "U" qualifier) were retained in the HHRA data set. Any samples with a "UR" qualifier (indicating a rejected nondetection) or "R" qualifier (indicating a rejected positive detection) were not included in the HHRA data set. Based upon the evaluation of the analytical data in conformance with the DQOs, the data presented in this report are acceptable for use in this HHRA.

Initial analytical results for cesium-137 and cobalt-60 appeared to be erroneous. Cesium-137 and cobalt-60 are fission products and would be expected at the site of a nuclear explosion or in waste from a reactor (Campbell, 1998). The historic uses of the site do not support the presence of these isotopes.

The samples were reanalyzed and cesium-137 and cobalt-60 were not found. Cesium-137 and cobalt-60 were not included in the HHRA.

A review of soil and groundwater analytical results showed that wells in Area 1 have similar concentrations and chemical contamination profiles as other wells in Area 1. Likewise, wells in Areas 2 and 3 show a similar pattern of concentrations and contamination with other wells in Areas 2 and 3. Figures 3-4A, 3-4B, and 3-6C show Area 1, Area 2, and Area 3. However, the concentrations and chemical contamination profiles for Area 1 differed from Areas 2 and 3. For example, PAH concentrations in Area 1 do not exceed 1 mg/kg, whereas PAH concentrations in Areas 2 and 3 do exceed 1 mg/kg in several locations. Because of the different concentrations and chemical profiles, for the HHRA, OU 2 was divided into two exposure units. These exposure units will be referred to as Area 1 and Area 2/3 in the HHRA. Soil and groundwater data were grouped appropriately to correspond to whether the sampling location was in Area 1 or Area 2/3. No contamination pattern was noted in surface water and sediment data sets; therefore, the surface water and sediment data sets were not subdivided for purposes of the HHRA. The entire surface water and sediment data sets were used for both Area 1 and Area 2/3.

Phase I and Phase II

For Phase I and Phase II groundwater sampling, monitoring wells MW01A, MW01B, MW02A, MW02B, MW03A, and MW03B were included in Area 1. Monitoring wells MW05A, MW05B, MW06A, and MW06B were included in Area 1 although they are just inside Area 2 because they are better grouped with Area 1 wells than with Area 2/3 wells based on location (they are downgradient of Area 1) and contamination profile, particularly for radionuclides and metals. Monitoring wells MW11A, MW11B, MW12A, MW12B, MW14A, MW14B, MW18A, MW18B, MW20A, and MW20B were included in Area 2/3.

Monitoring wells MW04A, MW04B, MW09A, MW09B, MW10A, MW10B, MW13A, MW13B, MW15A, MW15B, MW16A, MW16B, MW17A, MW17B, MW19A, and MW19B are located on GOAA property which is hydraulically separated from OU 2. Monitoring wells MW21A and MW21B are also off-property, west of the former landfill across a fenceline. Monitoring wells MW22A and MW22B are hydraulically upgradient of the former landfill. Monitoring wells MW23C, MW24C, MW25C, and MW26C are not located in the surficial aquifer but are in the deep Hawthorn aquifer. Monitoring wells MW07A, MW07B, MW08A, and MW08B had significantly less contamination than the other wells in terms of radionuclides, organics, and filtered metals. These wells were not included in risk calculations for the HHRA.

Phase III

In accordance with Region 4 Guidance (USEPA, 1995b), groundwater exposure assessment is of wells in the highly concentrated area of the plume. For Phase III groundwater sampling, monitoring wells MW05A, MW05B, MW06A, and MW06B had significantly less contamination than the other wells and were not included in the risk calculation for the Phase III groundwater. In addition, the turbidity in wells MW01A and MW11B could not be reduced below 150 NTU; therefore, these wells were considered not potable and not included in the Phase III groundwater risk calculation. Therefore, the wells evaluated for risk in Area 1 for Phase III were MW01B, MW02A, MW02B, MW03A, and MW03B. Monitoring wells MW11A, MW12A, MW12B, MW14A, MW14B, MW18A, MW18B, MW20A, and MW20B were included in Area 2/3.

The data evaluation included the calculation of basic descriptive statistics for each data set evaluated in the HHRA. Basic statistics included items such as frequency of detection, range of positive detections, arithmetic mean, and lognormal 95 percent Upper Confidence Limit (95 UCL-L) on the mean. According to USEPA comments to the Draft RI Report dated May 5, 1999, the data were assumed to fit a lognormal distribution. If there were less than 10 samples, the maximum concentration was chosen as the exposure point concentration (EPC). Otherwise, the 95 percent UCL-L was calculated for each analyte in each medium and data set using one-half the reporting limit for all nondetects and the average for samples with duplicates. The lesser of the maximum concentration and the 95 percent UCL-L was used for the EPC. Appendix E-12 provides the equations used to determine the UCL-L and the normal 95 percent UCL on the mean.

EPCs were calculated for analytes in soil samples located in Area 1. Separate EPCs were calculated for analytes in soil in Area 2/3. EPCs were calculated for Phase I and Phase II groundwater samples in Area 1. Separate EPCs were calculated for Phase III groundwater samples in Area 1. Likewise, EPCs were calculated for Phase I and Phase II groundwater samples in Area 2/3 and separate EPCs were calculated for Phase III groundwater samples in Area 2/3. For surface water and sediment samples, surface water and sediment EPCs were calculated for each analyte in the entire data set for OU 2. EPCs were calculated for Phase I and Phase II surface water samples and separate EPCs were calculated for Phase III surface water samples. The surface water and sediment EPC lists were used in the HHRA for both Area 1 and Area 2/3.

USEPA Region 4 guidance (USEPA, 1999) was followed to determine an equivalent benzo(a)pyrene EPC representative of total carcinogenic PAH. The Region 4 guidance uses a Toxicity Equivalency Factor (TEF) methodology for each carcinogenic PAH. The equivalent benzo(a)pyrene EPC was referred to as benzo(a)pyrene (equiv) EPC in this HHRA. The following TEFs were used to convert each PAH

concentration to a benzo(a)pyrene (equiv) concentration: (1) benzo(a)pyrene, TEF = 1.0; (2) benzo(a)anthracene, TEF = 0.1; (3) benzo(b)fluoranthene, TEF = 0.1; (4) dibenzo(a,h)anthracene, TEF = 1.0; (5) benzo(k)fluoranthene, TEF = 0.01; (6) chrysene, TEF = 0.001; and (7) indeno(1,2,3-cd)pyrene, TEF = 0.1. If any of the carcinogenic PAHs were detected at a sample location, the benzo(a)pyrene (equiv) concentration was calculated for that location by multiplying the concentration of each carcinogenic PAH by the appropriate TEF and summing these values. If any of the carcinogenic PAHs were below detection limits at that sample location, then half the detection limit of that PAH was used as its concentration. If all of the carcinogenic PAHs were below detection limits at a sample location, then the benzo(a)pyrene (equiv) concentration was calculated by multiplying half the detection limit for each PAH by the appropriate TEF and summing these values.

6.2 SELECTION OF CHEMICALS OF POTENTIAL CONCERN FOR HHRA

USEPA Region 4 guidelines and criteria were used to select COPCs (USEPA, 1999). For soil and groundwater, COPCs were selected for each medium and exposure unit (e.g., arsenic in soil in Area 1). For surface water and sediment, COPCs were selected for each medium and evaluated as COPCs for both exposure units (e.g., arsenic in surface water, if selected as a COPC, would be evaluated as a COPC in both Area 1 and Area 2/3). COPCs were selected separately for the Phase I and Phase II groundwater and surface water data sets and for the Phase III groundwater and surface water data sets. The COPCs were defined as chemicals that were positively detected in at least one sample in each medium/exposure unit at a maximum concentration exceeding background and screening values.

For each medium/exposure unit, the following criteria were used to exclude detected analytes from the list of COPCs. Each criterion by itself was justification for excluding the analyte.

- Less than Background Screening Concentrations. If the maximum detected concentration of an analyte in a medium/exposure unit were less than twice the arithmetic mean of the background concentration (inorganics only), the analyte was not selected as a COPC (USEPA, 1995b). The background screening values for surface soil and groundwater were taken from the Background Sampling Report (ABB-ES, 1995). *A Handbook of Radioactivity Measurement Procedures*, NCRP Report No. 58 (NCRP, 1985) lists the average potassium-40 concentration in soils as 10 pCi/g. Potassium-40 was screened out because the maximum potassium-40 concentration (3.3 pCi/g) was less than this average value.

- Less than Risk-Based Screening Concentrations, Standards, and Guidelines. If the maximum detected concentration of the analyte in a medium/exposure unit were less than its corresponding

adjusted USEPA Region 3 risk-based concentration (RBC) (USEPA, 1999), and less than Florida standards and guidelines, the analyte was not selected as a COPC. In the USEPA Region 3 RBC table, the target cancer risk is 1×10^{-6} and the target hazard quotient (HQ) is 1. All RBCs based on noncarcinogenic effects were adjusted for a target HQ of 0.1 in accordance with Region 4 guidance (USEPA, 1995b). To make this adjustment, all RBCs based on noncarcinogenic effects were divided by 10. Florida risk-based screening concentrations were based on residential use and were taken from *Technical Report: Development of Soil Cleanup Target Levels (SCTLs) for Chapter 62-777, F.A.C.* (FDEP, 1999). No RBC is available for lead in soil due to a lack of toxicity data. Based on the USEPA recommendation, a screening level of 400 mg/kg for lead under residential land use was used as the RBC for lead in soil (USEPA, 1994c). The residential land use value for lead was used to be conservative and consistent with previous reports. Safe Drinking Water Act (SDWA) action levels were used as screening standards for lead and copper in groundwater. The Florida risk-based screening concentrations (FDEP, 1999) for total recoverable petroleum hydrocarbons (TRPH) were used for TPH (c8-c40). No RBC is available for DRO or GRO; therefore, naphthalene was used as a surrogate for DRO and hexane was used for a surrogate for GRO in the screening process. Chromium was evaluated as hexavalent chromium.

The screening level for radium of 5 pCi/g in soil was taken from 40 CFR 141. The same screening level in soil was used for daughter products in the decay chain of radium: actinium-228, bismuth-214, lead-210, lead-212, lead-214, and thallium-208. The screening levels for gross beta of 15 pCi/g in soil and 50 pCi/L in groundwater also were taken from 40 CFR 141. The screening levels for gross alpha of 5 pCi/g in soil and 15 pCi/L in water were taken from FDEP (1999). In addition to screening against Region 3 RBCs and Florida risk-based screening concentrations, volatiles in soil were also screened against Generic Soil Screening Levels (SSLs) for the migration of chemicals from soil to air given in the Soil Screening Guidance (USEPA, 1996). This was a conservative measure as the Florida screening concentrations already consider the inhalation pathway. No volatiles in soil exceeded their respect SSLs.

- Less than Essential Nutrient Screening Values. If the maximum detected concentration of an essential nutrient (i.e., calcium, magnesium, potassium, and sodium) in a medium were below a toxic level or consistent with or only slightly above its background concentration, the essential nutrient was not selected as a COPC. The derivation of essential nutrient screening values for calcium, magnesium, potassium, and sodium is presented in Appendix C-1 of the *Remedial Investigation and Feasibility Study, General Information Report, Naval Air Station Whiting Field, Milton, Florida* (ABB-ES, 1998a). A copy of this derivation is provided in Appendix E-13. Iron was

not screened using the essential nutrient value because no value was derived for it in the document provided in Appendix E-13.

If the analyte met any of the above criteria, it was not selected as a COPC. In situations where multiple risk-based screening values or criteria were available, a chemical was excluded only if its maximum concentration were less than all of the screening values. After applying these criteria with professional judgment, COPCs were identified for each medium and exposure unit. Tables 2.1 through 2.10 in Appendix E-2 provide the basic descriptive statistics for analytes detected in each medium and exposure unit, identify which analytes were selected as COPCs, and present the COPC selection rationale. Appendix E-3, Tables 3.1 through 3.10, provide the EPC determinations for the COPCs in each medium and exposure unit.

6.2.1 COPCs for Area 1

Sections 6.2.1.1 through 6.2.1.4 identify Area 1 COPCs in surface soil, groundwater, surface water, and sediment, respectively. Separate groundwater and surface water COPCs are presented for both the combined Phases I and II sampling and for the Phase III resampling. Arsenic, determined to be a COPC in all media in Area 1 except for Phase III groundwater, was a component of herbicides that were commonly used in the past at golf courses. VOCs were only determined to be COPCs in groundwater. SVOCs were found to be COPCs in surface soil, surface water, and groundwater. A number of metals were determined to be COPCs in groundwater sampled in Phases I and II and surface water, while fewer metals were determined to be COPCs in sediments and groundwater sampled in Phase III. Arsenic was the only metal determined to be a COPC in surface soil. Of the radionuclides, gross beta was determined to be a COPC in groundwater sampled in Phases I and II, while gross alpha was determined to be a COPC in surface water, sediment, and groundwater. No radionuclides were detected in groundwater sampled in Phase III. According to the discussion of the nature and extent of radionuclide contamination in Section 5.6, the radionuclide levels present are considered a function of naturally occurring conditions, and for groundwater, turbidity. Therefore, radionuclides were noted as COPCs but were not carried forward in the HHRA.

6.2.1.1 Surface Soil – Area 1

Table 6-2A lists location identification numbers for surface soil samples considered for Area 1 COPCs. Figure 3-4B depicts the location of these soil samples. Sample location NTCSS103 was excavated and

TABLE 6-2A

AREA 1 SAMPLE LOCATION NUMBERS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Surface Soil[a]	Groundwater[b]	Surface Water[c]	Sediment[d]
S083	MW01A[e]	SW001	SW001
S099	MW01B	SW002	SW002
S104	MW02A	SW003	SW003
S105	MW02B	SW004	SW004
S108	MW03A	SW005	SW005
S109	MW03B	SW006	SW006
S113	MW05A[f]	SW007	SW007
S114	MW05B[f]	SW008	SW008
S115	MW06A[f]	SW009	SW009
S116	MW06B[f]	SW010	SW010
S117		SW011	SW011
S118		SW012	SW012
S119		SW013	SW013
S123		SW014	SW014
S124		SW015	SW015
S125		SW016	SW016
S126		SW017	SW017
S127		SW018	SW018
S128		SW019	SW019
S129		SW020	SW020
S133		SW021	SW021
S134		SW022	SW022
S135			
S137			
S138			
S139			
S151			
S152			
S153			
S154			
S155			
S156			
S157			
S158			
S159			
S160			

[a] Sample locations shown on Figure 3-4B.

[b] Sample locations shown on Figure 3-6C.

[c] Sample locations shown on Figure 3-4A.

[d] Sample locations shown on Figure 3-4A.

[e] Not included in Phase III evaluation because of high (>150 NTU) turbidity.

[f] Wells included in Area 1 for Phases I and II although they are just inside Area 2 because they are better matched with Area 1 wells than Area 2/3 wells. During Phase III these wells had significantly less contamination and were not used in either Area 1 or Area 2/3 evaluations.

data from this location were removed from the data set. Table 6-2B lists analytes selected as COPCs for surface soil at Area 1. The COPC selection process for surface soils in Area 1 is summarized in Appendix E-2, Tables E2.1 and E2.5. The following chemicals were identified as COPCs for Area 1 surface soil: benzo(a)pyrene (equiv) and arsenic.

6.2.1.2 Groundwater – Area 1

Table 6-2A lists location identification numbers for groundwater samples considered for Area 1 COPCs for Phase I and Phase II sampling and numbers for groundwater samples considered for Area 1 COPCs for Phase III resampling. Section 6.1 explains well locations selected for Area 1. Figure 3-6C depicts the location of the sampled monitoring wells. Table 6-2B lists analytes selected as COPCs for groundwater at Area 1 in both Phase I and Phase II sampling and Phase III resampling. The COPC selection process for groundwater in Area 1 is summarized in Appendix E-2, Tables E2.9A and E2.9B. The following chemicals were identified as COPCs for Area 1 groundwater in Phases I and II: benzene, chlorobenzene, methane, vinyl chloride, 1,4-dichlorobenzene, aluminum, arsenic, barium, chromium, iron, lead, manganese, selenium, vanadium, gross alpha, and gross beta. The following chemicals were identified as COPCs for Area 1 groundwater in Phase III: benzene, chlorobenzene, 1,4-dichlorobenzene, iron, and manganese. Nine metals were identified as COPCs in groundwater during Phases I and II. For Phase III, sampling techniques were used to lower the turbidity of samples, and, consequently, only two metals were identified as COPCs.

6.2.1.3 Surface Water – Area 1

Table 6-2A lists location identification numbers for all surface water samples considered for Area 1 COPCs. The same sample locations were sampled for the Phase I and Phase II sampling as for Phase III resampling. All surface water samples collected in Areas 1, 2, and 3 were considered in the determination of Area 1 COPCs because no contamination pattern differences were noted in surface water analytical results between Area 1 and Area 2/3. Figure 3-4A depicts the location of all surface water samples. Table 6-2B lists analytes selected as COPCs for surface water at Area 1 and Area 2/3 in both Phase I and Phase II sampling and Phase III resampling. The COPC selection process for surface water is summarized in Appendix E-2, Tables E2.3A, E2.3B, E2.7A, and E2.7B. The following chemicals were identified as COPCs for Area 1 and Area 2/3 surface water for Phases I and II: benzo(a)pyrene (equiv), bis(2-ethylhexyl)phthalate, aluminum, arsenic, barium, chromium, iron, lead, manganese, mercury, vanadium, and gross alpha. The following chemicals were identified as COPCs for Area 1 and Area 2/3 surface water for Phase III: bis(2-ethylhexyl)phthalate, aluminum, arsenic, chromium, iron, lead, manganese, mercury, and gross alpha.

TABLE 6-2B

CHEMICALS OF POTENTIAL CONCERN SUMMARY
OPERABLE UNIT 2 - AREA 1

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	Medium								
	Surface Soil		Surface Water		Sediments	Groundwater			
	Area 1	Area 2/3	Areas 1 & 2/3		Areas 1 & 2/3	Area 1	Area 2/3	Area 1	Area 2/3
Volatiles			Phase I & Phase II	Phase III		Phase I &	Phase II	Phase III	
1,1,2,2-Tetrachloroethane	no	no	no	no	no	no	yes	no	no
Benzene	no	no	no	no	no	yes	yes	yes	yes
Chlorobenzene	no	no	no	no	no	yes	yes	yes	no
Chloroform	no	no	no	no	no	no	yes	no	no
Methane	no	no	no	no	no	yes	yes	no	no
Tetrachloroethene	no	no	no	no	no	no	yes	no	yes
Trichloroethene	no	no	no	no	no	no	yes	no	yes
Vinyl Chloride	no	no	no	no	no	yes	yes	no	yes
cis-1,2-dichloroethene	no	no	no	no	no	no	yes	no	yes
Semivolatiles									
Benzo(a)pyrene (equiv)[a]	yes	yes	yes	no	no	no	no	no	no
Bis(2-ethylhexyl)phthlate	no	no	yes	yes	no	no	no	no	no
1,4-Dichlorobenzene	no	no	no	no	no	yes	no	yes	no
Pesticides									
Dieldrin	no	yes	no	no	no	no	no	no	no
Heptachlor	no	yes	no	no	no	no	no	no	no
Metals									
Aluminum	no	no	yes	yes	yes	yes	yes	no	no
Arsenic	yes	yes	yes	yes	yes	yes	no	no	yes
Barium	no	yes	yes	no	no	yes	yes	no	no
Chromium	no	no	yes	yes	no	yes	yes	no	no
Iron	no	no	yes	yes	yes	yes	yes	yes	yes
Lead	no	no	yes	no	no	yes	yes	no	no
Manganese	no	no	yes	yes	no	yes	no	yes	no
Mercury	no	no	yes	yes	no	no	no	no	no
Selenium	no	no	no	no	no	yes	yes	no	no
Vanadium	no	no	yes	no	yes	yes	yes	no	yes
TPH									
TPH (c8-c40)	no	yes	no	no	no	no	no	no	no
Radionuclides									
gross Alpha	no	yes	yes	yes	yes	yes	yes	no	no
gross Beta	no	yes	no	no	no	yes	no	no	no

[a]Benzo(a)pyrene equivalents include benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene.

6.2.1.4 Sediment – Area 1

Table 6-2A lists location identification numbers for all sediment samples considered for Area 1 COPCs. All sediment samples collected in Areas 1, 2, and 3 were considered in the determination of Area 1 COPCs because no contamination pattern differences were noted in sediment analytical results between Area 1 and Area 2/3. Samples from the canals are those collected after the canals were dredged. Figure 3-4A depicts the location of all sediment samples. Table 6-2B lists analytes selected as COPCs for sediment at Area 1 and Area 2/3. The COPC selection process for sediment is summarized in Appendix E-2, Tables E2.4 and E2.8. The following chemicals were identified as COPCs for Area 1 and Area 2/3 sediment: aluminum, arsenic, iron, vanadium, and gross alpha.

6.2.2 COPCs for Area 2/3

Sections 6.2.2.1 through 6.2.2.4 identify Area 2/3 COPCs in surface soil, groundwater, surface water, and sediment, respectively. Separate groundwater and surface water COPCs are presented for both the combined Phase I and Phase II sampling and for Phase III resampling. Arsenic, determined to be a COPC in all media except groundwater in Area 2/3 Phases I and II, was a component of herbicides that were commonly used in the past at golf courses. VOCs were only determined to be COPCs in groundwater. SVOCs were found to be COPCs in surface soil and surface water. A number of metals were determined to be COPCs in surface water, while fewer metals were determined to be COPCs in groundwater and sediments. Fewer metals were determined to be COPCs in Phase III groundwater and surface water than in Phases I and II. Arsenic was the only metal determined to be a COPC in surface soil. Of the radionuclides, gross beta was determined to be a COPC in surface soil, while gross alpha was determined to be a COPC in surface soil, surface water, sediment, and Phase I and Phase II groundwater. According to the discussion of the nature and extent of radionuclide contamination in Section 5.6, the radionuclide levels present are considered a function of naturally occurring condition, and, for groundwater, turbidity. Therefore, radionuclides were noted as COPCs but were not carried forward in the HHRA.

6.2.2.1 Surface Soil – Area 2/3

Table 6-2C lists location identification numbers for surface soil samples considered for Area 2/3 COPCs. Figure 3-4B depicts the location of these soil samples. Sample location NTCSSS91 was excavated and data from this location were removed from the data set. Twenty-eight sample locations (NTCSSS002, NTCSSS003, NTCSSS04, NTCSSH002, NTCSSH003, NTCSSH004, NTCSSH005, NTCSSH007,

TABLE 6-2C

AREA 2/3 SAMPLE LOCATION NUMBERS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Surface Soil[a]	Groundwater[b]	Surface Water[c]	Sediment[d]
S001	MW11A	SW001	SW001
S010	MW11B [e]	SW002	SW002
S011	MW12A	SW003	SW003
S012	MW12B	SW004	SW004
S020	MW14A	SW005	SW005
S021	MW14B	SW006	SW006
S022	MW18A	SW007	SW007
S030	MW18B	SW008	SW008
S031	MW20A	SW009	SW009
S032	MW20B	SW010	SW010
S040		SW011	SW011
S041		SW012	SW012
S050		SW013	SW013
S051		SW014	SW014
S052		SW015	SW015
S060		SW016	SW016
S061		SW017	SW017
S062		SW018	SW018
S070		SW019	SW019
S071		SW020	SW020
S072		SW021	SW021
S080		SW022	SW022
S081			
S082			
S090			
S092			
S100			
S101			
S102			
S110			
S111			
S112			
S120			
S121			
S122			
S130			
S131			
S132			
S140			

TABLE 6-2C

AREA 2/3 SAMPLE LOCATION NUMBERS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Surface Soil[a]	Groundwater[b]	Surface Water[c]	Sediment[d]
H001			
H006			
H011			
H016			
H021			
H025			
H026			
H030			
H031			
H035			
H036			
H037			
H038			
H039			
H040			
H041			
H042			
H043			
H044			
H045			
H046			
H047			
H048			
H049			

[a] Sample locations shown on Figure 3-4B.
[b] Sample locations shown on Figure 3-6C.
[c] Sample locations shown on Figure 3-4A.
[d] Sample locations shown on Figure 3-4A.
[e] Not included in Phase III evaluation because of high (>150 NTU) turbidity.

NTCSSH008, NTCSSH009, NTCSSH010, NTCSSH012, NTCSSH013, NTCSSH014, NTCSSH015, NTCSSH017, NTCSSH018, NTCSSH019, NTCSSH020, NTCSSH022, NTCSSH023, NTCSSH024, NTCSSH027, NTCSSH028, NTCSSH029, NTCSSH032, NTCSSH033, NTCSSH034) were covered during the installation of a soil cover. Data from these locations were removed from the data set. Figure 3-7 shows the location of the soil cover over the surface soil sample locations. Table 6-2B lists analytes selected as COPCs for surface soil at Area 2/3. The COPC selection process for surface soils in Area 2/3 is summarized in Appendix E-2, Tables E2.2 and E2.6. The following chemicals were identified as COPCs for Area 2/3 surface soil: benzo(a)pyrene (equiv), arsenic, gross alpha, and gross beta.

6.2.2.2 Groundwater – Area 2/3

Table 6-2C lists location identification numbers for groundwater samples considered for Area 2/3 COPCs for Phase I and Phase II sampling and numbers for groundwater samples considered for Area 2/3 COPCs for Phase III resampling. Section 6.1 explains well locations selected for Area 2/3. Figure 3-6C depicts the location of the monitoring wells that were sampled. Table 6-2B lists analytes selected as COPCs for groundwater at Area 2/3 in both Phase I and Phase II sampling and Phase III resampling. The COPC selection process for groundwater in Area 2/3 is summarized in Appendix E-2, Tables E2.10A and E2.10B. The following chemicals were identified as COPCs for Area 2/3 groundwater for Phase I and Phase II: 1,1,2,2-tetrachloroethane, benzene, chlorobenzene, chloroform, methane, PCE, TCE, vinyl chloride, cis-1,2-dichloroethene, aluminum, barium, chromium, iron, lead, selenium, vanadium, and gross alpha. The following chemicals were identified as COPCs for Area 2/3 groundwater Phase III: benzene, PCE, TCE, vinyl chloride, cis-1,2-dichloroethene, arsenic, iron, and vanadium. Seven metals were identified as COPCs in groundwater during Phase I and Phase II. For Phase III, sampling techniques were used to lower the turbidity of samples and, consequently, only three metals were identified as COPCs.

6.2.2.3 Surface Water – Area 2/3

Table 6-2C lists location identification numbers for all surface water samples considered for COPCs. The same locations were sampled for the Phase I and Phase II sampling as for the Phase III resampling. All surface water samples collected in Areas 1, 2, and 3 were considered in the determination of Area 2/3 COPCs because no contamination pattern differences were noted in surface water analytical results between Area 1 and Area 2/3. Figure 3-4A depicts the location of all surface water samples. Table 6-2B lists analytes selected as COPCs for surface water at Area 1 and Area 2/3 in both Phase I and Phase II sampling and Phase III resampling. The COPC selection process for surface water is summarized in Appendix E-2, Tables E2.3A, E2.3B, E2.7A, and E2.7B. The following chemicals were identified as

COPCs for Area 1 and Area 2/3 surface water for Phase I and Phase II: benzo(a)pyrene (equiv), bis(2-ethylhexyl)phthalate, aluminum, arsenic, barium, chromium, iron, lead, manganese, mercury, vanadium, and gross alpha. The following chemicals were identified as COPCs for Area 1 and Area 2/3 surface water for Phase III: bis(2-ethylhexyl)phthalate, aluminum, arsenic, chromium, iron, manganese, mercury, and gross alpha.

6.2.2.4 Sediment – Area 2/3

Table 6-2C lists location identification numbers for all sediment samples considered for COPCs. All sediment samples collected in Areas 1, 2, and 3 were considered in the determination of Area 2/3 COPCs because no contamination pattern differences were noted in sediment analytical results between Area 1 and Area 2/3. Figure 3-4A depicts the location of all sediment samples. Table 6-2B lists analytes selected as COPCs for sediment at Area 1 and Area 2/3. Samples from the canals are those collected after the canals were dredged. The COPC selection process for sediment is summarized in Appendix E-2, Tables E2.4 and E2.8. The following chemicals were identified as COPCs for Area 1 and Area 2/3 sediment: aluminum, arsenic, iron, vanadium, and gross alpha.

6.3 EXPOSURE ASSESSMENT

The exposure assessment was conducted to identify the pathways by which humans are potentially exposed, the magnitude of potential human exposure, and the frequency and duration of exposure. This process involves several 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.
- Quantification of exposure for each population in terms of the amount of chemical which is either ingested, inhaled, or absorbed through the skin from all potentially complete exposure pathways.

6.3.1 Exposure Setting Characterization

Section 2.0 describes the regional and site-specific environmental setting of the McCoy Annex Landfill. The McCoy Annex Landfill is located at the southern end of McCoy Annex. The western portion of the landfill was reportedly used by the Air Force and the Navy from about 1960 to 1972, while the eastern

portion was used from 1972 until about 1978. The area was converted into a golf course in 1981. The northern portion of the property is currently being used as a golf course and is expected to remain a golf course for the foreseeable future. The proposed reuse of the southern wooded portion of the landfill area will be recreational. The recreational facilities may include soccer fields, softball/ baseball diamonds, a picnic area, and recreational trails.

6.3.2 Identification of Potential Receptors and Exposure Pathways

The receptors to be evaluated were selected based on the current and realistic future use of the sites and surrounding areas. The Navy plans to transfer the OU 2 site to the City of Orlando. Deed restrictions will be placed as part of the reuse plan because of the landfill underlying the golf course.

For both current and future time frames for the HHRA, three potential receptors were evaluated for OU 2 Area 1 and Area 2/3. These receptors are:

- A recreational user. The recreational user for Area 1 was considered to be a golfer, based on current and projected future site use. Both an adult and an adolescent (ages 7-16) golfer were considered. It is assumed that a recreational user for Area 2/3 would use the soccer fields, baseball diamonds, etc. Both an adult and a child recreator were considered.

- A site maintenance worker. The site maintenance worker was assumed to be responsible for maintaining the golf course.

- An off-site resident. The off-site resident might also be called a trespasser or visitor. These individuals may occasionally enter the site with or without proper authorization. Both an adult and an adolescent (ages 7-16) off-site resident were considered. Visitors to the proposed recreational area in the southern portion of the site are considered under the recreational user receptor.

Hypothetical future adult, adolescent (ages 7-16), and child (ages 1-6) on-site residents were quantified for information purposes only. Deed restrictions are planned to prevent on-site residents; therefore, on-site residential land use is not expected in the foreseeable future.

No excavation activities resulting in long-term exposure are expected to take place on the site because of deed restrictions; therefore, a construction worker scenario was not considered. Routine, minor surface excavations were considered as part of the maintenance worker scenario.

Summaries of potential exposure pathways to chemicals detected at Area 1 and Area 2/3 are presented in Tables 6-3A and 6-3B, respectively. Information in these tables includes the scenario time frame, exposure medium, potentially exposed receptor population, exposure route, and the rationale for pathway selection or exclusion. Sections 6.3.2.1 through 6.3.2.4 describe the receptors considered to be potentially exposed to surface soil, surface water, sediment, and groundwater, respectively.

6.3.2.1 Surface Soil

The receptors considered to be potentially exposed to surface soil are:

- **Hypothetical future on-site residents** who may directly contact contaminants in surface soils. These receptors were evaluated for information purposes only, because deed restrictions are expected to prevent future residential use of OU 2 Area 1 or Area 2/3.

- **Current and future site maintenance workers** who may come in contact with surface soils while maintaining the golf course and recreational area.

- **Current and future recreators** who may come in contact with contaminated surface soils on the site.

It was assumed that off-site residents, visitors, or trespassers would primarily wade in ponds and canals and their exposure to surface soils would be minimal. Exposures of hypothetical potential future residents (combined adult and child), current and future site maintenance workers, and current and future recreators (combined adolescent and adult) to surface soil contaminants were evaluated in this HHRA. Incidental ingestion, dermal contact, and inhalation exposure routes were considered.

6.3.2.2 Surface Water

Surface waters include drainage canals and ponds serving as golf course water hazards. Additional ponds are proposed near the future recreational fields. The receptors considered to be potentially exposed to surface water are:

- **Hypothetical future residents** who may wade in the surface water. These receptors were evaluated for information purposes only, because deed restrictions are expected to prevent future residential use of OU 2 Area 1 or Area 2/3.

TABLE 6-3A

SELECTION OF EXPOSURE PATHWAYS - AREA 1
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-site/ Off-site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/Future	Surface Soil[a]	Surface Soil/ Air	Entire Surface	Site Maintenance Worker	Adult	Ingestion	On-site	Quant[b]	The site is currently an active golf course in which workers are engaged in maintenance activities.
						Dermal	On-site	Quant	The site is currently an active golf course in which workers are engaged in maintenance activities.
						Inhalation	On-site	Quant	The site is currently an active golf course in which workers are engaged in maintenance activities.
				Recreational User (Golfer)	Adult and Adolescent	Ingestion	On-site	Quant	The site is currently an active site in which recreators are regularly on-site.
						Dermal	On-site	Quant	The site is currently an active site in which recreators are regularly on-site.
						Inhalation	On-site	Quant	The site is currently an active site in which recreators are regularly on-site.
	Groundwater	Groundwater	Tap Water	Site Maintenance Worker	Adult	Ingestion	On-site	None	Shallow groundwater is not and is not expected to be used as a water supply. Water is provided by the city.
				Recreators (Golfer)	Adult and Adolescent	Ingestion	On-site	None	Shallow groundwater is not and is not expected to be used as a water supply. Water is provided by the city.
		Groundwater/ Air	Entire Area	Site Maintenance Worker	Adult	Dermal	On-site	None	Dermal contact with groundwater does not occur under current land use and is not anticipated under future land use.
						Inhalation	On-site	None	Minimal exposure is anticipated; therefore, this pathway was not quantified.
				Recreators (Golfer)	Adult and Adolescent	Dermal	On-site	None	Dermal contact with groundwater does not occur under current land use and is not anticipated under future land use.
						Inhalation	On-site	None	Minimal exposure is anticipated; therefore, this pathway was not quantified.
	Surface Water	Surface Water/ Air	Ponds, Canals, etc.	Site Maintenance Worker	Adult	Ingestion	On-site	Quant	Site worker / golf ball retriever may be in contact with the surface waters during maintenance of the golf course.
						Dermal	On-site	Quant	Site worker / golf ball retriever may be in contact with the surface waters during maintenance of the golf course.
						Inhalation	On-site	None	Minimal exposure is anticipated; therefore, this pathway was not quantified.
				Recreational User (Golfer)	Adult and Adolescent	Ingestion	On-site	None	Minimal exposure is anticipated; therefore, this pathway was not quantified.
						Dermal	On-site	None	Minimal exposure is anticipated; therefore, this pathway was not quantified.
						Inhalation	On-site	None	Minimal exposure is anticipated; therefore, this pathway was not quantified.
				Resident (trespasser/visitor)	Adult and Adolescent	Ingestion	Off-site	Quant	Access to ponds and canals is not restricted to off-site residents. Wading may occur.
						Dermal	Off-site	Quant	Access to ponds and canals is not restricted to off-site residents. Wading may occur.
						Inhalation	Off-site	None	Minimal exposure is anticipated; therefore, this pathway was not quantified.

TABLE 6-3A

SELECTION OF EXPOSURE PATHWAYS - AREA 1
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-site/ Off-site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
	Sediments	Sediments	Ponds, Canals, etc.	Site Maintenance Worker	Adult	Ingestion	On-site	Quant	Site worker / golf ball retriever may be in contact with sediment during maintenance of the golf course.
						Dermal	On-site	Quant	Site worker / golf ball retriever may be in contact with sediment during maintenance of the golf course.
						Inhalation	On-site	None	Minimal exposure is anticipated; therefore, this pathway was not quantified.
				Recreational User (Golfer)	Adult and Adolescent	Ingestion	On-site	None	Minimal exposure is anticipated; therefore, this pathway was not quantified.
						Dermal	On-site	None	Minimal exposure is anticipated; therefore, this pathway was not quantified.
						Inhalation	On-site	None	Minimal exposure is anticipated; therefore, this pathway was not quantified.
				Resident (trespasser/visitor)	Adult and Adolescent	Ingestion	Off-site	Quant	Access to ponds and canals is not restricted to off-site residents. Wading may occur.
						Dermal	Off-site	Quant	Access to ponds and canals is not restricted to off-site residents. Wading may occur.
						Inhalation	Off-site	None	Minimal exposure is anticipated; therefore, this pathway was not quantified.
Future	Surface/ Subsurface Soil	Surface/ Subsurface Soil	Entire Area	Excavation/Construction Worker	Adult	Ingestion	On-site	None	No excavation is expected on the site. Deed restrictions will be placed as part of the reuse plan because of the landfill beneath the site.
						Dermal	On-site	None	No excavation is expected on the site. Deed restrictions will be placed as part of the reuse plan because of the landfill beneath the site.
		Air	Entire Area	Excavation/Construction Worker	Adult	Inhalation	On-site	None	No excavation is expected on the site. Deed restrictions will be placed on the site because of the landfill beneath the site.
	Surface Soil	Surface Soil/ Air	Entire Area	Resident	Adult and Child	Ingestion	On-site	Quant	The site is expected to remain a golf course in the future, and deed restrictions will prevent any on-site residents. This pathway was evaluated for comparison purposes.
						Dermal	On-site	Quant	The site is expected to remain a golf course in the future, and deed restrictions will prevent any on-site residents. This pathway was evaluated for comparison purposes.
						Inhalation	On-site	Quant	The site is expected to remain a golf course in the future, and deed restrictions will prevent any on-site residents. This pathway was evaluated for comparison purposes.
	Surface Water	Surface Water/ Air	Ponds, Canals, etc.	Resident	Adult and Adolescent	Ingestion	On-site	Quant	The site is expected to remain a golf course, and deed restrictions will prevent on-site residents. This pathway was evaluated for comparison purposes. Parameters are those used for off-site residents.
						Dermal	On-site	Quant	The site is expected to remain a golf course, and deed restrictions will prevent on-site residents. This pathway was evaluated for comparison purposes. Parameters are those used for off-site residents.
						Inhalation	On-site	Quant	The site is expected to remain a golf course, and deed restrictions will prevent on-site residents. This pathway was evaluated for comparison purposes. Parameters are those used for off-site residents.

TABLE 6-3A

SELECTION OF EXPOSURE PATHWAYS - AREA 1
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-site/ Off-site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
	Sediments	Sediments	Ponds, Canals, etc.	Resident	Adult and Adolescent	Ingestion	On-site	Quant	The site is expected to remain a golf course, and deed restrictions will prevent on-site residents. This pathway was evaluated for comparison purposes. Parameters are those used for off-site residents.
						Dermal	On-site	Quant	The site is expected to remain a golf course, and deed restrictions will prevent on-site residents. This pathway was evaluated for comparison purposes. Parameters are those used for off-site residents.
						Inhalation	On-site	Quant	The site is expected to remain a golf course, and deed restrictions will prevent on-site residents. This pathway was evaluated for comparison purposes. Parameters are those used for off-site residents.
	Groundwater	Groundwater/ Air	Shallow Excavation	Excavation/Construction Worker	Adult	Ingestion	On-site	None	No excavation is expected on the site. Deed restrictions will be placed on the site because of the landfill beneath the site.
						Dermal	On-site	None	No excavation is expected on the site. Deed restrictions will be placed on the site because of the landfill beneath the site.
						Inhalation	On-site	None	No excavation is expected on the site. Deed restrictions will be placed on the site because of the landfill beneath the site.
			Tap Water / Vapor	Resident	Adult	Ingestion	On-site	Quant	No residents currently reside on-site. The site is expected to remain a golf course in the future, and deed restrictions will prevent any on-site residents. Any use of the shallow groundwater for domestic water supply is unlikely. This pathway was evaluated for comparison purposes.
						Dermal	On-site	Quant	No residents currently reside on-site. The site is expected to remain a golf course in the future, and deed restrictions will prevent any on-site residents. Any use of the shallow groundwater for domestic water supply is unlikely. This pathway was evaluated for comparison purposes.
						Inhalation	On-site	Quant	No residents currently reside on-site. The site is expected to remain a golf course in the future, and deed restrictions will prevent any on-site residents. Any use of the shallow groundwater for domestic water supply is unlikely. This pathway was evaluated for comparison purposes.
					Child	Ingestion	On-site	Quant	No residents currently reside on-site. The site is expected to remain a golf course in the future, and deed restrictions will prevent any on-site residents. Any use of the shallow groundwater for domestic water supply is unlikely. This pathway was evaluated for comparison purposes.
						Dermal	On-site	Quant	No residents currently reside on-site. The site is expected to remain a golf course in the future, and deed restrictions will prevent any on-site residents. Any use of the shallow groundwater for domestic water supply is unlikely. This pathway was evaluated for comparison purposes.
						Inhalation	On-site	Quant	No residents currently reside on-site. The site is expected to remain a golf course in the future, and deed restrictions will prevent any on-site residents. Any use of the shallow groundwater for domestic water supply is unlikely. This pathway was evaluated for comparison purposes.

[a]Surface soil is defined as soil collected from 0 to 1 foot below ground surface (bgs)
[b]Quantitative.

TABLE 6-3B

SELECTION OF EXPOSURE PATHWAYS - AREA 2/3
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-site/ Off-site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/Future	Surface Soil[a]	Surface Soil/ Air	Entire Surface	Site Maintenance Worker	Adult	Ingestion	On-site	Quant[b]	The site is currently an active golf course with proposed soccer and baseball fields.
						Dermal	On-site	Quant	The site is currently an active golf course with proposed soccer and baseball fields.
						Inhalation	On-site	Quant	The site is currently an active golf course with proposed soccer and baseball fields.
				Recreational User	Adult and Child	Ingestion	On-site	Quant	The site is currently an active golf course with proposed soccer and baseball fields.
						Dermal	On-site	Quant	The site is currently an active golf course with proposed soccer and baseball fields.
						Inhalation	On-site	Quant	The site is currently an active golf course with proposed soccer and baseball fields.
	Groundwater	Groundwater	Tap Water	Site Maintenance Worker	Adult	Ingestion	On-site	None	Shallow groundwater is not and is not expected to be used as a water supply. Water is provided by the city.
				Recreators (Golfer)	Adult and Adolescent	Ingestion	On-site	None	Shallow groundwater is not and is not expected to be used as a water supply. Water is provided by the city.
		Groundwater/ Air	Entire Area	Site Maintenance Worker	Adult	Dermal	On-site	None	Dermal contact with groundwater does not occur under current land use and is not anticipated under future land use.
						Inhalation	On-site	None	Minimal exposure is anticipated; therefore, this pathway was not quantified.
				Recreators	Adult and Child	Dermal	On-site	None	Dermal contact with groundwater does not occur under current land use and is not anticipated under future land use.
						Inhalation	On-site	None	Minimal exposure is anticipated; therefore, this pathway was not quantified.
	Surface Water	Surface Water/ Air	Ponds, Canals, etc.	Site Maintenance Worker	Adult	Ingestion	On-site	Quant	Site worker/golf ball retriever may be in contact with the surface waters during maintenance of the golf course.
						Dermal	On-site	Quant	Site worker/golf ball retriever may be in contact with the surface waters during maintenance of the golf course.
						Inhalation	On-site	None	Minimal exposure is anticipated; therefore, this pathway was not quantified.
				Recreational User	Adult and Child	Ingestion	On-site	None	Minimal exposure is anticipated; therefore, this pathway was not quantified.
						Dermal	On-site	None	Minimal exposure is anticipated; therefore, this pathway was not quantified.
						Inhalation	On-site	None	Minimal exposure is anticipated; therefore, this pathway was not quantified.
				Resident (trespasser/visitor)	Adult and Adolescent	Ingestion	Off-site	Quant	Access to ponds and canals is not restricted to off-site residents. Wading may occur.
						Dermal	Off-site	Quant	Access to ponds and canals is not restricted to off-site residents. Wading may occur.
						Inhalation	Off-site	None	Minimal exposure is anticipated; therefore, this pathway was not quantified.

TABLE 6-3B

SELECTION OF EXPOSURE PATHWAYS - AREA 2/3
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-site/ Off-site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
	Sediments	Sediments	Ponds, Canals, etc.	Site Maintenance Worker	Adult	Ingestion	On-site	Quant	Site worker/golf ball retriever may be in contact with surface water sediment during maintenance of the golf course.
						Dermal	On-site	Quant	Site worker/golf ball retriever may be in contact with surface water sediment during maintenance of the golf course.
						Inhalation	On-site	None	Minimal exposure is anticipated; therefore, this pathway was not quantified.
				Recreational User	Adult and Child	Ingestion	On-site	None	Minimal exposure is anticipated; therefore, this pathway was not quantified.
						Dermal	On-site	None	Minimal exposure is anticipated; therefore, this pathway was not quantified.
						Inhalation	On-site	None	Minimal exposure is anticipated; therefore, this pathway was not quantified.
				Resident (trespasser/visitor)	Adult and Adolescent	Ingestion	Off-site	Quant	Access to ponds and canals is not restricted to off-site residents. Wading may occur.
						Dermal	Off-site	Quant	Access to ponds and canals is not restricted to off-site residents. Wading may occur.
						Inhalation	Off-site	None	Minimal exposure is anticipated; therefore, this pathway was not quantified.
Future	Surface/ Subsurface Soil	Surface/ Subsurface Soil	Entire Area	Excavation/Construction Worker	Adult	Ingestion	On-site	None	No excavation is expected on the site. Deed restrictions will be placed as part of the reuse plan because of the landfill beneath the site.
						Dermal	On-site	None	No excavation is expected on the site. Deed restrictions will be placed as part of the reuse plan because of the landfill beneath the site.
		Air	Entire Area	Excavation/ Construction Worker	Adult	Inhalation	On-site	None	No excavation is expected on the site. Deed restrictions will be placed on the site because of the landfill beneath the site.
	Surface Soil	Surface Soil/ Air	Entire Area	Resident	Adult and Child	Ingestion	On-site	Quant	The site is expected to remain a golf course in the future, and deed restrictions will prevent any on-site residents. This pathway was evaluated for comparison purposes.
						Dermal	On-site	Quant	The site is expected to remain a golf course in the future, and deed restrictions will prevent any on-site residents. This pathway was evaluated for comparison purposes.
						Inhalation	On-site	Quant	The site is expected to remain a golf course in the future, and deed restrictions will prevent any on-site residents. This pathway was evaluated for comparison purposes.
	Surface Water	Surface Water/ Air	Ponds, Canals, etc	Resident	Adult and Adolescent	Ingestion	On-site	Quant	The site is expected to remain a golf course, and deed restrictions will prevent on-site residents. This pathway was evaluated for comparison purposes. Parameters are those used for off-site residents.
						Dermal	On-site	Quant	The site is expected to remain a golf course, and deed restrictions will prevent on-site residents. This pathway was evaluated for comparison purposes. Parameters are those used for off-site residents.
						Inhalation	On-site	Quant	The site is expected to remain a golf course, and deed restrictions will prevent on-site residents. This pathway was evaluated for comparison purposes. Parameters are those used for off-site residents.
	Sediments	Sediments	Ponds, Canals, etc	Resident	Adult and Adolescent	Ingestion	On-site	Quant	The site is expected to remain a golf course, and deed restrictions will prevent on-site residents. This pathway was evaluated for comparison purposes. Parameters are those used for off-site residents.
						Dermal	On-site	Quant	The site is expected to remain a golf course, and deed restrictions will prevent on-site residents. This pathway was evaluated for comparison purposes. Parameters are those used for off-site residents.
						Inhalation	On-site	Quant	The site is expected to remain a golf course, and deed restrictions will prevent on-site residents. This pathway was evaluated for comparison purposes. Parameters are those used for off-site residents.

TABLE 6-3B

SELECTION OF EXPOSURE PATHWAYS - AREA 2/3
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-site/ Off-site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
	Groundwater	Groundwater/ Air	Shallow Excavation	Excavation/ Construction Worker	Adult	Ingestion	On-site	None	No excavation is expected on the site. Deed restrictions will be placed on the site because of the landfill beneath the site.
						Dermal	On-site	None	No excavation is expected on the site. Deed restrictions will be placed on the site because of the landfill beneath the site.
						Inhalation	On-site	None	No excavation is expected on the site. Deed restrictions will be placed on the site because of the landfill beneath the site.
			Tap Water / Vapor	Resident	Adult	Ingestion	On-site	Quant	No residents currently reside on-site. The site is expected to remain a golf course in the future, and deed restrictions will prevent any on-site residents. Any use of the shallow groundwater for domestic water supply is unlikely. This pathway was evaluated for comparison purposes.
						Dermal	On-site	Quant	No residents currently reside on-site. The site is expected to remain a golf course in the future, and deed restrictions will prevent any on-site residents. Any use of the shallow groundwater for domestic water supply is unlikely. This pathway was evaluated for comparison purposes.
						Inhalation	On-site	Quant	No residents currently reside on-site. The site is expected to remain a golf course in the future, and deed restrictions will prevent any on-site residents. Any use of the shallow groundwater for domestic water supply is unlikely. This pathway was evaluated for comparison purposes.
					Child	Ingestion	On-site	Quant	No residents currently reside on-site. The site is expected to remain a golf course in the future, and deed restrictions will prevent any on-site residents. Any use of the shallow groundwater for domestic water supply is unlikely. This pathway was evaluated for comparison purposes.
						Dermal	On-site	Quant	No residents currently reside on-site. The site is expected to remain a golf course in the future, and deed restrictions will prevent any on-site residents. Any use of the shallow groundwater for domestic water supply is unlikely. This pathway was evaluated for comparison purposes.
						Inhalation	On-site	Quant	No residents currently reside on-site. The site is expected to remain a golf course in the future, and deed restrictions will prevent any on-site residents. Any use of the shallow groundwater for domestic water supply is unlikely. This pathway was evaluated for comparison purposes.

- **Current and future off-site residents, visitors, or trespassers** who may enter a contaminated site with or without proper authorization and wade in the surface water. Some drainage canals form the boundary of this site and exit the property, enabling off-site residents access for wading without trespassing.

- **Current and future site maintenance workers** who may wade into the surface water while maintaining the golf course and recreational area.

Exposures of hypothetical potential future residents (combined adult and child), current and future off-site residents, visitors, and trespassers (combined adolescent and adult), and current and future site maintenance workers to surface water contaminants were evaluated in this HHRA. Incidental ingestion and dermal contact exposure routes were considered.

6.3.2.3 Sediment

Sediments are those associated with surface waters, which include drainage canals, ponds serving as golf course water hazards, and proposed ponds near future recreational fields. Surface water levels may vary with rainfall, especially drainage canals, exposing sediment. The receptors considered to be potentially exposed to sediment are:

- **Hypothetical future residents** who may wade in the site surface water and contact contaminated sediment. Such residents may also directly contact exposed sediment when surface water levels recede. These receptors were evaluated for information purposes only, because deed restrictions are expected to prevent future residential use of OU 2 Area 1 or Area 2/3.

- **Current and future off-site residents, visitors, or trespassers** who may enter a contaminated site with or without proper authorization and contact contaminated sediment in the course of wading in the surface water. In addition, they may directly contact exposed sediment when surface water levels recede. Some drainage canals form the boundary of this site, enabling off-site residents access for wading without trespassing.

- **Site maintenance workers** who may contact contaminated sediment while wading in surface waters during site maintenance activities. They may also directly contact exposed sediment when surface water levels recede.

Exposures of hypothetical future residents (combined adult, adolescent, and child), current and hypothetical future off-site residents, visitors, and trespassers (combined adolescent and adult), and current and future site maintenance workers to sediment contaminants were evaluated in this HHRA. Incidental ingestion and dermal contact exposure routes are considered.

6.3.2.4 Groundwater

The receptors considered to be potentially exposed to groundwater are hypothetical future residents, both child (ages 1-6), and adult. These receptors are described as individuals who may reside on OU 2 Area 1 or Area 2/3 sometime in the future. These residents may use groundwater from wells in the contaminated shallow aquifer. These receptors were evaluated for information purposes only, because deed restrictions are expected to prevent future residential use of OU 2 Area 1 or Area 2/3. In addition, water is provided to the area by the city, and it is unlikely that hypothetical future residents would install any wells.

Two irrigation wells existed on McCoy Annex some distance from OU 2; however, these wells are no longer in use. Gray water from the treatment plant is currently used for irrigation water. This practice is expected to continue in the future; therefore, the use of the shallow aquifer for future irrigation purposes was considered unlikely.

6.3.3 Exposure Quantification

6.3.3.1 Site Maintenance Workers

Site maintenance workers were assumed to be responsible for maintaining the golf course and proposed future recreational fields. Tables E4.1, E4.4, and E4.7 in Appendix E-4 provide formulas used to estimate chemical intake of site maintenance workers from exposure to surface soil, surface water, and sediment, respectively. Dose absorbed per event (DAevent) formulas are provided in Appendix E-14. Where available, parameters used in the equations were those given by standard USEPA guidance documents. Tables E4.1, E4.4, and E4.7 (Appendix E-4) provide a reference for each parameter. Parameters without standard USEPA values and deviations from parameters with standard USEPA values include:

- The particulate emission factor (PEF) for surface soil inhalation was the Florida default value used in the *Focused Risk Assessment for Operable Unit 2, McCoy Annex Landfill, Naval Training Center, Orlando, Florida* (Tetra Tech NUS, 1998b).

- No standard USEPA parameter was found for exposure time for ingestion of surface water during maintenance activities; therefore an exposure time of 1.0 hour/event was assumed. Similarly, an exposure frequency of 50 events/year was assumed. These two factors together assumed site maintenance workers were exposed to on-site surface water for 50 hours per year. This is equivalent to one event per week.

- No standard USEPA parameters were found for event frequency, exposure frequency, or duration of event for dermal exposure to surface water. An event frequency, exposure frequency, and duration of event of 1 event/day, 50 days/year, and 1.0 hour/event, respectively, were assumed so that the total number of hours per year for dermal exposure to surface water was consistent with the total hours per year for ingestion of surface water.

- No standard USEPA parameters were found for ingestion rate for sediment or exposure frequency for either ingestion or dermal contact with sediment. An exposure frequency of 50 days/year was assumed for both ingestion and dermal contact with sediment, based on the assumption that site maintenance workers would be exposed to sediment at the same rate that they were exposed to surface water overlying the sediment. An ingestion rate of 5 mg/day was assumed. This was believed to be conservative as the exposure to sediments is reduced when sediments are under water as they are much of the year and was based on one-tenth the soil ingestion rate for a typical worker scenario.

Intake values for site maintenance worker exposures to Area 1 and Area 2/3 noncarcinogens are provided in Appendix E-7, Tables E7.1, E7.4A, E7.4B, and E7.7. Intake values for site maintenance worker exposures to Area 1 and Area 2/3 carcinogens are provided in Appendix E-8, Tables E8.1, E8.4A, E8.4B, and E8.7.

6.3.3.2 Adult, Adolescent, and Child Recreators

Recreators in Area 1, both adult and adolescent, were assumed to be golfers. It was assumed that recreators in Area 2/3, both adult and child, would use the proposed recreational area including soccer fields, baseball diamonds, picnic areas, and trails. Tables E4.2A and E4.3A in Appendix E-4 provide formulas used to estimate chemical intake of Area 1 adult and adolescent golfers, respectively, from exposure to surface soil. Tables E4.2B and E4.3B in Appendix E-4 provide formulas used to estimate chemical intake for Area 2/3 adult and child recreators, respectively, from exposure to surface soil. Where available, parameters used in the equations were those given by standard USEPA guidance documents. Tables E4.2A, E4.2B, E4.3A,

and E4.3B (Appendix E-4) provide a reference for each parameter. Parameters without standard USEPA values and deviations from parameters with standard USEPA values include:

- The PEF for surface soil inhalation was the Florida default value used in the Focused Risk Assessment (Tetra Tech NUS, 1998b).

- A number of assumptions or estimates for golfers made in the Focused Risk Assessment (Tetra Tech NUS,1998b) were also used for the HHRA. The soil ingestion rate was assumed to be 50 mg/day for both adults and adolescents. The exposure frequency for both adults and adolescents was assumed to be 100 days/year for all exposure routes. The exposure duration was assumed to be 20 years for adults and 10 years for adolescents for all exposure routes. The exposure time for soil inhalation was assumed to be 5 hours/day for both adults and adolescents. In the Focused Risk Assessment, based on USEPA guidance (USEPA, 1992), the skin surface available for dermal contact for adolescents was estimated to be 4,540 cm^2/day; the same value was used in the HHRA.

- A number of assumptions or estimates for recreators were made in the HHRA. The recreators were assumed to be engaged in soccer, baseball, softball, picnicking, or walking on trails. The soil ingestion rate for recreators was assumed to be the residential values of 100 mg/day for an adult and 200 mg/day for a child. The fraction ingested term was adjusted to 0.5 to account for the fact that the receptors would not be exposed to the surface soil for a full day as residents would. The fraction ingested term also takes into account the variety of activities assumed for the receptor, ranging from very contact intensive to spectator-oriented. The exposure frequency was assumed to be 75 days/year based on a value from the ORNL risk assessment information web site (RAIS webpage) for recreating persons. This is equivalent to approximately 1½ visits per week and was considered a conservative estimate for central Florida. The exposure time was considered to be 5 hours/day for both adults and children. The receptors were assumed to be wearing shorts, short-sleeved shirts, and shoes; therefore the skin surface area available for contact was assumed to be 5700 cm^2 for an adult and 2800 cm^2 for a child (USEPA, 2000). The soil adherence factors selected for the adult and child were 0.08 mg/cm^2 and 0.3 mg/cm^2, respectively, and are based on activity specific values for soccer players (Exhibit 3.3, USEPA, 2000).

Intake values for the adult golfer exposures to Area 1 noncarcinogen COPCs are provided in Appendix E-7, Table E7.2A. Intake values for the adult recreator exposures to Area 2/3 noncarcinogen COPCs are provided in Appendix E-7, Table E7.2B. Intake values for adolescent recreator exposures to

Area 1 noncarcinogen COPCs are provided in Appendix E-7, Table E7.3A. Intake values for child recreator exposures to Area 2/3 noncarcinogen COPCs are provided in Appendix E-7, Table E7.3B. Intake values for adult golfer exposures to Area 1 carcinogen COPCs are provided in Appendix E-8, Table 8.2A. Intake values for the adult golfer exposures to Area 2/3 carcinogen COPCs are provided in Appendix E-8, Table E8.2B. Intake values for adolescent golfer exposures to Area 1 carcinogen COPCs are provided in Appendix E-8, Table E8.3A. Intake values for a child recreator exposure to Area 2/3 carcinogen COPCs are provided in Appendix E-8, Table E8.3B.

6.3.3.3 Adult and Adolescent Off-site Residents, Visitors, or Trespassers

Off-site residents, both adult and adolescent, were assumed to occasionally enter the site and wade in the drainage canals, ponds serving as golf course water hazards, and proposed ponds near future recreational fields. Tables E4.5 and E4.8 in Appendix E-4 provide formulas used to estimate chemical intake for adult off-site residents from exposure to surface water and sediment, respectively. Tables E4.6 and E4.9 in Appendix E-4 provide formulas used to estimate chemical intake for adolescent off-site residents from exposure to surface water and sediment, respectively. DAevent formulas are provided in Appendix E-14. Where available, parameters used in the equations were those given by standard USEPA guidance documents. Tables E4.5, E4.6, E4.8, and E4.9 (Appendix E-4) provide a reference for each parameter. Parameters without standard USEPA values and deviations from parameters with standard USEPA values include:

- No standard USEPA parameters were found for event frequency for adult and adolescent dermal exposure to surface water. An event frequency of one event/day was assumed.

- The exposure duration was assumed to be 20 years for adults and 10 years for adolescents for both surface water and sediment exposures. These values were the same values assumed in the Focused Risk Assessment (Tetra Tech NUS, 1998b) for recreational users (golfers).

- An exposure frequency of 100 events/year or days/year was assumed for adolescent exposure to surface water and sediment. This value was selected to be greater than the adult exposure frequency of 45 events/year (USEPA Region 4, 1995b) based on the belief that adolescents are more likely to participate in wading activities than adults. The value selected is equivalent to approximately twice per week during the course of a year.

- A sediment ingestion rate of 5 mg/day was assumed for both adults and adolescents. This assumption was believed to be conservative and was based on the same reasoning as for the maintenance worker (see Section 6.3.3.1).

Intake values for adult off-site resident (visitor) exposures to Area 1 and Area 2/3 noncarcinogens are provided in Appendix E-7, Tables E7.5A, E7.5B, and E7.8. Intake values for adolescent recreator exposures to Area 1 and Area 2/3 noncarcinogens are provided in Appendix E-7, Tables E7.6A, E7.6B, and E7.9. Intake values for adult recreator exposures to Area 1 and Area 2/3 carcinogens are provided in Appendix E-8, Tables E8.5A, E8.5B, and E8.8. Intake values for adolescent recreator exposures to Area 1 and Area 2/3 carcinogens are provided in Appendix E-8, Tables E8.6A, E8.6B, and E8.9.

6.3.3.4 Hypothetical Future Adult, Adolescent, and Child On-site Residents

The hypothetical future on-site resident adult, adolescent, and child were quantified for information purposes only. Deed restrictions are planned to prevent on-site residents; therefore, on-site residential land use is not expected in the foreseeable future. The adult intake was quantified for surface soil, surface water, sediment, and groundwater COPCs. The child intake was quantified for surface soil and groundwater COPCs. The adolescent intake was quantified for surface water and sediment COPCs.

Tables E4.10 through E4.17 in Appendix E-4 provide formulas used to estimate chemical intake of future hypothetical site residents from exposure to surface soil, surface water, sediment, and groundwater. Surface soil and groundwater intakes were estimated for hypothetical future adult and child residents (Tables E4.10, E4.11, E4.16, and E4.17 in Appendix E-4). Surface water and sediment intakes were estimated for hypothetical future adult and adolescent residents (Tables E4.12, E4.13, E4.14, and E4.15 in Appendix E-4). Inhalation intake from groundwater was not quantified for hypothetical future adult and child residents because the inhalation risk was assumed to be equal to the ingestion risk for VOCs and SVOCs (USEPA Region 4, 1995b). DAevent formulas are provided in Appendix E-14. Where available, parameters used in the equations were those given by standard USEPA guidance documents. Tables E4.10 through E4.17 (Appendix E-4) provide a reference for each parameter. Parameters without standard USEPA values and deviations from parameters with standard USEPA values include:

- The PEF for surface soil inhalation was the Florida default value used in the Focused Risk Assessment (Tetra Tech NUS, 1998b).

- No standard USEPA parameters were found for event frequency for adult and adolescent dermal exposure to surface water. An event frequency of one event/day was assumed.

- The exposure duration was assumed to be 20 years for adults and 10 years for adolescents for both surface water and sediment exposures. These values were the same values assumed in the Focused Risk Assessment (Tetra Tech NUS, 1998b) for recreational users (golfers).

- An exposure frequency of 100 events/year or days/year was assumed for adolescent exposure to surface water and sediment. This value was selected to be greater than the adult exposure frequency of 45 events/year (USEPA Region 4, 1995b) based on the belief that adolescents are more likely to participate in wading activities than adults. The value selected is equivalent to approximately twice per week during the course of a year.

- A sediment ingestion rate of 5 mg/day was assumed for both adults and adolescents. This assumption was believed to be conservative and was based on the reasoning as in Section 6.3.3.1.

Surface soil and groundwater intake values for hypothetical future adult and child resident exposures to Area 1 and Area 2/3 noncarcinogens are provided in Appendix E-7, Tables E7.10, E7.11, E7.16A, E7.16B, E7.17A, and E7.17B. Surface water and sediment intake values for hypothetical future adult and adolescent resident exposures to Area 1 and Area 2/3 noncarcinogens are provided in Appendix E-7, Tables E7.12A, E7.12B, E7.13A, E7.13B, E7.14, and E7.15. Surface soil and groundwater intake values for hypothetical future adult and child resident exposures to Area 1 and Area 2/3 carcinogens are provided in Appendix E-8, Tables E8.10, E8.11, E8.16A, E8.16B, E8.17A, and E8.17B. Surface water and sediment intake values for hypothetical future adult and adolescent resident exposures to Area 1 and Area 2/3 carcinogens are provided in Appendix E-8, Tables E8.12A, E8.12B, E8.13A, E8.13B, E8.14, and E8.15.

6.4 TOXICITY ASSESSMENT

The toxicity assessment for the COPCs examines information concerning the potential human health effects of exposure to COPCs. For each COPC, the goal of the toxicity assessment is to provide a quantitative estimate of the relationship between the magnitude and type of exposure and the severity or probability of human health effects. The toxicity values presented in this section are integrated with the exposure assessment (Section 6.3) to characterize the potential for the occurrence of adverse health effects.

The toxicological evaluation involves a critical review and interpretation of toxicity data from epidemiological, clinical, animal, and in vitro studies. This review of the data ideally determines both the nature of the health effects associated with a particular chemical and the probability that a given quantity of a chemical could result in the referenced effect. This analysis defines the relationship between the dose received and the incidence of an adverse effect for the COPCs.

The entire toxicological database is used to guide the derivation of cancer slope factors (CSFs) for carcinogenic effects and Reference Doses (RfDs) for noncarcinogenic effects. These data may include epidemiological studies, long-term animal bioassays, short-term tests, and evaluations of molecular structure. Data from these sources are reviewed to determine if a chemical is likely to be toxic to humans. Because of the lack of available human studies, however, the majority of toxicity data used to derive CSFs and RfDs comes from animal studies.

For noncarcinogenic effects, the most appropriate animal model (the species most biologically similar to the human) is identified. Pharmacokinetic data often enter into this determination. In the absence of sufficient data to identify the most appropriate animal model, the most sensitive species is chosen. The RfD is generally derived from the most comprehensive toxicology study that characterizes the dose-response relationship for the critical effect of the chemical. Preference is given to studies using the exposure route of concern; in the absence of such data, however, an RfD for one route of exposure may be extrapolated from data from a study that evaluated a different route of exposure. Such extrapolation must take into account pharmacokinetic and toxicological differences between the routes of exposure. Uncertainty factors are applied to the highest no-observed-adverse-effect level (NOAEL) to adjust for inter- and intraspecies variation, deficiencies in the toxicological database, and use of subchronic rather than chronic animal studies. Additional uncertainty factors may be applied to estimate a NOAEL from a lowest-observed-adverse-effect level (LOAEL) if the key study failed to determine a NOAEL. When chemical-specific data are not sufficient, an RfD may be derived from data for a chemical with structural and toxicologic similarity.

CSFs for weight-of-evidence Group A or Group B chemicals are generally derived from positive cancer studies that adequately identify the target organ in the test animal data and characterize the dose-response relationship. CSFs are derived for Group C compounds for which the data are sufficient, but they are not derived for Group D or Group E chemicals. (An explanation/definition of these weight-of-evidence classes is provided in Section 6.4.1.) No consideration is given to similarity in the animal and human target organs because a chemical capable of inducing cancer in any animal tissue is considered potentially carcinogenic to humans. Preference is given to studies using the route of exposure of concern, in which normal physiologic function was not impaired, and in which exposure occurred during most of the

animal's lifetime. Exposure and pharmacokinetic considerations are used to estimate equivalent human doses for computation of the CSF. When a number of studies of similar quality are available, the data may be combined in the derivation of the CSF.

Toxicological profiles for each of the COPCs are presented in Appendix E-11. These profiles present a summary of the available literature on carcinogenic and noncarcinogenic effects associated with human exposure to the chemical.

6.4.1 Carcinogenic Effects

The toxicity information considered in the assessment of potential carcinogenic risks includes a weight-of-evidence classification and a slope factor. The weight-of-evidence classification qualitatively describes the likelihood that a chemical is a human carcinogen and is based on an evaluation of the available data from human and animal studies. A chemical may be placed in one of three groups in USEPA's classification system to denote its potential for carcinogenic effects:

- Group A - known human carcinogen
- Group B1 or B2 - probable human carcinogen
- Group C - possible human carcinogen

Chemicals that cannot be classified as human carcinogens because of a lack of data are placed in Group D, and those for which there is evidence of noncarcinogenicity in humans are in Group E.

The CSF is the toxicity value used to quantitatively express the carcinogenic hazard of cancer-causing chemicals. It is defined as the upperbound estimate of the probability of cancer incidence per unit dose averaged over a lifetime. Slope factors are derived from studies of carcinogenicity in humans and/or laboratory animals and are typically calculated for compounds in Groups A, B1, and B2, although some Group C carcinogens also have slope factors and some B2 carcinogens such as lead have none. Slope factors are specific to a chemical and route of exposure and are expressed in units of $[mg/kg\text{-}day]^{-1}$ for both oral and inhalation routes. Inhalation cancer toxicity values are usually expressed as inhalation unit risks in units of reciprocal $\mu g/m^3$ $[1/(\mu g/m^3)]$. The inhalation unit risk must be converted to an inhalation slope factor. This is done by assuming that humans weigh 70 kg and inhale 20 m^3 of air per day (i.e., the inhalation unit risk $(1/\mu g/m^3)$ is divided by 20 m^3/day, multiplied by 70 kg, and multiplied by 1,000 $\mu g/mg$ to yield the mathematical equivalent of an inhalation slope factor $[mg/kg\text{-}day]^{-1}$) (USEPA, 1995b). CSFs for COPCs at McCoy Annex are presented in Appendix E-6 in Tables E6.1 and E6.2. The primary sources of

information for these values are the USEPA Washington (USEPA, 1997b, 1998b) and USEPA Region III (USEPA, 1999).

The USEPA database [the Integrated Risk Information System (IRIS)] (USEPA, 1998b) was consulted as the primary source for CSF values, as well as for RfDs. USEPA intends that IRIS supersede all other sources of toxicity information for risk assessment. If values are not available in IRIS, the annual Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997b) were consulted, as well as the current USEPA Region III Risk-Based Concentration Table (USEPA, 1999). If no CSF is available from any of these sources, carcinogenic risks are not quantified and potential exposures are addressed in the general uncertainty section, Section 6.5.

CSFs exist for several (but not all) Class C compounds, which are identified as "possible" human carcinogens. Based on data for these compounds, there is inadequate evidence of carcinogenicity in humans and limited evidence of carcinogenicity in animals. In this HHRA, Class C compounds are evaluated quantitatively as class A/B1/B2 compounds, but the risks associated with exposure to Class C compounds are also discussed separately if these chemicals are major risk drivers, underscoring the uncertainty associated with these estimations.

Dermal CSFs are derived from the corresponding oral values. In the derivation of a dermal CSF, the oral CSF is divided by the gastrointestinal absorption efficiency (USEPA, 1995b) to determine a CSF based on an absorbed dose rather than an administered dose. The oral CSF is divided by the absorption efficiency because CSFs are expressed as reciprocal doses. Dermal CSFs and the absorption efficiencies used in their determination are also included in Appendix E-6 in Table E6.1. When no absorption rate is available in the literature, no adjustment is made.

Risk estimates for PAHs have, in the past, assumed that all carcinogenic PAHs have a potency equal to that for benzo(a)pyrene. A benzo(a)pyrene equivalent concentration is calculated using TEFs for the other Class B2 PAHs as explained in Section 6.1. While benzo(a)pyrene was well studied, other Class B2 PAHs had insufficient data with which to calculate a CSF.

6.4.2 Noncarcinogenic Effects

For noncarcinogens, it is assumed that a dose exists below which no adverse health effects will be seen. Below this "threshold" dose, exposure to a chemical can be tolerated without adverse effects. Toxic effects are manifested only when physiologic protective mechanisms are overcome by exposures to a

chemical above its threshold level. Maternal and developmental endpoints are considered systemic toxicity.

The potential for noncarcinogenic health effects resulting from exposure to chemicals is assessed by comparing an exposure estimate (intake or dose) to an RfD. The RfD is expressed in units of mg/kg/day and represents a daily intake of contaminant per kilogram of body weight that is not sufficient to cause the threshold effect of concern. An RfD is specific to the chemical, the route of exposure, and the duration over which the exposure occurs. Separate RfDs are presented for ingestion and inhalation pathways. In particular, Reference Concentrations (RfCs) in units of [mg/m^3] are typically presented for the inhalation pathway. Because characterization of noncarcinogenic effects requires an estimate of dose in units of mg/kg/day, the inhalation RfC must be converted to an inhalation RfD. The conversion is performed by assuming that humans weigh 70 kg and inhale 20 m^3 of air per day (i.e., the inhalation RfC [mg/m^3] is multiplied by 20 m^3/day and divided by 70 kg to yield an inhalation RfD with units of [mg/kg-day] (USEPA, 1995b).

To derive an RfD, USEPA reviews all relevant human and animal studies for each compound and selects the study (studies) pertinent to the derivation of the specific RfD. Each study is evaluated to determine the NOAEL or, if the data are inadequate for such a determination, the LOAEL. The NOAEL corresponds to the dose (in mg/kg/day) that can be administered over a lifetime without inducing observable adverse effects. The LOAEL corresponds to the lowest daily dose that induces an observable adverse effect. The toxic effect characterized by the LOAEL is referred to as the "critical effect." To derive an RfD, the NOAEL (or LOAEL) is divided by uncertainty factors to ensure that the RfD will be protective of human health. Uncertainty factors are applied to account for extrapolation of data from laboratory animals to humans (interspecies extrapolation), variation in human sensitivity to the toxic effects of a compound (intraspecies differences), derivation of a chronic RfD based on a subchronic rather than a chronic study, or derivation of an RfD from the LOAEL rather than the NOAEL. In addition to these uncertainty factors, modifying factors between 1 and 10 may be applied to reflect additional qualitative considerations in evaluating the data. For most compounds, the modifying factor is one.

A dermal RfD is developed by multiplying an oral RfD (based on an administered dose) by the gastrointestinal tract absorption factor. The resulting dermal RfD, based on an absorbed dose, is used to evaluate the dermal (absorbed) dose calculated by the dermal exposure algorithms.

RfDs for the COPCs at McCoy Annex are presented in Appendix E-5 in Tables E5.1 and E5.2. The primary source of these values is the IRIS database, followed by other USEPA sources described for the carcinogens. This table also includes the primary target organs affected by a particular chemical. This

information may be used in the risk characterization section to segregate risks by target organ effects, unless the total HI is below unity.

6.5 RISK CHARACTERIZATION, UNCERTAINTY ANALYSIS, AND CONCLUSIONS

Summaries of the risk characterizations for Area 1 and Area 2/3 follow. As described in Section 3.8, additional groundwater, surface water, and sediment samples were collected at OU 2 and analyzed during the second half of 1999. This additional investigation, Phase III, was performed to mitigate uncertainties and data gaps in the Phase I and Phase II sampling identified during preparation of the Draft RI Report issued in January 1999 (Tetra Tech NUS, 1999) and to compensate for the dredging of the canals at OU 2. The scope and rationale for the Phase III investigation were discussed in Section 3.6.5. In addition, surface soil was excavated from OU 2 that included surface soil sample locations NTCSSS91 and NTCSS103 and a 2-foot soil cover was installed in the southern portion of OU 2. Based on these activities, updated data sets for each medium were used in this HHRA for risk characterization from those used in the Draft RI Report.

For the purposes of completeness, risk from groundwater and surface water is also presented for the Phase I and Phase II sampling rounds as well as the Phase III sampling round. Risk characterization was only presented for the updated surface soil data set without the excavated samples or those surface soil locations covered by the 2-foot soil cover because the soil from those locations, and therefore any associated risk, was completely removed from the site or was no longer surface soil. Likewise, risk characterization was only presented for the Phase III sediment data set because the 1999 dredging removed some sediments while exposing different sediments.

Risk characterization is presented in two groups. The risk from Phase I and Phase II groundwater and surface water is presented with the risk from the updated surface soil and Phase III sediment data sets. In addition, the risk from the Phase III groundwater and surface water data sets is presented also with the risk from the updated surface soil and Phase III sediment data sets. Tables in Appendix E containing Phase I and Phase II risk characterization are designated as A while tables containing Phase III risk characterization are designated as B. As previously discussed, groundwater samples from Phase I and Phase II were highly turbid, and surface water samples from Phase I and Phase II were collected prior to dredging. Therefore, the Phase I and Phase II groundwater and surface water data are likely not to be representative of the actual conditions at the site but are presented here for the purposes of completeness.

6.5.1 Risk Characterization for Area 1

A summary of the risk characterization for Area 1, the northeast portion of the McCoy Annex Landfill, is presented in this section. Phase III groundwater and surface water data superceded Phase I and Phase II data; therefore, Phase I and Phase II data are no longer considered representative of the site conditions. (Section 6.1) Phase I and Phase II risk characterizations are presented here for purposes of completeness. Total noncarcinogenic and carcinogenic risks for each exposure route, as well as the cumulative risks for each receptor for Phase I and Phase II, are presented in Tables E9.1A, E9.3, E9.5, E9.9A, E9.11A, and E9.13A in Appendix E-9. Total noncarcinogenic and carcinogenic risks for each exposure route, as well as the cumulative risks for each receptor for Phase III, are presented in Tables E9.1B, E9.3, E9.5, E9.9B, E9.11B, and E9.13B in Appendix E-9. The following receptors were evaluated:

- The maintenance worker
- A golfer (adult and adolescent)
- The hypothetical future resident (adult, adolescent, small child)

Example calculations and relevant risk calculation spreadsheets are presented in Appendix E.

6.5.1.1 Noncarcinogenic Risks for Area 1

Hazard Indexes (HIs) developed for the aforementioned receptors and presented in the referenced tables were as follows:

Phase III

Receptor	Hazard Index	Table in Appendix E
Maintenance Worker (Current/Future)	2.4E-02	E9.1B
Adult Golfer (Current/Future)	1.6E-03	E9.3
Adolescent Golfer (Current/Future)	2.5E-03	E9.5
Hypothetical Adult Resident (Future)	3.3E+00	E9.9B
Hypothetical Adolescent Resident (Future)	1.1E-01	E9.11B
Hypothetical Child Resident (Future)	7.7E+00	E9.13B

HIs calculated for the maintenance worker, the adult/adolescent golfers, and the adolescent resident are less than 1, indicating that adverse noncarcinogenic health effects are not anticipated under the conditions established in the exposure assessment.

HIs calculated for the hypothetical future resident exceed 1 for the adult and child. However, the HIs calculated for the adult and small child resident routinely exposed to soils only were 1.1E-02 and 9.6E-02, respectively. The HI calculated for the adult resident occasionally exposed to local surface waters/sediments only was 3.3E-02. HIs calculated on a target organ-specific basis did not exceed 1 when the COPCs selected for soil, surface waters, or sediments were evaluated independently. In contrast, HIs calculated for the small child (HI = 7.5E+00) and adult resident (HI = 3.2E+00) routinely exposed only to the COPCs selected for groundwater exceed 1. HQs developed for iron for the adult receptor and for iron and manganese for the child receptor hypothetically exposed to COPCs in groundwater exceed 1, indicating that adverse noncarcinogenic health effects are possible. Note that the maximum detected concentrations in groundwater reported for these metals exceed USEPA Region 3 RBCs for tap water and/or Federal SDWA Maximum Contaminant Levels (MCLs).

Phase I and Phase II

Groundwater samples from Phase I and Phase II were highly turbid, and surface water samples from Phase I and Phase II were collected prior to dredging. Therefore, the Phase I and Phase II groundwater and surface water data are likely not to be representative of the actual conditions at the site but are presented here for the purposes of completeness.

Receptor	Hazard Index	Table in Appendix E
Maintenance Worker (Current/Future)	9.9E-E-02	E9.1A
Adult Golfer User (Current/Future)	1.6E-03	E9.3
Adolescent Golfer User (Current/Future)	2.5E-03	E9.5
Hypothetical Adult Resident (Future)	1.4E+01	E9.9A
Hypothetical Adolescent Resident (Future)	6.7E-01	E9.11A
Hypothetical Child Resident (Future)	3.3E+01	E9.13A

HIs calculated for the maintenance worker, the adult/adolescent golfer users, and the adolescent resident are less than 1, indicating that adverse noncarcinogenic health effects are not anticipated under the conditions established in the exposure assessment.

when the COPCs selected for soil, surface waters, or sediments were evaluated independently. In contrast, HIs calculated for the small child (HI = 3.3E+01) and adult resident (HI = 1.4E+01) routinely exposed only to the COPCs selected for groundwater exceed 1. HQs developed for aluminum, arsenic, barium, chromium, iron, and vanadium in groundwater exceed 1, indicating that adverse noncarcinogenic health effects are possible. Note that the maximum detected concentrations in groundwater reported for all these metals exceed USEPA Region 3 RBCs for tap water and/or Federal SDWA MCLs.

6.5.1.2 Carcinogenic Risks for Area 1

Incremental lifetime cancer risk (ILCR) estimates calculated for the maintenance worker, the recreational user, and the hypothetical future resident and presented in the referenced tables were as follows:

Phase III

Receptor	Cancer Risk Estimate	Table in Appendix E
Maintenance Worker (Current/Future)	1.8E-06	E9.1B
Adult Golfer (Current/Future)	3.6E-07	E9.3
Adolescent Golfer (Current/Future)	2.6E-07	E9.5
Total for Golfer (Current/Future)	6.2E-07	
Hypothetical Adult Resident (Future)	9.2E-06	E9.9B
Hypothetical Adolescent Resident (Future)	1.2E-06	E9.11B
Hypothetical Child Resident (Future)	8.5E-06	E9.13B
Total for Hypothetical Resident	1.9E-05	

The ILCR estimate developed for the golfer (6.2E-07) exposed to Area 1 soils does not exceed 1E-06. ILCR estimates calculated for the maintenance worker and the hypothetical future resident exceed the conservative end of the USEPA target risk range of 1E-04 to 1E-06. A review of the media- and chemical-specific risk results indicates that risk estimates for benzo(a)pyrene and arsenic in surface soil, bis(2-ethylhexyl)phthalate in surface water, and benzene and 1,4-dichlorobenzene in groundwater exceed 1E-06 for the hypothetical future resident. No COPCs for Area 1 have a risk that exceeds 1E-06 for the maintenance worker receptor.

Receptor	Media	Cancer Risk Estimate	Table in Appendix E
Maintenance Worker (Current/Future)	Soils	1.1E-06	E9.1B
	Local SW	6.2E-07	E9.1B
	Local SED	1.2E-08	E9.1B
	Total	1.8E-06	E9.1B
Hypothetical Adult Resident (Future)	Soils	2.6E-06	E9.9B
	Local SW	7.6E-07	E9.9B
	Local SED	8.5E-09	E9.9B
	Groundwater	5.8E-06	E9.9B
	Total	9.2E-06	E9.9B
Hypothetical Adolescent Resident (Future)	Local SW	1.2E-06	E9.11B
	Local SED	1.4E-08	E9.11B
	Total	1.2E-06	E9.11B
Hypothetical Child Resident (Future)	Soils	5.2E-06	E9.13B
	Groundwater	3.4E-06	E9.13B
	Total	8.5E-06	E9.13B
Total for Resident		1.9E-05	

Benzo(a)pyrene (equiv) and arsenic were the only COPCs selected for surface soils; the risk estimates for exposure to one or both of these chemicals are within the USEPA target risk range of 1E-04 to 1E-06 for all receptors evaluated. In some cases evaluated, ILCR estimates developed for the dermal route of exposure exceed those developed for the ingestion route of exposure.

Bis(2-ethylhexyl)phthalate is the only risk driver in the risk evaluation of surface water COPCs. The ILCR estimate for this COPC is within the USEPA target risk range of 1E-04 to 1E-06 for hypothetical future adult and adolescent residents and below 1E-06 for maintenance workers. The risk estimates for dermal exposure to bis(2-ethylhexyl)phthalate in surface water were three orders of magnitude greater than the risk estimates calculated for the ingestion route of exposure. Although bis(2-ethylhexyl)phthalate is calculated to fall within the effective predictive domain (EPD) of the dermal exposure model (DAevent), the difference in the risk estimates for dermal exposure compared to the ingestion route of exposure suggests that the model is also overly conservative in the prediction of dermal absorption of bis(2-ethylhexyl)phthalate. In addition, bis(2-ethylhexyl)phthalate, a common laboratory contaminant, was detected in only 3 of the 22 surface water samples collected and was not detected in any other media.

The COPCs in groundwater with risk estimates above 1E-06 are benzene and 1-4-dichlorobenzene. Risk estimates developed for these chemicals are within the USEPA target risk range of 1E-04 to 1E-06.

Phase I and Phase II

Groundwater samples from Phase I and Phase II were highly turbid, and surface water samples from Phase I and Phase II were collected prior to dredging. Therefore, the Phase I and Phase II groundwater and surface water data are likely not to be representative of the actual conditions at the site but are presented here for the purposes of completeness.

Receptor	Cancer Risk Estimate	Table in Appendix E
Maintenance Worker (Current/Future)	1.8E-06	E9.1A
Adult Golfer (Current/Future)	3.6E-07	E9.3
Adolescent Golfer (Current/Future)	2.6E-07	E9.5
Total for Golfer (Current/Future)	6.2E-07	
Hypothetical Adult Resident (Future)	3.5E-04	E9.9A
Hypothetical Adolescent Resident (Future)	1.3E-06	E9.11A
Hypothetical Child Resident (Future)	2.1E-04	E9.13A
Total for Hypothetical Resident	5.6E-04	

The ILCR estimate developed for the golfer (6.2E-07) exposed to Area 1 soils does not exceed the USEPA target risk range of 1E-04 to 1E-06. In contrast, the ILCR estimate calculated for the maintenance worker exceeds the conservative end of the risk range, 1E-06, and the ILCR estimate calculated for the hypothetical future resident exceeds 1E-04. A review of the media- and chemical-specific risk results indicates that COPCs in groundwater and surface water are the predominant risk drivers.

Media-specific ILCR estimates were as follows:

Receptor	Media	Cancer Risk Estimate	Table in Appendix E
Maintenance Worker (Current/Future)	Soils	1.1E-06	E9.1A
	Local SW	6.1E-07	E9.1A
	Local SED	1.2E-08	E9.1A
	Total	1.8E-06	E9.1A
Hypothetical Adult Resident (Future)	Soils	2.6E-06	E9.9A
	Local SW	8.2E-07	E9.9A
	Local SED	8.5E-09	E9.9A
	Groundwater	3.5E-04	E9.9A
	Total	3.5E-04	E9.9A
Hypothetical Adolescent Resident (Future)	Local SW	1.3E-06	E9.11A
	Local SED	1.4E-08	E9.11A
	Total	1.3E-06	E9.11 A
Hypothetical Child Resident (Future)	Soils	5.2E-06	E9.13A
	Groundwater	2.0E-04	E9.13A
	Total	2.1E-04	E9.13A
Total for Resident		5.6E-04	

Benzo(a)pyrene (equiv) and arsenic were the only COPCs selected for surface soils; the risk estimates for exposure to one or both of these chemicals are within the USEPA target risk range of 1E-04 to 1E-06 for all receptors evaluated. In some cases evaluated, ILCR estimates developed for the dermal route of exposure exceeded those developed for the ingestion route of exposure.

Bis(2-ethylhexyl)phthalate was the only surface water COPC that exceeded the 1E-06 risk level for water; the risk estimate for exposure to this chemical is within the USEPA target risk range of 1E-04 to 1E-06 for all receptors evaluated. In some cases evaluated, ILCR estimates developed for the dermal route of exposure exceed those developed for the ingestion route of exposure.

A high level of uncertainty is attached to the risk estimates for dermal exposure to benzo(a)pyrene (equiv) in surface water. Consequently the dermal exposure pathway was not included in the risk summaries. The calculated risk estimates for dermal exposure to benzo(a)pyrene (equiv) in surface water were three orders of magnitude greater than the risk estimates calculated for the ingestion route of exposure. USEPA guidance (USEPA, 2000) suggests that these types of results are counterintuitive and raise concerns that the USEPA model used to evaluate dermal absorption of chemicals from surface waters "may be overly conservative" for some chemicals. The risk estimates for dermal exposure to bis(2-ethylhexyl)phthalate in surface water were also three orders of magnitude greater than the risk estimates calculated for the ingestion route of exposure. Although bis(2-ethylhexyl)phthalate is calculated to fall within the EPD of the dermal exposure model (DAevent) whereas benzo(a)pyrene does not fall within the EPD, the difference in the risk estimates for dermal exposure compared to the ingestion route of exposure suggests that the model is also overly conservative in the prediction of dermal absorption of bis(2-ethylhexyl)phthalate. However, because bis(2-ethylhexyl)phthalate does fall within the EPD, the chemical was included in the quantitative analysis.

ILCR estimates calculated for COPCs in sediments do not exceed 1E-06 for any receptor evaluated.

Risk drivers (i.e., COPCs with risk estimates that exceed 1E-06) for Phase I and Phase II groundwater are benzene, vinyl chloride, 1,4-dichlorobenzene, and arsenic. Risk estimates for the first three chemicals are within the target risk range of 1E-04 to 1E-06. The risk estimate for arsenic exceeds 1E-04.

6.5.1.3 Evaluation of Area 1 Lead Concentrations

The maximum concentrations of lead in Area 1 soils and OU 2 sediments are 11.6 mg/kg and 33.2 mg/kg, respectively. These concentrations are less than the USEPA action level for residential land use (400 mg/kg) and the site-specific background concentration. Lead was not detected in the Phase III Area

1 groundwater samples. The maximum concentration of lead in OU 2 Phase III surface waters (16.6 µg/L) is slightly greater than the USEPA action level of 15 µg/L. However, note that lead was not a COPC in soils, sediments, or groundwater, and surface waters are not used as a drinking water source. Phase I and Phase II maximum concentrations for Area 1 groundwater (197 µg/L) and OU 2 surface water (109 µg/L) are greater than USEPA SDWA action levels; however, the high turbidity may have influenced the metals concentrations.

6.5.1.4 Uncertainty Analysis for Area 1

The following uncertainties should be considered when evaluating the results of the risk characterization conducted for Area 1:

- Note that the average (1.43 mg/kg) arsenic concentration for Area 1 soils is less than the background value used for COPC selection (1.9 mg/kg). The 95 percent UCL (2.24 mg/kg – assuming a lognormal distribution) arsenic concentration for Area 1 soils is similar to the background value. These results suggest most, if not all, of the Area 1 arsenic concentrations may be reflective of background conditions. Additionally, any elevated arsenic concentrations detected in the Area 1 soils are more likely reflective of the use of arsenic-containing pesticides/herbicides rather than contamination associated with the OU 2 McCoy Annex Landfill.

- The toxicity criteria for arsenic are a major source of uncertainty for this baseline risk assessment. While conventional risk assessment methodology suggests that there is no "zero risk concentration" for a carcinogen such as arsenic, the human body does have a limited capacity to methylate arsenic and this limit is not generally reached until the body's intake of arsenic exceeds 500 µg/day. Most environmental exposures result in intakes lower than 500 µg/day. Additionally, the USEPA suggests that an order of magnitude adjustment of risk (downward) may be appropriate for arsenic in some cases.

- Note that benzo(a)pyrene was detected in only 2 of 36 Area 1 surface soil samples and no other carcinogenic PAHs were detected. These COPCs are not pervasive in the Area 1 soils and the concentrations detected are similar to those frequently noted in rural or urban background soil samples. In addition the EPC for carcinogenic PAHs was calculated in a conservative manner (see Section 6.1). For samples without detectable carcinogenic PAHs, one half the detection limits for all carcinogenic PAHs were multiplied by their respective TEFs and summed. In cases with high detection limits, this method can significantly inflate the EPC. For example, in surface water data from Phases I and II, detectable carcinogenic PAHs (in the duplicate only) were

reported for only one out of 22 samples. Using the method described above for the calculation of benzo(a)pyrene (equiv) concentrations for samples without detectable carcinogenic PAHs, the 95 percent UCL (assuming a normal distribution) is calculated to be 3.18 µg/L and the 95 percent UCL (assuming a lognormal distribution) is 9.63 µg/L. Both of these values are much higher than the maximum and only detection of 0.341 µg/L in surface water.

- USEPA Region 4 guidance does not recommend specific ingestion rates for sediment exposure. The ingestion rate assumed in this baseline risk assessment is one-tenth the amount assumed for soils when a typical worker scenario is evaluated. Professional judgment was used to select this value because some of the OU 2 surface water/sediment sampling locations are submerged part or all of the year and because wading only (not swimming) is possible for most of the sampled water bodies. The risk estimates calculated for sediments in this assessment are generally one or more orders of magnitude less than USEPA target risks. Consequently, the sediment ingestion rate assumed for the assessment has little impact on the risk assessment results.

- Bis(2-ethylhexyl)phthalate (detected in only 3 of 22 samples) is a common laboratory contaminant and is not present in any other medium besides surface water. It is likely this chemical is not actually present in OU 2 surface water and this should be considered in any risk management decision. In addition, the risk estimates for dermal exposure to bis(2-ethylhexyl)phthalate are three orders of magnitude greater than risk estimates calculated for the ingestion route. These results are counterintuitive and may indicate the dermal intake model (USEPA, 2000) is overly conservative for this chemical.

- Risk-based screening levels and/or toxicity criteria are not available for several analytes detected in Area 1 environmental media: gross alpha, gross beta, TPH, GRO or DRO, and methane. The impact of the lack of toxicity criteria for the TPH and the GRO or DRO is anticipated to be limited by the fact that the environmental samples were analyzed by a comprehensive suite of volatile and semivolatile parameters. Methane is described as a simple asphyxiant that does not produce general systemic effects. However, it is a severe fire and explosion hazard [e.g., methane forms an explosive mixture with air (5 to 15 percent by volume)].

- The RfD for iron is derived based on inadvertent consumption of iron in beer brewed in iron vessels. This is not considered a proper RfD (Simon, 1997), and the risk estimates calculated for iron using the RfD is uncertain. Without the contribution of iron, the HIs were as follows:

Receptor	Adjusted Hazard Index without Iron Contribution	Table in Appendix E	Iron Contribution (HI) / Media
Area 1			
Maintenance Worker	2.0E-02	E9.1B	3.5E-03 surface water 5.5E-04 sediment
Adult Resident	1.1E+00	E9.9B	8.3E-03 surface water 4.2E-04 sediment 2.2E+00 groundwater
Adolescent Resident	7.8E-02	E9.11B	2.6E-02 surface water 1.6E-03 sediment
Child Resident	2.4E+00	E9.13B	5.1E+00 groundwater
Area 2/3			
Maintenance Worker	2.0E-02	E9.2B	3.5E-03 surface water 5.5E-04 sediment
Adult Resident	1.6E+01	E9.10B	8.3E-03 surface water 2.4E-01 groundwater 4.2E-04 sediment
Adolescent Resident	7.8E-02	E9.11B	2.6E-02 surface water 1.6E-03 sediment
Child Resident	3.7E+01	E9.14B	5.7E-01 groundwater
Local Resident/Visitor/Trespasser			
Adult	2.4E-02	E9.7B	8.3E-03 surface water 4.2E-04 sediment
Adolescent	7.8E-02	E9.8B	2.6E-02 surface water 1.6E-03 sediment

- As detailed in Section 6.2, several naturally occurring radionuclides (actinium-228, bismuth-214, lead-212, lead-214, and potassium-40) were detected in the OU 2 sediment samples. The concentrations detected were considered to be reflective of background based on a comparison of site concentrations to background data presented in the scientific literature. However, site-specific background soil or sediment data are not available at this time. The lack of site-specific background data is not anticipated to be a significant source of uncertainty because of the wealth of background data presented in the literature.

Uncertainties Associated with Phase I and Phase II Data Only

- Phase I and Phase II groundwater data may have artificially high concentrations because of the turbidity. The reduction in VOC concentrations in several of the wells between the Phase II and Phase III sampling events appears to be related to reductions in sample turbidity. Because organic chemicals may be sorbed to organic matter and/or clay materials in the aquifer matrix, the acid preservation and subsequent analysis of samples with high turbidity (i.e., suspended matrix material) may have resulted in a high bias for VOCs in the 1998 sample results. The reduction in turbidity achieved by the Phase III sampling, therefore, has resulted in a more representative, although synoptic, characterization of the VOC content of the groundwater flowing beneath OU 2.

There was also a corresponding decrease in the concentration of SVOCs detected between the two sampling events. The reduction in chemical concentrations in the wells, coupled with the similar reduction in VOCs in groundwater (see above discussion), appears to be a result of reductions in sample turbidity. Inorganic concentrations were also greatly reduced in the Phase III sampling from Phase I and Phase II sampling. Sample turbidity can contribute inorganic species to groundwater samples; the increase in inorganics may be facilitated by sample preservation (i.e., acidification). Inorganic materials can occur in natural formation water as cations, anions, complex ions, and undissociated molecules. In addition, they can occur in the form of colloids and as suspended matter. Because clay-sized particles in the aquifer matrix may contain a wide variety of minerals, the acid preservation and subsequent analysis of samples with high turbidity (i.e., suspended material) may have resulted in a high bias for certain inorganic ions.

Despite sampling techniques designed to lower the turbidity of samples in Phase III, turbidity readings reported for six wells could not be reduced below 150 NTU. Four of those wells, MW04A, MW04B, MW06B, and MW07A, had turbidities greater than 1100 NTU. These four wells were previously excluded from the groundwater data set for Area 1 or Area 2/3 for reasons other than turbidity. The remaining two wells with high turbidity in Phase III were initially included in the Phase I and Phase II groundwater data set (MW01A in Area 1 and MW11B in Area 2/3) but were excluded from the Phase III risk calculations because these wells were not considered potable. Turbidity in MW01A was 159 NTU and turbidity in MW11B was 320 NTU. For purposes of completeness, the risk calculations for Phase III Area 1 and Area 2/3 groundwater were repeated including the two high turbidity wells. The results are shown below:

Receptor	Adjusted HI or Cancer Risk From Groundwater Including Turbid Well Data	Table in Appendix E	Adjusted Total HI or Cancer Risk from All Media Including Turbid Well Data
Area 1			
Non-carcinogenic	**HI**		**HI**
Adult Resident	3.7E+00	E7.16C	3.7E+00
Child Resident	2.5E+01	E7.17C	2.5E+01
Carcinogenic	**Cancer Risk**		**Cancer Risk**
Adult Resident	7.3E-06	E8.16C	1.1E-05
Child Resident	3.7E-06	E8.17C	8.9E-06
Area 2/3			
Non-carcinogenic	**HI**		**HI**
Adult Resident	1.7E+01	E7.16C	1.7E+01
Child Resident	1.0E+02	E7.17C	1.0E+02
Carcinogenic	**Cancer Risk**		**Cancer Risk**
Adult Resident	9.4E-04	E8.16C	9.4E-04
Child Resident	1.6E-04	E8.17C	1.7E-04

With the inclusion of data from the turbid well MW01A, there were three additional groundwater COPCs in Area 1: 1,4-dichlorobenzene, chromium, and vanadium. Total risk from 1,4-dichlorobenzene exceeded 1E-06 for both the adult resident (3.5E-6) and the child resident (2.1E-06). No other risks or hazards exceeded 1E-06 or 1, respectively, for the new COPCs. Risks and hazards for the original Phase III groundwater COPCs did not change with the inclusion of the MW01A data.

With the inclusion of data from turbid well MW11B, there were six additional groundwater COPCs in Area 2/3: chlorobenzene, chloroform, trans-1,2-dichloroethene, aluminum, barium, and zinc. No risks or hazards exceeded 1E-06 or 1, respectively, for the new COPCs. Risks and hazards for the Phase III groundwater COPCs did not change with the inclusion of the MW11B data for cis-1,2-dichloroethene, trichloroethene, vinyl chloride, and vanadium. Inclusion of the MW11B resulted in different EPCs and therefore different calculated risks for benzene, tetrachloroethene, arsenic, and iron, as shown below.

Area 2/3 COPC	Groundwater Receptor	Risk with Turbid Well	Risk without Turbid Well	Hazard with Turbid Well	Hazard without Turbid Well
Benzene	Adult	**8.2E-06**	1.4E-06	**0.15**	0.025
	Child	**4.8E-06**	8.2E-07	**0.34**	0.058
Tetrachloroethene	Adult	1.8E-05	**4.0E-05**	0.10	**0.22**
	Child	1.0E-05	**2.3E-05**	0.23	**0.52**
Arsenic	Adult	3.4E-05	**7.3E-05**	0.22	**0.48**
	Child	2.0E-05	**4.3E-05**	0.51	**1.1**
Iron	Adult	NA	NA	**0.49**	0.24
	Child	NA	NA	**1.1**	0.57

6.5.1.5 Summary and Conclusions for Area 1

The following items summarize the results of the risk characterization for Area 1 using updated Phase III sample data.

- Noncancer risk estimates (HIs) developed for the maintenance worker, golfer, and adolescent resident are less than 1, indicating that adverse noncarcinogenic effects are not anticipated under the conditions considered in the risk assessment. HIs calculated for the hypothetical future resident, the only receptor assumed to be exposed to groundwater, do exceed 1 as a result of the evaluation of COPCs selected for groundwater.

- The ILCR estimate for the maintenance worker (1.8E-06) exceeds the conservative end of the USEPA target risk range (1E-06). No risk from individual COPCs exceeds 1E-06.

- The ILCR estimate for the hypothetical future resident (1.9E-05) exceeds the conservative end of the USEPA target risk range (1E-06).

Phase I and Phase II Summary

Groundwater samples from Phase I and Phase II were highly turbid, and surface water samples from Phase I and Phase II were collected prior to dredging. Therefore, the Phase I and Phase II groundwater and surface water data are likely not to be representative of the actual conditions at the site but are presented here for the purposes of completeness.

The following items summarize the results of the risk characterization for Area 1 using data from Phase I and Phase II only.

- Noncancer risk estimates (HIs) developed for the maintenance worker, recreational user, and the hypothetical adolescent resident are less than 1, indicating that adverse noncarcinogenic effects are not anticipated under the conditions considered in the risk assessment. HIs calculated for the hypothetical future adult and child residents, the only receptors assumed to be exposed to groundwater, do exceed 1 as a result of the evaluation of COPCs selected for groundwater in Area 1.
- The ILCR estimate for the maintenance worker (1.8E-06) exceeds the conservative end of the USEPA target risk range (1E-06). No risk from individual COPCs exceeds 1E-06.
- The ILCR estimate for the hypothetical future resident (5.6E-04) exceeds 1E-04.

6.5.2 Risk Characterization for Area 2/3

A summary of the risk characterization for Area 2/3, the central and southern portions of the McCoy Annex Landfill, is presented in this section. Phase III groundwater and surface water data superceded Phase I and Phase II data; therefore, Phase I and Phase II data are no longer considered representative of the site conditions (Section 6.1). Phase I and Phase II risk characterizations are presented here for purposes of completeness. Total noncarcinogenic and carcinogenic risks for each exposure route, as well as the cumulative risks for each receptor based on a risk evaluation of the Phase III data, are presented in Tables E9.2B, E9.4, E9.6, E9.10B, E9.12B, and E9.14B in Appendix E. Total noncarcinogenic and carcinogenic risks for each exposure route, as well as the cumulative risks for each receptor from Phase I and Phase II data, are presented in Tables E9.2A, E9.4, E9.6, E9.10A, E9.12A, and E9.14A in Appendix E. The following receptors were evaluated:

- The maintenance worker
- The recreational user (adult and child)
- The hypothetical future resident (adult, adolescent, small child)

Example calculations and relevant risk calculation spreadsheets are presented in Appendix E.

6.5.2.1 Noncarcinogenic Risks for Area 2/3

HIs developed for the aforementioned receptors and presented in the referenced tables were as follows:

Phase III

Receptor	Hazard Index	Table in Appendix E
Maintenance Worker (Current/Future)	2.4E-02	E9.2B
Adult Recreational User (Current/Future)	1.0E-03	E9.4
Child Recreational User (Current/Future)	9.5E-03	E9.6
Hypothetical Adult Resident (Future)	1.7E+01	E9.10B
Hypothetical Adolescent Resident (Future)	1.1E-01	E9.12B
Hypothetical Child Resident (Future)	3.8E+01	E9.14B

HIs calculated for the maintenance worker, the adult/child recreational users, and the hypothetical adolescent resident are less than 1, indicating that adverse noncarcinogenic health effects are not anticipated under the conditions established in the exposure assessment.

HIs calculated for the hypothetical future resident exceed 1 for the adult and child. The HIs calculated for the adult and small child resident routinely exposed to soils only were 1.0E-02 and 8.9E-02, respectively. The HIs calculated for the adult and adolescent resident occasionally exposed to local surface waters/sediments only were 3.3E-02 and 1.1E-01, respectively. HIs calculated on a target organ-specific basis did not exceed 1 when the COPCs selected for soil, surface waters, or sediments were evaluated independently. In contrast, HIs calculated for the small child (HI = 3.8E+01) and adult resident (HI = 1.7E+01) routinely exposed only to the COPCs selected for groundwater exceed 1. HQs developed for TCE exceed 1, indicating that adverse noncarcinogenic health effects are possible. Note that the maximum concentrations in groundwater for this COPC exceed USEPA Region 3 RBCs for tap water and/or Federal SDWA MCLs. The HIs calculated for the Area 2/3 groundwater COPCs are an order of magnitude greater than those calculated for Area 1.

Phase I and Phase II

Groundwater samples from Phase I and Phase II were highly turbid, and surface water samples from Phase I and Phase II were collected prior to dredging. Therefore, the Phase I and Phase II groundwater and surface water data are likely not to be representative of the actual conditions at the site but are presented here for the purposes of completeness.

HIs developed for the aforementioned receptors and presented in the referenced tables were as follows:

Receptor	Hazard Index	Table in Appendix E
Maintenance Worker (Current/Future)	9.9E-02	E9.2A
Adult Recreational User (Current/Future)	1.0E-03	E9.4
Adolescent Recreational User (Current/Future)	9.5E-03	E9.6
Hypothetical Adult Resident (future)	2.5E+01	E9.10A
Hypothetical Adolescent Resident (future)	6.7E-01	E9.12A
Hypothetical Child Resident (future)	5.6E+01	E9.14A

HIs calculated for the maintenance worker, the adult/adolescent recreational users, and the hypothetical adolescent resident are less than 1, indicating that adverse noncarcinogenic health effects are not anticipated under the conditions established in the exposure assessment.

HIs calculated for the hypothetical future resident exceed 1 for the adult and child. The HIs calculated for the adult and small child resident routinely exposed to soils only were 1.0E-02 and 8.9E-02, respectively. The HIs calculated for the adult and adolescent resident occasionally exposed to local surface waters/sediments only were 2.1E-01 and 6.7E-01, respectively. HIs calculated on a target organ-specific basis did not exceed 1 when the COPCs selected for soil, surface waters, or sediments were evaluated independently. In contrast, HIs calculated for the small child (HI = 5.6E+01) and adult resident (HI = 2.4E+01) routinely exposed only to the COPCs selected for groundwater exceed 1. HQs developed for TCE, aluminum, barium, chromium, iron, and vanadium exceed 1, indicating that adverse noncarcinogenic health effects are possible. Note that the maximum concentrations in groundwater for these COPCs exceed USEPA Region 3 RBCs for tap water and/or Federal SDWA MCLs. The HIs

calculated for the Area 2/3 groundwater COPCs are an order of magnitude greater than those calculated for Area 1.

6.5.2.2 Carcinogenic Risks for Area 2/3

Phase III

ILCR estimates calculated for the maintenance worker, the recreational user, and the hypothetical future resident and presented in the referenced tables were as follows:

Receptor	Cancer Risk Estimate	Table in Appendix E
Maintenance Worker (Current/Future)	1.8E-06	E9.2B
Adult Recreational User (Current/Future)	2.0E-07	E9.4
Adolescent Recreational User (Current/Future)	5.4E-07	E9.6
Total for Recreational User (Current/Future)	7.4E-07	
Hypothetical Adult Resident (future)	1.0E-03	E9.10B
Hypothetical Adolescent Resident (future)	1.2E-06	E9.12B
Hypothetical Child Resident (future)	5.8E-04	E9.14B
Total for Hypothetical Resident	1.6E-03	

The ILCR estimate developed for the recreational user (7.4E-07) exposed to Area 2/3 soils did not exceed 1E-06. The ILCR estimate developed for the maintenance worker exposed to Area 2/3 soils is within the USEPA target risk range of 1E-04 to 1E-06. No risk estimates for individual COPCs for the maintenance worker exceeded 1E-06. In contrast the ILCR estimate calculated for the hypothetical future resident exceeds 1E-04. A review of the media- and chemical-specific risk results indicates that COPCs in groundwater and surface water are the predominant risk drivers.

Media-specific ILCR estimates were as follows:

Receptor	Media	Cancer Risk Estimate	Table in Appendix E
Maintenance Worker (Current/Future)	Soils	1.2E-06	E9.2B
	Local SW	6.2E-07	E9.2B
	Local SED	1.2E-08	E9.2B
	Total	1.8E-06	E9.2B
Hypothetical Adult Resident (future)	Soils	2.7E-06	E9.10B
	Local SW	7.6E-07	E9.10B
	Local SED	8.5E-09	E9.10B
	Groundwater	9.9E-04	E9.10B
	Total	1.0E-03	E9.10B
Hypothetical Adolescent Resident (future)	Local SW	1.2E-06	E9.12B
	Local SED	1.4E-08	E9.12B
	Total	1.2E-06	E9.12B
Hypothetical Child Resident (future)	Soils	5.2E-06	E9.14B
	Groundwater	5.7E-04	E9.14B
	Total	5.8E-04	E9.14B
Total for Hypothetical Future Resident		1.6E-03	

Benzo(a)pyrene (equiv) and arsenic were the only carcinogenic COPCs selected for surface soils; the risk estimates for soil exposure for benzo(a)pyrene (equiv) exceed 1E-06 for all receptors except the maintenance worker. The risk estimates for soil exposure to arsenic exceed 1E-06 for the hypothetical future residents. ILCR estimates developed for the dermal route of exposure are similar to those developed for the ingestion route of exposure.

Bis(2-ethylhexyl)phthalate is the only COPC in the risk evaluation of surface water COPCs where the ILCR estimate for this COPC exceeds 1E-06 for the hypothetical residents. In contrast, the ILCR estimates for the other carcinogenic COPC selected for surface water (arsenic) do not exceed 1E-06. Note the maximum arsenic concentration in surface waters (7.0 μg/L) is less than the current Federal SDWA MCL (50 μg/L) but greater than the current USEPA Region 3 RBC for tap water (0.045 μg/L). ILCR estimates calculated for COPCs in sediments do not exceed 1E-06 for any receptor evaluated.

The predominant risk drivers for groundwater are PCE, TCE, vinyl chloride, and arsenic. The maximum concentration of these chemicals exceeds the Federal SDWA MCL and/or the USEPA Region 3 RBC for tap water. The maximum concentration of TCE (1200 µg/L) is orders of magnitude greater than the SDWA MCL (5 µg/L). Note that the maximum concentration of arsenic (5.2 µg/L) is only slightly above the background screening level of 5 µg/L.

Phase I and Phase II

Groundwater samples from Phase I and Phase II were highly turbid, and surface water samples from Phase I and Phase II were collected prior to dredging. Therefore, the Phase I and Phase II groundwater and surface water data are likely not to be representative of the actual conditions at the site but are presented here for the purposes of completeness.

ICLR estimates calculated for the maintenance worker, the recreational user, and the hypothetical future resident and presented in the referenced tables were as follows:

Receptor	Cancer Risk Estimates	Table in Appendix E
Maintenance Worker (Current/Future)	2.1E-06	E9.2A
Adult Recreational User (Current/Future)	2.0E-07	E9.4
Adolescent Recreational User (Current/Future)	5.4E-07	E9.6
Total for Recreational User (Current/Future)	7.4E-07	
Hypothetical Adult Resident (future)	1.1E-03	E9.10A
Hypothetical Adolescent Resident (future)	1.3E-06	E9.12A
Hypothetical Child Resident (future)	6.6E-04	E9.14A
Total for Hypothetical Future Resident	1.8E-03	

The ILCR estimate developed for the recreational user (7.4E-07) exposed to Area 2/3 soils did not exceed 1E-06. The ILCR estimate developed for the maintenance worker exposed to Area 2/3 soils is within the USEPA target risk range of 1E-04 to 1E-06. No Risk for individual COPCs for the maintenance worker exceeded 1E-06. In contrast, the ILCR estimate calculated for the hypothetical future resident exceeds 1E-04. A review of the media- and chemical-specific risk results indicates that COPCs in groundwater and surface water are the predominant risk drivers.

Media-specific ILCR estimates were as follows:

Receptor	Media	Cancer Risk Estimate	Table in Appendix E
Maintenance Worker (Current/Future)	Soils	1.2E-06	E9.2A
	Local SW	9.2E-07	E9.2A
	Local SED	1.2E-08	E9.2A
	Total	2.1E-06	E9.2A
Hypothetical Adult Resident (Future)	Soils	2.7E-06	E9.10A
	Local SW	8.2E-07	E9.10A
	Local SED	8.5E-09	E9.10A
	Groundwater	1.1E-03	E9.10A
	Total	1.1E-03	E9.10A
Hypothetical Adolescent Resident (Future)	Local SW	1.3E-06	E9.12A
	Local SED	1.4E-08	E9.12A
	Total	1.3E-06	E9.12A
Hypothetical Child Resident (Future)	Soils	5.2E-06	E9.14A
	Groundwater	6.5E-04	E9.14A
	Total	6.6E-04	E9.14A
Total for Hypothetical Future Resident		1.8E-03	

Benzo(a)pyrene (equiv) and arsenic were the only carcinogenic COPCs selected for surface soils; the risk estimates for soil exposure for benzo(a)pyrene (equiv) exceed 1E-06 for all receptors except the maintenance worker. The risk estimates for soil exposure to arsenic exceed 1E-06 for the hypothetical future residents. ILCR estimates developed for the dermal route of exposure are similar to those developed for the ingestion route of exposure.

Bis(2-ethylhexyl)phthalate is the only COPC in the risk evaluation of surface water COPCs that exceeds 1E-06. Bis(2-ethylhexyl)phthalate is a common laboratory contaminant. The ILCR estimates for the other carcinogenic COPC selected for surface water (arsenic) do not exceed 1E-06. Note that the maximum arsenic concentration in surface waters (18.4 µg/L) is less than the current federal SDWA MCL (50 µg/L)

but greater than the current USEPA Region 3 RBC for tap water (0.045 µg/L). ILCR estimates for COPCs in sediment do not exceed 1E-06 for any receptor evaluated.

A high level of uncertainty is attached to the risk estimates for dermal exposure to benzo(a)pyrene (equiv) in surface water. Consequently the dermal exposure pathway was not included in the risk summaries. The calculated risk estimates for the dermal exposure to benzo(a)pyrene (equiv) were in surface water three orders of magnitude greater than the risk estimates calculated for the ingestion route of exposure. USEPA guidance (USEPA, 2000) suggests that these types of results are counterintuitive and raises concerns that the USEPA model used to evaluate dermal absorption of chemicals from surface waters "may be overly conservative" for some chemicals.

The risk estimates for dermal exposure to bis(2-ethylhexyl)phthalate in surface water were also three orders of magnitude greater than the risk estimates calculated for the ingestion route of exposure. Although bis(2-ethylhexyl)phthalate is calculated to fall within the EPD of the dermal exposure model (DAevent) whereas benzo(a)pyrene does not fall within the EPD, the difference in the risk estimates for dermal exposure compared to the ingestion route of exposure suggests that the model is also overly conservative in the prediction of dermal absorption of bis(2-ethylhexyl)phthalate. However, because bis(2-ethylhexyl)phthalate does fall within the EPD, the chemical was included in the quantitative analysis.

The predominant risk drivers for groundwater are 1,1,2,2-tetrachloroethane, benzene, PCE, TCE, and vinyl chloride. The maximum concentration of these chemicals exceeds the federal SDWA MCL and/or the USEPA Region 3 RBC for tap water. The maximum concentration of TCE (1250 µg/L) is orders of magnitude greater than the SDWA MCL (5 µg/L).

6.5.2.3 Evaluation of Area 2/3 Lead Concentrations

The maximum concentration of lead in Area 2/3 soils is 97.3 mg/kg. This concentration is greater than the site-specific background concentration but less than the USEPA action level for residential land use (400 mg/kg). Lead was not selected as a COPC for soils. Likewise, the maximum concentration of lead in sediments did not exceed the USEPA action level. In contrast, the maximum concentrations of lead in Area 2/3 groundwater (164 µg/L) and OU 2 surface water (109 µg/L) for Phase I and Phase II sampling were greater than the USEPA SDWA action levels. However, high turbidity (i.e., suspended soil particulates) may be influencing the metals concentrations detected in the groundwater or surface waters. During the Phase III sampling, the maximum concentration of lead in Area 2/3 groundwater was 1.9 µg/L, which is less than the USEPA action level of 15 µg/L. The maximum concentration of lead in OU 2

surface waters for Phase III (16.6 µg/L in a duplicate) only slightly exceeds the USEPA action level of 15 µg/L. Note that neither on-site groundwater or surface waters are used as a drinking water source.

6.5.2.4 Uncertainty Analysis for Area 2/3

Most of the uncertainties presented for Area 1 (Section 6.5.1.4) are relevant for Area 2/3. In particular it is important to note that significant PAH contamination (e.g., total carcinogenic PAH concentrations greater than 1 mg/kg) is sporadic (not pervasive) across Area 2/3. This conclusion is proffered with a high degree of certainty because of the high sample density within Area 2/3.

Although the maximum concentration of arsenic in Phase III Area 2/3 groundwater (5.2 µg/L) is greater than the Region 3 RBC of 0.045 µg/L, the background screening level is 5.0 µg/L. These results suggest arsenic concentrations in groundwater may be reflective of background conditions. Additionally, any elevated arsenic concentrations detected in Area 2/3 groundwater are more likely reflective of the use of arsenic-containing pesticides/herbicides rather than contamination associated with the OU 2 McCoy Annex Landfill.

6.5.2.5 Summary and Conclusions for Area 2/3

The following items summarize the results of the risk characterization for Area 2/3 Phase III.

- Noncancer risk estimates (HIs) developed for the maintenance worker, recreational user, and the hypothetical adolescent resident are less than 1, indicating that adverse noncarcinogenic effects are not anticipated under the conditions considered in the risk assessment. HIs calculated for the hypothetical future resident, the only receptor assumed to be exposed to groundwater, do exceed 1 as a result of the evaluation of COPCs selected for groundwater. The HIs calculated for Area 2/3 groundwater COPCs are an order of magnitude greater than those calculated for Area 1.

- The ILCR estimate for the recreational user (7.4E-07) did not exceed 1E-06.

- The ILCR estimate for the maintenance worker (1.8E-06) is within the USEPA target risk range (1E-04 to 1E-06). The risk estimate assuming exposure to soils only was 1.2E-06.

- The ILCR estimate for the hypothetical future resident exceeds 1E-04. Risk calculated for exposure to surface soils in Area 2/3 and surface water are within the target risk range of 1E-04 to 1E-06. COPCs in groundwater are the primary risk drivers.

6.5.3 Risk Characterization for Trespassers Exposed to Local Surface Waters/Sediments – Entire OU 2 Site

A summary of the risk characterization conducted for off-site residents, visitors, or trespassers occasionally exposed to surface waters/sediments local to OU 2 is presented in this section. Phase III groundwater and surface water data superceded Phase I and Phase II data; therefore, Phase I and Phase II data are no longer considered representative of the site conditions (Section 6.1). Phase I and Phase II risk characterizations are presented here for purposes of completeness. Total noncarcinogenic and carcinogenic risks for each exposure route, as well as the cumulative risks for each receptor based on Phase III sampling, are presented in Tables E9.7B and E9.8B in Appendix E. Total noncarcinogenic and carcinogenic risks for each exposure route, as well as the cumulative risks for each receptor for Phase I and Phase II sampling, are presented in Tables E9.7A and E9.8A in Appendix E. Example calculations and relevant risk calculation spreadsheets are also presented in Appendix E.

6.5.3.1 Noncarcinogenic Risks for the Trespasser

HIs developed for the off-site resident, visitor, or trespasser and presented in the referenced tables were as follows:

Phase III

Receptor	Hazard Index	Table in Appendix E
Adult Trespasser (Current/Future)	3.3E-02	E9.7B
Adolescent Trespasser (Current/Future)	1.1E-01	E9.8B

HIs calculated for the adult and adolescent trespasser are less than 1, indicating that adverse noncarcinogenic health effects are not anticipated under the conditions established in the exposure assessment.

Phase I and Phase II

Surface water samples from the Phase I and Phase II sampling were collected prior to the 1999 dredging of the canals. Therefore, the Phase I and Phase II surface water data are likely not to be representative of the actual conditions at the site but are presented here for the purposes of completeness.

HIs developed for the trespasser and presented in the referenced tables were as follows:

Receptor	Hazard Index	Table in Appendix E
Adult Trespasser (Current/Future)	2.1E-01	E9.7A
Adolescent Trespasser (Current/Future)	6.7E-01	E9.8A

HIs calculated for the adult and adolescent trespasser are less than 1, indicating that adverse noncarcinogenic health effects are not anticipated under the conditions established in the exposure assessment.

6.5.3.2 Carcinogenic Risks for the Trespasser – Entire OU 2 Site

ILCR estimates calculated for the adult and adolescent trespasser and presented in the referenced tables were as follows:

Phase III

Receptor	Media	Cancer Risk Estimate	Table in Appendix E
Adult Trespasser	Local SW	7.6E-07	E9.7B
	Total	7.7E-07	E9.7B
Adolescent Trespasser	Local SW	1.2E-06	E9.8B
	Total	1.2E-06	E9.8B
Total for Trespasser		2.0E-06	

The ILCR estimate developed for the trespasser (2.0E-06) is within the USEPA target risk range of 1E-04 to 1E-06. Bis(2-ethylhexyl)phthalate in surface water is the risk driver, responsible for 1.7E-06 of the estimated ILCR (2.0E-06).

The risk estimates for dermal exposure to bis(2-ethylhexyl)phthalate in surface water were three orders of magnitude greater than the risk estimates calculated for the ingestion route of exposure. Although bis(2-ethylhexyl)phthalate is calculated to fall within the EPD of the dermal exposure model (DAevent), the difference in the risk estimates for dermal exposure compared to the ingestion route of exposure suggests that the model is also overly conservative in the prediction of dermal absorption of

bis(2-ethylhexyl)phthalate. In addition, bis(2-ethylhexyl)phthalate, a common laboratory contaminant, was detected in only 3 of the 22 surface water samples collected and was not detected in any other media.

Phase I and Phase II

Surface water samples from the Phase I and Phase II sampling were collected prior to dredging of the canals. Therefore, the Phase I and Phase II surface water data are likely not to be representative of the actual conditions at the site but are presented here for the purposes of completeness.

Receptor	Media	Cancer Risk Estimate	Table in Appendix E
Adult Trespasser (Current/Future)	Local SW	8.2E-07	E9.7A
	Local SED	8.5E-09	E9.7A
	Total	8.2E-07	E9.7A
Adolescent Trespasser (Current/Future)	Local SW	1.3E-06	E9.8A
	Local SED	1.4E-08	E9.8A
	Total	1.3E-06	E9.8A
Total for Trespasser		2.1E-06	

The ILCR estimate developed for the trespasser (2.1E-06) is within the USEPA target risk range of 1E-04 to 1E-06. Bis(2-ethylhexyl)phthalate in surface water is the risk driver.

A high level of uncertainty is attached to the risk estimates for dermal exposure to benzo(a)pyrene (equiv) in surface water. Consequently, the dermal exposure pathway was not included in the risk summaries. The calculated risk estimates for risk from dermal exposure to benzo(a)pyrene (equiv) in surface water were three orders of magnitude greater than the risk estimates calculated for the ingestion route of exposure. USEPA guidance (USEPA, 2000) suggests that these types of results are counterintuitive and raise concerns that the USEPA model used to evaluate dermal absorption of chemicals from surface waters "may be overly conservative" for some chemicals.

The risk estimates for dermal exposure to bis(2-ethylhexyl)phthalate in surface water were three orders of magnitude greater than the risk estimates calculated for the ingestion route of exposure. Although bis(2-ethylhexyl)phthalate is calculated to fall within the EPD of the dermal exposure model (DAevent), the difference in the risk estimates for dermal exposure compared to the ingestion route of exposure suggests that the model is also overly conservative in the prediction of dermal absorption of

bis(2 ethylhexyl)phthalate. In addition, bis(2-ethylhexyl)phthalate, a common laboratory contaminant, was detected in only 3 of the 22 surface water samples collected and was not detected in any other media.

6.5.3.3 Evaluation of Lead for the Trespasser – Entire OU 2 Site

Lead concentrations in OU 2 surface waters and sediments were discussed in Section 6.5.1.3.

6.5.3.4 Uncertainty Analysis for the Trespasser – Entire OU 2 Site

Several of the aforementioned uncertainties listed for Area 1 are relevant for the trespasser occasionally exposed to OU 2 surface waters/sediments. Most important are the uncertainties regarding the evaluation of the dermal route of exposure for bis(2-ethylhexyl)phthalate and arsenic.

6.5.3.5 Summary and Conclusions for the Trespasser – Entire OU 2 Site

The following items summarize the results of the risk characterization for the trespasser occasionally exposed to surface waters and sediments.

- HIs calculated for the adult and adolescent trespasser are less than 1, indicating that adverse noncarcinogenic health effects are not anticipated under the conditions established in the exposure assessment.

- The ILCR estimate for the trespasser (3.1E-06) is within the USEPA target risk range (1E-04 to 1E-06). ILCR estimates calculated for COPCs in sediments do not exceed 1E-08.

6.5.4 Summary of Risks

A summary of all risks is presented in Tables 6-5A and Tables 6-5B.

TABLE 6-5A

SUMMARY OF CANCER RISKS AND HAZARD INDICES
AREA 1
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Receptor	Exposure Medium	Exposure Route	Cancer Risk (RME)	Chemicals with Cancer Risks $>10^{-4}$	Chemicals with Cancer Risks $>10^{-5}$	Chemicals with Cancer Risks $>10^{-6}$	Hazard Index (RME)	Chemicals with HI > 1
Trespasser Adolescent	Surface Water	Ingestion	9.2E-08	--	--	--	7.1E-03	--
		Dermal Contact	1.0E-06	--	--	Bis(2-ethylhexyl)phthalate	8.3E-02	--
		Inhalation	--	--	--	--	--	--
		Total	1.2E-06	--	--	Bis(2-ethylhexyl)phthalate	9.0E-02	--
Trespasser Adolescent	Sediment	Ingestion	4.8E-09	--	--	--	4.2E-04	--
		Dermal Contact	9.1E-09	--	--	--	1.5E-02	--
		Inhalation	--	--	--	--	--	--
		Total	1.4E-08	--	--	--	1.5E-02	--
		TOTAL	1.2E-06				1.1E-01	
Trespasser Adult	Surface Water	Ingestion	5.3E-08	--	--	--	2.1E-03	--
		Dermal Contact	7.1E-07	--	--	--	2.7E-02	--
		Inhalation	--	--	--	--	--	--
		Total	7.6E-07	--	--	--	2.9E-02	--
Trespasser Adult	Sediment	Ingestion	2.7E-09	--	--	--	1.2E-04	--
		Dermal Contact	5.8E-09	--	--	--	4.0E-03	--
		Inhalation	--	--	--	--	--	--
		Total	8.5E-09	--	--	--	4.1E-03	--
		TOTAL	7.7E-07				3.3E-02	
Site Maintenance Worker	Surface Soil	Ingestion	7.9E-07	--	--	--	3.6E-03	--
		Dermal Contact	3.3E-07	--	--	--	4.4E-04	--
		Inhalation	1.9E-09	--	--	--	--	--
		Total	1.1E-06	--	--		4.0E-03	--
Site Maintenance Worker	Surface Water	Ingestion	2.8E-08	--	--	--	8.8E-04	--
		Dermal Contact	5.9E-07	--	--	--	1.4E-02	--
		Inhalation	--	--	--	--	--	--
		Total	6.2E-07	--	--		1.4E-02	--
Site Maintenance Worker	Sediment	Ingestion	3.8E-09	--	--	--	1.3E-04	--
		Dermal Contact	8.0E-09	--	--	--	5.3E-03	--
		Inhalation	--	--	--	--	--	--
		Total	1.2E-08	--	--		5.5E-03	--
		TOTAL	1.8E-06				2.4E-02	
Recreational User (Golfer) Adolescent	Surface Soil	Ingestion	2.0E-07	--	--	--	2.3E-03	--
		Dermal Contact	6.5E-08	--	--	--	2.2E-04	--
		Inhalation	1.0E-10	--	--	--	--	--
		Total	2.6E-07	--	--		2.5E-03	--
Recreational User (Golfer) Adult	Surface Soil	Ingestion	2.5E-07	--	--	--	1.5E-03	--
		Dermal Contact	1.1E-07	--	--	--	1.8E-04	--
		Inhalation	1.3E-10	--	--	--	--	--
		Total	3.6E-07	--	--		1.7E-03	--
		TOTAL	6.2E-07				4.2E-03	

TABLE 6-5A

SUMMARY OF CANCER RISKS AND HAZARD INDICES
AREA 1
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Receptor	Exposure Medium	Exposure Route	Cancer Risk (RME)	Chemicals with Cancer Risks $>10^{-4}$	Chemicals with Cancer Risks $>10^{-5}$	Chemicals with Cancer Risks $>10^{-6}$	Hazard Index (RME)	Chemicals with HI > 1
Hypothetical Future On-Site Resident Adult and Child	Surface Soil	Ingestion	7.1E-06	--	--	Benzo(a)pyrene (equiv), Arsenic	NA	--
		Dermal Contact	6.6E-07	--	--	--	NA	--
		Inhalation	4.9E-09	--	--	--	NA	--
		Total	7.7E-06	--	--	Benzo(a)pyrene (equiv), Arsenic	NA	--
Hypothetical Future On-Site Resident Adult and Adolescent	Surface Water	Ingestion	1.5E-07	--	--		NA	--
		Dermal Contact	1.8E-06	--	--	Bis(2-ethylhexyl)phthalate	NA	--
		Inhalation	--	--	--	--	NA	--
		Total	2.0E-06	--	--	Bis(2-ethylhexyl)phthalate	NA	--
Hypothetical Future On-Site Resident Adult and Adolescent	Sediment	Ingestion	7.5E-09	--	--		NA	--
		Dermal Contact	1.5E-08	--	--	--	NA	--
		Inhalation	--	--	--	--	NA	--
		Total	2.2E-08	--	--		NA	--
Hypothetical Future On-Site Resident Adult and Child	Groundwater	Ingestion	5.1E-06	--	--	Benzene, 1,4-dichlorobenzene	NA	--
		Dermal Contact	1.5E-06	--	--	--	NA	--
		Inhalation	2.8E-06	--	--	--	NA	--
		Total	9.2E-06	--	--	Benzene, 1,4-dichlorobenzene	NA	--
		TOTAL	1.9E-05					
Hypothetical Future On-Site Resident Adult	Surface Soil	Ingestion	NA	NA	NA	NA	1.0E-02	--
		Dermal Contact	NA	NA	NA	NA	6.2E-04	--
		Inhalation	NA	NA	NA	NA	--	--
		Total	NA	NA	NA	NA	1.1E-02	--
Hypothetical Future On-Site Resident Adult	Surface Water	Ingestion	NA	NA	NA	NA	2.1E-03	--
		Dermal Contact	NA	NA	NA	NA	2.7E-02	--
		Inhalation	NA	NA	NA	NA	--	--
		Total	NA	NA	NA	NA	2.9E-02	--
Hypothetical Future On-Site Resident Adult	Sediment	Ingestion	NA	NA	NA	NA	1.2E-04	--
		Dermal Contact	NA	NA	NA	NA	4.0E-03	--
		Inhalation	NA	NA	NA	NA	--	--
		Total	NA	NA	NA	NA	4.1E-03	--
Hypothetical Future On-Site Resident Adult	Groundwater	Ingestion	NA	NA	NA	NA	3.1E+00	Iron
		Dermal Contact	NA	NA	NA	NA	1.0E-01	--
		Inhalation	NA	NA	NA	NA	6.3E-02	--
		Total	NA	NA	NA	NA	3.3E+00	Iron
		TOTAL					3.3E+00	

TABLE 6-5A

SUMMARY OF CANCER RISKS AND HAZARD INDICES
AREA 1
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Receptor	Exposure Medium	Exposure Route	Cancer Risk (RME)	Chemicals with Cancer Risks $>10^{-4}$	Chemicals with Cancer Risks $>10^{-5}$	Chemicals with Cancer Risks $>10^{-6}$	Hazard Index (RME)	Chemicals with HI > 1
Hypothetical Future On-Site Resident Adolescent	Surface Water	Ingestion	NA	NA	NA	NA	7.1E-03	--
		Dermal Contact	NA	NA	NA	NA	8.3E-02	--
		Inhalation	NA	NA	NA	NA	--	--
		Total	NA	NA	NA	NA	9.0E-02	--
Hypothetical Future On-Site Resident Adolescent	Sediment	Ingestion	NA	NA	NA	NA	4.2E-04	--
		Dermal Contact	NA	NA	NA	NA	1.5E-02	--
		Inhalation	NA	NA	NA	NA	--	--
		Total	NA	NA	NA	NA	1.5E-02	--
		TOTAL					1.1E-01	
Hypothetical Future On-Site Resident Child	Surface Soil	Ingestion	NA	NA	NA	NA	9.5E-02	--
		Dermal Contact	NA	NA	NA	NA	1.1E-03	--
		Inhalation	NA	NA	NA	NA	--	--
		Total	NA	NA	NA	NA	9.6E-02	--
Hypothetical Future On-Site Resident Child	Groundwater	Ingestion	NA	NA	NA	NA	7.2E+00	Iron, Manganese
		Dermal Contact	NA	NA	NA	NA	2.1E-01	--
		Inhalation	NA	NA	NA	NA	1.5E-01	--
		Total	NA	NA	NA	NA	7.6E+00	Iron, Manganese
		TOTAL					7.7E+00	

RME - Reasonable maximum exposure
HI - Hazard index
NA - not applicable

TABLE 6-5B

SUMMARY OF CANCER RISKS AND HAZARD INDICES
AREA 1
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Receptor	Exposure Medium	Exposure Route	Cancer Risk (RME)	Chemicals with Cancer Risks $>10^{-4}$	Chemicals with Cancer Risks $>10^{-5}$	Chemicals with Cancer Risks $>10^{-6}$	Hazard Index (RME)	Chemicals with HI > 1
Trespasser Adolescent	Surface Water	Ingestion	9.2E-08	--	--	--	7.1E-03	--
		Dermal Contact	1.0E-06	--	--	Bis(2-ethylhexyl)phthalate	8.3E-02	--
		Inhalation	--	--	--	--	--	--
		Total	1.2E-06	--	--	Bis(2-ethylhexyl)phthalate	9.0E-02	--
Trespasser Adolescent	Sediment	Ingestion	4.8E-09	--	--	--	4.2E-04	--
		Dermal Contact	9.1E-09	--	--	--	1.5E-02	--
		Inhalation	--	--	--	--	--	--
		Total	1.4E-08	--	--	--	1.5E-02	--
		TOTAL	1.2E-06				1.2E-01	
Trespasser Adult	Surface Water	Ingestion	5.3E-08	--	--	--	2.1E-03	--
		Dermal Contact	7.1E-07	--	--	--	2.7E-02	--
		Inhalation	--	--	--	--	--	--
		Total	7.6E-07	--	--	--	2.9E-02	--
Trespasser Adult	Sediment	Ingestion	2.7E-09	--	--	--	1.2E-04	--
		Dermal Contact	5.8E-09	--	--	--	4.0E-03	--
		Inhalation	--	--	--	--	--	--
		Total	8.5E-09	--	--	--	4.1E-03	--
		TOTAL	1.2E-06				3.3E-02	
Site Maintenance Worker	Surface Soil	Ingestion	7.9E-07	--	--	--	3.4E-03	--
		Dermal Contact	3.9E-07	--	--	--	4.1E-04	--
		Inhalation	1.8E-09	--	--	--	--	--
		Total	1.2E-06	--	--	--	3.8E-03	--
Site Maintenance Worker	Surface Water	Ingestion	2.8E-08	--	--	--	8.8E-04	--
		Dermal Contact	5.9E-07	--	--	--	1.4E-02	--
		Inhalation	--	--	--	--	--	--
		Total	6.2E-07	--	--		1.4E-02	--
Site Maintenance Worker	Sediment	Ingestion	3.8E-09	--	--	--	1.3E-04	--
		Dermal Contact	8.0E-09	--	--	--	5.3E-03	--
		Inhalation	--	--	--	--	--	--
		Total	1.2E-08	--	--		5.4E-03	--
		TOTAL	1.8E-06				2.4E-02	
Recreational User (Golfer) Adolescent	Surface Soil	Ingestion	5.3E-07	--	--	--	9.4E-03	--
		Dermal Contact	1.9E-09	--	--	--	8.3E-06	--
		Inhalation	2.3E-09	--	--	--		--
		Total	5.4E-07	--	--		9.4E-03	--
Recreational User (Golfer) Adult	Surface Soil	Ingestion	1.9E-07	--	--	--	1.0E-03	--
		Dermal Contact	7.5E-09	--	--	--	9.8E-06	--
		Inhalation	2.7E-10	--	--	--		--
		Total	2.0E-07	--	--		1.0E-03	--
		TOTAL	7.4E-07				1.0E-02	

TABLE 6-5B

SUMMARY OF CANCER RISKS AND HAZARD INDICES
AREA 1
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Receptor	Exposure Medium	Exposure Route	Cancer Risk (RME)	Chemicals with Cancer Risks $>10^{-4}$	Chemicals with Cancer Risks $>10^{-5}$	Chemicals with Cancer Risks $>10^{-6}$	Hazard Index (RME)	Chemicals with HI > 1
Hypothetical Future On-Site Resident Adult and Child	Surface Soil	Ingestion	7.1E-06	--	--	Benzo(a)pyrene (equiv), Arsenic	NA	--
		Dermal Contact	7.7E-07	--	--	--	NA	--
		Inhalation	4.5E-09	--	--	--	NA	--
		Total	7.9E-06	--	--	Benzo(a)pyrene (equiv), Arsenic	NA	--
Hypothetical Future On-Site Resident Adult and Adolescent	Surface Water	Ingestion	1.5E-07	--	--		NA	--
		Dermal Contact	1.8E-06	--	--	Bis(2-ethylhexyl)phthalate	NA	--
		Inhalation	--	--	--	--	NA	--
		Total	2.0E-06	--	--	Bis(2-ethylhexyl)phthalate	NA	--
Hypothetical Future On-Site Resident Adult and Adolescent	Sediment	Ingestion	7.5E-09	--	--		NA	--
		Dermal Contact	1.5E-08	--	--	--	NA	--
		Inhalation	--	--	--	--	NA	--
		Total	2.2E-08	--	--		NA	--
Hypothetical Future On-Site Resident Adult and Child	Groundwater	Ingestion	7.6E-04	Trichloroethene, Vinyl Chloride, Arsenic	Tetrachloroethene, Trichloroethene, Vinyl Chloride, Arsenic	Tetrachloroethene, Trichloroethene, Vinyl Chloride, Arsenic	NA	--
		Dermal Contact	1.7E-04	Trichloroethene	Tetrachloroethene, Vinyl Chloride, Trichloroethene	Tetrachloroethene, Vinyl Chloride, Trichloroethene	NA	--
		Inhalation	6.4E-04	Trichloroethene, Vinyl Chloride	Tetrachloroethene, Vinyl Chloride, Trichloroethene	Tetrachloroethene, Vinyl Chloride, Trichloroethene	NA	--
		Total	1.6E-03	Trichloroethene, Vinyl Chloride, Arsenic	Tetrachloroethene, Trichloroethene, Vinyl Chloride, Arsenic	Tetrachloroethene, Trichloroethene, Vinyl Chloride, Arsenic	NA	--
		TOTAL	1.6E-03					
Hypothetical Future On-Site Resident Adult	Surface Soil	Ingestion	NA	NA	NA	NA	9.4E-03	--
		Dermal Contact	NA	NA	NA	NA	5.7E-04	--
		Inhalation	NA	NA	NA	NA		--
		Total	NA	NA	NA	NA	1.0E-02	--
Hypothetical Future On-Site Resident Adult	Surface Water	Ingestion	NA	NA	NA	NA	2.1E-03	--
		Dermal Contact	NA	NA	NA	NA	2.7E-02	--
		Inhalation	NA	NA	NA	NA	--	--
		Total	NA	NA	NA	NA	2.9E-02	--
Hypothetical Future On-Site Resident Adult	Sediment	Ingestion	NA	NA	NA	NA	1.2E-04	--
		Dermal Contact	NA	NA	NA	NA	4.0E-03	--
		Inhalation	NA	NA	NA	NA	--	--
		Total	NA	NA	NA	NA	4.1E-03	--
Hypothetical Future On-Site Resident Adult	Groundwater	Ingestion	NA	NA	NA	NA	6.6E+00	Trichloroethene
		Dermal Contact	NA	NA	NA	NA	4.2E+00	Trichloroethene
		Inhalation	NA	NA	NA	NA	5.8E+00	Trichloroethene
		Total	NA	NA	NA	NA	1.7E+01	Trichloroethene
		TOTAL					1.7E+01	

TABLE 6-5B

SUMMARY OF CANCER RISKS AND HAZARD INDICES
AREA 1
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Receptor	Exposure Medium	Exposure Route	Cancer Risk (RME)	Chemicals with Cancer Risks $>10^{-4}$	Chemicals with Cancer Risks $>10^{-5}$	Chemicals with Cancer Risks $>10^{-6}$	Hazard Index (RME)	Chemicals with HI > 1
Hypothetical Future On-Site Resident Adolescent	Surface Water	Ingestion	NA	NA	NA	NA	7.1E-03	--
		Dermal Contact	NA	NA	NA	NA	8.3E-02	--
		Inhalation	NA	NA	NA	NA	--	--
		Total	NA	NA	NA	NA	9.0E-02	--
Hypothetical Future On-Site Resident Adolescent	Sediment	Ingestion	NA	NA	NA	NA	4.2E-04	--
		Dermal Contact	NA	NA	NA	NA	1.5E-02	--
		Inhalation	NA	NA	NA	NA	--	--
		Total	NA	NA	NA	NA	1.5E-02	--
		TOTAL					1.1E-01	
Hypothetical Future On-Site Resident Child	Surface Soil	Ingestion	NA	NA	NA	NA	8.8E-02	--
		Dermal Contact	NA	NA	NA	NA	1.1E-03	--
		Inhalation	NA	NA	NA	NA		--
		Total	NA	NA	NA	NA	8.9E-02	--
Hypothetical Future On-Site Resident Child	Groundwater	Ingestion	NA	NA	NA	NA	1.5E+01	Trichloroethene, Arsenic
		Dermal Contact	NA	NA	NA	NA	9.1E+00	Trichloroethene
		Inhalation	NA	NA	NA	NA	1.3E+01	Trichloroethene
		Total	NA	NA	NA	NA	3.8E+01	Trichloroethene, Arsenic
		TOTAL					3.8E+01	

RME - Reasonable maximum exposure
HI - Hazard index
NA - not applicable

7.0 ECOLOGICAL RISK ASSESSMENT

In addition to characterizing the nature and extent of site contamination and assessing potential risks to human health, the RI process requires an assessment of the potential adverse effects of site contamination on the environment. Specifically, ecological receptors that inhabit OU 2 and nearby areas may be at risk from environmental contamination associated with OU 2. Accordingly, an ERA was performed to characterize the potential risks from OU 2-related chemicals to ecological receptors. Section 7.1 provides an overview of the ERA methodology that was used. Sections 7.2 through 7.5 describe these methods in detail. Section 7.6 provides the results of the initial two steps of the ERA process. Section 7.7 presents the Step 3A – Refinement of Chemicals of Potential Concern discussion. Section 7.8 presents the Phase III data discussion, and Section 7.9 discusses the uncertainties. Section 7.10 provides a summary of the ERA, Section 7.11 provides a discussion of the risk management activities that have been undertaken at OU 2, and Section 7.12 presents conclusions.

7.1 OVERVIEW

This section provides an outline of the general approach taken to assess the impacts of site contamination on ecological receptors. This assessment generally followed a two-step process:

Step 1: Preliminary Problem Formulation (Section 7.2) and Preliminary Ecological Effects Evaluation (Section 7.3).

- Preliminary Problem Formulation - This is the first phase of an ERA, which discusses the goals, breadth, and focus of the assessment. It includes general descriptions of the site to be investigated (OU 2) with emphasis on the habitats and ecological receptors present. This phase also involves characterization of chemical sources and migration pathways, evaluation of routes of chemical exposure, and selection of analytes to be assessed. Assessment and measurement endpoints are also selected in this phase. Finally, a conceptual model is developed that describes how chemicals associated with OU 2 may come into contact with ecological receptors.

- Preliminary Ecological Effects Evaluation - In this phase, medium-specific ecological screening guidelines for each analyte (i.e., concentrations of each chemical above which adverse effects to ecological receptors may occur) are identified. Chemical doses associated with toxicity to representative

ecological receptors are also identified. This step is undertaken concurrently with the exposure assessment described below.

Step 2: Preliminary Exposure Estimate (Section 7.4) and Preliminary Risk Calculation (Section 7.5)

- Preliminary Exposure Estimate - This portion of the ERA includes the identification of data sources containing concentrations of chemicals to which ecological receptors may be exposed in various media. It also includes the selection of exposure point chemical concentrations from those data. Chemical doses for representative receptors are also calculated.

- Preliminary Risk Calculation - In this step, exposure point concentrations are compared to guidelines to characterize potential risk to ecological receptors. Chemical doses associated with toxicity are compared to calculated doses for representative receptors. Analytes found to pose potential risk after these comparisons are selected as COPCs.

When these two steps are completed, the results can be interpreted and the uncertainties associated with the ERA can be addressed. The above process, described in further detail below, represents the general ERA approach recommended in the most recent USEPA guidance for performing ERAs, the "Process Document" (USEPA, 1997a), which served as the basis for the ERA methodology. Furthermore, the ERA was conducted in accordance with other available ERA guidance documents (DON, 1999; USEPA, 1995a; USEPA, 1998c; Wentsel et al., 1996; Ingersoll, Dillon, and Biddinger, 1997). The methods used in this ERA are based also, in part, on those used in previous ERAs for NTC Orlando (ABB-ES, Inc., 1998b).

Due to the potential complexity of ERAs, they are often conducted using a tiered approach and punctuated with Scientific/Management Decision Points (SMDPs). SMDPs are meetings involving the risk assessors, risk managers, and client to control costs, prevent unnecessary analyses, and ensure that the ERA is proceeding in an efficient, timely manner. Information analyzed in one tier is evaluated to determine whether the objectives of the study have been met, and then that information may be used to identify the data required for the next tier, if necessary. This ERA can be considered a "screening level" assessment since it is based on comparing chemical concentrations against conservative screening values and an evaluation of historical ecological data. It comprises steps 1 and 2 of the Superfund ERA process. Region 4 USEPA (1995a) refers to the screening level assessment as a "preliminary risk evaluation." In accordance with Region 4 guidance for performing preliminary risk evaluations, comparisons of maximum chemical concentrations to Region 4 screening levels are performed prior to the first two steps (the "ecological screening value comparison"). For clarity, the ecological screening value comparison is discussed in Sections 7.3 and 7.4.

A baseline ERA (BERA), steps 3 through 7 in the Superfund ERA process, may be conducted if the results of the screening level ERA indicate that additional study is warranted. The BERA includes more focused studies that incorporate the initial screening, but it may also encompass detailed laboratory and field studies or extensive modeling (USEPA, 1997a).

7.2 PRELIMINARY PROBLEM FORMULATION

This section presents a discussion of the physical characteristics and ecology of OU 2 and nearby areas. It includes descriptions of the habitats, ecological receptors, wetlands, and rare, threatened, and endangered species that are present or may be present on OU 2.

7.2.1 Habitat Types and Ecological Receptors

7.2.1.1 Site and Habitat Description

OU 2, the McCoy Annex Landfill, is an inactive dumping area located under and around most of the periphery of the current nine-hole golf course at McCoy Annex. The golf course is laid out roughly in a "J" shape (the northern and central sections of OU 2), with another wooded, undeveloped area approximately 50 acres in size located south of the central portion of the course (the southern section of OU 2). The site is comprised of a wide variety of ecological and geographical features, including open, mowed turfgrass areas, cart paths, ponds, woodlots, wetlands, canals, and intermittent streams.

The northern section of OU 2 consists of the northern one-third of the golf course and includes the clubhouse, parking area, course maintenance and support buildings, driving range, and holes 1, 8 and 9 (see Figure 1-2B). McCoy Annex housing is located to the west, 8th Express Street is located to the north, and a petroleum tank farm is located to the east. Most of the northern section is comprised of the driving range and golf holes. These portions of the northern section are mostly mowed turfgrass with scattered ornamental trees. Wooded areas are located adjacent to holes 8 and 9 and are mainly slash pine (*Pinus elliottii*). A small, intermittent stream, essentially a drainage ditch, runs through the wooded areas, around the green for hole 9, and then runs along the south side of 8th Express Street until it empties into a canal that forms the eastern boundary of the northern section. Water flow in the canal is to the south. Both the intermittent stream and the canal contain heavy vegetation, primarily consisting of cattails (*Typha* spp.), water lilies (*Lilium* spp.), and other aquatic vegetation. Slash pines, wax myrtle (*Myrica cerifera*), and red maple (*Acer rubrum*) are located along the edges of most of the canal. Three, small, isolated ponds are also located on the northern section of OU 2, ranging in size from approximately 2 to 5 acres.

The ponds contain emergent vegetation and some trees around their margins, dominated by cattails and slash pine. Unmowed turfgrass and brushy vegetation border the edges of the ponds.

The central section of OU 2 consists of the southern and western two-thirds of the golf course and peripheral areas (see Figure 1-2B). McCoy Annex housing is located to the north; canals and ponds are located to the west; open, undeveloped areas are located to the east; and ammunition bunkers, bunker support areas, and the undeveloped, wooded area are located to the south. Most of the central section of OU 2 is comprised of the golf course (holes 2–7) and hence is mostly mowed turfgrass with small, scattered areas of slash pine. The canal east of OU 2 continues south along the eastern boundary of the operable unit and bends to the east along the southeastern boundary of the central section of the OU. At that point it connects with the canal in the central portion of the operable unit (see Figure 2-2-A) and flows east under Tradeport Drive, where it empties into Lake Gillooly. The other fork of the canal in the central section of the operable unit turns south between the bunker area and the wooded area south of the golf course. The canal is filled with vegetation and trees along its margins until the turn south. A 15-acre pond is located adjacent to the western boundary of the central section of OU 2. The pond is lined with trees, mostly willows (*Salix* spp.), and contains cattails along its margins. In addition, a series of small aquatic habitats is present on the central section of OU 2, consisting of open water ponds, ponds filled with cattails, cypress (*Taxodium distichum*) swamps, and ditches (see Figure 1-2B).

The southern section of OU 2 is comprised of an undeveloped, wooded area about 50 acres in size. The canal and bunker area are located to the east, wooded areas are located to the west, and Boggy Creek road is located to the south. The southern section is predominantly pine flatwoods, mainly slash pines, although a few isolated cabbage palmetto trees (*Sabal palmetto*) are present. Thick sawtooth palmetto (*Serenoa repens*) constitutes most of the understory, with scattered patches of muscadine (*Vitis rotundafolia*) and other brushy vegetation present. Three areas within the southern section of OU 2 deviate from pine flatwoods. First, a 2–3-acre stand of cypress trees is located in the east-central portion of the area south of the golf course. Second, a dirt access road runs north/south through the far west portion of the area south of the golf course. A thick stand of cassava (*Manihot grahamii*) approximately 100 feet long by 20 feet wide is located along the eastern side of the dirt road. The soil was saturated in this area during a summer 1998 site reconnaissance by Tetra Tech NUS personnel. Third, several large earpod trees (*Enterolobium contortisiliquum*) are located west of the dirt road. Several patches of large elephant ear comprise the understory in this area.

The canal along the eastern border of the southern section of OU 2 flows through a culvert under Tradeport Drive and into another canal. This canal empties into Lake Gillooly approximately 600 feet from the southern section of OU 2.

7.2.1.2 Ecological Receptors

The golf course itself provides marginal terrestrial habitat and thus would attract limited terrestrial fauna. The wooded areas on and around the McCoy Annex Landfill would be expected to attract a variety of wildlife, including invertebrates, mammals, birds, reptiles, and amphibians.

The mole salamander (*Ambystoma* spp.), which spends at least part of the year in woodlands, may exist on McCoy Annex. Various species of lizards and colubrid snakes may also live in the pine flatwoods in the area.

Several species of venomous snakes may be found in the area, including the eastern coral snake (*Micururus fulvius fulvius*), dusky pygmy rattlesnake (*Sistrurus miliarus barbouri*), and eastern diamondback rattlesnake (*Crotalus adamanteus*). A gopher tortoise (*Gopherus polyphemus*) was observed on the eastern side of the canal between the golf course and tank farm during a summer 1998 reconnaissance by Tetra Tech NUS personnel.

Small mammals that may exist at the site include the eastern cottontail rabbit (*Sylvilagus floridanus*), hispid cotton rat (*Sigmodon hispidus*), shrew (*Blarina* spp.) and cotton mouse (*Peromyscus gossipinus*). Larger mammals such as the red fox (*Vulpes vulpes*), gray fox (*Urocyon cinereoargenteus*), and raccoon (*Procyon lotor*) probably exist in the McCoy Annex area.

Species of birds that may be present in the more open areas of OU 2 include the black vulture (*Coragyps atratus*), turkey vulture (*Cathartes aura*), red-tailed hawk (*Buteo jamaicensis*), and red-shouldered hawk (*B. lineatus*). Other bird species that are probably common at the site include the mourning dove (*Zenaida macroura*), brown-headed cowbird (*Molothrus ater*), brown thrasher (*Toxostoma rufum*), bobwhite quail (*Colinus virginianus*), mockingbird (*Mimus polyglottus*), common grackle (*Quiscalus quiscula*), killdeer (*Charadrius vovoferus*), northern cardinal (*Cardinalis cardinalis*), blue jay (*Cyanocitta cristata*), rufous-sided towhee (*Pipilo erythrophthalmus*), common flicker (*Colaptes auratus*), and red-bellied woodpecker (*Centurus carolinus*). The forested wetlands on and near OU 2 may attract the swamp sparrow (*Melospiza georgiana*), Carolina wren (*Thryothorus ludovicianus*), common yellowthroat (*Geothlypis trichas*), wood duck (*Aix sponsa*), great blue heron (*Herodias ardea*), great-horned owl (*Bubo virginianus*), white ibis (*Eudocimus albus*), and egrets (*Egretta* spp.).

The aquatic habitats on and near OU 2 may provide habitat for aquatic invertebrates, amphibians, and fishes. The aquatic habitats on and near OU 2 that contain sufficient surface water, mainly the ponds, provide habitat for a number of fish species, including largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), redear sunfish (*Lepomis microlophus*), golden shiner (*Notemigonus crysoleuca*),

yellow bullhead (*Ictalurus natalis*), and killifish (*Fundulus* spp.). The NTC Orlando Master Plan (SOUTHNAVFACENGCOM, 1985) states that grass carp (*Ctenopharyngodon idella*) may have been introduced into several of the larger lakes on the base to control the invasive hydrilla (*Hydrilla verticillata*).

A number of other amphibians, such as frogs (members of the genera *Hyla*, *Rana*, and *Pseudacris*) and toads (*Bufo* spp.) may inhabit the aquatic habitats on OU 2. The Florida cottonmouth (*Agkistrodon piscivorous*), a venomous water snake, could inhabit these habitats as well. The American alligator (*Alligator mississippiensis*) is often observed by golf course personnel and golfers in the OU 2 ponds, as is the river otter (*Lutra canadensis*) in the ponds in the central section of the site.

7.2.1.3 Wetlands

To date, no formal wetland delineations have been performed on OU 2. The U. S. Fish and Wildlife Service's (USFWS's) National Wetlands Inventory (NWI) map indicates several wetlands on OU 2. The three ponds on the northern section of OU 2 and the pond north of hole 6 are classified as palustrine (swamp-like), unconsolidated bottom, permanently flooded wetlands. The wooded areas adjacent to holes 8 and 9 and the two cypress areas on the western portion of the central section of OU 2 are classified as palustrine, forested, intermediate deciduous, semipermanently flooded wetlands. The pond south of hole 6 is a palustrine, aquatic bed, floating vascular, semipermanently flooded wetland.

The NWI map classifies the entire extreme southeastern portion of the central section of OU 2 as a palustrine, forested, intermediate deciduous, seasonally flooded wetland. No wetlands other than the small pond in this area were evident during a summer 1998 site reconnaissance by Tetra Tech NUS personnel. The canal may be part of this wetland. The cypress-covered area within the southern section of OU 2 is classified by the NWI map as a palustrine, forested, intermediate deciduous, semipermanently flooded wetland. The map identifies another similar wetland a few hundred feet south of this wetland, but none was evident during the summer 1998 site reconnaissance. Also, the thick stand of cassava along the eastern side of the dirt road had saturated soil during summer 1998, but is not indicated as a wetland on the NWI map. The U. S. Geological Survey (USGS) quadrangle map for the site indicates a marshy area near the eastern side of the dirt road, which may be the area containing cassava.

7.2.1.4 Rare, Threatened, and Endangered Species

The USFWS, Florida Game and Fresh Water Fish Commission (FGFWFC), and Florida Natural Areas Inventory (FNAI) were consulted to obtain information regarding the potential presence of rare, threatened, and endangered species on the McCoy Annex and vicinity. USFWS and FGFWFC indicate that several rare, threatened, and endangered species may currently use or inhabit the McCoy Annex area. The USFWS was only able to provide information on Federal candidate, threatened, and endangered species that could be found in Orange County (Palmer, 1998). FGFWFC provided occurrence records for rare, threatened, and

endangered species that FGFWFC has documented near McCoy Annex (FGFWFC, 1998). The FGFWFC information is provided in Table 7-2.

TABLE 7-2

**RARE, THREATENED, AND ENDANGERED SPECIES INFORMATION
FLORIDA GAME AND FRESH WATER FISH COMMISSION
McCOY ANNEX AND SURROUNDING AREA**

**NAVAL TRAINING CENTER
ORLANDO, FLORIDA**

Occurrence Type	Location	Date	Species Status (Florida)
Bald eagle (Haliaeetus leucocephalus) nest (gone)	4 miles north of McCoy Annex	NA[(a)]	Threatened
Bald eagle nest (gone)	6 miles southwest of McCoy Annex	NA	Threatened
Bald eagle nest (inactive)	3.5 miles east of McCoy Annex	1997/1998	Threatened
Bald eagle nest (active)	7 miles southeast of McCoy Annex	1997/1998	Threatened
Least tern (Sterna antillarum) colony	5 miles northwest of McCoy Annex	NA	Threatened
Florida scrub-jay (Aphelocoma coerulescens)	6 miles southeast of McCoy Annex	1981	Threatened

[(a)]NA = Not Applicable or Available

FNAI has recorded three gopher tortoise burrows (one active) in the wooded area south of the golf course, with the last observation in 1992 (NeSmith, 1998). This reptile is a State of Florida species of special concern. FNAI has observed least terns in the McCoy Annex area, possibly nesting on rooftops in the vicinity of the golf course.

7.2.2 Major Chemical Sources and Migration Pathways

The chemical sources at OU 2 are media impacted by historical landfilling activities, mainly soils. The chemical migration pathways that were evaluated for OU 2 include volatilization, wind erosion, overland runoff, and infiltration of chemicals. Constituents in the site soil may volatilize from surficial material or become airborne via resuspension. Contaminated fugitive dust may also be generated during ground-disturbing activities, such as construction or excavation. These chemicals are dispersed in the surrounding environment and transported to downwind locations where they may become entrained in surface soil, surface water, or sediment through precipitation and deposition.

Precipitation runoff may carry constituents to nearby surface water and sediment in the ditches, canals, and small wetlands. Furthermore, surface runoff into the canal eventually discharges to the downgradient lake. Thus, both the canal and Lake Gillooly could act as a sink for OU 2-related chemicals that are transported downgradient. Infiltrating precipitation may cause the contamination of subsurface soil and groundwater. Groundwater from the site may discharge to surface water; chemicals in groundwater may be subsequently deposited in sediment; or they may accumulate in the tissues of aquatic organisms. Specifically, groundwater at OU 2 interfaces with the canal along the eastern and southern portions of OU 2. Discharge of groundwater to the canal could result in transport of groundwater-associated chemicals to these waterbodies. The pond system on OU 2 appears to act as a surficial aquifer recharge system and, thus, groundwater discharge to these ponds does not appear to be occurring. Additional discussion of the interaction of OU 2 groundwater and surface water is provided in Section 8.0 Contaminant Fate and Transport.

Section 7.2.4 provides a discussion of the analytes that were included in the ERA. For the most part, these detected chemicals were metals, PAHs, and organochlorine pesticides. Metals like arsenic, cadmium, chromium, copper, lead, mercury, and zinc vary in their ability to be transported within an organism and in the organs that they affect, depending on both the general properties of the metal and its specific chemical form. However, heavy metals tend to have a similar general mechanism at the molecular level in that they inactivate enzymes. This leads to a variety of effects, including disruption of cellular transport, cellular respiration, and other important processes. When cellular function is compromised by metals, symptoms will occur earlier in tissues with more critical functions. For example, lead interferes with the reproductive and nervous systems of higher animals. It is perhaps best known for affecting the blood and blood-forming tissues (bone marrow). Thus, symptoms like sperm count reduction, learning impairment, and anemia are associated with lead toxicity.

PAHs or their metabolites can bind to cellular macromolecules and thereby disrupt their function. Biological macromolecules include polymers of carbohydrates (e.g., starch), amino acids (proteins), and nucleotides (e.g., DNA). The cellular functions of these polymers include structure, energy storage, energy transfer, material transport, and the storage and transmittal of genetic information. For example, many PAHs have carcinogenic and mutagenic properties, apparently caused by the ability of their metabolites to bind with, and disrupt the function of, DNA.

Organochlorine pesticides like DDT and dieldrin affect the nervous systems of insects, causing hyperactivity, convulsions, paralysis, and death. Neurotoxic actions have also been observed in vertebrates. Pesticides and PCBs interfere with hormonal receptors in vertebrates, leading to hormonal imbalances within the body

and a variety of symptoms, including reproductive abnormalities. Some PCBs cause chromosome damage *in vitro*.

7.2.3 Exposure Routes

Aquatic and semi-aquatic organisms in aquatic habitats on OU 2 may be exposed to chemicals via direct contact with surface water and sediments, incidental ingestion of surface water and sediments, and consumption of contaminated food items. Aquatic and semi-aquatic organisms may also be exposed to constituents from contaminated groundwater that discharges to nearby surface water. Aquatic and semi-aquatic receptors at OU 2 would be associated with the system of ponds on-site and, to a lesser degree, the canal that borders the eastern and southern portions of OU 2. Theoretically, aquatic and semi-aquatic receptors in Lake Gillooly could also be exposed to OU 2-associated chemicals that are transported downgradient.

Terrestrial animals may be exposed to soil chemicals through ingestion of contaminated food items. Animals can incidentally ingest soil while grooming fur, preening feathers, digging, grazing close to the soil, or feeding on items to which soil has adhered (such as roots and tubers). Terrestrial vegetation may be exposed to chemicals via direct aerial deposition and root translocation. Aerial deposition was not investigated, primarily because the chemical sources at the sites under investigation are largely covered by vegetation and surface water, reducing the amount of bare soil and fugitive dust. These areas include the turfgrass on the golf course, the wooded areas of OU 2, the system of ponds, and the canal, none of which contain bare soil. Terrestrial animal receptors may also come into contact with chemicals in surface water by drinking it from the system of ponds or the canal, although this exposure route represents a negligible portion of total exposure for most receptors (Sample, Opresko, and Suter, 1996). Exposure to chemicals in the soil via dermal contact may occur but is unlikely to represent a major exposure pathway because fur, feathers, and chitinous exoskeletons probably minimize transfer of chemicals across dermal tissue. In addition, little information is available (e.g., absorption factors) to evaluate dermal exposures to wildlife.

Volatile constituents are present in some OU 2 soils and soil-bound chemical resuspension is possible from any disturbances that could occur on OU 2 soils (i.e., golf course-related construction). However, inhalation does not represent a significant exposure pathway because air chemical concentrations are assumed to be quite low, even for burrowing wildlife. In addition, inhalation ecotoxicity data for chronic exposure are lacking. Hence, the air pathway was not considered for ecological receptors at OU 2.

7.2.4 Selection of Analytes to be Investigated

Analytes initially included in the ERA for quantitative analysis were all chemicals detected in surface water, sediment, surface soil, and groundwater samples collected in 1997 (Phase I) and 1998 (Phase II) RI sampling. A detailed description of the objectives of Phase I and Phase II data collected is provided in Section 3.0. Calcium, magnesium, potassium, and sodium were excluded as analytes to be investigated since they are essential nutrients that are toxic only in extremely high concentrations. Due to the scarcity of data for these essential nutrients, it was not possible to develop ranges of toxicity for them, even at high concentrations. The limited toxicity data available indicate that high dietary intake of these nutrients is well tolerated. The process that was used to select COPCs from the detected analytes is described in Section 7.5.

Inorganics in surface soil that were detected in maximum concentrations less than two times the average background concentrations were excluded from further consideration. This was performed in accordance with USEPA Region 4 preference since inorganics are naturally occurring chemicals that can be found in locally high concentrations regardless of anthropogenic influences. Background surface soil data were from the basewide background sampling at McCoy Annex (ABB-ES, 1995). No site-specific surface water or sediment background data were available.

It should also be noted that a third phase of sampling was performed in 1999. The Phase III data most germane to this ERA were surface water and sediment samples collected in the canal. Due to dredging of the canal by the City subsequent to the submission of the draft RI report, areas that were dredged were re-sampled to be more reflective of current conditions. In addition, surface water and sediment samples collected upgradient of OU 2 were collected in the canal to evaluate whether chemicals from upgradient (primarily inorganics) were being transported to the canal along OU 2. The Phase III surface water and sediment data are presented and discussed in Section 7.8.

Some radiological chemicals were analyzed as part of RI sampling activities since the Air Force is known to have landfilled some low-level radiological waste. The inclusion of these chemicals was due to human health concerns, and it is now believed that the radiological activity present at OU 2 may be due to natural phosphate deposits underlying the site. Ecological toxicity data (i.e., screening levels) for radionuclides are sparse. As a result, radionuclides were not included as part of this ERA. A detailed discussion of radionuclides in OU 2 samples is provided in Section 6.5.1.4.

Also, unfiltered surface water data were used since the concentrations are higher than filtered and therefore more conservative.

7.2.5 Assessment and Measurement Endpoints

As discussed in USEPA (1997a) and Wentsel et al. (1996), one of the major tasks in preliminary problem formulation is the selection of assessment and measurement endpoints. An assessment endpoint is defined as "an explicit expression of actual environmental values that are to be protected" (USEPA, 1997a). Measurement endpoints are "measurable ecological characteristics that are related to the valued characteristic chosen as the assessment endpoint" (USEPA, 1997a). Assessment endpoints reflect the resources that are to be protected and thus are the underpinning of the entire ERA. The remainder of the ERA will directly and indirectly focus and support the assessment endpoints. Hence, the selection of appropriate assessment endpoints is a crucial step in the ERA process. For this ERA, the assessment endpoints are protection of the following groups of receptors from adverse effects of chemicals on their growth, survival, and reproduction:

- Benthic invertebrate communities
- Birds that feed on terrestrial invertebrates and plants
- Carnivorous birds
- Carnivorous mammals
- Omnivorous mammals
- Mammals that feed on soil invertebrates
- Herbivorous mammals
- Terrestrial vegetation
- Terrestrial invertebrates
- Fish communities
- Birds that feed on aquatic organisms
- Amphibians and reptiles

As indicated above, measurement endpoints are related to assessment endpoints, but these endpoints are more easily quantified or observed. In essence, measurement endpoints, also known as measures of effects (USEPA, 1998c), serve as surrogates for assessment endpoints. While declines in populations and shifts in community structure can be quantified, studies of this nature are generally time-consuming and difficult to interpret. However, measurement endpoints indicative of observed adverse effects on individuals are relatively easy to measure in toxicity studies and can be related to the assessment endpoint. For example, chemical concentrations that lead to decreased reproductive success or increased mortality of individuals in toxicity tests could, if found in the environment, result in shifts in population structure, potentially altering the communities on and near OU 2.

For surface water, the measurement endpoints were chemical concentrations in surface water associated with adverse effects on growth, survival, and reproduction of aquatic organisms (surface water screening levels). For sediments, the measurement endpoints were chemical concentrations in sediment associated with adverse effects on growth, survival, and reproduction of benthic organisms (sediment screening levels). Again, aquatic and benthic communities are limited at the site. For surface soils, the measurement endpoints were chemical concentrations in surface soil associated with adverse effects on growth, survival, and reproduction of terrestrial vegetation and soil invertebrates (surface soil screening levels). For terrestrial and semi-aquatic wildlife, the measurement endpoints were the chemical doses associated with adverse effects on growth, survival, and reproduction of these receptors [toxicity reference values (TRVs)]. The measurement endpoints listed above incorporate, to the fullest extent possible, the groups of receptors listed in the assessment endpoints.

7.2.6 Conceptual Site Model

The conceptual model is designed to diagrammatically identify potentially exposed receptor populations and applicable exposure pathways, based on the physical nature of the site and the potential chemical source areas. Actual or potential exposures of ecological receptors associated with the sites assessed in this ERA were determined by identifying the most likely pathways of chemical release and transport. A complete exposure pathway has three components: a source of chemicals that can be released to the environment, a route of chemical transport through an environmental medium, and an exposure route or contact point for an ecological receptor. A preliminary conceptual model for OU 2 is presented in Figure 7-2. The dermal route (direct contact) and inhalation exposure routes are included in the conceptual model since they are theoretically possible, but, as mentioned earlier, they were not quantitatively investigated.

Aquatic habitats, including surface water and sediments, depicted on the figure include the system of ponds/wetlands on OU 2 and the canal that borders the site. Aquatic and semi-aquatic receptors shown on the conceptual model would most likely be associated with these areas and related exposure routes. Groundwater-to-surface water migration depicted on the conceptual model is groundwater discharge of the surficial aquifer to the canal.

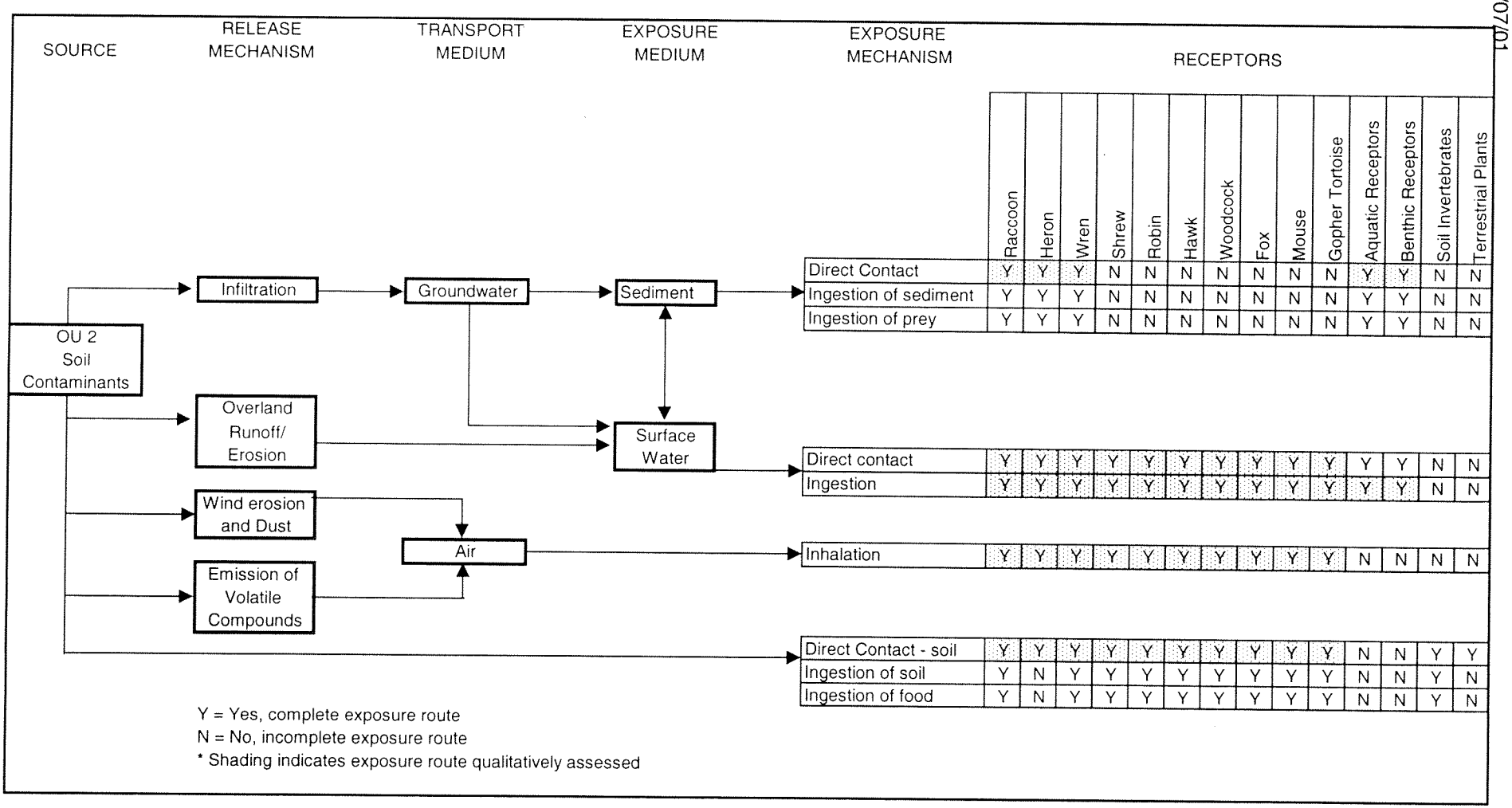

FIGURE 7-2
CONCEPTUAL SITE MODEL – OU 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Although terrestrial organisms could be found on the surface soils of the golf course proper, these receptors and related exposure routes would most likely be associated with the wooded wetlands on the central portion of the operable unit and the wooded area in the southern portion of the operable unit.

This conceptual model reflects the results of the habitat/receptor/chemical transport survey conducted by Tetra Tech NUS ecologists prior to the ERA conduct, the assessment endpoints chosen, and the wide variety of chemicals detected in OU 2 media (and their wide-ranging ecotoxicities).

7.3 PRELIMINARY ECOLOGICAL EFFECTS EVALUATION

For this ERA, exposure point concentrations of detected analytes in surface water, groundwater, sediment, and surface soil were compared to ecologically based guidelines to determine if they should be selected as COPCs. In addition, toxic doses of chemicals were compared to modeled doses for representative receptors. The methods used for screening level selection and TRV selection are discussed in detail below.

7.3.1 Region 4 Screening Levels

As mentioned in Section 7.1, the first step in the USEPA Region 4 ERA process is comparison of maximum concentrations of chemicals to Region 4 screening levels, or the "ecological screening value comparison." Chemicals whose maximum concentrations do not exceed Region 4 screening levels are dropped from further consideration, while those that equal or exceed Region 4 screening levels are considered further. For surface water, Region 4 screening levels are primarily chronic ambient water quality criteria (AWQC). Since OU 2 is located in an inland area, Region 4 freshwater values were used. As per discussions with FDEP, Florida Water Quality Standards for freshwater are presented for informational purposes only. Although several FDEP values for inorganics are calculated using site-specific hardness, they were not calculated for this ERA because they were used only qualitatively. Region 4 sediment screening levels are primarily based on FDEP threshold effects levels (TELs) and National Oceanographic and Atmospheric Administration (NOAA) Effects Range-Low (ER-L) values from Long et al. (1995). USEPA Region 4 has not promulgated its own surface soil guidelines. Work has been initiated by a USEPA task group, but those values were not available when the draft RI report was written. Recently Region 4 has recommended soil guidelines from a USFWS document (Beyer, 1990) for use in the ecological screening value comparison. These values are commonly known as the "Dutch" soil guidelines. Beyer (1990) presents "A," "B," and "C" Dutch values, which represent background concentrations or detection limits, moderate soil contamination that may require additional study, and contamination that should be considered for immediate cleanup, respectively. Region 4 recommended the use of A values. The Dutch values from Beyer (1990) were superceded by new Dutch

values promulgated in 1994 (MHSP&E, 1994). The 1994 values are referred to as "Target Values" and "Intervention Values." Target values represent the "soil quality required for the full restoration of the soil's functionality for human, animal and plant life" or "soil quality ultimately aimed for." The intervention values replace the 1990 C values and represent "the concentration levels of the chemicals in the soil above which the functionality of the soil for human, plant, and animal life is seriously impaired or threatened." The Dutch B values were discontinued in the Dutch document (MHSP&E, 1994). Similar values can be calculated using methods described in the 1994 Dutch document that consider site-specific parameters (e.g., soil organic carbon) but were beyond the scope of this ERA. The 1994 intervention values also consider ecotoxicological considerations.

Region 4 (Wellman, 1998) has most recently recommended the use of surface soil screening levels as compiled by Friday (1998). Surface soil screening levels compiled by Friday (1998) were those values issued by Beyer (1990), Oak Ridge National Laboratory (ORNL) (Efroymson et al., 1997 a, b), the Netherlands (MHSP&E, 1994; Crommentuijn et al., 1997), and the Canadian Council of Ministers of the Environment (CCME, 1997). Screening levels were the lowest value from among the above sources with three exceptions: (1) when the lowest screening value is from Beyer (1990) or Crommentuijn et al. (1997), the latter was used; (2) when the lowest screening value is from MHSP&E (1994) or Crommentuijn et al. (1997), the latter was used; and (3) if only an MHSP&E (1994) intervention value was available, it was divided by a factor of 10 to derive the screening level.

Although not promulgated by Region 4, the screening levels mentioned above are loosely referred to in this ERA as Region 4 screening levels. This was done only when the screening values for all media were referred to as a group. According to conversations with USEPA Region 4, the screening level for benzo(a)pyrene was used as a surrogate for high molecular weight PAHs when screening levels were not available for those compounds, and the screening level for diethylhexylphthalate (DEHP) was used when screening levels were not available for some phthalates. Moreover, when screening levels were available for different species of the same inorganic, the screening level for the most toxic form was used, including those for hexavalent chromium, trivalent arsenic, methyl mercury, and tributyl-tin.

7.3.2 Toxicity Reference Values

Modeling of chemical exposure via the food chain was performed to investigate potential risks to terrestrial wildlife. For estimating potential risks to representative receptors, toxic doses (TRVs) for individual receptors were obtained for comparison to doses that the receptors may receive in the environment. TRVs were preferentially identified that represent a threshold for sublethal effects. Sublethal effects are defined as those

based on the measurement endpoint, which is impairment of reproduction, growth, or long-term survival. Separate TRVs were obtained for mammals and birds, as discussed below.

Since, in general, toxicity data for the specific receptors chosen were not available, toxicity data from laboratory species were extrapolated to receptor species. Most of the toxicity data were obtained from ORNL wildlife toxicity data (Sample, Opresko, and Suter, 1996). Several other sources of toxicity data were used, including the IRIS and the Agency for Toxic Substances and Disease Registry (ATSDR) toxicity profiles. NOAELs and LOAELs were used in the models. As specified in USEPA Region 4 guidance, LOAELs were divided by a factor of 10 to obtain NOAELs if NOAELS were not available for a chemical. Following discussions with Region 4 USEPA, VOCs were not included in food chain modeling. Analytes with log K_{ow} values less than 3.5 (VOCs) generally do not accumulate in animal tissue (Suter, 1993). TRVs used in this ERA and their sources are presented in Tables 7-3A (mammals) and 7-3B (birds).

Species used in the food chain modeling were chosen to represent the groups of receptors most likely to be exposed to the highest chemical concentrations because of their position in the food web, diet (ingestion rate and food type), home range (contained within the area of contamination), and body size. The species selected were assumed to be representative of other species within the same trophic group or guild. For each of the representative species, information on life history was collected including diet, average body weight, food ingestion rates, home range, and exposure durations (percent of total time that a receptor may reside at the site), when applicable. Initially, however, area use factor and exposure duration was conservatively assumed to be 100 percent. A discussion of the receptors chosen for this ERA is presented below. These receptors were selected to be representative of the groups of organisms specified in the assessment endpoints.

Red fox (*Vulpes vulpes*)

The red fox was chosen as a representative mammalian predator because it is common in Florida and the entire eastern United States. It is one of only a few midsize carnivorous mammals in the region and its ecology resembles that of similar species. The red fox prefers several different vegetated habitats and edge areas (USEPA, 1993), all of which can be found on and near OU 2.

Great Horned Owl (Bubo virginianus)

The great horned owl was selected as a representative raptor because it is a common avian predator in Florida and the entire eastern United States. It is known to inhabit low, wet woods and forested wetlands,

TABLE 7-3A

TOXICITY REFERENCE VALUES (TRVs) FOR MAMMALS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	Test Species	Endpoint	NOAEL Derived TRV (mg/kg/day)	LOAEL Derived TRV (mg/kg/day)	NOAEL Source of TRV	LOAEL Source of TRV
Semivolatile Organic Compounds						
3- & 4-Methylphenol			NA	NA		
Acenaphthene	mouse	reproduction	1	10	Sample et al., 1996	NOAEL*10
Anthracene	mouse	reproduction	1	10	Sample et al., 1996	NOAEL*10
Benzo(a)anthracene	mouse	reproduction	1	10	Sample et al., 1996	NOAEL*10
Benzo(a)pyrene	mouse	reproduction	1	10	Sample et al., 1996	NOAEL*10
Benzo(b)fluoranthene	mouse	reproduction	1	10	Sample et al., 1996	NOAEL*10
Benzo(g,h,i)perylene	mouse	reproduction	1	10	Sample et al., 1996	NOAEL*10
Benzo(k)fluoranthene	mouse	reproduction	1	10	Sample et al., 1996	NOAEL*10
Chrysene	mouse	reproduction	1	10	Sample et al., 1996	NOAEL*10
Dibenzo(a,h)anthracene	mouse	reproduction	1	10	Sample et al., 1996	NOAEL*10
Fluoranthene	mouse	reproduction	1	10	Sample et al., 1996	NOAEL*10
Fluorene	mouse	reproduction	1	10	Sample et al., 1996	NOAEL*10
Indeno(1,2,3-cd)pyrene	mouse	reproduction	1	10	Sample et al., 1996	NOAEL*10
Pentachlorophenol	rat	reproduction	0.24	2.4	Sample et al., 1996	NOAEL*10
Phenanthrene	mouse	reproduction	1	10	Sample et al., 1996	NOAEL*10
Pyrene	mouse	reproduction	1	10	Sample et al., 1996	NOAEL*10
Pesticides and PCBs						
4,4'-DDD	rat	reproduction	0.8	4	Sample et al., 1996	Sample et al., 1996
4,4'-DDE	rat	reproduction	0.8	4	Sample et al., 1996	Sample et al., 1996
4,4'-DDT	rat	reproduction	0.8	4	Sample et al., 1996	Sample et al., 1996
Aldrin	rat	reproduction	0.2	1	Sample et al., 1996	Sample et al., 1996
alpha-Chlordane	mouse	reproduction	4.58	9.16	Sample et al., 1996	Sample et al., 1996
gamma-Chlordane	mouse	reproduction	4.58	9.16	Sample et al., 1996	Sample et al., 1996
Dieldrin	rat	reproduction	0.02	0.2	Sample et al., 1996	Sample et al., 1996
Endosulfan II	rat	reproduction	0.15	1.5	Sample et al., 1996	NOAEL*10
Endrin	mouse	reproduction	0.092	0.92	Sample et al., 1996	Sample et al., 1996
Endrin Ketone	mouse	reproduction	0.092	0.92	Sample et al., 1996	Sample et al., 1996
Heptachlor	mink	reproduction	0.1	1	Sample et al., 1996	NOAEL*10
Heptachlor epoxide	mink	reproduction	0.1	1	Sample et al., 1996	NOAEL*10
Methoxychlor	rat	reproduction	4	8	Sample et al., 1996	Sample et al., 1996

TABLE 7-3A

TOXICITY REFERENCE VALUES (TRVs) FOR MAMMALS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	Test Species	Endpoint	NOAEL Derived TRV (mg/kg/day)	LOAEL Derived TRV (mg/kg/day)	NOAEL Source of TRV	LOAEL Source of TRV
Metals and Inorganic Compounds						
Aluminum	mouse	reproduction	1.93	19.3	Sample et al., 1996	Sample et al., 1996
Arsenic	mouse	reproduction	0.126	1.26	Sample et al., 1996	NOAEL*10
Barium	rat	growth, hypertension	5.1	51	Sample et al., 1996	NOAEL*10
Chromium	rat	body weight & food consumption	3.28	32.8	Sample et al., 1996	NOAEL*10
Cobalt	rat	testicular atrophy	5	20	ATSDR, 1997	ATSDR, 1997
Copper	rat	reproduction	11.7	15.14	Sample et al., 1996	Sample et al., 1996
Iron			NA	NA		
Lead	rat	reproduction	8	80	Sample et al., 1996	Sample et al., 1996
Manganese	rat	reproduction	88	880	Sample et al., 1996	NOAEL*10
Mercury	mink	morality, weight loss/ataxia	0.015	0.025	Sample et al., 1996	Sample et al., 1996
Nickel	rat	reproduction	40	400	Sample et al., 1996	NOAEL*10
Selenium	rat	reproduction	0.2	2	Sample et al., 1996	NOAEL*10
Silver	mouse	hypoactivity	1.8	18	ATSDR, 1997	ATSDR, 1997
Vanadium	rat	reproduction	0.2	2	Sample et al., 1996	Sample et al., 1996
Zinc	rat	reproduction	160	320	Sample et al., 1996	Sample et al., 1996

TABLE 7-3B

TOXICITY REFERENCE VALUES (TRVs) FOR BIRDS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	Test Species	Endpoint	NOAEL Derived TRV (mg/kg/day)	LOAEL Derived TRV (mg/kg/day)	NOAEL Source of TRV	LOAEL Source of TRV
Semivolatile Organic Compounds						
3- & 4-Methylphenol			NA	NA		
Acenaphthene	starlings	NA	10	100	Trust et al., 1994	NOAEL*10
Anthracene	starlings	NA	10	100	Trust et al., 1994	NOAEL*10
Benzo(a)anthracene	starlings	NA	10	100	Trust et al., 1994	NOAEL*10
Benzo(a)pyrene	starlings	NA	10	100	Trust et al., 1994	NOAEL*10
Benzo(b)fluoranthene	starlings	NA	10	100	Trust et al., 1994	NOAEL*10
Benzo(g,h,i)perylene	starlings	NA	10	100	Trust et al., 1994	NOAEL*10
Benzo(k)fluoranthene	starlings	NA	10	100	Trust et al., 1994	NOAEL*10
Chrysene	starlings	NA	10	100	Trust et al., 1994	NOAEL*10
Dibenzo(a,h)anthracene	starlings	NA	10	100	Trust et al., 1994	NOAEL*10
Fluoranthene	starlings	NA	10	100	Trust et al., 1994	NOAEL*10
Fluorene	starlings	NA	10	100	Trust et al., 1994	NOAEL*10
Indeno(1,2,3-cd)pyrene	starlings	NA	10	100	Trust et al., 1994	NOAEL*10
Pentachlorophenol			NA	NA		
Phenanthrene	starlings	NA	10	100	Trust et al., 1994	NOAEL*10
Pyrene	starlings	NA	10	100	Trust et al., 1994	NOAEL*10
Pesticides and PCBs						
4,4'-DDD	pelican	reproduction	0.0028	0.028	Sample et al., 1996	NOAEL*10
4,4'-DDE	pelican	reproduction	0.0028	0.028	Sample et al., 1996	NOAEL*10
4,4'-DDT	pelican	reproduction	0.0028	0.028	Sample et al., 1996	NOAEL*10
Aldrin			NA	NA		
alpha-Chlordane	red-winged	mortality	2.14	10.7	Sample et al., 1996	Sample et al., 1996
	blackbird					
gamma-Chlordane	red-winged	mortality	2.14	10.7	Sample et al., 1996	Sample et al., 1996
	blackbird					
Dieldrin	barn owl	reproduction	0.077	0.77	Sample et al., 1996	NOAEL*10
Endosulfan II	gray partridge	reproduction	10	100	Sample et al., 1996	NOAEL*10
Endrin	screech owl	reproduction	0.01	0.1	Sample et al., 1996	Sample et al., 1996
Endrin Ketone	screech owl	reproduction	0.01	0.1	Sample et al., 1996	Sample et al., 1996
Heptachlor			NA	NA		
Heptachlor epoxide			NA	NA		
Methoxychlor			NA	NA		

TABLE 7-3B

TOXICITY REFERENCE VALUES (TRVs) FOR BIRDS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	Test Species	Endpoint	NOAEL Derived TRV (mg/kg/day)	LOAEL Derived TRV (mg/kg/day)	NOAEL Source of TRV	LOAEL Source of TRV
Metals and Inorganic Compounds						
Aluminum	ringed dove	reproduction	109.7	1097	Sample et al., 1996	NOAEL*10
Arsenic	cowbird	mortality	2.46	7.38	Sample et al., 1996	Sample et al., 1996
Barium	chicks	mortality	20.8	41.7	Sample et al., 1996	Sample et al., 1996
Chromium	black duck	reproduction	1	5	Sample et al., 1996	Sample et al., 1996
Cobalt			NA	NA		
Copper			NA	NA		
Iron			NA	NA		
Lead	quail	reproduction	1.13	11.3	Sample et al., 1996	NOAEL*10
Manganese	quail	growth	977	9770	Sample et al., 1996	NOAEL*10
Mercury	mallard duck	reproduction	0.0064	0.064	Sample et al., 1996	NOAEL*10
Nickel	mallard duckling	mortality, growth, behavior	77.4	107	Sample et al., 1996	Sample et al., 1996
Selenium	mallard duck	reproduction	0.5	1	Sample et al., 1996	Sample et al., 1996
Silver			NA	NA		
Vanadium	mallard duck	mortality, body weight	11.38	113.8	Sample et al., 1996	NOAEL*10
Zinc	hens	reproduction	14.5	131	Sample et al., 1996	Sample et al., 1996

which are common on OU 2. It feeds primarily on small mammals but will also consume small birds and other terrestrial organisms (USEPA, 1993).

American woodcock (*Scolopax minor*)

The American woodcock was selected as a representative vermivorous (earthworm-eating) avian species since some of OU 2 is moist and low lying. The woodcock prefers moist woodlands and thickets near open fields (USEPA, 1993). It will also eat insect larvae in the soil, when available. The species is common in Florida and the entire eastern United States.

Short-tailed shrew (*Blarina brevicauda*)

The short-tailed shrew was selected as a representative insectivorous small mammal. It can be found in forested areas, fields, brushy areas, and marshes (Burt and Grossenheider, 1980). It feeds primarily on insects but is an opportunistic feeder preying on earthworms, snails, centipedes, slugs, and even small vertebrates, if available. The short-tailed shrew has a voracious appetite for its body size and, as a result, may receive high doses of chemicals relative to other small mammals. Its home range is small (0.5—1.0 acre), allowing it to potentially spend all or much of its time on OU 2.

Cotton Mouse (*Peromyscus gossypinus*)

The cotton mouse was chosen as a representative herbivorous small mammal for this ERA. It prefers low moist areas, high grasslands, areas adjacent to aquatic environments, and forested areas with little ground cover (Burt and Grossenheider, 1980). It is extremely common in the southeast and feeds on grasses, sedges, seeds, fruits, grains, and bark. Since its home range is small (0.1–1.0 acre) it may potentially spend all or much of its time on OU 2.

American robin (*Turdus migratorius*)

The American robin was chosen as a representative omnivorous bird that feeds in open areas. It frequents grassy and old field habitat, which are present on OU 2. The species is common in Florida and the entire eastern United States.

Mourning Dove (*Zenaida macroura*)

The mourning dove was selected as a representative herbivorous bird on OU 2. The mourning dove feeds almost exclusively on seeds. It prefers open fields with scattered trees for foraging, which are numerous on OU 2. The species is common in Florida and the entire eastern United States.

Great blue heron (*Ardea herodias*)

The great blue heron was selected as a representative avian piscivore for this ERA. It can be exposed to surface water, sediment, and prey contamination in the marsh. The species is common in Florida and the entire eastern United States. It forages primarily on small fish in marshes and along gently sloping shorelines but also consumes frogs and aquatic invertebrates.

Raccoon (*Procyon lotor*)

The raccoon was selected as a representative mammalian omnivore. The raccoon is found in a variety of habitats and is extremely common in Florida. The raccoon is an opportunistic feeder that will feed on both terrestrial and aquatic plants and animals.

Other types of representative receptors, such as the bullfrog (*Rana catesbeiana*) (amphibian) or similar species were not used in this ERA since toxicity data for this and similar species are lacking (only a few suitable NOAELs could be located), resulting in a small, sporadic toxicity database. Hence, the potential risks to this type of organism from most chemicals cannot be adequately assessed via the food chain modeling and, therefore, their inclusion in the modeling adds little value to the assessment. Sufficient toxicity data for reptiles are also unavailable, precluding the use of reptiles in the food chain modeling. A discussion of the uncertainties associated with the absence of toxicity data for this group of receptors is provided in Section 7.9.2. Also, data for toxic doses are scarce for fish species, such as the largemouth bass (*Micropterus salmoides*) (large aquatic predator). The surface water screening levels used in this ERA are based, in part, on toxicity to sensitive fish species (e.g., salmonids). Note also that the exposure parameters for the cotton mouse, mourning dove, and great horned owl were those used in previous ERAs for NTC Orlando (ABB-ES, 1998b).

7.4 PRELIMINARY EXPOSURE ESTIMATE

7.4.1 Exposure Point Concentrations

Data used to obtain exposure point chemical concentrations in this ERA were gathered from Phase I and Phase II sampling performed by Tetra Tech NUS during 1997 and 1998. Again, Phase III data are discussed later in the ERA. Unlike most CERCLA sites, OU 2 is a large, diverse area with a variety of habitats. As a result, the use of one concentration, such as the maximum concentration across the entire OU, could result in a misrepresentation of chemical concentrations in different areas of the site. Therefore, OU 2 was divided into three discrete sections for quantitative analysis in this ERA as described earlier (northern, central, and southern).

The maximum detected concentrations of chemicals in surface water, sediment, and surface soil detected on each individual "subsection" were used as exposure point concentrations to be compared to ecological screening levels in the risk calculation step. This compartmentalization also enables more realistic food chain modeling (Section 7.4.2). The northern and central sections of the golf course are comprised of wetlands and open areas. The wooded area south of the golf course is completely forested. Although the NWI map shows wetlands in this area, no aquatic community or even standing water was present during a summer 1998 reconnaissance by Tetra Tech NUS personnel. As a result of these differences in habitat and the large spatial extent of the entire operable unit, only those receptors that would be found in each section-specific habitat were used in the food chain modeling for each subsection. A list of the receptors and the sections they were assessed on for the food chain modeling is provided below.

- Red fox (*Vulpes vulpes*) - all three sections.
- Great horned owl (*Bubo virginianus*) - all three sections.
- American woodcock (*Scolopax minor*) – all three sections.
- Short-tailed shrew (*Blarina brevicauda*) – all three sections.
- Cotton mouse (*Peromyscus gossypinus*) – all three sections.
- American robin (*Turdus migratorius*) – northern and central sections.
- Mourning dove (*Zenaida macroura*) – northern and central sections.
- Great blue heron (*Ardea herodias*) – northern and central sections.
- Raccoon (*Procyon lotor*) – all three sections (aquatic for northern/central and terrestrial for the wooded area south of the golf course).

The maximum detected concentrations in groundwater were used as exposure point chemicals in that medium in all three sections of the operable unit. As mentioned earlier, aquatic and semiaquatic organisms will not be directly exposed to groundwater chemicals but could be exposed via groundwater discharge to aquatic environments. Comparing groundwater concentrations to Region 4 surface water screening levels is a very conservative measure of potential impacts to aquatic media from contaminated groundwater discharge. It does not take into account dilution at the discharge point(s), which would probably be substantial; the amount of discharge; location of the point(s) of discharge; direction of groundwater flow; or bioavailability of groundwater chemicals.

7.4.2 Chemical Doses for Representative Receptors

A simple model was used to predict dietary exposures for representative receptor species to be compared to TRVs in the risk calculation step. The actual dose a receptor species receives as the result of indirect or direct exposure is dependent upon the habits of the species and other factors. The equations used to

calculate the dose of chemicals ingested for each exposure route for the representative receptors used in this ERA are presented below.

Both the maximum and average detected concentrations of chemicals from all three sections of the operable unit were used in the model. Although the use of the average concentration may not be considered part of a conservative, screening level assessment, it was used in this ERA to provide balance.

Incidental Ingestion of Soil

Daily intake of each chemical as a result of ingestion of soil was determined using the following equation:

$$PD_{soil} = (C_{soil} * FI * SA * F)/WR$$

where

PD_{soil} = predicted dose from ingestion of soil (mg/kg/day)

C_{soil} = concentration in soil (mg/kg)

FI = fractional intake (percent of home range that overlaps impacted area assumed to be 100 percent)

SA = percent of diet that equals soil

F = food consumed (kg/day)

WR = body weight (kg).

Ingestion of Food Items

The following equation was used to estimate chemical intake from ingestion of contaminated food items:

$$PD_{food} = (C_{food} * F * FA * FI)/WR$$

where

PD_{food} = predicted dose from ingestion of food items (mg/kg/day)

C_{food} = chemical concentration (vegetation or prey; mg/kg)

F = food consumed (kg/day)

FA = animals/vegetation as a percentage of diet

FI = fractional intake (percent of home range that overlaps affected area assumed to be 100 percent)

WR = weight of receptor (kg).

Nearly all of the input parameters (e.g., body weight, ingestion rate) for the representative receptors were obtained from USEPA's *Wildlife Exposure Factors Handbook: Volumes I and II* (1993). In general, the values

used for the input parameters were conservative (e.g., upper bound food ingestion rate) presented in the USEPA publication. These values are presented on Table 7-4.

For simplicity in the screening level ERA, bioaccumulation factors (BAFs) were set equal to 1.0; USEPA Environmental Response Team (ERT) currently recommends this approach. ORNL states that the drinking water exposure route is negligible for most receptors (Sample et al., 1996), and it has been shown to be miniscule in similar food chain modeling at other Navy sites. As reflected also in USEPA (1993), surface water ingestion as a percentage of total ingestion (e.g., ingestion of water, soil/sediment, and food) is generally marginal. Therefore, exposure to surface water chemicals from drinking water was assumed to be insignificant for terrestrial and semi-aquatic wildlife and not considered for OU 2.

7.5 PRELIMINARY RISK CALCULATION

As identified by USEPA (1997a), the preliminary risk calculation step in the ERA process compares chemical doses for representative receptors with doses associated with toxic effects. Prior to that step, the maximum concentrations of chemicals in each medium are compared to Region 4 screening levels. The ratio of the exposure point chemical concentration to the screening level or the modeled dose to the toxic dose is called the HQ, and is defined as follows:

$$HQ_i = EPC_i/ESG_i \text{ or } HQ_i = ID_i/TRV_i$$

where

HQ_i = Hazard quotient for analyte "i" (unitless)

EPC_i = Exposure point concentration for analyte "i" (μg/L or μg/kg or mg/kg)

ESG_i = Ecological screening guideline for analyte "i" (μg/L or μg/kg or mg/kg)

ID_i = Intake dose for analyte "i" (mg/kg/day)

TRV_i = Toxicity reference value for analyte "i" (mg/kg/day).

TABLE 7-4

SUMMARY OF RECEPTORS FOR FOOD CHAIN MODELING AND EXPOSURE PARAMETERS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Receptor	Guild (Representative Group)	Body Weight (kg)	Body Weight Notes	Food Ingestion Rate (kg/day)[(a)(b)]	Food Ingestion Rate Notes	Soil/Sediment Ingestion Rate (kg/day)	Soil/Sediment Ingestion Rate Notes
Short-tailed Shrew (*Blarina brevicauda*)	Insectivorous Mammal	0.015	USEPA, 1993[2]	0.00795	USEPA, 1993; value from a study in Ohio given in g/day	0.0002	from USEPA, 1993: 2% of diet for white-footed mouse
Cotton Mouse (*Peromyscus gossypinus*)	Herbivorous Mammal	0.021	Ave. of male and female deer mice from USEPA, 1993	0.0029	Calculated using body weight equation from USEPA, 1993	0.00006	from USEPA, 1993: 2% of diet for white-footed mouse
Great Blue Heron (*Ardea herodias*)	Piscivorous Bird	2.229	USEPA, 1993	0.401	USEPA, 1993; using rate of 0.18 g/g-day	0.008	from USEPA, 1993: 2% of diet for mallard
American Woodcock (*Scolopax minor*)	Vermivorous Bird (wooded areas)	0.197	Ave. of males and females from USEPA, 1993	0.151	USEPA, 1993; using rate of 0.77 g/g-day	0.016	10.4% of diet (USEPA, 1993)
Great Horned Owl (*Bubo virginianus*)	Avian Predator	1.59	USEPA, 1993	0.079	Calculated using body weight equation from USEPA, 1993	0.00079	1% of diet (ABB-ES, 1998b)
Red Fox (*Vulpes vulpes*)	Mammalian Predator	4.53	Ave. of males and females from USEPA, 1993	0.498	USEPA, 1993; using ave. rate of 0.11 g/g-day for pre/post whelp	0.01	3% of diet (USEPA, 1993)
Mourning Dove (*Zenaida macroura*)	Herbivorous Bird	0.13	Terres (1980)	0.0154	Calculated using body weight equation from USEPA, 1993	0.00077	Terres (1980)
Raccoon (*Procyon lotor*)	Mammalian Omnivore	3.99	Ave. of males and females from USEPA, 1993	0.21	Calculated using body weight equation from USEPA, 1993	0.02	9% of diet (USEPA, 1993)
American Robin (*Turdus migratorius*)	Omnivorous Bird (open areas)	0.0773	USEPA, 1993	0.117	USEPA, 1993; using rate of 1.52 g/g-day	0.012	from USEPA, 1993: 10.4% of diet for woodcock

(a) Drinking water/incidental ingestion of water exposure route is miniscule and, therefore, not applicable.

(b) USEPA, 1993 = USEPA's *Wildlife Exposure Factors Handbook* Volumes I and II (EPA/600/R-93/187)

When the ratio of the exposure point concentration to its respective guideline exceeded 1.0, adverse impacts were considered possible, and the chemical was selected as a COPC. The HQ value should not be construed as being probabilistic; rather, it is a numerical indicator of the extent to which an exposure point concentration exceeds, or is less than, a guideline. When HQ values exceed 1.0, it is an indication that ecological receptors are potentially at risk. Additional evaluation or data may be necessary to confirm with greater certainty whether ecological receptors are actually at risk, especially since most guidelines are conservatively derived (see below).

The use of HQs is probably the most common method used for risk characterization in ERAs. Advantages of this method, according to Barnthouse et al. (1986), include the following:

- The HQ method is relatively easy to use, is generally accepted, and can be applied to any data.
- The method is useful when a large number of chemicals must be screened.

This method of risk characterization has some inherent limitations. One primary limitation is that it is a "no/maybe" method for relating toxicity to exposure. That is, it uses single values for exposure concentrations and guidelines. The HQ method does not account for the variability in both these parameters, nor for incremental or cumulative toxicity. To loosely address cumulative toxicity, HQs from comparisons to Region 4 screening levels were summed to obtain an HI when chemicals were determined to have similar modes of action, as recommended by USEPA Region 4. This was done primarily for organochlorine pesticides and PAHs.

The comparisons described above are presented in screening tables for each of the three sections of OU 2 to select COPCs. Screening tables include the frequency of detection for each analyte, two times the average site-specific background concentrations (for inorganics), the minimum and maximum detected concentrations, and the chemical-specific Region 4 screening levels. Using maximum chemical concentrations, tables were also generated that present the HQ values for each representative receptor used in the food chain modeling. Separate screening tables are provided for maximum and average concentrations for each of the three sections of OU 2. As a result, two sets of COPCs were generated for the food chain modeling: maximum concentration COPCs and average concentration COPCs.

In summary, the COPC selection process is as follows:

1. The maximum concentrations of detected chemicals in Phase I and Phase II OU 2 surface water, groundwater, sediment, and surface soil were compared to Region 4 screening levels, with the exception of the inorganics whose maximum concentrations did not exceed 2 times average

background and the essential nutrients mentioned earlier. If the maximum concentration did not exceed the Region 4 screening level, it was dropped from further consideration; if it exceeded or equaled the Region 4 screening level, it was selected as a COPC. If no Region 4 screening level was available, the analyte was selected as a COPC, in accordance with USEPA guidance (1997a).

2. All sediment and surface soil chemicals whose maximum concentrations exceeded Region 4 screening levels were used in the food chain modeling, where applicable, as were those for which no Region 4 screening levels were available.

3. The maximum and average concentrations of COPCs from Region 4 screening comparisons were used in the food chain modeling. Hence, a list of maximum concentration COPCs and a list of average concentration COPCs were generated.

Since no direct exposure is associated with groundwater, COPCs were not selected for this medium. Nevertheless, groundwater analytes with HQs greater than 1.0 are presented and discussed, as are groundwater analytes for which no Region 4 screening levels were available.

7.6 RESULTS

This section presents the results of the chemical screening process and food chain modeling for the northern, central, and southern sections of OU 2.

7.6.1 Northern Section

7.6.1.1 Surface Water

Aluminum, chromium, copper, iron, lead, mercury, and zinc were detected in northern section surface water at concentrations in excess of Region 4 screening levels and thus were selected as surface water COPCs (Table 7-6A). Barium, cobalt, manganese, and vanadium were selected as COPCs since no Region 4 screening levels are available.

7.6.1.2 Sediment

No sediment inorganics in northern section sediments had maximum concentrations that exceeded Region 4 screening (Table 7-6B). The concentrations of alpha- and gamma-chlordane exceeded Region 4 screening levels and were selected as organic COPCs in sediments. Aluminum, barium, cobalt, iron, manganese,

TABLE 7-6A

SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE WATER
OPERABLE UNIT 2 - NORTH SECTION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	Frequency of Detection	Range of Detections		Location of Maximum	Florida Water Quality Standard*	USEPA Region 4 Screening Level	Maximum Hazard Quotient	HQ > 1.0 (Y/N?)
		Min.	Max.					
Inorganics (µg/L)								
Aluminum	5/6	908	22600	SW010	NA	87	259.77	Y
Arsenic	3/6	5.4	18.4	SW010	50	190	0.10	N
Barium	5/6	11.5	118	SW010	NA	NA	NA	Y
Chromium	3/6	2.2	29.2	SW010	11	11	2.65	Y
Cobalt	1/6	12.4	12.4	SW010	NA	NA	NA	Y
Copper	4/6	5.8	36.2	SW010	NA*	6.54	5.54	Y
Iron	6/6	588	49000	SW010	1000	1000	49.00	Y
Lead	3/6	5.7	41.1	SW010	NA*	1.32	31.14	Y
Manganese	6/6	31.6	1360	SW010	NA	NA	NA	Y
Mercury	3/6	0.12	0.18	SW010	0.012	0.012	15.00	Y
Nickel	2/6	2.9	9.2	SW010	NA*	87.71	0.10	N
Selenium	1/6	4	4	SW010	NA	5	0.80	N
Vanadium	4/6	4.5	272	SW010	NA	NA	NA	Y
Zinc	5/6	37.9	310	SW012	NA*	58.91	5.26	Y
Volatiles (µg/L)								
Toluene	1/5	16.3	16.3	SW011	NA	175	0.09	N

NA = Not Available or Applicable
Y = Yes
N = No
* presented for comparative purposes only; NA with asterisk indicates the value is calculated using site-specific hardness.

TABLE 7-6B

SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SEDIMENT
OPERABLE UNIT 2 - NORTH SECTION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	Frequency of Detection	Range of Detections		Location of Maximum	USEPA Region 4 Screening Level	Maximum Hazard Quotient	HQ > 1.0 (Y/N?)
		Min.	Max.				
Inorganics (mg/kg)							
Aluminum	5/5	664	6460	SD011	NA	NA	Y
Arsenic	1/5	0.07	0.07	SW009	7.24	0.01	N
Barium	5/5	2.1	21.5	SD011	NA	NA	Y
Chromium	5/5	1.6	6.1	SD011	52.3	0.12	N
Cobalt	1/5	0.29	0.29	SW009	NA	NA	Y
Copper	4/5	0.6	2.1	SD012	18.7	0.11	N
Iron	5/5	161	728	SD011	NA	NA	Y
Lead	4/5	0.86	4.8	SW007	30.2	0.16	N
Manganese	4/5	1.1	4.6	SD012	NA	NA	Y
Nickel	3/5	0.31	0.47	SW009	15.9	0.03	N
Selenium	1/5	0.66	0.66	SW010	NA	NA	Y
Vanadium	5/5	1.5	24.9	SW010	NA	NA	Y
Zinc	3/5	1.7	74.7	SD012	124	0.60	N
Volatile Organics (µg/kg)							
Toluene	2/5	2.6	3.8	SD011	NA	NA	Y
Pesticides/PCBs (µg/kg)							
alpha-Chlordane	1/5	2.5	2.5	SW010	1.7	1.47	Y
gamma-Chlordane	1/5	4.4	4.4	SW010	1.7	2.59	Y
Heptachlor	1/5	1.3	1.3	SW010	NA	NA	Y

NA = Not Available or Applicable
Y = Yes
N = No

selenium, and vanadium were selected as inorganic sediment COPCs since no Region 4 screening levels were available. The VOCs toluene and heptachlor were selected as COPCs since no Region 4 screening levels were available.

7.6.1.3 Surface Soil

Iron, mercury, silver, and vanadium had maximum concentrations in northern section surface soil in excess of 2 times average background and screening levels and thus were selected as inorganic COPCs (Table 7-6C). Twelve PAHs, 4,4'-DDE, 4,4'-DDT, and dieldrin had maximum concentrations in excess of screening levels and thus were selected as organic COPCs. Acetone, endrin ketone, gamma-chlordane, and heptachlor were selected as surface soil COPCs since no screening levels were available.

7.6.1.4 Groundwater Chemical Screening

Aluminum, chromium, copper, iron, lead, mercury, and zinc had maximum concentrations in northern section groundwater in excess of Region 4 surface water screening levels (Table 7-6D). No Region 4 screening levels were available for manganese, vanadium, cis-1,2-dichloroethene, vinyl chloride, total xylenes, and methane.

7.6.1.5 Food Chain Modeling

Using maximum and average concentrations, mercury and vanadium had at least one HQ greater than 1.0 for the terrestrial food chain modeling for the northern section (Tables 7-6E and 7-6F). Benzo(a)pyrene, fluoranthene, pyrene, 4,4'-DDE, 4,4'-DDT, and endrin ketone had at least one HQ greater than 1.0 for the terrestrial food chain modeling using maximum concentrations; only 4,4'-DDT using average concentrations. Aluminum and vanadium had at least one HQ greater than 1.0 using both maximum and average concentrations in the semi-aquatic food chain modeling (Tables 7-6G and 7-6H).

7.6.2 Central Section

7.6.2.1 Surface Water

Aluminum, copper, iron, lead, mercury, zinc, and bis(2-ethylhexyl)phthalate were detected in central section surface water at concentrations in excess of Region 4 screening levels and thus were selected as surface water COPCs (Table 7-6I). Barium, manganese, vanadium, and four PAHs were selected as COPCs since no Region 4 screening levels were available.

TABLE 7-6C

SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE SOIL
OPERABLE UNIT 2 - NORTH SECTION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	Frequency of Detection	Range of Detections		Location of Maximum	Two Times Average Background	USEPA Region 4 Screening Level	Maximum Hazard Quotient[a]	HQ > 1.0 (Y/N?)
		Min.	Max.					
Inorganics (mg/kg)								
Aluminum	34/34	524	3180	S139	4870	50	63.90	Y
Arsenic	25/34	0.73	4.8	S133	1.9	10	0.48	N
Barium	34/34	1.9	10.5	S159	21.6	165	0.06	N
Chromium	31/34	1.4	5.7	S160	7.7	0.4	14.25	Y
Copper	8/34	2.3	5	S154	2.6	40	0.13	N
Iron	34/34	137	925	S139	843	200	4.63	Y
Lead	34/34	1.6	11.6	S152	21.3	50	0.23	N
Manganese	34/34	0.6	35.5	S160	10.6	100	0.36	N
Mercury	2/34	0.13	0.22	S153	0.05	0.1	2.20	Y
Nickel	28/34	0.26	1.1	S157	NA	30	0.04	N
Selenium	7/34	0.45	0.54	S157	1.1	0.81	0.67	N
Silver	3/34	0.24	2.4	S153	NA	2	1.20	Y
Vanadium	34/34	0.5	5.7	S139	4.9	2	2.85	Y
Zinc	8/34	4.4	9.6	S157	4.6	50	0.19	N
Semivolatiles (ug/kg)								
Anthracene	1/34	339	339	S103	NA	100	3.39	Y
Benzo(a)anthracene	1/34	1380	1380	S103	NA	100	13.80	Y
Benzo(a)pyrene	3/34	48	2360	S103	NA	100	23.60	Y
Benzo(b)fluoranthene	1/34	937	937	S103	NA	100	9.37	Y
Benzo(g,h,i)perylene	1/34	805	805	S103	NA	100	8.05	Y
Benzo(k)fluoranthene	1/34	767	767	S103	NA	100	7.67	Y
Chrysene	1/34	1160	1160	S103	NA	100	11.60	Y
Dibenzo(a,h)anthracene	1/34	560	560	S103	NA	100	5.60	Y
Fluoranthene	2/34	509	3000	S103	NA	100	30.00	Y
Indeno(1,2,3-cd)pyrene	1/34	753	753	S103	NA	100	7.53	Y
Phenanthrene	1/34	1380	1380	S103	NA	100	13.80	Y
Pyrene	1/34	2080	2080	S103	NA	100	20.80	Y

SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE SOIL
OPERABLE UNIT 2 - NORTH SECTION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	Frequency of Detection	Range of Detections		Location of Maximum	Two Times Average Background	USEPA Region 4 Screening Level	Maximum Hazard Quotient[a]	HQ > 1.0 (Y/N?)
		Min.	Max.					
Volatiles (µg/kg)								
Acetone	7/9	123	51400	S116	NA	NA	NA	Y
Pesticides/PCBs (µg/kg)								
4,4'-DDE	7/34	1.3	22	S103	NA	2.5	8.80	Y
4,4'-DDT	1/34	9.1	9.1	S128	NA	2.5	3.64	Y
Dieldrin	1/34	3	3	S155	NA	0.5	6.00	Y
Endrin ketone	1/34	19	19	S103	NA	NA	NA	Y
gamma-Chlordane	1/34	1.9	1.9	S115	NA	NA	NA	Y
Heptachlor	1/34	1.1	1.1	S135	NA	NA	NA	Y

NA = Not Available or Applicable
Y = Yes
N = No
[a]Chemical was not a COPC if the maximum did not exceed two times average background.

TABLE 7-6D

GROUNDWATER CHEMICAL SCREENING
OPERABLE UNIT 2 - NORTH SECTION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	Frequency of Detection	Range of Detections		Location of Maximum	USEPA Region 4 Screening Level	Maximum Hazard Quotient	HQ > 1.0 (Y/N?)
		Min.	Max.				
Inorganics (µg/L)							
Aluminum	5/6	4520	83700	OU2MW03B	87	962.07	Y
Chromium	4/6	53.6	147	OU2MW03B	11	13.36	Y
Copper	1/6	36	36	OU2MW03B	6.54	5.50	Y
Iron	6/6	1400	26400	OU2MW03A	1000	26.40	Y
Lead	4/6	21.3	76	OU2MW03B	1.32	57.58	Y
Manganese	6/6	23.7	194	OU2MW03A	NA	NA	Y
Mercury	1/6	0.29	0.29	OU2MW01A	0.012	24.17	Y
Vanadium	5/6	52.2	222	OU2MW03B	NA	NA	Y
Zinc	2/6	112	268	OU2MW01B	58.91	4.55	Y
Semivolatiles (µg/L)							
1,4-Dichlorobenzene	1/6	6.3	6.3	OU2MW03B	11.2	0.56	N
Naphthalene	1/6	4.8	4.8	OU2MW03B	62	0.08	N
Volatiles (µg/L)							
Benzene	2/6	5.5	6.2	OU2MW03B	53	0.12	N
Chlorobenzene	1/6	19.1	19.1	OU2MW03B	195	0.10	N
Cis-1,2-dichloroethene	1/6	2	2	OU2MW03A	NA	NA	Y
Ethylbenzene	1/6	4.1	4.1	OU2MW03A	453	0.01	N
Methane	5/6	186	1310	OU2MW03A	NA	NA	Y
Toluene	1/6	8	8	OU2MW03A	175	0.05	N
Vinyl chloride	1/6	4.8	4.8	OU2MW03A	NA	NA	Y
Xylenes, total	1/6	15.7	15.7	OU2MW03A	NA	NA	Y

NA = Not Available or Applicable
Y = Yes
N = No

TABLE 7-6E

RESULTS OF FOOD CHAIN MODELING
TERRESTRIAL RECEPTORS MAXIMUM CONCENTRATIONS
OPERABLE UNIT 2 NORTH

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Ecological Contaminant of Concern	Shrew		Mouse		Woodcock		Owl		Fox		Robin		Dove	
	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l
Metals and Inorganic Compounds														
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	**7.97E+00**	**4.78E+00**	**2.07E+00**	**1.24E+00**	**2.91E+01**	**2.91E+00**	**1.73E+00**	1.73E-01	**1.64E+00**	9.87E-01	**5.74E+01**	**5.74E+00**	**4.28E+00**	4.28E-01
Silver	7.24E-01	7.24E-02	1.88E-01	1.88E-02	NA	NA	NA	NA	1.50E-01	1.50E-02	NA	NA	NA	NA
Vanadium	**1.55E+01**	**1.55E+00**	**4.02E+00**	4.02E-01	4.25E-01	4.25E-02	2.51E-02	2.51E-03	**3.20E+00**	3.20E-01	8.36E-01	8.36E-02	6.23E-02	6.23E-03
Semivolatile Organic Compounds														
Anthracene	1.84E-01	1.84E-02	4.78E-02	4.78E-03	2.87E-02	2.87E-03	1.70E-03	1.70E-04	3.80E-02	3.80E-03	5.66E-02	5.66E-03	4.22E-03	4.22E-04
Benzo(a)anthracene	7.50E-01	7.50E-02	1.95E-01	1.95E-02	1.17E-01	1.17E-02	6.93E-03	6.93E-04	1.55E-01	1.55E-02	2.30E-01	2.30E-02	1.72E-02	1.72E-03
Benzo(a)pyrene	**1.28E+00**	1.28E-01	3.33E-01	3.33E-02	2.00E-01	2.00E-02	1.18E-02	1.18E-03	2.65E-01	2.65E-02	3.94E-01	3.94E-02	2.94E-02	2.94E-03
Benzo(b)fluoranthene	5.09E-01	5.09E-02	1.32E-01	1.32E-02	7.94E-02	7.94E-03	4.70E-03	4.70E-04	1.05E-01	1.05E-02	1.56E-01	1.56E-02	1.17E-02	1.17E-03
Benzo(g,h,i)perylene	4.37E-01	4.37E-02	1.13E-01	1.13E-02	6.82E-02	6.82E-03	4.04E-03	4.04E-04	9.03E-02	9.03E-03	1.34E-01	1.34E-02	1.00E-02	1.00E-03
Benzo(k)fluoranthene	4.17E-01	4.17E-02	1.08E-01	1.08E-02	6.50E-02	6.50E-03	3.85E-03	3.85E-04	8.60E-02	8.60E-03	1.28E-01	1.28E-02	9.54E-03	9.54E-04
Chrysene	6.30E-01	6.30E-02	1.64E-01	1.64E-02	9.83E-02	9.83E-03	5.82E-03	5.82E-04	1.30E-01	1.30E-02	1.94E-01	1.94E-02	1.44E-02	1.44E-03
Dibenzo(a,h)anthracene	3.04E-01	3.04E-02	7.89E-02	7.89E-03	4.75E-02	4.75E-03	2.81E-03	2.81E-04	6.28E-02	6.28E-03	9.35E-02	9.35E-03	6.97E-03	6.97E-04
Fluoranthene	**1.63E+00**	1.63E-01	4.23E-01	4.23E-02	2.54E-01	2.54E-02	1.51E-02	1.51E-03	3.36E-01	3.36E-02	5.01E-01	5.01E-02	3.73E-02	3.73E-03
Indeno(1,2,3-cd)pyrene	4.09E-01	4.09E-02	1.06E-01	1.06E-02	6.38E-02	6.38E-03	3.78E-03	3.78E-04	8.44E-02	8.44E-03	1.26E-01	1.26E-02	9.37E-03	9.37E-04
Phenanthrene	7.50E-01	7.50E-02	1.95E-01	1.95E-02	1.17E-01	1.17E-02	6.93E-03	6.93E-04	1.55E-01	1.55E-02	2.30E-01	2.30E-02	1.72E-02	1.72E-03
Pyrene	**1.13E+01**	**1.13E+00**	**2.93E+00**	2.93E-01	**1.76E+00**	1.76E-01	1.04E-01	1.04E-02	**2.33E+00**	2.33E-01	**3.47E+00**	3.47E-01	2.59E-01	2.59E-02
Pesticides/PCBs														
4,4'-DDE	1.49E-02	2.99E-03	3.88E-03	7.75E-04	6.66E+00	6.66E-01	3.94E-01	3.94E-02	3.08E-03	6.17E-04	**1.31E+01**	**1.31E+00**	9.77E-01	9.77E-02
4,4'-DDT	6.18E-03	1.24E-03	1.60E-03	3.21E-04	2.76E+00	2.76E-01	1.63E-01	1.63E-02	1.28E-03	2.55E-04	**5.42E+00**	5.42E-01	4.04E-01	4.04E-02
Dieldrin	8.15E-02	8.15E-03	2.11E-02	2.11E-03	3.30E-02	3.30E-03	1.96E-03	1.96E-04	1.68E-02	1.68E-03	6.50E-02	6.50E-03	4.85E-03	4.85E-04
Endrin ketone	1.12E-01	1.12E-02	2.91E-02	2.91E-03	**1.61E+00**	1.61E-01	9.53E-02	9.53E-03	2.32E-02	2.32E-03	**3.17E+00**	3.17E-01	2.36E-01	2.36E-02
gamma-Chlodane	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Heptachlor	5.98E-03	5.98E-04	1.55E-03	1.55E-04	NA	NA	NA	NA	1.23E-03	1.23E-04	NA	NA	NA	NA

NA - NOAEL or LOAEL Not Available

TABLE 7-6F

RESULTS OF FOOD CHAIN MODELING
TERRESTRIAL RECEPTORS MEAN CONCENTRATIONS
OPERABLE UNIT 2 NORTH

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Ecological Contaminant of Concern	Shrew		Mouse		Woodcock		Owl		Fox		Robin		Dove	
	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l
Metals and Inorganic Compounds														
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	**1.93E+00**	**1.16E+00**	5.02E-01	3.01E-01	**7.07E+00**	7.07E-01	4.19E-01	4.19E-02	3.99E-01	2.39E-01	**1.39E+01**	**1.39E+00**	**1.04E+00**	1.04E-01
Silver	7.15E-02	7.15E-03	1.85E-02	1.85E-03	NA	NA	NA	NA	1.48E-02	1.48E-03	NA	NA	NA	NA
Vanadium	**4.55E+00**	4.55E-01	**1.18E+00**	1.18E-01	1.25E-01	1.25E-02	7.38E-03	7.38E-04	9.39E-01	9.39E-02	2.46E-01	2.46E-02	1.83E-02	1.83E-03
Semivolatile Organic Compounds														
Anthracene	1.05E-01	1.05E-02	2.72E-02	2.72E-03	1.64E-02	1.64E-03	9.70E-04	9.70E-05	2.17E-02	2.17E-03	3.22E-02	3.22E-03	2.40E-03	2.40E-04
Benzo(a)anthracene	1.22E-01	1.22E-02	3.15E-02	3.15E-03	1.90E-02	1.90E-03	1.12E-03	1.12E-04	2.51E-02	2.51E-03	3.74E-02	3.74E-03	2.78E-03	2.78E-04
Benzo(a)pyrene	6.35E-02	6.35E-03	1.65E-02	1.65E-03	9.91E-03	9.91E-04	5.87E-04	5.87E-05	1.31E-02	1.31E-03	1.95E-02	1.95E-03	1.45E-03	1.45E-04
Benzo(b)fluoranthene	1.15E-01	1.15E-02	2.97E-02	2.97E-03	1.79E-02	1.79E-03	1.06E-03	1.06E-04	2.36E-02	2.36E-03	3.52E-02	3.52E-03	2.62E-03	2.62E-04
Benzo(g,h,i)perylene	1.12E-01	1.12E-02	2.92E-02	2.92E-03	1.75E-02	1.75E-03	1.04E-03	1.04E-04	2.32E-02	2.32E-03	3.45E-02	3.45E-03	2.57E-03	2.57E-04
Benzo(k)fluoranthene	1.12E-01	1.12E-02	2.90E-02	2.90E-03	1.74E-02	1.74E-03	1.03E-03	1.03E-04	2.31E-02	2.31E-03	3.43E-02	3.43E-03	2.56E-03	2.56E-04
Chrysene	1.18E-01	1.18E-02	3.06E-02	3.06E-03	1.84E-02	1.84E-03	1.09E-03	1.09E-04	2.44E-02	2.44E-03	3.63E-02	3.63E-03	2.70E-03	2.70E-04
Dibenzo(a,h)anthracene	3.46E-02	3.46E-03	8.97E-03	8.97E-04	5.40E-03	5.40E-04	3.19E-04	3.19E-05	7.14E-03	7.14E-04	1.06E-02	1.06E-03	7.92E-04	7.92E-05
Fluoranthene	1.53E-01	1.53E-02	3.96E-02	3.96E-03	2.38E-02	2.38E-03	1.41E-03	1.41E-04	3.15E-02	3.15E-03	4.69E-02	4.69E-03	3.49E-03	3.49E-04
Indeno(1,2,3-cd)pyrene	1.12E-01	1.12E-02	2.89E-02	2.89E-03	1.74E-02	1.74E-03	1.03E-03	1.03E-04	2.30E-02	2.30E-03	3.43E-02	3.43E-03	2.55E-03	2.55E-04
Phenanthrene	1.22E-01	1.22E-02	3.15E-02	3.15E-03	1.90E-02	1.90E-03	1.12E-03	1.12E-04	2.51E-02	2.51E-03	3.74E-02	3.74E-03	2.78E-03	2.78E-04
Pyrene	1.33E-01	1.33E-02	3.45E-02	3.45E-03	2.07E-02	2.07E-03	1.23E-03	1.23E-04	2.74E-02	2.74E-03	4.08E-02	4.08E-03	3.04E-03	3.04E-04
Pesticides/PCBs														
4,4'-DDE	1.02E-03	2.03E-04	2.64E-04	5.28E-05	4.54E-01	4.54E-02	2.68E-02	2.68E-03	2.10E-04	4.20E-05	8.93E-01	8.93E-02	6.65E-02	6.65E-03
4,4'-DDT	1.66E-03	3.31E-04	4.30E-04	8.60E-05	7.39E-01	7.39E-02	4.37E-02	4.37E-03	3.42E-04	6.84E-05	**1.45E+00**	1.45E-01	1.08E-01	1.08E-02
Dieldrin	1.51E-02	1.51E-03	3.93E-03	3.93E-04	6.13E-03	6.13E-04	3.63E-04	3.63E-05	3.12E-03	3.12E-04	1.21E-02	1.21E-03	9.00E-04	9.00E-05
Endrin ketone	2.47E-02	2.47E-03	6.42E-03	6.42E-04	3.55E-01	3.55E-02	2.10E-02	2.10E-03	5.11E-03	5.11E-04	6.99E-01	6.99E-02	5.21E-02	5.21E-03
gamma-Chlordane	6.03E-05	3.01E-05	1.56E-05	7.82E-06	2.01E-04	4.02E-05	1.19E-05	2.38E-06	1.24E-05	6.22E-06	3.96E-04	7.92E-05	2.95E-05	5.91E-06
Heptachlor	2.73E-03	2.73E-04	7.08E-04	7.08E-05	NA	NA	NA	NA	5.63E-04	5.63E-05	NA	NA	NA	NA

NA - NOAEL or LOAEL Not Available

TABLE 7-6G

RESULTS OF FOOD CHAIN MODELING
AQUATIC RECEPTORS MAXIMUM CONCENTRATIONS
OPERABLE UNIT 2 NORTH

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Ecological Contaminant of Concern	Heron		Raccoon	
	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l
Metals and Inorganic Compounds				
Aluminum	**1.08E+01**	**1.08E+00**	**1.93E+02**	**1.93E+01**
Barium	1.90E-01	9.46E-02	2.43E-01	2.43E-02
Cobalt	NA	NA	3.34E-03	8.36E-04
Iron	NA	NA	NA	NA
Manganese	8.64E-04	8.64E-05	3.01E-03	9.34E-04
Selenium	2.42E-01	1.21E-01	1.90E-01	1.15E-01
Vanadium	4.01E-01	4.01E-02	**7.18E+00**	7.18E-01
Pesticides/PCBs				
alpha-Chlordane	2.14E-04	4.29E-05	3.15E-05	1.57E-05
gamma-Chlordane	3.77E-04	7.55E-05	5.54E-05	2.77E-05
Heptachlor	NA	NA	7.49E-04	7.49E-05

NA - NOAEL or LOAEL Not Available

TABLE 7-6H

RESULTS OF FOOD CHAIN MODELING
AQUATIC RECEPTORS MEAN CONCENTRATIONS
OPERABLE UNIT 2 NORTH

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Ecological Contaminant of Concern	Heron		Raccoon	
	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l
Metals and Inorganic Compounds				
Aluminum	**4.03E+00**	4.03E-01	**7.19E+01**	**7.19E+00**
Barium	1.08E-01	5.37E-02	1.38E-01	1.38E-02
Cobalt	NA	NA	9.50E-03	2.37E-03
Iron	NA	NA	NA	NA
Manganese	3.62E-04	3.62E-05	1.26E-03	3.92E-04
Selenium	5.73E-01	2.87E-01	4.50E-01	2.73E-01
Vanadium	1.32E-01	1.32E-02	**2.36E+00**	2.36E-01
Pesticides/PCBs				
alpha-Chlordane	1.37E-04	2.75E-05	2.02E-05	1.01E-05
gamma-Chlordane	1.71E-04	3.43E-05	2.52E-05	1.26E-05
Heptachlor	NA	NA	5.42E-04	5.42E-05

NA - NOAEL or LOAEL Not Available

TABLE 7-6I

SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE WATER
OPERABLE UNIT 2 - CENTRAL SECTION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	Frequency of Detection	Range of Detections		Location of Maximum	Florida Water Quality Standard*	USEPA Region 4 Screening Level	Maximum Hazard Quotient	HQ > 1.0 (Y/N?)
		Min.	Max.					
Inorganics (µg/L)								
Aluminum	8/13	468	18200	SW015	NA	87	209.20	Y
Arsenic	1/13	3.625	3.625	SW006	50	190	0.02	N
Barium	11/13	10.6	117	SW015	NA	NA	NA	Y
Chromium	1/13	3.75	3.75	SW006	11	11	0.34	N
Copper	9/13	2.8	32.9	SW015	NA*	6.54	5.03	Y
Iron	12/13	272	12000	SW015	1000	1000	12.00	Y
Lead	2/13	8.65	34.9	SW015	NA*	1.32	26.44	Y
Manganese	10/13	6.4	77.9	SW013	NA	NA	NA	Y
Mercury	2/13	0.12	0.16	SW014	0.012	0.012	13.33	Y
Vanadium	2/13	5.5	33.3	SW015	NA	NA	NA	Y
Zinc	8/13	11.1	313.35	SW016	NA*	58.91	5.32	Y
Semivolatiles (µg/L)								
Benzo(a)anthracene	1/13	0.14	0.14	SW019	NA	NA	NA	Y
Benzo(a)pyrene	1/13	0.17	0.17	SW019	NA	NA	NA	Y
Benzo(b)fluoranthene	1/13	0.245	0.245	SW019	NA	NA	NA	Y
Indeno(1,2,3-cd)pyrene	1/13	0.14	0.14	SW019	NA	NA	NA	Y
Bis(2-ethylhexyl)phthalate	1/13	10.3	10.3	SW008	3	0.3	34.33	Y

NA = Not Available or Applicable
Y = Yes
N = No
* presented for comparative purposes only; NA with asterisk indicates the value is calculated using site-specific hardness

Sediment

No inorganics in central section sediments had maximum concentrations that exceeded Region 4 screening levels (Table 7-6J). The maximum concentration of 4,4'-DDE exceeded its Region 4 screening level and was selected as an organic COPC in sediments. Aluminum, barium, iron, manganese, selenium, and vanadium were selected as inorganic sediment COPCs since no Region 4 screening levels were available. The SVOC total methylphenol (3- & 4-) and the VOCs toluene, benzene, ethylbenzene, and xylenes were selected as COPCs since no Region 4 screening levels were available.

7.6.2.2 Surface Soil

Aluminum, iron, lead, mercury, vanadium, and zinc had maximum concentrations in central section surface soils in excess of 2 times average background and surface soil screening levels and thus were selected as inorganic COPCs (Table 7-6K). Thirteen PAHs, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, dieldrin, and pentachlorophenol had maximum concentrations in excess of screening levels and thus were selected as organic COPCs. Acetone, methylene chloride, endosulfan, alpha- and gamma-chlordane, and heptachlor were selected as surface soil COPCs since no screening levels were available.

7.6.2.3 Groundwater Chemical Screening

Aluminum, chromium, copper, iron, lead, selenium, and zinc had maximum concentrations in central section groundwater in excess of Region 4 surface water screening levels (Table 7-6L). No Region 4 screening levels were available for barium, manganese, vanadium, carbon disulfide, total methylphenol, cis-1,2-dichloroethene, trans-1,2-dichloroethene, trichloroethene, vinyl chloride, total xylenes, and methane.

7.6.2.4 Food Chain Modeling

Using maximum and average concentrations, the inorganics aluminum, lead, mercury, vanadium, and zinc had at least one HQ greater than 1.0 for the terrestrial food chain modeling (Table 7-6M). Several PAHs and pesticides/daughter products had at least one HQ greater than 1.0 using maximum concentrations. No organics had an HQ greater than 1.0 using average concentrations (Table 7-6N). Aluminum, barium, and vanadium had at least one HQ greater than 1.0 using maximum concentrations in the semi-aquatic food chain modeling (Table 7-6O). Aluminum and vanadium were the only chemicals with an HQ greater than 1.0 using average concentrations (Table 7-6P).

TABLE 7-6J

SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SEDIMENT
OPERABLE UNIT 2 - CENTRAL SECTION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	Frequency of Detection	Range of Detections		Location of Maximum	USEPA Region 4 Screening Level	Maximum Hazard Quotient	HQ > 1.0 (Y/N?)
		Min.	Max.				
Inorganics (mg/kg)							
Aluminum	13/13	233	5620	SD019	NA	NA	Y
Arsenic	2/13	0.435	0.82	SW004	7.24	0.11	N
Barium	13/13	1.7	154	SD014	NA	NA	Y
Chromium	12/13	0.63	6.95	SD019	52.3	0.13	N
Copper	12'13	0.34	6.2	SD019	18.7	0.33	N
Iron	13/13	37.1	1750	SW004	NA	NA	Y
Lead	13/13	0.86	19.2	SD017	30.2	0.64	N
Manganese	6/13	0.58	3.1	SD017	NA	NA	Y
Mercury	4/13	0.0225	0.1	SD017	0.13	0.77	N
Nickel	7/13	0.24	2.1	SD014	15.9	0.13	N
Selenium	3/13	0.525	1	SW005	NA	NA	Y
Vanadium	12/13	0.3	14	SD019	NA	NA	Y
Zinc	9/13	1.7	27.8	SW004	124	0.22	N
Semivolatile Organics (µg/kg)							
3&4-Methylphenol	1/13	289	289	SD019	NA	NA	Y
Volatile Organics (µg/kg)							
Toluene	3/12	4.95	59.9	SD014	NA	NA	Y
Benzene	1/13	4.1	4.1	SW008	NA	NA	Y
Ethylbenzene	1/13	4.2	4.2	SW008	NA	NA	Y
Xylenes	1/13	5.9	5.9	SW008	NA	NA	Y
Pesticides/PCBs (µg/kg)							
4,4'-DDD	1/13	3.25	3.25	SD016	3.3	0.98	N
4,4'-DDE	1/13	3.5	3.5	SD017	3.3	1.06	Y

NA = Not Available or Applicable
Y = Yes
N = No

TABLE 7-6K

SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE SOIL
OPERABLE UNIT 2 - CENTRAL SECTION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	Frequency of Detection	Range of Detections		Location of Maximum	Two Times Average Background	USEPA Region 4 Screening Level	Maximum Hazard Quotient[a]	HQ > 1.0 (Y/N?)
		Min.	Max.					
Inorganics (mg/kg)								
Aluminum	37/37	928	4980	S110	4870	50	99.60	Y
Arsenic	34/37	0.51	4.8	S52	1.9	10	0.48	N
Barium	27/37	2.4	24.8	S04	21.6	165	0.15	N
Cadmium	6/37	0.07	0.23	S22	NA	1.6	0.14	N
Chromium	36/37	1.5	6.5	S04	7.7	0.4	16.25	Y
Cobalt	9/37	0.21	0.48	S04	NA	20	0.02	N
Copper	32/37	0.82	17.8	S04	2.6	40	0.45	N
Iron	37/37	114	1300	S04	843	200	6.50	Y
Lead	36/37	2.4	97.3	S04	21.3	50	1.95	Y
Manganese	37/37	2.2	18	S04	10.6	100	0.18	N
Mercury	2/37	0.09	0.12	S132	0.05	0.1	1.20	Y
Nickel	34/37	0.34	5.4	S140	NA	30	0.18	N
Selenium	2/37	0.43	0.66	S03	1.1	0.81	0.80	N
Silver	6/37	0.24	0.55	S81	NA	2	0.28	N
Vanadium	36/37	0.18	5.8	S70	4.9	2	2.90	Y
Zinc	26/37	4.5	106	S04	4.6	50	2.12	Y
Semivolatile Organics (ug/kg)								
Acenaphthene	1/37	1630	1630	S04	NA	20000	0.08	N
Anthracene	1/37	2700	2700	S04	NA	100	27.00	Y
Benzo(a)anthracene	5/37	497	7940	S04	NA	100	79.40	Y
Benzo(a)pyrene	12/37	112	6320	S04	NA	100	63.20	Y
Benzo(b)fluoranthene	4/37	403	5470	S04	NA	100	54.70	Y
Benzo(g,h,i)perylene	4/37	876	9860	S04	NA	100	98.60	Y
Benzo(k)fluoranthene	4/37	272	4190	S04	NA	100	41.90	Y
Chrysene	5/37	509	8510	S04	NA	100	85.10	Y
Dibenzo(a,h)anthracene	6/37	119	1720	S04	NA	100	17.20	Y
Fluoranthene	8/37	427	22400	S04	NA	100	224.00	Y
Fluorene	1/37	1370	1370	S04	NA	100	13.70	Y
Indeno(1,2,3-cd)pyrene	4/37	810	8800	S04	NA	100	88.00	Y
Pentachlorophenol	2/37	4.5	109	S04	NA	2	54.50	Y
Phenanthrene	3/37	571	13600	S04	NA	100	136.00	Y
Pyrene	7/37	383	14500	S04	NA	100	145.00	Y

TABLE 7-6K

SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE SOIL
OPERABLE UNIT 2 - CENTRAL SECTION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	Frequency of Detection	Range of Detections		Location of Maximum	Two Times Average Background	USEPA Region 4 Screening Level	Maximum Hazard Quotient[a]	HQ > 1.0 (Y/N?)
		Min.	Max.					
Volatile Organics (µg/kg)								
Acetone	4/14	99	18500	S32	NA	NA	NA	Y
Methylene chloride	1/37	12.6	12.6	S121	NA	NA	NA	Y
Tetrachloroethene	1/37	3	3	S92	NA	10	0.30	N
Toluene	3/37	5	9.4	S71	NA	50	0.19	N
Xylenes, total	2/37	6	7.8	S20	NA	50	0.16	N
Pesticides/PCBs (µg/kg)								
4,4'-DDD	1/37	5.3	5.3	S30	NA	2.5	2.12	Y
4,4'-DDE	13/37	2.2	178	S04	NA	2.5	71.20	Y
4,4'-DDT	5/37	6.1	274	S04	NA	2.5	109.60	Y
Aldrin	1/37	13	13	S03	NA	2.5	5.20	Y
alpha-Chlordane	6/37	1.3	219	S04	NA	NA	NA	Y
Dieldrin	3/37	1	97	S04	NA	0.5	194.00	Y
Endosulfan II	2/37	2.2	4.5	S92	NA	NA	NA	Y
gamma-Chlordane	6/37	1.3	243	S04	NA	NA	NA	Y
Heptachlor	8/37	1.1	48	S04	NA	NA	NA	Y

NA = Not Available or Applicable
Y = Yes
N = No
[a]Chemical was not a COPC if the maximum did not exceed two times average background.

TABLE 7-6L

GROUNDWATER CHEMICAL SCREENING
OPERABLE UNIT 2 - CENTRAL SECTION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	Frequency of Detection	Range of Detections		Location of Maximum	USEPA Region 4 Screening Level	Maximum Hazard Quotient	HQ > 1.0 (Y/N?)
		Min.	Max.				
Inorganics (µg/L)							
Aluminum	12/13	2890	171000	OU2MW08B	87	1965.52	Y
Arsenic	2/13	36.8	38.6	OU2MW06B	190	0.20	N
Barium	9/13	364	3910	OU2MW06B	NA	NA	Y
Chromium	10/13	43.6	266	OU2MW08B	11	24.18	Y
Copper	9/13	25.8	144	OU2MW08B	6.54	22.02	Y
Iron	10/13	3780	64000	OU2MW23C	1000	64.00	Y
Lead	11/13	17.6	237	OU2MW08B	1.32	179.55	Y
Manganese	9/13	19.8	734	OU2MW23C	NA	NA	Y
Nickel	1/13	61	61	OU2MW23C	87.71	0.70	N
Selenium	3/13	30.325	42	OU2MW06B	5	8.40	Y
Vanadium	9/13	40.225	225	OU2MW11A	NA	NA	Y
Zinc	1/13	334	334	OU2MW23C	58.91	5.67	Y
Semivolatiles (µg/L)							
3- & 4-Methylphenol	1/12	3.8	3.8	OU2MW07A	NA	NA	Y
Volatiles (µg/L)							
Benzene	1/13	9.2	9.2	OU2MW11B	53	0.17	N
Carbon disulfide	1/13	33.6	33.6	OU2MW23C	NA	NA	Y
Chlorobenzene	1/13	6.6	6.6	OU2MW11B	195	0.03	N
Chloroform	2/13	2	3.7	OU2MW23C	289	0.01	N
Cis-1,2-dichloroethene	1/13	26.5	26.5	OU2MW11B	NA	NA	Y
Methane	10/13	71.2	1150	OU2MW11B	NA	NA	Y
Toluene	2/13	2.6	6.95	OU2MW11A	175	0.04	N
Trans-1,2-dichloroethene	1/13	7.7	7.7	OU2MW11B	NA	NA	Y
Trichloroethene	1/13	3.4	3.4	OU2MW11B	NA	NA	Y
Vinyl chloride	1/13	18.2	18.2	OU2MW11B	NA	NA	Y
Xylenes, total	1/13	37.2	37.2	OU2MW11B	NA	NA	Y

NA = Not Available or Applicable
Y = Yes
N = No

TABLE 7-6M

RESULTS OF FOOD CHAIN MODELING
TERRESTRIAL RECEPTORS MAXIMUM CONCENTRATIONS
OPERABLE UNIT 2 CENTRAL

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Ecological Contaminant of Concern	Shrew		Mouse		Woodcock		Owl		Fox		Robin		Dove	
	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l
Metals and Inorganic Compounds														
Aluminum	**1.40E+03**	**1.40E+02**	**3.64E+02**	**3.64E+01**	**3.85E+01**	**3.85E+00**	**2.28E+00**	2.28E-01	**2.89E+02**	**2.89E+01**	**7.58E+01**	**7.58E+00**	**5.65E+00**	5.65E-01
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	**6.61E+00**	6.61E-01	**1.71E+00**	1.71E-01	**7.30E+01**	**7.30E+00**	**4.32E+00**	**4.32E-01**	**1.36E+00**	1.36E-01	**1.44E+02**	**1.44E+01**	**1.07E+01**	**1.07E+00**
Mercury	**4.35E+00**	**2.61E+00**	**1.13E+00**	6.77E-01	**1.59E+01**	**1.59E+00**	9.41E-01	9.41E-02	8.97E-01	5.38E-01	**3.13E+01**	**3.13E+00**	**2.33E+00**	2.33E-01
Vanadium	**1.58E+01**	**1.58E+00**	**4.09E+00**	4.09E-01	4.32E-01	4.32E-02	2.56E-02	2.56E-03	**3.25E+00**	3.25E-01	8.51E-01	8.51E-02	6.34E-02	6.34E-03
Zinc	3.60E-01	1.80E-01	9.34E-02	4.67E-02	**6.20E+00**	6.86E-01	3.67E-01	4.06E-02	7.43E-02	3.71E-02	**1.22E+01**	**1.35E+00**	9.09E-01	1.01E-01
Semivolatile Organic Compounds														
Anthracene	**1.47E+00**	1.47E-01	3.81E-01	3.81E-02	2.29E-01	2.29E-02	1.35E-02	1.35E-03	3.03E-01	3.03E-02	4.51E-01	4.51E-02	3.36E-02	3.36E-03
Benzo(a)anthracene	**4.31E+00**	4.31E-01	**1.12E+00**	1.12E-01	6.73E-01	6.73E-02	3.98E-02	3.98E-03	8.90E-01	8.90E-02	**1.33E+00**	1.33E-01	9.88E-02	9.88E-03
Benzo(a)pyrene	**3.43E+00**	3.43E-01	8.91E-01	8.91E-02	5.36E-01	5.36E-02	3.17E-02	3.17E-03	7.09E-01	7.09E-02	**1.05E+00**	1.05E-01	7.86E-02	7.86E-03
Benzo(b)fluoranthene	**2.97E+00**	2.97E-01	7.71E-01	7.71E-02	4.64E-01	4.64E-02	2.74E-02	2.74E-03	6.13E-01	6.13E-02	9.13E-01	9.13E-02	6.80E-02	6.80E-03
Benzo(g,h,i)perylene	**5.36E+00**	5.36E-01	**1.39E+00**	1.39E-01	8.36E-01	8.36E-02	4.95E-02	4.95E-03	**1.11E+00**	1.11E-01	**1.65E+00**	1.65E-01	1.23E-01	1.23E-02
Benzo(k)fluoranthene	**2.28E+00**	2.28E-01	5.91E-01	5.91E-02	3.55E-01	3.55E-02	2.10E-02	2.10E-03	4.70E-01	4.70E-02	6.99E-01	6.99E-02	5.21E-02	5.21E-03
Chrysene	**4.62E+00**	4.62E-01	**1.20E+00**	1.20E-01	7.21E-01	7.21E-02	4.27E-02	4.27E-03	9.54E-01	9.54E-02	**1.42E+00**	1.42E-01	1.06E-01	1.06E-02
Dibenzo(a,h)anthracene	9.35E-01	9.35E-02	2.42E-01	2.42E-02	1.46E-01	1.46E-02	8.63E-03	8.63E-04	1.93E-01	1.93E-02	2.87E-01	2.87E-02	2.14E-02	2.14E-03
Fluoranthene	**1.22E+01**	**1.22E+00**	**3.16E+00**	3.16E-01	**1.90E+00**	1.90E-01	1.12E-01	1.12E-02	**2.51E+00**	2.51E-01	**3.74E+00**	3.74E-01	2.79E-01	2.79E-02
Fluorene	7.44E-01	7.44E-02	1.93E-01	1.93E-02	1.16E-01	1.16E-02	6.87E-03	6.87E-04	1.54E-01	1.54E-02	2.29E-01	2.29E-02	1.70E-02	1.70E-03
Indeno(1,2,3-cd)pyrene	**4.78E+00**	4.78E-01	**1.24E+00**	1.24E-01	7.46E-01	7.46E-02	4.42E-02	4.42E-03	9.87E-01	9.87E-02	**1.47E+00**	1.47E-01	1.09E-01	1.09E-02
Pentachlorophenol	2.47E-01	2.47E-02	6.40E-02	6.40E-03	1.35E-02	NA	7.99E-04	NA	5.09E-02	5.09E-03	2.66E-02	NA	1.98E-03	NA
Phenanthrene	**7.39E+00**	7.39E-01	**1.92E+00**	1.92E-01	**1.15E+00**	1.15E-01	6.82E-02	6.82E-03	**1.53E+00**	1.53E-01	**2.27E+00**	2.27E-01	1.69E-01	1.69E-02
Pyrene	**7.88E+00**	7.88E-01	**2.04E+00**	2.04E-01	**1.23E+00**	1.23E-01	7.28E-02	7.28E-03	**1.63E+00**	1.63E-01	**2.42E+00**	2.42E-01	1.80E-01	1.80E-02
Pesticides/PCBs														
4,4'-DDD	3.60E-03	7.20E-04	9.34E-04	1.87E-04	**1.60E+00**	1.60E-01	9.50E-02	9.50E-03	7.43E-04	1.49E-04	**3.16E+00**	3.16E-01	2.35E-01	2.35E-02
4,4'-DDE	1.21E-01	2.42E-02	3.14E-02	6.27E-03	**5.39E+01**	**5.39E+00**	**3.19E+00**	3.19E-01	2.50E-02	4.99E-03	**1.06E+02**	**1.06E+01**	**7.91E+00**	7.91E-01
4,4'-DDT	1.86E-01	3.72E-02	4.83E-02	9.66E-03	**8.30E+01**	**8.30E+00**	**4.91E+00**	4.91E-01	3.84E-02	7.68E-03	**1.63E+02**	**1.63E+01**	**1.22E+01**	**1.22E+00**
Aldrin	3.53E-02	7.06E-03	9.16E-03	1.83E-03	NA	NA	NA	NA	7.29E-03	1.46E-03	NA	NA	NA	NA
alpha-Chlordane	2.60E-02	1.30E-02	6.74E-03	3.37E-03	8.68E-02	1.74E-02	5.14E-03	1.03E-03	5.36E-03	2.68E-03	1.71E-01	3.42E-02	1.27E-02	2.55E-03
Dieldrin	**2.64E+00**	2.64E-01	6.84E-01	6.84E-02	**1.07E+00**	1.07E-01	6.32E-02	6.32E-03	5.44E-01	5.44E-02	**2.10E+00**	2.10E-01	1.57E-01	1.57E-02
Endosulfan II	1.63E-02	1.63E-03	4.23E-03	4.23E-04	3.81E-04	3.81E-05	2.26E-05	2.26E-06	3.36E-03	3.36E-04	7.51E-04	7.51E-05	5.60E-05	5.60E-06
gamma-Chlordane	2.88E-02	1.44E-02	7.48E-03	3.74E-03	9.63E-02	1.93E-02	5.70E-03	1.14E-03	5.95E-03	2.97E-03	1.89E-01	3.79E-02	1.41E-02	2.82E-03
Heptachlor	**2.61E-01**	2.61E-02	6.77E-02	6.77E-03	NA	NA	NA	NA	5.38E-02	5.38E-03	NA	NA	NA	NA

NA - NOAEL or LOAEL Not Available

TABLE 7-6N

RESULTS OF FOOD CHAIN MODELING
TERRESTRIAL RECEPTORS MEAN CONCENTRATIONS
OPERABLE UNIT 2 CENTRAL

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Ecological Contaminant of Concern	Shrew		Mouse		Woodcock		Owl		Fox		Robin		Dove	
	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l
Metals and Inorganic Compounds														
Aluminum	**7.27E+02**	**7.27E+01**	**1.89E+02**	**1.89E+01**	**2.00E+01**	**2.00E+00**	**1.18E+00**	1.18E-01	**1.50E+02**	**1.50E+01**	**3.93E+01**	**3.93E+00**	**2.93E+00**	2.93E-01
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	6.22E-01	6.22E-02	1.61E-01	1.61E-02	**6.87E+00**	6.87E-01	4.06E-01	4.06E-02	1.28E-01	1.28E-02	**1.35E+01**	**1.35E+00**	**1.01E+00**	1.01E-01
Mercury	**1.76E+00**	**1.06E+00**	4.57E-01	2.74E-01	**6.44E+00**	6.44E-01	3.81E-01	3.81E-02	3.64E-01	2.18E-01	**1.27E+01**	**1.27E+00**	9.45E-01	9.45E-02
Vanadium	**6.69E+00**	6.69E-01	**1.74E+00**	1.74E-01	1.84E-01	1.84E-02	1.09E-02	1.09E-03	**1.38E+00**	1.38E-01	3.61E-01	3.61E-02	2.69E-02	2.69E-03
Zinc	3.34E-02	1.67E-02	8.67E-03	4.34E-03	5.76E-01	6.37E-02	3.41E-02	3.77E-03	6.90E-03	3.45E-03	**1.13E+00**	1.25E-01	8.44E-02	9.35E-03
Semivolatile Organic Compounds														
Anthracene	1.85E-01	1.85E-02	4.80E-02	4.80E-03	2.88E-02	2.88E-03	1.71E-03	1.71E-04	3.82E-02	3.82E-03	5.68E-02	5.68E-03	4.23E-03	4.23E-04
Benzo(a)anthracene	2.67E-01	2.67E-02	6.92E-02	6.92E-03	4.16E-02	4.16E-03	2.46E-03	2.46E-04	5.51E-02	5.51E-03	8.19E-02	8.19E-03	6.11E-03	6.11E-04
Benzo(a)pyrene	1.74E-01	1.74E-02	4.52E-02	4.52E-03	2.72E-02	2.72E-03	1.61E-03	1.61E-04	3.60E-02	3.60E-03	5.35E-02	5.35E-03	3.99E-03	3.99E-04
Benzo(b)fluoranthene	2.29E-01	2.29E-02	5.95E-02	5.95E-03	3.58E-02	3.58E-03	2.12E-03	2.12E-04	4.74E-02	4.74E-03	7.05E-02	7.05E-03	5.25E-03	5.25E-04
Benzo(g,h,i)perylene	3.08E-01	3.08E-02	8.00E-02	8.00E-03	4.81E-02	4.81E-03	2.85E-03	2.85E-04	6.37E-02	6.37E-03	9.47E-02	9.47E-03	7.06E-03	7.06E-04
Benzo(k)fluoranthene	2.02E-01	2.02E-02	5.25E-02	5.25E-03	3.16E-02	3.16E-03	1.87E-03	1.87E-04	4.18E-02	4.18E-03	6.22E-02	6.22E-03	4.64E-03	4.64E-04
Chrysene	2.76E-01	2.76E-02	7.17E-02	7.17E-03	4.31E-02	4.31E-03	2.55E-03	2.55E-04	5.70E-02	5.70E-03	8.49E-02	8.49E-03	6.33E-03	6.33E-04
Dibenzo(a,h)anthracene	6.93E-02	6.93E-03	1.80E-02	1.80E-03	1.08E-02	1.08E-03	6.40E-04	6.40E-05	1.43E-02	1.43E-03	2.13E-02	2.13E-03	1.59E-03	1.59E-04
Fluoranthene	5.32E-01	5.32E-02	1.38E-01	1.38E-02	8.30E-02	8.30E-03	4.91E-03	4.91E-04	1.10E-01	1.10E-02	1.63E-01	1.63E-02	1.22E-02	1.22E-03
Fluorene	1.65E-01	1.65E-02	4.29E-02	4.29E-03	2.58E-02	2.58E-03	1.53E-03	1.53E-04	3.41E-02	3.41E-03	5.08E-02	5.08E-03	3.79E-03	3.79E-04
Indeno(1,2,3-cd)pyrene	2.88E-01	2.88E-02	7.47E-02	7.47E-03	4.49E-02	4.49E-03	2.66E-03	2.66E-04	5.94E-02	5.94E-03	8.85E-02	8.85E-03	6.59E-03	6.59E-04
Pentachlorophenol	9.38E-03	9.38E-04	2.43E-03	2.43E-04	5.13E-04	NA	3.04E-05	NA	1.94E-03	1.94E-04	1.01E-03	NA	7.52E-05	NA
Phenanthrene	3.47E-01	3.47E-02	9.00E-02	9.00E-03	5.41E-02	5.41E-03	3.20E-03	3.20E-04	7.16E-02	7.16E-03	1.07E-01	1.07E-02	7.94E-03	7.94E-04
Pyrene	3.84E-01	3.84E-02	9.96E-02	9.96E-03	5.99E-02	5.99E-03	3.54E-03	3.54E-04	7.92E-02	7.92E-03	1.18E-01	1.18E-02	8.79E-03	8.79E-04
Pesticides/PCBs														
4,4'-DDD	1.78E-03	3.55E-04	4.61E-04	9.22E-05	7.92E-01	7.92E-02	4.69E-02	4.69E-03	3.67E-04	7.33E-05	1.56E+00	1.56E-01	1.16E-01	1.16E-02
4,4'-DDE	5.60E-03	1.12E-03	1.45E-03	2.90E-04	2.50E+00	2.50E-01	1.48E-01	1.48E-02	1.16E-03	2.31E-04	4.91E+00	4.91E-01	3.66E-01	3.66E-02
4,4'-DDT	7.11E-03	1.42E-03	1.84E-03	3.69E-04	3.17E+00	3.17E-01	1.88E-01	1.88E-02	1.47E-03	2.93E-04	6.24E+00	6.24E-01	4.65E-01	4.65E-02
Aldrin	7.30E-03	1.46E-03	1.89E-03	3.79E-04	NA	NA	N	NA	1.51E-03	3.01E-04	N	NA	NA	NA
alpha-Chlordane	1.17E-03	5.83E-04	3.03E-04	1.51E-04	3.89E-03	7.79E-04	2.31E-04	4.61E-05	2.41E-04	1.20E-04	7.67E-03	1.53E-03	5.71E-04	1.14E-04
Dieldrin	1.03E-01	1.03E-02	2.68E-02	2.68E-03	4.19E-02	4.19E-03	2.48E-03	2.48E-04	2.13E-02	2.13E-03	8.24E-02	8.24E-03	6.14E-03	6.14E-04
Endosulfan II	8.31E-03	8.31E-04	2.16E-03	2.16E-04	1.95E-04	1.95E-05	1.15E-05	1.15E-06	1.72E-03	1.72E-04	3.83E-04	3.83E-05	2.85E-05	2.85E-06
gamma-Chlordane	1.21E-03	6.04E-04	3.14E-04	1.57E-04	4.04E-03	8.07E-04	2.39E-04	4.78E-05	2.50E-04	1.25E-04	7.95E-03	1.59E-03	5.92E-04	1.18E-04
Heptachlor	1.22E-02	1.22E-03	3.16E-03	3.16E-04	NA	NA	NA	NA	2.52E-03	2.52E-04	NA	NA	NA	NA

NA - NOAEL or LOAEL Not Available

TABLE 7-6O

RESULTS OF FOOD CHAIN MODELING
AQUATIC RECEPTORS MAXIMUM CONCENTRATIONS
OPERABLE UNIT 2 CENTRAL

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Ecological Contaminant of Concern	Heron		Raccoon	
	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l
Metals and Inorganic Compounds				
Aluminum	**9.40E+00**	9.40E-01	**1.68E+02**	**1.68E+01**
Barium	**1.36E+00**	6.78E-01	**1.74E+00**	1.74E-01
Iron	NA	NA	NA	NA
Manganese	5.82E-04	5.82E-05	2.03E-03	6.29E-04
Selenium	3.67E-01	1.83E-01	2.88E-01	1.75E-01
Vanadium	2.26E-01	2.26E-02	**4.04E+00**	4.04E-01
Semivolatile Organic Compounds				
3- & 4-Methylphenol	NA	NA	NA	NA
Pesticides/PCBs				
4,4'-DDE	2.29E-01	2.29E-02	2.52E-04	5.04E-05

NA - NOAEL or LOAEL Not Available

TABLE 7-6P

RESULTS OF FOOD CHAIN MODELING
AQUATIC RECEPTORS MEAN CONCENTRATIONS
OPERABLE UNIT 2 CENTRAL

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Ecological Contaminant of Concern	Heron		Raccoon	
	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l
Metals and Inorganic Compounds				
Aluminum	**3.18E+00**	3.18E-01	**5.68E+01**	**5.68E+00**
Barium	2.25E-01	1.12E-01	2.88E-01	2.88E-02
Iron	NA	NA	NA	NA
Manganese	1.67E-04	1.67E-05	5.83E-04	1.81E-04
Selenium	1.25E-01	6.26E-02	9.83E-02	5.96E-02
Vanadium	5.68E-02	5.68E-03	**1.01E+00**	1.01E-01
Semivolatile Organic Compounds				
3- & 4-Methylphenol	NA	NA	NA	NA
Pesticides/PCBs				
4,4'-DDE	9.72E-02	9.72E-03	1.07E-04	2.14E-05

NA - NOAEL or LOAEL Not Available

7.6.3 Southern Section

7.6.3.1 Surface Water

Aluminum, chromium, copper, iron, lead, mercury, and zinc were detected in southern section surface water in concentrations in excess of Region 4 screening levels and thus were selected as surface water COPCs (Table 7-6Q). Barium, iron, manganese, and vanadium were selected as COPCs since no Region 4 screening levels were available.

7.6.3.2 Sediment

No sediment inorganics had maximum concentrations in southern section sediments in concentrations that exceeded Region 4 screening levels, and no organics were detected (Table 7-6R). Aluminum, barium, iron, manganese, and vanadium were selected as COPCs because no Region 4 screening levels were available.

7.6.3.3 Surface Soil

Aluminum, barium, iron, and mercury had maximum concentrations in southern section surface soils in excess of 2 times average background and surface soil screening levels and thus were selected as inorganic COPCs (Table 7-6S). Twelve PAHs, pentachlorophenol, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dieldrin, and endrin had maximum concentrations in excess of screening levels and thus were retained as organic COPCs. Acetone, carbon disulfide, chloromethane, methylene chloride, endrin ketone, alpha- and gamma-chlordane, heptachlor, heptachlor epoxide, and methoxychlor were selected as surface soil COPCs since no screening levels were available.

7.6.3.4 Groundwater Chemical Screening

Aluminum, chromium, copper, iron, lead, and zinc had maximum concentrations in southern section groundwater in excess of Region 4 surface water screening levels (Table 7-6T). No Region 4 screening levels were available for barium, manganese, vanadium, total methylphenol, 2-butanone, 2-hexanone, 4-methyl-2-pentanone, carbon disulfide, bromodichloromethane, cis-1,2-dichloroethene, PCE, TCE, vinyl chloride, and methane.

TABLE 7-6Q

SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE WATER
OPERABLE UNIT 2 - SOUTH SECTION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	Frequency of Detection	Range of Detections		Location of Maximum	Florida Water Quality Standard*	USEPA Region 4 Screening Level	Maximum Hazard Quotient	HQ > 1.0 (Y/N?)
		Min.	Max.					
Inorganics (µg/L)								
Aluminum	3/4	1220	87000	SW021	NA	87	1000.00	Y
Arsenic	2/4	13.6	18.3	SW021	50	190	0.10	N
Barium	4/4	16.9	524	SW021	NA	NA	NA	Y
Chromium	1/4	74.2	74.2	SW021	11	11	6.75	Y
Copper	4/4	1.8	82.7	SW021	NA*	6.54	12.65	Y
Iron	4/4	732	149000	SW020	1000	1000	149.00	Y
Lead	2/4	55	109	SW021	NA*	1.32	82.58	Y
Manganese	3/4	16.6	419	SW020	NA	NA	NA	Y
Mercury	2/4	0.06	0.16	SW020	0.012	0.012	13.33	Y
Nickel	1/4	17.7	17.7	SW021	NA*	87.71	0.20	N
Vanadium	2/4	24.9	77.9	SW021	NA	NA	NA	Y
Zinc	4/4	64.2	501	SW021	NA*	58.91	8.50	Y

NA = Not Available or Applicable
Y = Yes
N = No
* presented for comparative purposes only; NA with asterisk indicates the value is calculated using site-specific hardness.

TABLE 7-6R

SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SEDIMENT
OPERABLE UNIT 2 - SOUTH SECTION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	Frequency of Detection	Range of Detections		Location of Maximum	USEPA Region 4 Screening Level	Maximum Hazard Quotient	HQ > 1.0 (Y/N?)
		Min.	Max.				
Inorganics (mg/kg)							
Aluminum	4/4	2240	7170	SD020	NA	NA	Y
Barium	4/4	11.7	72.5	SD020	NA	NA	Y
Chromium	4/4	3	7.1	SD020	52.3	0.14	N
Copper	4/4	1.8	2.5	SD022	18.7	0.13	N
Iron	4/4	219	606	SD020	NA	NA	Y
Lead	4/4	2.7	4.8	SD020	30.2	0.16	N
Manganese	1/4	1.6	1.6	SD021	NA	NA	Y
Nickel	1/4	1.2	1.2	SD020	15.9	0.08	N
Vanadium	4/4	1.7	5.6	SD020	NA	NA	Y
Zinc	4/4	8.5	16.3	SD018	124	0.13	N

NA = Not Available or Applicable
Y = Yes
N = No

TABLE 7-6S

SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE SOIL
OPERABLE UNIT 2 - SOUTH SECTION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	Frequency of Detection	Range of Detections		Location of Maximum	Two Times Average Background	USEPA Region 4 Screening Level	Maximum Hazard Quotient[a]	HQ > 1.0 (Y/N?)
		Min.	Max.					
Inorganics (mg/kg)								
Aluminum	45/45	58.4	6520	H3	4870	50	130.40	Y
Antimony	1/45	0.4	0.4	S01	NA	3.5	0.11	N
Arsenic	8/45	0.35	1.7	H23	1.9	10	0.17	N
Barium	16/45	2.7	177	H14	21.6	165	1.07	Y
Cadmium	4/45	0.08	0.16	H23	NA	1.6	0.10	N
Chromium	38/45	0.21	6.2	H23	7.7	0.4	15.50	Y
Cobalt	7/45	0.15	0.33	H14	NA	20	0.02	N
Copper	33/45	0.3	21.4	H18	2.6	40	0.54	N
Iron	45/45	19.7	936	S01	843	200	4.68	Y
Lead	40/45	2.3	17.1	H23	21.3	50	0.34	N
Manganese	35/45	0.57	11.9	S01	10.6	100	0.12	N
Mercury	2/45	0.12	0.15	H23	0.05	0.1	1.50	Y
Nickel	31/45	0.24	3.7	H20	NA	30	0.12	N
Selenium	8/45	0.3	0.56	H36/S01	1.1	0.81	0.69	N
Thallium	1/45	0.45	0.45	H37	NA	1	0.45	N
Vanadium	26/45	0.22	4.3	H4	4.9	2	2.15	Y
Zinc	25/45	2.9	45.8	H14	4.6	50	0.92	N
Semivolatile Organics (µg/kg)								
Anthracene	1/45	515	515	H28	NA	100	5.15	Y
Benzo(a)anthracene	3/45	603	1730	H28	NA	100	17.30	Y
Benzo(a)pyrene	10/45	100	1780	H28	NA	100	17.80	Y
Benzo(b)fluoranthene	3/45	505	1280	H28	NA	100	12.80	Y
Benzo(g,h,i)perylene	3/45	420	1350	S02	NA	100	13.50	Y
Benzo(k)fluoranthene	3/45	399	1080	H28	NA	100	10.80	Y
Chrysene	3/45	717	2500	S02	NA	100	25.00	Y
Dibenzo(a,h)anthracene	7/45	89.9	769	H28	NA	100	7.69	Y
Fluoranthene	8/45	191	5380	H28	NA	100	53.80	Y
Indeno(1,2,3-cd)pyrene	3/45	417	1210	H28/S02	NA	100	12.10	Y
Pentachlorophenol	2/45	4.7	13.5	H10	NA	2	6.75	Y
Phenanthrene	5/45	178	2040	H28	NA	100	20.40	Y
Pyrene	7/45	145	3740	H28	NA	100	37.40	Y

TABLE 7-6S

SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE SOIL
OPERABLE UNIT 2 - SOUTH SECTION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	Frequency of Detection	Range of Detections		Location of Maximum	Two Times Average Background	USEPA Region 4 Screening Level	Maximum Hazard Quotient[a]	HQ > 1.0 (Y/N?)
		Min.	Max.					
Volatile Organics (ug/kg)								
Acetone	2/27	24	39.5	H36	NA	NA	NA	Y
Carbon disulfide	1/45	3.6	3.6	H24	NA	NA	NA	Y
Chloromethane	1/45	7.4	7.4	H22	NA	NA	NA	Y
Methylene chloride	7/45	3	16.3	H46	NA	NA	NA	Y
Toluene	12/45	1.5	14.9	H43	NA	50	0.30	N
Xylenes, total	4/45	2.2	5.7	H37	NA	50	0.11	N
Pesticides/PCBs (ug/kg)								
4,4'-DDD	6/46	2.2	23	H7	NA	2.5	9.20	Y
4,4'-DDE	9/46	1.8	39.4	H7	NA	2.5	15.76	Y
4,4'-DDT	5/46	4.8	234	H7	NA	2.5	93.60	Y
alpha-Chlordane	8/46	2.3	60	H10	NA	NA	NA	Y
Dieldrin	2/46	4.1	9	H10	NA	0.5	18.00	Y
Endrin	1/46	4.4	4.4	H2	NA	1	4.40	Y
Endrin ketone	1/46	7.5	7.5	H28	NA	NA	NA	Y
gamma-Chlordane	9/46	2.3	66	H10	NA	NA	NA	Y
Heptachlor	3/46	1.8	4.2	H7	NA	NA	NA	Y
Heptachlor epoxide	2/46	1.4	6.3	H10	NA	NA	NA	Y
Methoxychlor	1/46	27	27	H28	NA	NA	NA	Y

NA = Not Available or Applicable
Y = Yes
N = No
[a]Chemical was not a COPC if the maximum did not exceed two times average background.

TABLE 7-6T

GROUNDWATER CHEMICAL SCREENING
OPERABLE UNIT 2 - SOUTH SECTION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	Frequency of Detection	Range of Detections		Location of Maximum	USEPA Region 4 Screening Level	Maximum Hazard Quotient	HQ > 1.0 (Y/N?)
		Min.	Max.				
Inorganics (µg/L)							
Aluminum	9/12	2670	94100	OU2MW14A	87	1081.61	Y
Arsenic	1/12	40.3	40.3	OU2MW26C	190	0.21	N
Barium	4/12	211	1520	OU2MW14B	NA	NA	Y
Chromium	3/12	83.9	99.7	OU2MW14A	11	9.06	Y
Copper	4/12	25.8	27.1	OU2MW18A	6.54	4.14	Y
Iron	9/12	1740	29700	OU2MW26C	1000	29.70	Y
Lead	5/12	24.5	70.7	OU2MW14A	1.32	53.56	Y
Manganese	10/12	19.2	386	OU2MW26C	NA	NA	Y
Nickel	1/12	61.2	61.2	OU2MW26C	87.71	0.70	N
Vanadium	3/12	62.5	110	OU2MW14A	NA	NA	Y
Zinc	5/12	73.2	269	OU2MW21B	58.91	4.57	Y
Semivolatiles (µg/L)							
3- & 4-Methylphenol	1/12	15.3	15.3	OU2MW21B	NA	NA	Y
Diethyl phthalate	1/12	5	5	OU2MW18B	521	0.01	N
Dimethyl phthalate	2/12	4.2	14.9	OU2MW20B	330	0.05	N
Naphthalene	1/12	6.1	6.1	OU2MW12B	62	0.10	N
Phenol	1/12	3.4	3.4	OU2MW21B	256	0.01	N
Volatiles (µg/L)							
1,1,2,2-Tetrachloroethane	1/12	0.92	0.92	OU2MW20A	240	0.0038	N
2-Butanone	2/2	13.3	15.3	OU2MW20A	NA	NA	Y
2-Hexanone	2/12	9.7	12.9	OU2MW20A	NA	NA	Y
4-Methyl-2-pentanone	2/12	8.5	10.4	OU2MW20A	NA	NA	Y
Benzene	1/12	8.6	8.6	OU2MW12B	53	0.16	N
Bromodichloromethane	1/12	2.4	2.4	OU2MW26C	NA	NA	Y
Carbon disulfide	1/12	11.8	11.8	OU2MW26C	NA	NA	Y

TABLE 7-6T

GROUNDWATER CHEMICAL SCREENING
OPERABLE UNIT 2 - SOUTH SECTION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Chemical	Frequency of Detection	Range of Detections		Location of Maximum	USEPA Region 4 Screening Level	Maximum Hazard Quotient	HQ > 1.0 (Y/N?)
		Min.	Max.				
Volatiles (ug/L) (Continued)							
Chlorobenzene	1/12	13	13	OU2MW12B	195	0.07	N
Chloroform	3/12	2.1	12.2	OU2MW26C	289	0.04	N
Cis-1,2-dichloroethene	1/12	62	62	OU2MW18B	NA	NA	Y
Methane	7/12	54.9	1300	OU2MW21B	NA	NA	Y
Tetrachloroethene	2/12	2.8	64.3	OU2MW18B	NA	NA	Y
Toluene	1/12	1.6	1.6	OU2MW18B	175	0.01	N
Trichloroethene	1/12	1250	1250	OU2MW18B	NA	NA	Y
Vinyl chloride	2/12	1.5	20.3	OU2MW18B	NA	NA	Y

NA = Not Available or Applicable
Y = Yes
N = No

7.6.3.5 Food Chain Modeling

Using maximum concentrations, the inorganics aluminum, barium, and mercury had at least one HQ greater than 1.0 for the terrestrial food chain modeling in the southern section of OU 2 (Table 7-6U). Using average concentrations, aluminum and mercury had at least one HQ greater than 1.0 (Table 7-6V). Four PAHs and two pesticides had at least one HQ greater than 1.0 using their maximum concentrations. Only 4,4'-DDT had an HQ greater than 1.0 using average concentrations.

7.7 STEP 3A – REFINEMENT OF CHEMICALS OF POTENTIAL CONCERN

The use of conservative guidelines and maximum detected concentrations as a starting point for assessing risks in the screening level assessment is necessary to ensure that potential risks are not underestimated. However, the use of only a comparison of conservative guidelines to maximum detected concentrations as a tool for determining the need for, nature and magnitude of additional ecological work, and/or a complex baseline ERA has severe limitations.

The undertaking of costly additional ecological analyses must be weighed against benefits, especially in such cases where remedial alternatives are limited or do not exist. Moreover, the environment may suffer as sites of lesser ecological significance are given the same priority as sites of clearly greater ecological concern. For these reasons, the consideration of other relevant factors should be employed after the screening level assessment in Step 3A – Refinement of Chemicals of Potential Concern. Department of the Navy guidance (DON, 1999) specifies that a Step 3A assessment should be performed if COPCs remain after the screening assessment.

Several factors to be considered that are outside the boundaries of simple concentration/guideline comparisons have already been presented. These factors include the use of average chemical concentrations and LOAELs in the food chain modeling.

The frequency of detection and spatial analysis of exceedances should be evaluated as part of Step 3A. Evaluation of these items allows for determination of whether potential risks are widespread or limited to a small area. The magnitude of the HQs should also be evaluated. As described earlier, the relationship between the magnitude of an HQ and toxicity is not necessarily linear. However, the magnitude of an HQ can be used as a rough approximation of the extent of potential risks, especially if there is sufficient confidence in the guideline used. Region 4 guidelines are designed to be conservative. Therefore, less conservative guidelines are presented for sediment and surface soils when chemical concentrations exceed

TABLE 7-6U

RESULTS OF FOOD CHAIN MODELING
TERRESTRIAL RECEPTORS MAXIMUM CONCENTRATIONS
OPERABLE UNIT 2 SOUTH

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Ecological Contaminant of Concern	Shrew		Mouse		Woodcock		Owl		Fox		Raccoon	
	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l
Metals and Inorganic Compounds												
Aluminum	**1.84E+03**	**1.84E+02**	**4.76E+02**	**4.76E+01**	**5.04E+01**	**5.04E+00**	**2.98E+00**	2.98E-01	**3.79E+02**	**3.79E+01**	**1.95E+02**	**1.95E+01**
Barium	**1.89E+01**	**1.89E+00**	**4.89E+00**	4.89E-01	7.21E+00	3.60E+00	4.27E-01	2.13E-01	**3.89E+00**	3.89E-01	**2.00E+00**	2.00E-01
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	**5.43E+00**	**3.26E+00**	**1.41E+00**	8.46E-01	**1.99E+01**	**1.99E+00**	**1.18E+00**	1.18E-01	**1.12E+00**	6.73E-01	5.76E-01	3.46E-01
Semivolatile Organic Compounds												
Anthracene	2.80E-01	2.80E-02	7.26E-02	7.26E-03	4.37E-02	4.37E-03	2.58E-03	2.58E-04	5.78E-02	5.78E-03	2.97E-02	2.97E-03
Benzo(a)anthracene	9.40E-01	9.40E-02	2.44E-01	2.44E-02	1.47E-01	1.47E-02	8.68E-03	8.68E-04	1.94E-01	1.94E-02	9.97E-02	9.97E-03
Benzo(a)pyrene	9.67E-01	9.67E-02	2.51E-01	2.51E-02	1.51E-01	1.51E-02	8.93E-03	8.93E-04	2.00E-01	2.00E-02	1.03E-01	1.03E-02
Benzo(b)fluoranthene	6.95E-01	6.95E-02	1.80E-01	1.80E-02	1.09E-01	1.09E-02	6.42E-03	6.42E-04	1.44E-01	1.44E-02	7.38E-02	7.38E-03
Benzo(g,h,i)perylene	7.34E-01	7.34E-02	1.90E-01	1.90E-02	1.14E-01	1.14E-02	6.77E-03	6.77E-04	1.51E-01	1.51E-02	7.78E-02	7.78E-03
Benzo(k)fluoranthene	5.87E-01	5.87E-02	1.52E-01	1.52E-02	9.16E-02	9.16E-03	5.42E-03	5.42E-04	1.21E-01	1.21E-02	6.23E-02	6.23E-03
Chrysene	**1.36E+00**	1.36E-01	3.52E-01	3.52E-02	2.12E-01	2.12E-02	1.25E-02	1.25E-03	2.80E-01	2.80E-02	1.44E-01	1.44E-02
Dibenzo(a,h)anthracene	4.18E-01	4.18E-02	1.08E-01	1.08E-02	6.52E-02	6.52E-03	3.86E-03	3.86E-04	8.62E-02	8.62E-03	4.43E-02	4.43E-03
Fluoranthene	**2.92E+00**	2.92E-01	7.58E-01	7.58E-02	4.56E-01	4.56E-02	2.70E-02	2.70E-03	6.03E-01	6.03E-02	3.10E-01	3.10E-02
Indeno(1,2,3-cd)pyrene	6.57E-01	6.57E-02	1.71E-01	1.71E-02	1.03E-01	1.03E-02	6.07E-03	6.07E-04	1.36E-01	1.36E-02	6.97E-02	6.97E-03
Pentachlorophenol	3.06E-02	3.06E-03	7.93E-03	7.93E-04	1.67E-03	NA	9.89E-05	NA	6.31E-03	6.31E-04	3.24E-03	3.24E-04
Phenanthrene	**1.11E+00**	1.11E-01	2.88E-01	2.88E-02	1.73E-01	1.73E-02	1.02E-02	1.02E-03	2.29E-01	2.29E-02	1.18E-01	1.18E-02
Pyrene	**2.03E+00**	2.03E-01	5.27E-01	5.27E-02	3.17E-01	3.17E-02	1.88E-02	1.88E-03	4.19E-01	4.19E-02	2.16E-01	2.16E-02
Pesticides/PCBs												
4,4'-DDD	1.56E-02	3.12E-03	4.05E-03	8.10E-04	6.96E+00	6.96E-01	4.12E-01	4.12E-02	3.22E-03	6.45E-04	1.66E-03	3.31E-04
4,4'-DDE	2.68E-02	5.35E-03	6.94E-03	1.39E-03	1.19E+01	**1.19E+00**	7.06E-01	7.06E-02	5.52E-03	1.10E-03	2.84E-03	5.68E-04
4,4'-DDT	1.59E-01	3.18E-02	4.12E-02	8.25E-03	**7.08E+01**	**7.08E+00**	**4.19E+00**	4.19E-01	3.28E-02	6.56E-03	1.69E-02	3.37E-03
alpha-Chlordane	7.12E-03	3.56E-03	1.85E-03	9.23E-04	2.38E-02	4.75E-03	1.41E-03	2.81E-04	1.47E-03	7.35E-04	7.55E-04	3.78E-04

TABLE 7-6U

RESULTS OF FOOD CHAIN MODELING
TERRESTRIAL RECEPTORS MAXIMUM CONCENTRATIONS
OPERABLE UNIT 2 SOUTH

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Ecological Contaminant of Concern	Shrew		Mouse		Woodcock		Owl		Fox		Raccoon	
	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l
Pesticides/PCBs (Continued)												
Dieldrin	2.45E-01	2.45E-02	6.34E-02	6.34E-03	9.91E-02	9.91E-03	5.87E-03	5.87E-04	5.05E-02	5.05E-03	2.59E-02	2.59E-03
Endrin	2.36E-02	2.36E-03	6.13E-03	6.13E-04	3.39E-01	3.39E-02	2.01E-02	2.01E-03	4.88E-03	4.88E-04	2.51E-03	2.51E-04
Endrin ketone	4.43E-02	4.43E-03	1.15E-02	1.15E-03	6.36E-01	6.36E-02	3.76E-02	3.76E-03	9.14E-03	9.14E-04	4.70E-03	4.70E-04
gamma-Chlordane	7.83E-03	3.91E-03	2.03E-03	1.02E-03	2.61E-02	5.23E-03	1.55E-03	3.10E-04	1.62E-03	8.08E-04	8.31E-04	4.15E-04
Heptachlor	2.28E-02	2.28E-03	5.92E-03	5.92E-04	NA	NA	NA	NA	4.71E-03	4.71E-04	2.42E-03	2.42E-04
Heptachlor epoxide	3.42E-02	3.42E-03	8.88E-03	8.88E-04	NA	NA	NA	NA	7.06E-03	7.06E-04	3.63E-03	3.63E-04
Methoxychlor	3.67E-03	1.83E-03	9.51E-04	4.76E-04	NA	NA	NA	NA	7.57E-04	3.78E-04	3.89E-04	1.95E-04

NA = NOAEL or LOAEL Not Available

TABLE 7-6V

RESULTS OF FOOD CHAIN MODELING
TERRESTRIAL RECEPTORS MEAN CONCENTRATIONS
OPERABLE UNIT 2 SOUTH

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Ecological Contaminant of Concern	Shrew		Mouse		Woodcock		Owl		Fox		Raccoon	
	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l
Metals and Inorganic Compounds												
Aluminum	**5.13E+02**	**5.13E+01**	**1.33E+02**	**1.33E+01**	**1.41E+01**	**1.41E+00**	8.33E-01	8.33E-02	**1.06E+02**	**1.06E+01**	**5.44E+01**	**5.44E+00**
Barium	9.04E-01	9.04E-02	2.34E-01	2.34E-02	3.46E-01	1.72E-01	2.05E-02	1.02E-02	1.86E-01	1.86E-02	9.59E-02	9.59E-03
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	**1.66E+00**	9.97E-01	4.31E-01	2.59E-01	**6.08E+00**	6.08E-01	3.60E-01	3.60E-02	3.43E-01	2.06E-01	1.76E-01	1.06E-01
Semivolatile Organic Compounds												
Anthracene	1.31E-01	1.31E-02	3.40E-02	3.40E-03	2.05E-02	2.05E-03	1.21E-03	1.21E-04	2.71E-02	2.71E-03	1.39E-02	1.39E-03
Benzo(a)anthracene	1.61E-01	1.61E-02	4.18E-02	4.18E-03	2.52E-02	2.52E-03	1.49E-03	1.49E-04	3.33E-02	3.33E-03	1.71E-02	1.71E-03
Benzo(a)pyrene	8.25E-02	8.25E-03	2.14E-02	2.14E-03	1.29E-02	1.29E-03	7.62E-04	7.62E-05	1.70E-02	1.70E-03	8.75E-03	8.75E-04
Benzo(b)fluoranthene	1.53E-01	1.53E-02	3.98E-02	3.98E-03	2.39E-02	2.39E-03	1.42E-03	1.42E-04	3.17E-02	3.17E-03	1.63E-02	1.63E-03
Benzo(g,h,i)perylene	1.55E-01	1.55E-02	4.02E-02	4.02E-03	2.42E-02	2.42E-03	1.43E-03	1.43E-04	3.19E-02	3.19E-03	1.64E-02	1.64E-03
Benzo(k)fluoranthene	1.48E-01	1.48E-02	3.83E-02	3.83E-03	2.31E-02	2.31E-03	1.36E-03	1.36E-04	3.05E-02	3.05E-03	1.57E-02	1.57E-03
Chrysene	1.79E-01	1.79E-02	4.64E-02	4.64E-03	2.79E-02	2.79E-03	1.65E-03	1.65E-04	3.69E-02	3.69E-03	1.90E-02	1.90E-03
Dibenzo(a,h)anthracene	4.78E-02	4.78E-03	1.24E-02	1.24E-03	7.45E-03	7.45E-04	4.41E-04	4.41E-05	9.86E-03	9.86E-04	5.07E-03	5.07E-04
Fluoranthene	2.17E-01	2.17E-02	5.62E-02	5.62E-03	3.38E-02	3.38E-03	2.00E-03	2.00E-04	4.47E-02	4.47E-03	2.30E-02	2.30E-03
Indeno(1,2,3-cd)pyrene	1.53E-01	1.53E-02	3.96E-02	3.96E-03	2.38E-02	2.38E-03	1.41E-03	1.41E-04	3.15E-02	3.15E-03	1.62E-02	1.62E-03
Pentachlorophenol	3.36E-03	3.36E-04	8.73E-04	8.73E-05	1.84E-04	NA	1.09E-05	NA	6.94E-04	6.94E-05	3.57E-04	3.57E-05
Phenanthrene	1.59E-01	1.59E-02	4.14E-02	4.14E-03	2.49E-02	2.49E-03	1.47E-03	1.47E-04	3.29E-02	3.29E-03	1.69E-02	1.69E-03
Pyrene	1.77E-01	1.77E-02	4.59E-02	4.59E-03	2.76E-02	2.76E-03	1.63E-03	1.63E-04	3.65E-02	3.65E-03	1.88E-02	1.88E-03
Pesticides/PCBs												
4,4'-DDD	1.74E-03	3.48E-04	4.51E-04	9.02E-05	7.75E-01	7.75E-02	4.59E-02	4.59E-03	3.59E-04	7.18E-05	1.84E-04	3.69E-05
4,4'-DDE	1.88E-03	3.77E-04	4.88E-04	9.77E-05	8.39E-01	8.39E-02	4.97E-02	4.97E-03	3.89E-04	7.77E-05	2.00E-04	3.99E-05
4,4'-DDT	8.85E-03	1.77E-03	2.30E-03	4.59E-04	**3.95E+00**	3.95E-01	2.34E-01	2.34E-02	1.83E-03	3.66E-04	9.39E-04	1.88E-04
alpha-Chlordane	4.84E-04	2.42E-04	1.26E-04	6.28E-05	1.62E-03	3.23E-04	9.56E-05	1.91E-05	9.98E-05	4.99E-05	5.13E-05	2.57E-05
Dieldrin	3.03E-02	3.03E-03	7.85E-03	7.85E-04	1.23E-02	1.23E-03	7.26E-04	7.26E-05	6.25E-03	6.25E-04	3.21E-03	3.21E-04

TABLE 7-6V

RESULTS OF FOOD CHAIN MODELING
TERRESTRIAL RECEPTORS MEAN CONCENTRATIONS
OPERABLE UNIT 2 SOUTH

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Ecological Contaminant of Concern	Shrew		Mouse		Woodcock		Owl		Fox		Raccoon	
	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l	NOAEL HQ_n	LOAEL HQ_l
Pesticides/PCBs (Continued)												
Endrin	7.26E-03	7.26E-04	1.88E-03	1.88E-04	1.04E-01	1.04E-02	6.17E-03	6.17E-04	1.50E-03	1.50E-04	7.70E-04	7.70E-05
Endrin ketone	2.38E-02	2.38E-03	6.18E-03	6.18E-04	3.42E-01	3.42E-02	2.02E-02	2.02E-03	4.91E-03	4.91E-04	2.53E-03	2.53E-04
gamma-Chlordane	5.26E-04	2.63E-04	1.37E-04	6.83E-05	1.76E-03	3.51E-04	1.04E-04	2.08E-05	1.09E-04	5.43E-05	5.58E-05	2.79E-05
Heptachlor	4.42E-03	4.42E-04	1.15E-03	1.15E-04	NA	NA	NA	NA	9.13E-04	9.13E-05	4.69E-04	4.69E-05
Heptachlor epoxide	4.45E-03	4.45E-04	1.15E-03	1.15E-04	NA	NA	NA	NA	9.18E-04	9.18E-05	4.72E-04	4.72E-05
Methoxychlor	7.69E-04	3.84E-04	1.99E-04	9.97E-05	NA	NA	NA	NA	1.59E-04	7.94E-05	8.16E-05	4.08E-05

NA = NOAEL or LOAEL Not Available

Region 4 screening levels (Tables 7-7A to 7-7F). ORNL (Sample et al., 1998) suggests the presentation of all available screening levels in the ERA to help determine potential risks using the "weight-of-evidence."

The use of less conservative guidelines provides balance to the conservative screening level assessment in Step 3A. For example, some Region 4 sediment guidelines are based on ER-L guidelines obtained from Long et al. (1995). However, an ER-L is defined as the concentration below which adverse ecological "effects would rarely be observed" (Long et al., 1995). The Effects Range-Medium (ER-M) is the point below which adverse effects "would occasionally occur" (Long et al., 1995). Therefore, ascribing risk to a sediment chemical detected in a concentration which exceeds the ER-L, but is below the ER-M, can be misleading. Hence, when chemical concentrations exceed Region 4 screening levels, or no Region 4 screening level was available, less conservative guidelines, such as ER-Ms, are presented in tables containing all of the sediment and surface soil COPCs from comparisons to Region 4 screening levels. The tables also present the average concentration of the COPCs.

Sediment severe effects levels (SELs), ER-Ms, and FDEP probable effects levels (PELs) are presented for comparison. SELs, as presented in Jones, Hull, and Suter (1996), are from the Ontario Ministry of the Environment (MOE). MOE guidelines are based exclusively on observed effects in the field (absence of certain species). The SEL represents the chemical level that could potentially eliminate most of the benthic organisms. Unlike NOAA and FDEP guidelines, MOE guidelines are based exclusively on freshwater sediments. Hence, they may be more appropriate for OU 2 assessment. Also, Environment Canada PELs are provided. These guidelines were derived using the same methodology as the NOAA guidelines, but with a slightly different data set.

For surface soils, Dutch B and C values from Beyer (1990) are presented, as well as surface soil guidelines from ORNL indicative of toxicity to soil invertebrates and terrestrial plants (Efroymson et al., 1997a, b), if not used as primary screening levels. In addition, Dutch Intervention values (MHSP&E, 1994) are presented, which superceded the Dutch values presented in Beyer (1990). Additionally, CCME guidelines are presented.

Since few sources of guidelines other than AWQC are available for surface water, other guidelines are not presented for that medium. Since the groundwater screening is a rough estimation of potential surface water and sediment potential risks from groundwater discharge to the canal, other groundwater guidelines are not presented. Furthermore, toxicity data and information from various sources in the literature are discussed as they relate to the interpretation of potential risks from each COPC. These sources include the USFWS Chemical Hazard Reviews, commonly referred to as the "Eisler" publications, and ecotoxicological journals.

TABLE 7-7A

COMPARISON OF CHEMICALS OF POTENTIAL CONCERN TO OTHER GUIDELINES - SEDIMENT
OPERABLE UNIT 2 - NORTH SECTION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

COPC	Maximum Concentration	Average Concentration[a]	MOE Severe Effects Level	Effects Range-Median	Environment Canada Probable Effects Level	Florida Probable Effects Level
Inorganics (mg/kg)						
Aluminum	6460	2409	NA	NA	NA	NA
Barium	21.5	12.2	NA	NA	NA	NA
Cobalt	0.29	0.824	NA	NA	NA	NA
Iron	728	486.8	NA	NA	NA	NA
Manganese	4.6	1.93	1110	NA	NA	NA
Selenium	0.66	1.56	NA	NA	NA	NA
Vanadium	24.9	8.2	NA	NA	NA	NA
Volatile Organics (µg/kg)						
Toluene	3.8	3.26	NA	NA	NA	NA
Pesticides/PCBs (µg/kg)						
alpha-Chlordane	2.5	1.6	60	6.00	8.9	4.79
gamma-Chlordane	4.4	2	60	6.00	8.9	4.79
Heptachlor	1.3	0.94	NA	NA	NA	NA

NA = Not Available or Applicable
[a] Average of all samples

TABLE 7-7B

COMPARISON OF CHEMICALS OF POTENTIAL CONCERN TO OTHER GUIDELINES - SURFACE SOIL
OPERABLE UNIT 2 - NORTH SECTION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

COPC	Maximum Concentration	Average Concentration	Dutch "B" Value[a]	Dutch "C" Value[a]	Dutch Intervention Value[b]	Canadian Council of Ministers of the Environment[a]	ORNL Earthworm Benchmark	ORNL Plant Benchmark	ORNL Soil Microbe Benchmark
Inorganics (mg/kg)									
Iron	925	326	NA	NA	NA	NA	NA	NA	200
Mercury	0.22	0.05	2	10.00	10	10	0.1	0.3	30
Silver	2.4	0.24	NA	NA	NA	NA	NA	2	50
Vanadium	5.7	1.67	NA	NA	NA	130	NA	2	20
Semivolatiles (µg/kg)									
Anthracene	339	193	10000	100000.00	40000	700	NA	NA	NA
Benzo(a)anthracene	1380	224	1000	10000.00	40000	700	NA	NA	NA
Benzo(a)pyrene	2360	117	1000	10000.00	40000	700	NA	NA	NA
Benzo(b)fluoranthene	937	211	1000	10000.00	40000	700	NA	NA	NA
Benzo(g,h,i)perylene	805	207	1000	10000.00	40000	700	NA	NA	NA
Benzo(k)fluoranthene	767	206	1000	10000.00	40000	700	NA	NA	NA
Chrysene	1160	217	1000	10000.00	40000	700	NA	NA	NA
Dibenzo(a,h)anthracene	560	63.6	1000	10000.00	40000	700	NA	NA	NA
Fluoranthene	3000	281	10000	100000.00	40000	700	NA	NA	NA
Indeno(1,2,3-cd)pyrene	753	205	1000	10000.00	40000	700	NA	NA	NA
Phenanthrene	1380	224	5000	50000.00	40000	700	NA	NA	NA
Pyrene	2080	244	10000	100000.00	40000	700	NA	NA	NA
Volatiles (µg/kg)									
Acetone	51400	13773	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs (µg/kg)									
4,4'-DDE	22	1.5	NA	NA	4000	NA	NA	NA	NA
4,4'-DDT	9.1	2.44	NA	NA	4000	NA	NA	NA	NA
Dieldrin	3	0.56	NA	NA	NA	NA	NA	NA	NA
Endrin ketone	19	4.2	NA	NA	NA	NA	NA	NA	NA
gamma-Chlordane	1.9	0.51	NA	NA	NA	NA	NA	NA	NA
Heptachlor	1.1	0.5	NA	NA	NA	NA	NA	NA	NA

NA = Not Available or Applicable

[a] Values for PAHs are for individual chemicals.

[b] Values for PAHs are for total PAHs and the values for 4,4'-DDT, 4,4'-DDE, and 4,4'-DDT are for the total of these compounds.

TABLE 7-7C

COMPARISON OF CHEMICALS OF POTENTIAL CONCERN TO OTHER GUIDELINES - SEDIMENT
OPERABLE UNIT 2 - CENTRAL SECTION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

COPC	Maximum Concentration	Average Concentration[a]	MOE Severe Effects Level	Effects Range-Median	Environment Canada Probable Effects Level	Florida Probable Effects Level
Inorganics (mg/kg)						
Aluminum	5620	1902	NA	NA	NA	NA
Barium	154	25.46	NA	NA	NA	NA
Iron	1750	455	NA	NA	NA	NA
Manganese	3.1	0.89	1110	NA	NA	NA
Selenium	1	0.34	NA	NA	NA	NA
Vanadium	14	3.52	NA	NA	NA	NA
Semivolatile Organics (µg/kg)						
3- & 4-Methylphenol	289	231	NA	NA	NA	NA
Volatile Organics (µg/kg)						
Toluene	59.9	7.59	NA	NA	NA	NA
Benzene	4.1	2.49	NA	NA	NA	NA
Ethylbenzene	4.2	2.5	NA	NA	NA	NA
Xylenes (total)	5.9	3.95	NA	NA	NA	NA
Pesticides/PCBs (µg/kg)						
4,4'-DDE	3.5	1.48	190	27.00	NA	3.74

NA = Not Available or Applicable
[a] Average of all samples

TABLE 7-7D

COMPARISON OF CHEMICALS OF POTENTIAL CONCERN TO OTHER GUIDELINES - SURFACE SOIL
OPERABLE UNIT 2 - CENTRAL SECTION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

COPC	Maximum Concentration	Average Concentration	Dutch "B" Value[a]	Dutch "C" Value[a]	Dutch Intervention Value[b]	Canadian Council of Ministers of the Environment[a]	ORNL Earthworm Benchmark	ORNL Plant Benchmark	ORNL Soil Microbe Benchmark
Inorganics (mg/kg)									
Aluminum	4980	2584	NA	NA	NA	NA	NA	50	600
Iron	1300	625	NA	NA	NA	NA	NA	NA	200
Lead	97.3	9.15	150	600	530.00	70	500	50	900
Mercury	0.12	0.05	2	10	10.00	10	0.1	0.3	30
Vanadium	5.8	2.46	NA	NA	NA	130	NA	2	20
Zinc	106	9.84	500	3000	720.00	200	200	50	100
Semivolatile Organics (µg/kg)									
Anthracene	2700	340	10000	100000	40000.00	700	NA	NA	NA
Benzo(a)anthracene	7940	491	1000	10000	40000.00	700	NA	NA	NA
Benzo(a)pyrene	6320	320	1000	10000	40000.00	700	NA	NA	NA
Benzo(b)fluoranthene	5470	422	1000	10000	40000.00	700	NA	NA	NA
Benzo(g,h,i)perylene	9860	568	1000	10000	40000.00	700	NA	NA	NA
Benzo(k)fluoranthene	4190	373	1000	10000	40000.00	700	NA	NA	NA
Chrysene	8510	509	1000	10000	40000.00	700	NA	NA	NA
Dibenzo(a,h)anthracene	1720	128	1000	10000	40000.00	700	NA	NA	NA
Fluoranthene	22400	979	10000	100000	40000.00	700	NA	NA	NA
Fluorene	1370	304	1000	10000	40000.00	700	NA	NA	NA
Indeno(1,2,3-cd)pyrene	8800	530	1000	10000	40000.00	700	NA	NA	NA
Pentachlorophenol	109	4.1	NA	NA	NA	10000	6000	3000	400000
Phenanthrene	13600	638	5000	50000	40000.00	700	NA	NA	NA
Pyrene	14500	706	10000	100000	40000.00	700	NA	NA	NA
Volatile Organics (µg/kg)									
Acetone	18500	1892	NA	NA	NA	NA	NA	NA	NA
Methylene chloride	12.6	8.3	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs (µg/kg)									
4,4'-DDD	5.3	2.6	NA	NA	4000.00	NA	NA	NA	NA
4,4'-DDE	178	8.2	NA	NA	4000.00	NA	NA	NA	NA
4,4'-DDT	274	10.4	NA	NA	4000.00	NA	NA	NA	NA
Aldrin	13	2.69	NA	NA	NA	NA	NA	NA	NA
alpha-Chlordane	219	9.8	NA	NA	NA	NA	NA	NA	NA
Dieldrin	97	3.8	NA	NA	NA	NA	NA	NA	NA
Endosulfan II	4.5	2.3	NA	NA	NA	NA	NA	NA	NA
gamma-Chlordane	243	10.2	NA	NA	NA	NA	NA	NA	NA
Heptachlor	48	2.2	NA	NA	NA	NA	NA	NA	NA

NA = Not Available or Applicable

[a] Values for PAHs are for individual chemicals.

[b] Values for PAHs are for total PAHs and the values for 4,4'-DDT, 4,4'-DDE, and 4,4'-DDT are for the total of these compounds.

TABLE 7-7E

COMPARISON OF CHEMICALS OF POTENTIAL CONCERN TO OTHER GUIDELINES - SEDIMENT
OPERABLE UNIT 2 - SOUTH SECTION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

COPC	Maximum Concentration	Average Concentration[(a)]	MOE Severe Effects Level	Effects Range-Median	Environment Canada Probable Effects Level	Florida Probable Effects Level
Inorganics (mg/kg)						
Aluminum	7170	4590	NA	NA	NA	NA
Barium	72.5	30.3	NA	NA	NA	NA
Iron	606	360	NA	NA	NA	NA
Manganese	1.6	0.68	1110	NA	NA	NA
Vanadium	5.6	3.65	NA	NA	NA	NA

NA = Not Available or Applicable
[(a)]Average of all samples

TABLE 7-7F

COMPARISON OF CHEMICALS OF POTENTIAL CONCERN TO OTHER GUIDELINES - SURFACE SOIL
OPERABLE UNIT 2 - SOUTH SECTION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

COPC	Maximum Concentration	Average Concentration	Dutch "B" Value[a]	Dutch "C" Value[a]	Dutch Intervention Value[b]	Canadian Council of Ministers of the Environment[a]	ORNL Earthworm Benchmark	ORNL Plant Benchmark	ORNL Soil Microbe Benchmark
Inorganics (mg/kg)									
Aluminum	6520	1820	NA	NA	NA	NA	NA	50	600
Barium	177	8.48	400	2000	625.00	NA	NA	500	3000
Iron	936	353	NA	NA	NA	NA	NA	NA	200
Mercury	0.15	0.05	2	10	10.00	10	0.1	0.3	30
Semivolatile Organics (µg/kg)									
Anthracene	515	241	10000	100000	40000.00	700	NA	NA	NA
Benzo(a)anthracene	1730	297	1000	10000	40000.00	700	NA	NA	NA
Benzo(a)pyrene	1780	152	1000	10000	40000.00	700	NA	NA	NA
Benzo(b)fluoranthene	1280	282	1000	10000	40000.00	700	NA	NA	NA
Benzo(g,h,i)perylene	1350	284	1000	10000	40000.00	700	NA	NA	NA
Benzo(k)fluoranthene	1080	271	1000	10000	40000.00	700	NA	NA	NA
Chrysene	2500	329	1000	10000	40000.00	700	NA	NA	NA
Dibenzo(a,h)anthracene	769	87.9	1000	10000	40000.00	700	NA	NA	NA
Fluoranthene	5380	398	10000	100000	40000.00	700	NA	NA	NA
Indeno(1,2,3-cd)pyrene	1210	281	1000	10000	40000.00	700	NA	NA	NA
Pentachlorophenol	13.5	1.49	NA	NA	NA	11000	6000	3000	400000
Phenanthrene	2040	294	5000	50000	40000.00	700	NA	NA	NA
Pyrene	3740	326	10000	100000	40000.00	700	NA	NA	NA
Volatile Organics (µg/kg)									
Acetone	39.5	6.5	NA	NA	NA	NA	NA	NA	NA
Carbon disulfide	3.6	2.42	NA	NA	NA	NA	NA	NA	NA
Chloromethane	7.4	4.77	NA	NA	NA	NA	NA	NA	NA
Methylene chloride	16.3	3.73	NA	NA	NA	NA	NA	NA	NA

TABLE 7-7F

COMPARISON OF CHEMICALS OF POTENTIAL CONCERN TO OTHER GUIDELINES - SURFACE SOIL
OPERABLE UNIT 2 - SOUTH SECTION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

COPC	Maximum Concentration	Average Concentration	Dutch "B" Value[a]	Dutch "C" Value[a]	Dutch Intervention Value[b]	Canadian Council of Ministers of the Environment[a]	ORNL Earthworm Benchmark	ORNL Plant Benchmark	ORNL Soil Microbe Benchmark
Pesticides/PCBs (µg/kg)									
4,4'-DDD	23	2.6	NA	NA	4000.00	NA	NA	NA	NA
4,4'-DDE	39.4	2.8	NA	NA	4000.00	NA	NA	NA	NA
4,4'-DDT	234	13	NA	NA	4000.00	NA	NA	NA	NA
alpha-Chlordane	60	4.1	NA	NA	NA	NA	NA	NA	NA
Dieldrin	9	1.1	NA	NA	NA	NA	NA	NA	NA
Endrin	4.4	1.2	NA	NA	NA	NA	NA	NA	NA
Endrin ketone	7.5	4	NA	NA	NA	NA	NA	NA	NA
gamma-Chlordane	66	4.4	NA	NA	NA	NA	NA	NA	NA
Heptachlor	4.2	0.81	NA	NA	NA	NA	NA	NA	NA
Heptachlor epoxide	6.3	0.82	NA	NA	NA	NA	NA	NA	NA
Methoxychlor	27	5.7	NA	NA	NA	NA	NA	NA	NA

NA = Not Available or Applicable

[a] Values for PAHs are for individual chemicals.

[b] Values for PAHs are for total PAHs and the values for 4,4'-DDT, 4,4'-DDE, and 4,4'-DDT are for the total of these compounds.

The weight-of-evidence approach (USEPA, 1997a), which incorporates all available tools, was used in this ERA and is presented below. This approach was used in Step 3A to determine the extent of potential risks when HQ values exceeded 1.0, although analytes were automatically selected as COPCs if their maximum concentration HQ exceeded 1.0 after screening against Region 4 guidelines. A summary regarding the potential risks associated with OU 2 and recommendations for additional ecological study or remedial considerations are presented in Section 9.0.

7.7.1 Northern Section

Surface Water

Several inorganics had concentrations in excess of Region 4 screening levels, including aluminum, chromium, copper, lead, mercury, and zinc (see Table 7-6A). With the exception of zinc, all of the maximum concentrations of these inorganics were detected in sample SW010. This sample was collected in the drainage ditch along the northeastern border of OU 2 (see Figure 1-2). This drainage ditch collects runoff from 8th Express Street, the golf course parking lot, and the housing area upgradient of the golf course. As a result, the elevated concentrations of chemicals in this sample may be a result of upgradient influences. However, several of the metals detected in surface water were detected also in groundwater in this area. It is possible that the surficial aquifer is transporting metals to the ditch in this area. Note that the canal contains aquatic vegetation but standing water is present only after periods of rainfall. Thus, the canal does not contain a diverse or abundant aquatic community.

With the exception of mercury, all of the other detections of the inorganics in northern section surface water mentioned above are roughly half the maximum concentration or less. Nevertheless, other detections of aluminum, chromium, copper, lead, mercury, and zinc are higher than their Region 4 screening levels, indicating that some risks to aquatic receptors are present. As discussed below, however, the elevated concentrations of these inorganics in surface water do not correlate well with their concentrations in sediments. That is, concentrations of inorganics in sediments were not elevated relative to screening levels. Nevertheless, exceedances of screening levels or the absence of them in sediments may not be as appropriate as comparisons to background data for evaluating sources of chemicals to surface water. No site-specific background data for surface water or sediment data were available.

No Region 4 screening levels were available for barium, cobalt, iron, manganese, and vanadium. The maximum concentrations of these inorganics were also in sample SW010. All of the other detections of these inorganics, except barium, were approximately an order of magnitude lower than the maximum concentrations or less. The other detections of barium were approximately one-half the maximum or less.

These inorganics are generally associated with low ecotoxicities, but without adequate toxicity data the potential risks from these inorganics in OU 2 surface water cannot be fully assessed.

Note that, in general, surface water is a poor indicator of potential risks at OU 2 due to the "snapshot" effect. Surface water conditions at the site, especially in the canal and drainage ditches, are heavily influenced by several factors, including precipitation and runoff. Yet, surface water can be used as an indicator of a source of chemicals to this medium, such as sediments or groundwater.

Groundwater

Several inorganics, including aluminum, chromium, copper, iron, lead, mercury, and zinc, had maximum concentrations in groundwater that exceeded Region 4 screening levels (see Table 7-6D). Some of these inorganics significantly exceeded surface water screening levels, indicating potential risks to aquatic receptors if discharge to surface water in the canal occurs. All of these inorganics were elevated in surface water, indicating possible discharge to surface water. Yet, as discussed below, none of these inorganics were elevated in northern section sediments relative to screening levels. Again, screening levels are based on effects and do not necessarily reflect background concentrations, which would be more appropriate to use in evaluating sediments as a source of or sink for surface water and groundwater chemicals. Given the usually low flow and the thick vegetation in the canal, precipitating chemicals in groundwater would be expected to settle in sediments. This does not appear to have occurred. Settling would not be pronounced if groundwater chemicals are in forms unlikely to precipitate. Despite the presence of some ambiguous data, it does appear that groundwater could be the source of inorganics to surface water.

The VOCs cis-1,2-dichloroethene, methane, vinyl chloride, and total xylenes had maximum concentrations in northern section groundwater in excess of Region 4 surface water screening levels (see Table 7-6D). These chemicals were not detected in northern section surface water or sediments. No Region 4 screening levels were available for the inorganics manganese and vanadium. The maximum concentration of manganese appears to be qualitatively elevated. Vanadium is a common element found in all types of substrates (ATSDR, 1997). It can also be found in all types of organisms due to its ubiquitous nature (Klaassen et al., 1986). Toxicity data for this element are scarce, but it is not generally considered to be toxic in the environment (Mailman, 1980), and it is not known to bioaccumulate or biomagnify. An LC_{50} range of 5,000 to 100,000 μg/L was obtained from Klassen et al. (1986) for freshwater fish. EPA Region III presents a chronic screening value for freshwater fauna of 10,000 μg/L (USEPA, 1995d). Although these values generally indicate a low aquatic toxicity, the site-specific toxicity and related potential risks due to vanadium in groundwater (or other site media) cannot be fully assessed without site-specific physico-chemical and toxicity data for this chemical. VOCs generally have low ecotoxicities and do not bioaccumulate or biomagnify.

Sediment

No inorganics had maximum concentrations in northern section sediments in excess of Region 4 screening levels. As a result, northern section sediments do not appear to be a source of the elevated inorganics in northern section surface water. Again, since the sediment screening levels were based on effects and not background concentrations, they are not a completely reliable indicator of whether sediments are serving as a chemical source to surface water or a chemical sink. As discussed below, it does not appear that surface soil is contributing inorganics to northern section surface water, despite some exceedances of surface soil screening values. The surface soil screening levels provide a more appropriate indicator of this medium as a potential source since they are based on background concentrations and detection limits. Thus, the reason(s) for the elevated concentrations of inorganics in surface water in the canal is unclear, but groundwater appears to be the most likely source.

Two pesticides, alpha- and gamma-chlordane, were detected in one sediment sample (sample SD010) and these concentrations exceeded Region 4 screening levels. As with the elevated inorganics in surface water, the maximum concentrations could be due to upgradient sources. The maximum concentrations of alpha- and gamma-chlordane were less than all of the less conservative guidelines presented on Table 7-7A.

No Region 4 guidelines were available for aluminum, barium, cobalt, iron, manganese, selenium, and vanadium. Aluminum and iron are two of the most common elements in the earth's crust. Iron and manganese are essential nutrients and common elements. Selenium is an essential nutrient, but is harmful at higher concentrations (Eisler, 1985). It was detected in one of five samples. The ecotoxicity of vanadium was discussed earlier. No ER-Ms or PELs are available for these inorganics, although an SEL was available, manganese (1,110 mg/kg). The maximum and average concentrations of manganese in OU 2 are orders of magnitude lower than the SELs (see Table 7-7A).

No Region 4 screening levels were available for the VOC toluene and the pesticide heptachlor. In addition, no alternate guidelines were available. Qualitatively, the maximum concentrations of these organics do not appear to be elevated (0.0038 mg/kg or less), although definitive conclusions regarding their ecological significance cannot be made without adequate toxicity data.

Surface Soil

Iron, mercury, silver, and vanadium were the inorganics whose maximum concentrations exceeded screening levels in northern section surface soils. Their HQs were relatively low, 4.6 or less. The ecotoxicity

of iron and vanadium were discussed above. The maximum concentration of mercury (0.22 mg/kg) was less than all of the alternate guidelines presented on Table 7-7B, except for the ORNL earthworm benchmark (0.1 mg/kg). Silver was detected in 3 of 34 samples. Its maximum concentration (2 mg/kg) was approximately equal to the ORNL plant benchmark and was an order of magnitude less that the ORNL soil microbe benchmark. No other alternate guidelines were available for silver in surface soils.

The modes of action of the inorganic COPCs in soils are complex and varied. Their toxicity will vary by receptor species that are exposed to soils, the species of the chemical present, and the physical chemistry of the soils and precipitation. Inorganics also tend to have complex interactions, often antagonistic. Therefore, summing of inorganic HQs in surface soils was not performed.

The maximum concentrations of 12 PAHs exceeded Region 4 screening levels. The HI for all PAHs (high and low molecular weight) was 155.2. All of the maximum concentrations were in one sample (S103), which was collected just north of the middle of the hole 7 fairway (see Figure 1-2B). Ten of the 12 PAHs were detected only in that sample. Of the two PAHs that were detected in more than one sample, benzo(a)pyrene (3 of 34 samples) and fluoranthene (2 of 34 samples), the detections other than the maximum were in the same order of magnitude as the Region 4 screening level. Some of the maximum concentrations of PAHs in sample S103 exceeded Dutch "B" values and CCME value, but all were less than the Dutch "C" values and the Dutch Intervention value (see Table 7-7B). The Dutch Intervention value of 40 mg/kg is for total PAHs. It should be noted that PAHs have a strong affinity for soil organic carbon and hence are unlikely to migrate as solutes or be appreciably bioavailable. For these reasons, potential risks from PAHs are present but appear to be confined to the area near sample S103. Thus, widespread, population, or community level adverse effects are unlikely.

Although localized concentrations of PAHs in soils are not likely to result in risks at the population or community level, they could potentially be present for individual receptors like the gopher tortoise, whose movement is somewhat more confined. Nonetheless, there is no suitable gopher tortoise habitat in the northern section of OU 2. PAHs were not detected in any other medium in the northern section of OU 2, with the exception of one detection of naphthalene in groundwater. Also, nearly all of the detections of PAHs were only in one sample (S103), which was collected in the Hole 7 area. The area of sample S103 has since been excavated (see Section 7.11 Risk Management). This suggests that PAHs are not migrating from surface soils near S103 to surface water in the nearby pond or other surface soils in this area. PAHs generally have a high affinity for organic carbon in soils (generally higher than inorganics), which inhibits runoff of these chemicals, especially in their dissolved forms.

In addition to the PAHs, the maximum concentrations of the pesticides and daughter products 4,4'-DDE, 4,4'-DDT, and dieldrin exceeded Region 4 surface soil screening levels. Assuming additive and similar modes of action, the HI for these compounds was 18.4. Dieldrin and 4,4'-DDT were detected only in 1 of 34 samples. The only alternate guideline for 4,4'-DDE and 4,4'-DDT (combined) is the Dutch Intervention value of 4000 μg/kg (for total DDE, DDT, and DDD), which is orders of magnitude higher than the concentrations of these two compounds combined. No alternate guidelines were available for dieldrin, although the one detection of this compound appears to be qualitatively low (0.003 mg/kg).

No Region 4 surface soil screening levels were available for acetone, endrin ketone, gamma-chlordane, and heptachlor. Acetone is a common laboratory chemical, although several detections of this VOC appear to be qualitatively high. Again, VOCs generally do not bioaccumulate or biomagnify. Endrin ketone, gamma-chlordane, and heptachlor were detected only in 1 of 34 samples. No alternate guidelines were available for these pesticides, although the lone detections of these chemicals qualitatively appear to be low (0.019 mg/kg or less).

Food Chain Modeling

Mercury and vanadium had at least one HQ greater than 1.0 using maximum concentrations in the terrestrial food chain modeling. The environmental significance of vanadium is discussed in previous sections. Mercury was detected only in 2 of 34 surface soil samples at a maximum of 0.22 mg/kg, making the possibility of widespread food chain exposure and potential risks remote. Benzo(a)pyrene, fluoranthene, pyrene, 4,4'-DDT, 4,4'-DDE, and endrin ketone had at least one HQ greater than 1.0 for the terrestrial food chain modeling using maximum concentrations. Benzo(a)pyrene, fluoranthene, pyrene, endrin ketone, and 4,4'-DDT were detected only in 3, 2, 1, 1, and 1 of 34 samples, respectively, also reducing the potential for widespread risk. 4,4'-DDE was detected in 7 of 34 samples. These five organics did not have an HQ greater than 1.0 using average concentrations, with the exception of 4,4'-DDT, but the HQ was relatively low (1.45). Aluminum and vanadium had at least one HQ greater than 1.0 using both maximum and average concentrations in the semi-aquatic food chain modeling. The ecotoxicological significance of aluminum and vanadium was discussed previously.

Several conservative assumptions were used in the food chain modeling. Bioavailability was assumed to be 100 percent at OU 2, as in most laboratory ingestion toxicity tests, but could be much less than 100 percent. For example, inorganics in soils at most hazardous waste sites are typically in poorly available forms (Efroymson et al., 1997a). Organic carbon in soils can bind inorganics and organics and reduce their bioavailability. Some of the ingestion rates were obtained from captive studies, which may overestimate the amount of food ingested relative to wild animals that may have limited food resources. The receptors were

assumed to spend 100 percent of their life on OU 2. While this may be plausible for smaller receptors (e.g., short-tailed shrew, cotton mouse), OU 2 (specifically each section) comprises only a portion of the home range of most of the other receptors. Most importantly, only portions of the northern section of OU 2 provide suitable habitat for each receptor since most of the site is mowed turfgrass with heavy human activity. The home range for the great horned owl has been estimated at 6 ha (Hager, 1957), which is much smaller than the total area of OU 2 (approximately 100 ha).

Typical home ranges or territories for the woodcock, red fox, raccoon, and robin are much larger than OU 2 (or the portions of OU 2 that provide suitable habitat). USEPA (1993) presents typical home ranges of 57 to 3,420 ha for the red fox, 0.3 to 171.2 ha for the woodcock, 39 to 2,560 ha for the raccoon, and 0.12 to 0.84 ha for the robin (a migratory species). If these area use factors (overlap of suitable site habitat size with home range and time per year potentially on-site) were used in the modeling, HQ values would likely drop, perhaps significantly. Additional discussion of these issues is presented in the Section 7.9 Uncertainties..

7.7.2 Central Section

Surface Water

Several analytes, including aluminum, copper, iron, lead, mercury, zinc, and bis(2-ethylhexyl)phthalate had maximum detected concentrations that significantly exceeded surface water screening levels (see Table 7-6l). The other detections of aluminum, copper, and lead were half the maximums or less, although a few other detections of these inorganics exceeded Region 4 screening levels. The two detections of mercury and several detections of zinc exceeded their Region 4 screening levels. As a result, potential risks could be present to aquatic receptors in the central section of OU 2. Iron is an essential nutrient and is generally associated with low ecotoxicity. Bis(2-ethylhexyl)phthalate had a relatively high HQ but was detected only in 1 of 13 samples and was not detected in any other medium in the central section. Surface water concentrations do not correlate well with sediment concentration of inorganics. Yet, as mentioned earlier, this is in relation to exceedances of sediment screening levels, which are based on effects and therefore not as appropriate an indicator of sediments as a chemical source or sink as comparisons to background data.

No Region 4 screening levels were available for barium, manganese, and vanadium. All of the other detections of these inorganics other than the maximum concentrations were roughly less than the maximum concentrations. These inorganics are generally associated with low ecotoxicities, but without adequate toxicity data the potential risks from these inorganics in OU 2 surface water cannot be fully assessed. Confidence in surface water data was discussed previously.

Groundwater

Aluminum, chromium, copper, iron, lead, selenium, and zinc had maximum concentrations in central section groundwater in excess of Region 4 surface water screening levels (see Table 7-6L). Aluminum, copper, lead, and zinc were elevated in central section surface water, suggesting possible discharge to surface water. Yet, as with the northern section, none of these inorganics was elevated in sediments. Again, it may be due to dilution of chemicals in groundwater upon discharge to surface water in the canal. Regardless, groundwater appears to be a potential source of inorganics to central section surface water.

No Region 4 screening levels were available for barium, manganese, vanadium, carbon disulfide, total methylphenol, cis-1,2-dichloroethene, trans-1,2-dichloroethene, trichloroethene, vinyl chloride, total xylenes, and methane. No surface water or sediment guidelines were available for barium. The ecotoxicities of the remainder of these compounds were discussed in previous sections.

Sediment

No inorganics had maximum concentrations in central section sediments in excess of Region 4 screening levels (see Table 7-6J). As a result, central section sediments do not appear to be toxic. This may also indicate that sediments are not a chemical source for surface water, but the sediment screening levels are not based on background concentrations, which would be a better indicator of sediments as a source or sink for inorganics. As discussed below, it does not appear that surface soil is contributing inorganics to central section surface water, despite some exceedances of surface soil screening values. Surface soil screening levels are based on background concentrations and detection limits. Thus, the reason(s) for the elevated concentrations of inorganics in surface water is unclear, but groundwater appears to be a potential source.

The pesticide daughter product 4,4'-DDE was the only chemical in central section sediments that exceeded its Region 4 guideline. It was detected only in 1 of 13 samples at a concentration less than all of the alternative guidelines presented in Table 7-7C.

No Region 4 guidelines were available for aluminum, barium, iron, manganese, selenium, and vanadium. The ecological significance of these inorganics in sediments was discussed in previous sections. No Region 4 screening levels were available for total methylphenol, toluene, benzene, ethylbenzene, and total xylenes. Total methylphenol was detected in 1 of 12 sediment samples and 1 of 12 groundwater samples but was not detected in surface soils or surface water in the central section of OU 2. Benzene, ethylbenzene, and xylenes were detected in 1 of 13 samples. Toluene, benzene, ethylbenzene, and xylenes are VOCs that do not bioaccumulate or biomagnify. No alternate guidelines were available for total methylphenol and the

VOCs. Therefore, without adequate toxicity data the potential risks from these compounds cannot be fully assessed.

Surface Soil

The inorganics aluminum, iron, lead, mercury, vanadium, and zinc had maximum concentrations in central section surface soils that exceeded 2 times average background and Region 4 screening levels (see Table 7-6K). The ecotoxicological significance of aluminum, iron, and vanadium were discussed previously. The HQs for lead, mercury, and zinc were all relatively low (2.1 or less). Also, all of the other detections of lead and mercury and all of the other detections of zinc but one were less than their Region 4 screening levels. The maximum concentrations of lead, mercury, and zinc were less than 5 of 7, 6 of 7, and 5 of 7 alternate guidelines, respectively, as presented in Table 7-6K.

Thirteen PAHs and pentachlorophenol had maximum concentrations in central section surface soils in excess of Region 4 screening levels. The HI for all PAHs was 1,073.9. The maximum concentrations of all of these compounds were in sample S04, which was collected at the extreme western edge of OU 2 (see Figure 1-2). Three of these PAHs were detected only in sample S04. Nearly all detections of all PAHs other than their maximum concentrations were an order of magnitude less than the maximum concentrations and all were less than half the maximum concentrations. Pentachlorophenol was detected in 2 of 37 samples; the second detection was an order of magnitude less than the maximum.

Several detections of PAHs other than the maximums and the second highest detected concentration still exceeded the Region 4 screening level. Nevertheless, the majority of PAH detections and the second pentachlorophenol value were less than, or comparable to, Dutch "B" values and the CCME value. They were less than Dutch "C" values and the Dutch Intervention value for total PAHs. The Intervention value for total PAHs was exceeded in sample S04.

The pesticides and daughter products 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, and dieldrin had maximum concentrations in excess of Region 4 screening levels. The HI for these compounds was 382.1. Similar to PAHs, the maximum concentrations of 4,4'-DDE, 4,4'-DDT, and dieldrin were in sample S04. All of the other detections of 4,4'-DDT and all for 4,4'-DDE except one (sample S30) were an order of magnitude less than the maximums. Aldrin and 4,4'-DDD were detected only in 1 of 37 samples. The only alternate guidelines available were for total 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT, which was the Intervention value of 4 mg/kg. The total of the maximums for these compounds was orders of magnitude lower than this value.

No Region 4 or alternate guidelines were available for acetone, methylene chloride, alpha-chlordane, Endosulfan II, gamma-chlordane, and heptachlor. Acetone is a common laboratory chemical and methylene chloride was detected only in 1 of 37 samples. Both are VOCs that do not bioaccumulate or biomagnify. The maximum concentrations of alpha-chlordane, gamma-chlordane, and heptachlor were in sample S04. All detections of alpha-chlordane, gamma-chlordane, and heptachlor other than the maximums were two orders of magnitude lower than the maximums, except in sample S03 (which was collected near S04). The maximum concentration of Endosulfan II was in sample S92. Endosulfan II was detected in 2 of 37 samples at concentrations of 0.002 and 0.0045 mg/kg, respectively.

Food Chain Modeling

Using maximum and average concentrations, the inorganics aluminum, lead, mercury, vanadium, and zinc had at least one HQ greater than 1.0 for the terrestrial food chain modeling. The ecotoxicological significance of aluminum and vanadium was discussed previously. As discussed above, all of the other detections of lead and mercury and all of the other detections of zinc but one (other than their maximums) were less than their Region 4 screening levels and thus would have been screened out and not used in the food chain modeling in the absence of this detection. Also, mercury was detected only in 2 of 37 surface soil samples in the central section of OU 2. Nevertheless, some potential food chain risks may exist from lead and zinc, primarily to small mammals.

Several PAHs and pesticides/daughter products had at least one HQ greater than 1.0 using maximum concentrations. Yet, no organics had an HQ greater than 1.0 using average concentrations. This is mainly because the HQs greater than 1.0 are due to the elevated concentrations in one sample (S04). Again, nearly all detections of PAHs other than their maximum concentrations were an order of magnitude less than the maximum concentrations and all were less than half the maximum concentrations. The pesticides 4,4'-DDT, 4,4'-DDD, and 4,4'-DDE had food chain modeling HQs greater than 1.0 using maximum concentrations. All of the other detections of 4,4'-DDT and all for 4,4'-DDE except one (sample S30), were an order of magnitude less than the maximums; 4,4'-DDD was detected only in 1 of 37 samples. The maximum concentrations of all other pesticides and daughter products with HQs greater than 1.0 had maximum concentrations in S04 and much lower concentrations in the other samples with detected concentrations.

Aluminum, barium, and vanadium had at least one HQ greater than 1.0 using maximum concentrations in the semi-aquatic food chain modeling. The ecotoxicological significance of aluminum and vanadium was discussed previously. The two HQs > 1.0 for barium were low (1.74 and 1.36), and all were less than 1.0 using the average concentration.

7.7.3 Southern Section

Surface Water

Several analytes, including aluminum, chromium, copper, lead, mercury, and zinc had maximum detected concentrations that significantly exceeded surface water screening levels (see Table 7-6Q). The other detections of all of these inorganics are half the maximums or less, although a few other detections of these inorganics exceeded Region 4 screening levels. Although aluminum and iron are not generally toxic under normal pH conditions, the maximum concentrations of these two inorganics appear to be elevated. As a result, potential risks could be present to aquatic receptors in the central section of OU 2. As discussed below, however, the elevated concentrations of these inorganics in surface water do not correlate well with their concentrations in sediments. Again, sediment screening levels are based on effects and not background concentrations, which would be more appropriate to use to determine if sediments are a source of, or sink for, surface water chemicals. The maximum concentrations of aluminum, chromium, copper, lead, zinc, and other inorganics with no Region 4 screening levels were in sample SW021. Sample SW021 was collected off-site east of Tradeport Drive. It is possible that the elevated concentrations of inorganics in this sample are due to off-site influences, although no major sources other than Tradeport Drive itself are evident. It is more likely that these inorganics in the canal are a result of groundwater discharge (see below).

No Region 4 screening levels were available for barium, iron, manganese, and vanadium. These inorganics are generally associated with low ecotoxicities, but without adequate toxicity data the potential risks from these inorganics in OU 2 surface water cannot be fully assessed. Confidence in surface water data was discussed previously.

Groundwater

Aluminum, chromium, copper, iron, lead, and zinc had maximum concentrations in southern section groundwater in excess of Region 4 surface water screening levels (see Table 7-6T). Aluminum, copper, chromium, lead, and zinc were elevated in southern section surface water, suggesting possible discharge to surface water in the canal. As with the northern and central sections of OU 2, none of these inorganics was elevated in sediments, which may be due to groundwater dilution upon discharge. It does appear that groundwater is a potential source of inorganics to surface water.

No Region 4 screening levels were available for barium, manganese, vanadium, total methylphenol, 2-butanone, 2-hexanone, 4-methyl-2-pentanone, carbon disulfide, bromodichloromethane, cis-1,2-dichloroethene, PCE, TCE, vinyl chloride, and methane. No surface water or sediment guidelines

were available for barium. The ecotoxicity of manganese, vanadium, and VOCs was discussed in previous sections.

Sediment

No analytes in southern section sediments exceeded Region 4 screening levels, indicating that southern section sediments do not appear to be toxic. This would also indicate that sediments are not a chemical source for surface water, but the sediment screening levels are not based on background concentrations, which would be a better indicator of sediments as a source or sink for inorganics. As discussed below, it does not appear that surface soil is contributing inorganics to southern section surface water, despite some exceedances of surface soil screening values. Surface soil screening levels are based on background concentrations and detection limits. No Region 4 guidelines were available for aluminum, barium, iron, manganese, and vanadium. An alternate guideline was available for manganese (see Table 7-7E); the maximum concentration of manganese was orders of magnitude lower than this alternate guideline. The ecological significance of the other inorganics in sediments was discussed in previous sections.

Surface Soil

The inorganics aluminum, barium, iron, and mercury had maximum concentrations in southern section surface soils that exceeded 2 times average background and Region 4 screening levels (see Table 7-6S). The ecotoxicological significance of aluminum and iron was discussed previously. The HQs for barium (1.07) and mercury (1.5) were relatively low. Mercury was detected only in 2 of 45 samples. The maximum concentrations of barium and mercury were less than 5 of 5 and 6 of 7 alternate guidelines, respectively, presented in Table 7-7F.

Twelve PAHs and pentachlorophenol had maximum concentrations in southern section surface soils in excess of Region 4 screening levels. The HI for all PAHs was 233.74. The maximum concentrations of all of these compounds were in samples H28 and S02, which were collected in the middle and at the extreme western edge of OU 2, respectively (see Figure 1-2B). Nearly all detections of PAHs were limited to three samples: H28, H29, and S02. Concentrations in H29 were generally less than in H28 and S02. Sample S02 was collected near sample S04 from the central section, which had elevated concentrations of PAHs. Most of the maximums slightly exceed Dutch "B" values and CCME values, but none exceed Dutch "C" values. The Intervention value for total PAHs was not exceeded. Pentachlorophenol was detected in 2 of 45 samples. Its maximum is orders of magnitude less than all of the alternate guidelines on Table 7-7F.

The pesticides and daughter products 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, endrin, and dieldrin had maximum concentrations in excess of Region 4 screening levels. The HI for these compounds was 141. For the most part, frequencies of detection were low and no clear pattern of elevated contamination exists for these compounds. Maximums for individual chemicals were scattered over several samples that were not collected near each other. There was no widespread prevalence of exceedances throughout the site for any of these compounds. This would be consistent with probable historical use of pesticides on the base. The only alternate guidelines available were for total 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT, which was the Intervention value of 4 mg/kg. The total of the maximums for these compounds was an order of magnitude lower than this value.

No Region 4 or alternate guidelines were available for acetone, carbon disulfide, chloromethane, methylene chloride, alpha-chlordane, endrin ketone, gamma-chlordane, heptachlor, heptachlor epoxide, and methoxychlor. Acetone is a common laboratory chemical and was detected in 2 of 27 samples, chloromethane was detected in 1 of 45 samples, and carbon disulfide was detected in 1 of 45 samples. Acetone, carbon disulfide, chloromethane, and methylene chloride are VOCs that do not bioaccumulate or biomagnify. No alternate guidelines were available for the VOCs detected in surface soils in the southern section of OU 2.

As with the other pesticides and daughter products, alpha-chlordane, endrin ketone, gamma-chlordane, heptachlor, heptachlor epoxide, and methoxychlor generally had low frequencies of detection and no distinct pattern of contamination. No alternate guidelines were available for these compounds.

Food Chain Modeling

Using maximum concentrations, the inorganics aluminum, barium, and mercury had at least one HQ greater than 1.0 for the terrestrial food chain modeling. The environmental significance of aluminum was discussed in previous sections, as was an interpretation of the food chain modeling results in light of attendant uncertainties. Mercury was detected only in 2 of 45 samples, minimizing the potential for widespread risks via the food chain. The maximum concentration of barium in surface soils (177 mg/kg) is much higher than the other detections; all of the other detections are less than the Region 4 surface soil screening value.

Four PAHs and two pesticides had at least one HQ greater than 1.0 using their maximum concentrations. HQs for PAHs were low (2.92 or less) and none had an HQ greater than 1.0 using average concentrations. The HQs greater than 1.0 are probably due to the elevated concentrations in sample H28, which are much higher than the other detections. Only 4,4'-DDT had an HQ greater than 1.0 using average concentrations, and it was relatively low (3.95). This probably reflects the fact that the other detections of this compound are

much lower than the maximum. As mentioned above, no clear pattern of elevated pesticide contamination exists in the southern section of OU 2.

7.8 ASSESSMENT OF PHASE III DATA

A third phase of surface water, sediment, and groundwater samples was collected at OU 2 in late 1999. The purpose of this sampling effort was two-fold. First, the elevated inorganics in Phase I and Phase II groundwater samples were thought to be a result of high turbidity in these samples, which influenced the chemical results. OU 2 monitoring wells were re-sampled in Phase III to further investigate this potential confounding factor in the previous data. Second, subsequent to the conduct of the draft RI, the county dredged the canal east and south of the site to facilitate better water flow and drainage. Thus, the site conditions had changed. Areas that were dredged were re-sampled for surface water and sediment in Phase III (see Figure 3-4A). Also as part of the Phase III sampling effort, six surface water and sediment samples were collected upgradient of OU 2 in the canal to serve as reference data (see Figure 3-4A) and help determine any upgradient chemical influences on OU 2 data.

Two lines of evidence indicate that the Phase III surface water data are more representative of typical site conditions than the Phase I and Phase II sample results. First, the Phase I and Phase II samples were collected following precipitation events and may be representative of antecedent conditions related to the rainfall. As such, the surface water may reflect a significant influx of channel flow (surface runoff), bank storage recession, and subsurface flow (i.e., quick return flow) that are not representative of the site's normal groundwater discharge that supports the long-term base flow of site surface water. As shown in Figure 5-4B and stated in the text, upstream surface water sample locations sampled during Phase III show exceedances of organics, pesticides, and inorganics; that area is clearly not associated with OU 2 runoff or groundwater discharge (see sample locations SW-023, -024, -025, -026, -027, and -028). Higher runoff and stream flow prior to or during Phase I and Phase II sampling were likely to include stronger off-site influences on the surface water sampled at OU 2, and therefore, are less representative of OU 2-specific impacts to surface water.

Secondly, the canal dredging that occurred between the Phases I and II and Phase III surface water sampling events has likely had a significant impact on the sediment that the surface water is in contact with. Sediments present during Phase I and Phase II sampling likely contained a larger percent of settled particulates and organic matter, and associated chemical constituents, brought to the site from upstream areas; dredging is assumed to mostly expose the neolithic sediments. Because upstream samples indicate that chemicals are being transported to the site, the removal of accumulated sediment by dredging could

substantially improve the site conditions. The historical practice of canal dredging has likely played a significant role in the sediment and surface water quality at OU 2.

As presented in Section 8.4, the movement of metals via groundwater flow at OU 2 is a very slow process. Because of the low contaminant velocity in groundwater and the precipitation factors discussed above, the discharge of metals from landfilled areas of OU 2 to surface water via the groundwater pathway is expected to be insignificantly impacted by precipitation events.

Table 7-8A presents the detected chemicals in Phase III surface water in the canal for the north, central, and south sections of OU 2, respectively. Table 7-8B presents the Phase III data for sediment in the canal for the north, central, and south sections of OU 2, respectively. These tables present comparisons of the maximum concentrations of COPCs in each data subset to Region 4 screening levels. HQs were calculated for each area from these comparisons.

In north section surface water samples collected during Phase III, aluminum, iron, mercury, and bis(2-ethylhexyl)phthalate had HQs greater than 1.0 (Table 7-8A). In central section surface water, aluminum, iron, mercury, and bis(2-ethylhexyl)phthalate had HQs greater than 1.0. In south section surface water samples collected during Phase III, aluminum, chromium, iron, lead, mercury, and bis(2-ethylhexyl)phthalate had HQs greater than 1.0 (Table 7-8A). HQs for iron, chromium, and lead were all relatively low (5.5 or less). Aluminum is rarely toxic under normal pH conditions, and bis(2-ethylhexyl)phthalate is ubiquitous in industrialized areas. However, mercury in surface water was significantly elevated in all sections of the canal along OU 2 as part of Phase III sampling; it was not elevated in the upgradient samples. Barium, manganese, and vanadium were detected in Phase III surface water samples but no Region 4 screening levels were available. The ecotoxicities of these chemicals were discussed earlier.

No inorganics had HQs greater than 1.0 in Phase III sediment samples (Table 7-8B). Gamma-chlordane and 4,4'-DDE had HQs greater than 1.0 in north and central section sediment samples, but the HQs were all low (3.2 or less). No Region 4 sediment screening levels were available for aluminum, antimony, barium, beryllium, cobalt, iron, manganese, selenium, vanadium, and endosulfan I. In general, the concentrations of these compounds were qualitatively low, although without adequate toxicity data their site-specific risks cannot be fully assessed.

TABLE 7-8A

COMPARISON OF PHASE III CANAL SURFACE WATER DATA TO REGION 4 SCREENING LEVELS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Parameter	Region 4 Screening Level	Maximum Detected Concentration in the Canal - North Section	North Section Hazard Quotient	Maximum Detected Concentration in the Canal - Central Section	Central Section Hazard Quotient	Maximum Detected Concentration in the Canal - South Section	South Section Hazard Quotient
bis(2-ethylhexyl)phthalate	0.30	6.6	22.00	4.90	16.33	4.30	14.33
Naphthalene	62.00	ND	NA	ND	NA	0.43	0.01
Aluminum	7.00	638	91.14	819.00	117.00	1810.00	258.57
Barium	NA	24	NA	28.10	NA	45.70	NA
Chromium	11.00	ND	NA	ND	NA	14.50	1.32
Copper	6.54	1.4	0.21	4.30	0.66	3.30	0.50
Iron	1000.00	1180	1.18	1510.00	1.51	2340.00	2.34
Lead	1.32	1.2	0.91	ND	NA	7.30	5.53
Manganese	NA	12.5	NA	19.70	NA	10.90	NA
Mercury	0.01	8.37	697.50	2.86	238.33	4.62	385.00
Nickel	87.71	ND	NA	5.70	0.06	5.70	0.06
Vanadium	NA	8.1	NA	5.00	NA	11.00	NA
Zinc	58.91	6.5	0.11	11.70	0.20	23.10	0.39

NA = Not Available or Not Applicable
Units in μg/L

TABLE 7-8B

COMPARISON OF PHASE III SEDIMENT DATA TO REGION 4 SCREENING LEVELS
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Parameter	Region 4 Screening Level	Maximum Detected Concentration in the Canal - North Section	North Section Hazard Quotient	Maximum Detected Concentration in the Canal - Central Section	Central Section Hazard Quotient	Maximum Detected Concentration in the Canal - South Section	South Section Hazard Quotient
Organics (ug/kg)							
4,4'-DDD	3.30	ND	NA	ND	NA	ND	NA
4,4'-DDE	3.30	3.4	1.03	8.20	2.48	ND	NA
alpha-Chlordane	3.30	ND	NA	1.10	0.33	ND	NA
Endosulfan I	NA	ND	NA	2.10	NA	ND	NA
gamma-Chlordane	1.70	5.4	3.18	2.00	1.18	ND	NA
Inorganics (mg/kg)							
Aluminum	NA	2070	NA	5970.00	NA	6490.00	NA
Antimony	NA	ND	NA	0.30	NA	ND	NA
Arsenic	7.24	ND	NA	0.29	0.04	0.80	0.11
Barium	NA	7.1	NA	30.10	NA	30.40	NA
Beryllium	NA	ND	NA	0.81	NA	ND	NA
Chromium	52.30	3.8	0.07	8.60	0.16	6.70	0.13
Cobalt	NA	ND	NA	ND	NA	ND	NA
Copper	18.70	4.2	0.22	8.30	0.44	3.60	0.19
Iron	NA	666	NA	1200.00	NA	519.00	NA
Lead	30.20	10.7	0.35	7.30	0.24	4.90	0.16
Manganese	NA	8.9	NA	7.00	NA	ND	NA
Mercury	0.13	ND	NA	ND	NA	0.06	0.46
Nickel	15.90	ND	NA	3.60	0.23	ND	NA
Selenium	NA	ND	NA	0.87	NA	ND	NA
Vanadium	NA	27.1	NA	17.60	NA	5.10	NA
Zinc	124.00	17.9	0.14	9.00	0.07	ND	NA

NA = Not Available or Not Applicable

Table 7-8C presents the detected chemicals from Phase III surface water samples that had HQs greater than 1.0. The table also presents Phase I and Phase II data by area, as well as FDEP water quality standards and two times the average upgradient concentrations for comparative purposes. In nearly all cases, the concentrations of chemicals in canal surface water decreased over time, and often by orders of magnitude. The exceptions were mercury, which increased in all areas of the canal, and bis(2-ethyhexyl)phthalate to a much lesser extent. On the whole, two times the concentrations of chemicals that were detected in upgradient samples were comparable to Phase III concentrations. This includes inorganics and bis(2-ethylhexyl)phthalate in the southern section data set, which includes sample SW-021. This sample was collected immediately upgradient of Lake Gillooly. Concentrations of aluminum, chromium, copper, lead, and zinc were all elevated in the Phase I and Phase II sample collected at location SW-021. However, all of these inorganics were below Region 4 screening levels in the Phase III SW-021 sample.

Table 7-8D presents the chemicals from Phase III sediment samples that had HQs greater than 1.0. The table also presents Phase I and Phase II data by area, as well as ER-Ms, PELs, and two times the average upgradient concentrations for comparative purposes. The pre- and post-dredging concentrations of inorganics presented on Table 7-8D were generally comparable and had nearly no alternate guidelines.

These inorganics are generally ubiquitous chemicals, which may explain the consistency of concentrations temporally. They are also associated with low ecotoxicities. Some low, spotty detections of 4,4'-DDE and endosulfan I were detected in Phase III samples.

As was determined in the screening/Step 3A ERA, canal sediments do not appear to be impacted, nor do related risks appear to be present. Concentrations of both inorganics and organics in sediments were low. Potential risks associated with canal surface water appear to be relatively low, with the exception of mercury. The frequency of detection for mercury was generally low in Phase III sediment samples, especially in the northern and central sections where mercury was not detected in any samples, and no detected concentrations exceeded the Region 4 screening level.

Due to the semi-quantitative nature of this Phase III data discussion, a detailed evaluation of groundwater data will not be performed. Section 5.3.2 presents a thorough evaluation of Phase III groundwater data and a discussion of the potential impacts of site groundwater to site surface water, including the canal. In short, it was determined from the Phase III data that the landfill has likely impacted the surficial aquifer, which has resulted in at least some groundwater discharge of inorganics from the surficial aquifer to the canal.

TABLE 7-8C

COMPARISON OF PHASE III CANAL SURFACE WATER DATA TO PHASE I/II
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Parameter	Maximum Detected Concentration in the Canal - North Section	Maximum Detected Concentration in the Canal - Central Section	Maximum Detected Concentration in the Canal - South Section	Phase I/II Maximum Detected Concentration in the Canal - North Section	Phase I/II Maximum Detected Concentration in the Canal - Central Section	Phase I/II Maximum Detected Concentration in the Canal - South Section	FDEP Water Quality Standard	2X Average Upgradient Concentration
bis(2-ethylhexyl)phthalate	6.6	4.90	4.30	ND	10.30	ND	3.00	9.60
Aluminum	638	819.00	1810.00	22600.00	18200.00	87000.00	NA	1360.00
Barium	24	28.10	45.70	118.00	49.00	524.00	NA	40.10
Chromium	ND	ND	14.50	29.20	ND	24.20	11.00	ND
Iron	1180	1510.00	2340.00	49000.00	12000.00	149000.00	1000.00	1542.00
Lead	1.2	ND	7.30	41.10	34.90	109.00	NA*	ND
Manganese	12.5	19.70	10.90	136.00	47.70	419.00	NA	85.90
Mercury	8.37	2.86	4.62	0.18	0.16	0.16	0.01	0.01
Vanadium	8.1	5.00	11.00	272.00	33.30	77.90	NA*	ND

NA = Not Available or Not Applicable
ND = Not Detected
*calculated using site-specific water hardness
Units in μg/L

TABLE 7-8D

COMPARISON OF PHASE III SEDIMENT DATA TO PHASE I/II AND ALTERNATE GUIDELINES
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Parameter	Maximum Detected Concentration in the Canal - North Section	Maximum Detected Concentration in the Canal - Central Section	Maximum Detected Concentration in the Canal - South Section	Phase I/II Maximum Detected Concentration in the Canal - North Section	Phase I/II Maximum Detected Concentration in the Canal - Central Section	Phase I/II Maximum Detected Concentration in the Canal - South Section	2X Average Upgradient Concentration	Effects Range-Median	FDEP Probable Effects Level
Organics (ug/kg)									
4,4'-DDE	3.4	8.20	ND	ND	ND	ND	ND	27.00	374.00
Endosulfan I	ND	2.10	ND	ND	ND	ND	ND	NA	NA
Inorganics (mg/kg)									
Aluminum	2070	5970.00	6490.00	1230.00	5620.00	7170.00	2959.00	NA	NA
Antimony	ND	0.30	ND	ND	ND	ND	ND	25.00	NA
Barium	7.1	30.10	30.40	20.20	102.00	725.00	13.90	NA	NA
Beryllium	ND	0.81	ND	ND	ND	ND	ND	NA	NA
Cobalt	ND	ND	ND	ND	ND	ND	ND	NA	NA
Iron	666	1200.00	519.00	710.00	8.37	606.00	859.00	NA	NA
Manganese	8.9	7.00	ND	4.60	1.80	1.60	ND	NA	NA
Selenium	ND	0.87	ND	0.66	1.00	ND	0.69	NA	NA
Vanadium	27.1	17.60	5.10	24.90	14.00	5.60	3.65	NA	NA

NA = Not Available or Not Applicable
ND = Not Detected

In summary, it appears that some aquatic risks are present from mercury in canal surface water. Groundwater discharge from the surficial aquifer is likely the source, as no substantive runoff of chemicals from surface soil is apparent. Further, the upgradient surface water and sediment concentrations are low, indicating that upgradient influences are minor. There do not appear to be any risks associated with canal sediments. The results of the ERA and the Phase III data also suggest that surface water inorganics are not accumulating in sediments. Also mentioned earlier is the marginal and limited nature of aquatic habitat in the canal. The canal is relatively narrow (less than 20 feet), shallow (2 feet or less), and stagnant with generally low water flow. Some aquatic vegetation is present, but the canal serves mainly as a runoff catch system. Note also that the canal is dredged periodically, significantly disturbing the available habitat.

As a result of the absence of good quality and quantity of habitat in the canal, potential ecological risks from mercury associated with OU 2 are more salient to downgradient Lake Gillooly. Mercury was detected in an elevated concentration (0.92 μg/L) in Phase III surface water sample SW021, which was collected in the canal a few hundred feet upgradient of Lake Gillooly. However, this concentration was less than the other detected concentrations in Phase III south section surface water samples, suggesting a decreasing gradient. Mercury was not detected in Phase I and Phase II surface water sample SW021, although the detection limit was somewhat high (0.2 μg/L). Mercury was not detected in Phase III sediment sample SD021 (detection limit 0.02 mg/kg). It was also not detected in Phase I and Phase II sediment sample SD022, which was collected in Lake Gillooly near the canal's discharge point into the lake (detection limit 0.05 mg/kg). No Phase III sample was collected in Lake Gillooly because this area was not dredged. Zinc was the only chemical detected in the Phase I and Phase II Lake Gillooly surface water sample that exceeded the Region 4 screening level of 58.9 μg/L, but this detection (69.2 μg/L) only slightly exceeded that value. It should be noted that no Phase III surface water hardness data were available to help interpret the site-specific toxicity of surface water inorganics.

For these reasons, it does not appear that mercury (or other OU 2-related chemicals) has migrated to any appreciable degree to Lake Gillooly, although occasionally elevated detection limits add some uncertainty to this conclusion. Mercury was not widespread or substantially elevated in OU 2 groundwater samples. Again, although some exceedances of Region 4 screening levels were present in Phase III surface water and immediately upgradient and in Lake Gillooly, both the surface water and sediment data collected near and in Lake Gillooly indicate that no OU 2 chemicals have appreciably migrated from the canal to the lake. That is, no unacceptable risks appear to be present in the Lake Gillooly from OU 2-related samples as evidenced by the canal surface water and sediment samples collected in the lake and immediately upgradient of the lake.

7.9 UNCERTAINTY ANALYSIS

Uncertainty is associated with all aspects of the ERA process. This section provides a summary of the general uncertainties involved in this ERA, with a discussion of how they may affect the final risk values and conclusions. Several of the sources of uncertainty discussed below overlap with the risk characterization considerations described above. Site-specific uncertainties are also discussed below.

Once an ERA is complete, the results must be reviewed and evaluated to identify the types and magnitudes of uncertainties involved. Relying on results from a risk assessment without consideration of uncertainties, limitations, and assumptions inherent in the process can be misleading. If numerous conservative assumptions are combined in the ERA process, the resulting calculations will propagate the uncertainties associated with each of those assumptions. The resulting bias is toward overpredicting risks. Thus, both the results of the risk assessment and the uncertainties associated with those results must be considered when making risk management decisions.

Generally, risk assessments carry two types of uncertainty: measurement and informational. Measurement uncertainty refers to the variability inherent in measured data. The risk assessment reflects the accumulated variances of the individual values used for several different parameters. Informational uncertainty stems from the limited availability of necessary information. Often the gap between what is needed and what is available is significant; information regarding the effects of some chemicals on wildlife receptors, the biological mechanism of a chemical, the impact of physiological differences on exposure pathways, or the behavior of a chemical in various environmental media is often absent.

Uncertainty is associated with each of the steps of the risk assessment process:

- Uncertainty in preliminary problem formulation can result from limited information regarding chemical sources, release mechanisms, exposure routes, and receptors present, especially as these issues relate to endpoint selection.

- Uncertainty in the ecological effects characterization arises from the quality of the existing screening values and toxicity data to support a determination of potential adverse impacts to ecological receptors.

- Uncertainty associated with the exposure assessment includes the methods used and the assumptions made to determine exposure point concentrations or calculate chemical doses.

- Uncertainty in risk characterization includes that associated with combining conservative assumptions made in earlier activities.

7.9.1 Uncertainty in the Preliminary Problem Formulation

Since landfilling has not occurred at the site in several years, the potentially impacted areas are difficult to define. The extent and type of all activities that could have occurred at the site may not be fully known because several years have passed since operations were conducted. Also, because the site is large and contains a wide variety of habitats, difficulties arise when selecting proper assessment endpoints.

Uncertainties are inherent also in the site conceptual model. In particular, there are uncertainties associated with the source/chemical transport aspects of the conceptual model. This is mainly due to the hydrogeological conditions at OU 2. The interaction of surface water, surface water bodies, and groundwater recharge at the site is complex. Although extensive hydrogeological study at OU 2 has greatly elucidated conditions at the site, the amount of, types of, and locations of groundwater discharge are not fully known. This leads to uncertainties when discussing potential chemical exposures for OU 2 aquatic and semi-aquatic receptors.

7.9.2 Uncertainty in the Ecological Effects Characterization

A great deal of uncertainty in this risk assessment arises from the nature and quality of the available toxicity data used to derive guidelines. This uncertainty is reduced when similar effects are observed across species, strain, sex, and exposure route; when the magnitude of the response is clearly dose related; and when mechanisms of toxicity are similar for laboratory and wildlife species. Most guidelines are based on conservative assumptions. Although an inherent level of conservatism is needed in a screening level ERA to ensure that the most sensitive receptors are protected, conservative guidelines may heavily overestimate potential risks and the resulting HQ values may be misleading. Region 4 screening levels and the NOAELs and LOAELs used in this assessment are based on laboratory studies that do not consider mitigating or ameliorating physical and chemical conditions in the environment. That is, the most bioavailable (i.e., toxic) form of the chemical is usually applied to the exposure medium. In reality, bioavailability is rarely, if ever, 100 percent.

Conservative guidelines for surface water are set to protect the majority of aquatic organisms from adverse effects on growth, survival, and reproduction. The laboratory testing that is used for the development of guidelines generally uses the most toxic form of the element (ionic species derived from a inorganic salt such as $AgNO_3$ or CuCl). These guidelines overestimate toxicity by not considering the speciation of the inorganic

in a natural water system. USEPA has begun to recognize that other factors such as hardness and organic carbon (OC) concentrations have an effect on the toxicity of an inorganic. USEPA has incorporated hardness coefficients into the freshwater guidelines for many inorganics, but coefficients for OC have yet to be proposed.

Several chemicals were present in sediments and surface soils for which no toxicity data were available. These chemicals were selected as COPCs. In general, these chemicals were antimony, barium, manganese, thallium, vanadium, acetone, and toluene. To a lesser degree, aluminum and iron were among these chemicals as well. These chemicals are not usually associated with ecotoxicity and the inorganics were comparable to background concentrations in soils in most instances. They were dismissed in nearly all instances for these and other site-specific reasons (e.g., low frequency of detection). Nevertheless, without adequate toxicity data their ecotoxicity cannot be fully assessed.

Uncertainties are associated also with the absence of toxicity data for the essential nutrients discussed in Section 7.2.4. As mentioned in Section 7.2.4, toxicity data for these compounds are scarce, but available data and information suggest that these chemicals can be tolerated by most organisms at relatively high doses. Thus, it is unlikely that these chemicals could pose risks at OU 2, but these risks cannot be fully determined for the site without adequate toxicity data.

As mentioned earlier, little data for investigating dietary exposures and related risks to reptiles and amphibians are available. USEPA (1993) presents input parameters for a small number of reptiles and amphibians, including a few species of turtles, snakes, a newt, and two species of frogs. Nevertheless, the absence of toxicity data for these species precludes modeling of potential risks to them. As a result, direct conclusions about the potential risks to reptiles and amphibians cannot be made, and only qualitative inferences can be drawn. Given the generally elevated concentrations of several inorganics in surface water, aquatic herptiles could be at risk. Sediment chemicals do not appear to pose potential risks to aquatic herptiles. Inorganics in surface soils do not appear to pose potential risks to terrestrial herptiles, with the possible exception of lead and zinc in the central section of OU 2. PAHs and some pesticides could pose some risks to terrestrial herptiles, but elevated concentrations are present in only a few areas, including the southwestern and northwestern portions of the central and southern sections, respectively, and an area in the middle of the southern section.

In addition, ERAs, unlike HHRAs, must consider risks to many different species. Calculation of risk values for every potential receptor species is not possible. For this ERA, conservative guidelines protective of a wide range of ecological receptors were sought. The underlying assumption associated with the use of these guidelines is that chemical concentrations in excess of these values are indicative of potential impacts to

actual receptors inhabiting the area. However, species-specific physiological differences that may influence an organism's response to a chemical or subtle behavioral differences that may increase/decrease a receptor's contact with a chemical are seldom known. Also, some chemicals were present in sediments for which no suitable guidelines were available and, as a result, they could not be quantitatively assessed. The use of guidelines, while necessary, will introduce error into the results of an assessment.

7.9.3 Uncertainty in the Exposure Assessment

Uncertainty in the exposure assessment arises mainly in the methods used to obtain exposure point concentrations. The maximum detected chemical concentrations were generally used to represent the highest chemical concentrations to which ecological receptors might be exposed. If the samples evaluated in this ERA are representative of chemical concentrations associated with the sites, then this approach is conservative and should overestimate potential risks to ecological receptors. The maximum concentration of a chemical in a given medium may have been collected in a "hot spot" of contamination, and may be much higher than the remaining values in the data set. Although use of maximum values is appropriate for screening in an ERA, they may grossly overpredict potential risks. To somewhat mitigate these uncertainties, average concentrations were also used, but they do not fully account for the uncertainties involved in selecting exposure point chemical concentrations.

Nonetheless, the uncertainties related to the location of samples was reduced in this ERA by the generally large number of samples collected. Grids were established on each section which resulted in the collection of a large number of surface soil samples and excellent areal coverage of each section. Thus, the average concentration in surface soils for each section is probably a relatively accurate estimate of average exposure. Moreover, at least one surface water/sediment sample was collected in every pond on OU 2. Several samples were collected along the entire length of the canal that borders the entire eastern half of the site, including areas upgradient and downgradient of OU 2. This reduces the chances that areas with elevated concentrations of chemicals were missed during sampling.

Dermal exposure is usually limited by the outer coverings of most receptors. Nevertheless, certain portions of some receptors, such as foot pads, eyes, and the nose do not contain fur or feathers, for example, and may have a higher chance of exposure. Yet, these areas generally constitute a small portion of the total surface area of most receptors. Some of the elevated concentrations of inorganics in surface water and PAHs/pesticides in surface soil could increase the potential risks from dermal exposure. Exposure to soils would probably be limited due to outer coverings such as fur and feathers, but surface water can reach the dermis regardless of outer coverings.

Inhalation of chemicals is assumed to be miniscule. Airborne aerosols, particulates, and vapors are not assumed to be applicable for aquatic media. As mentioned earlier, bare soil is minimal at the site. As a result, airborne particles contaminated from site sources would be expected to be minimal. Concentrations of VOCs in surface soils at OU 2 were low. The PAHs and pesticides detected have high Henry's Law constants and hence do not volatilize easily. They also have high affinities for organic carbon, which would preclude significant volatilization. Burrowing wildlife would be expected to have a higher probability of inhalation exposure, but data regarding inhalation exposure and toxicity for wildlife were not available. The factors discussed above would be expected to reduce the chances of exposure for burrowers.

In summary, dermal and inhalation exposures for terrestrial and semi-aquatic receptors were not evaluated in this ERA. As discussed in Section 7.2.3 and above, these exposure routes are assumed to be miniscule, but since they cannot be quantitatively assessed, only limited, qualitative conclusions regarding their significance can be drawn and uncertainties remain.

Uncertainty is also associated with the omission of literature-based BAFs from the screening level food chain modeling. USEPA ERT is currently advocating the use of BAFs of 1.0 in the screening level food chain modeling. This can lead to both over- and underestimation of potential risks. For example, compounds such as mercury, lead, pesticides, and PCBs can bioaccumulate significantly. When BAFs of 1.0 are assumed for those compounds, potential risks may be underestimated. In contrast, some inorganics and organic compounds have BAFs much less than 1.0. In those instances, potential risks may be overestimated. Note, however, that the concentrations of mercury, lead, pesticides, and PCBs in sediments and surface soils were not generally elevated (one elevated detection of Aroclor-1260 was present in OU 2A sediments). Therefore, the uncertainties associated with using 1.0 as BAFs or for those compounds may not be of significance.

Note also that the quantitative background comparisons were used in the screening as per previous discussions with Region 4 USEPA and to conform with previous ERAs performed for NTC Orlando. Although background comparisons are now viewed to be more appropriate as part of Step 3A, they were retained in the screening in this ERA due to past agreements and because the use of background in the screening had little effect on the assessment of risks. That is, background comparisons were used for surface soil inorganics only and few chemicals were dismissed as a result of these comparisons.

As a matter of note, certain radionuclides were analyzed for in OU 2 media. Based on the data available to date, it has been determined that it is unlikely that the radionuclides detected in site media are a result of the landfill or landfill processes. A detailed discussion of radionuclides in OU 2 samples is provided in Section 5.6.

7.9.4 Uncertainty in the Risk Calculation

Uncertainty in the risk characterization is affected by all aspects of the ERA process described in the above sections. Uncertainty in risk characterization also stems, in part, from combining different components of the ERA in this step. Each of those components already contains uncertainty. Thus, uncertainties may be propagated when these components are combined. To try to reduce the overall uncertainty in the risk assessment, the weight of evidence approach is used to make risk decisions. This approach takes the results of all aspects of the assessment into account, including the uncertainties, to make determinations of potential risk/no risk.

7.10 ECOLOGICAL RISK ASSESSMENT SUMMARY

7.10.1 Northern Section

All of the maximum concentrations of the inorganics that exceeded Region 4 screening levels in surface water (Phase I and Phase II samples), except for zinc, were detected in a sample that was collected in the drainage ditch along the northeastern border of OU 2. The elevated concentrations of chemicals in this sample may be a result of upgradient influences, but are more likely due to groundwater discharge from the surficial aquifier. Also, the ditch contains aquatic vegetation, but standing water is present only after periods of rainfall. Thus, the ditch does not contain a diverse or abundant aquatic community. Besides the maximum concentrations, a few other detections of inorganics are higher than their Region 4 screening levels, indicating that some risks to aquatic receptors are present. No organics had maximum concentrations in surface water that exceeded Region 4 screening levels. In general, concentrations of chemicals in northern section Phase III surface water samples were much lower than in Phase I and Phase II samples.

Several inorganics had maximum concentrations in groundwater that exceeded Region 4 screening levels. Some of these inorganics significantly exceeded surface water screening levels, and all of these inorganics were elevated in surface water. Yet, none of these inorganics were elevated in northern section sediments relative to screening levels. The reason for this is unclear, but it may be the result of dilution of chemicals in groundwater upon discharge to surface water. It does appear that groundwater may be a source of inorganics in surface water.

No inorganics had maximum concentrations in northern section sediments in excess of Region 4 screening levels. As a result, northern section sediments do not appear to be a source of the elevated inorganics in

northern section surface water, nor does it appear that deposition of inorganics to sediments is occurring. However, background data would be more appropriate for use in determining if sediments are a source of or sink for surface water inorganics because sediment screening levels are based on effects only. No site-specific sediment background data were available. Alpha- and gamma-chlordane were detected in one sediment sample and in excess of Region 4 screening levels but were less than all of the less conservative guidelines presented in this ERA. As with the elevated inorganics in surface water, the maximum concentrations of these two chemicals could be due to upgradient sources.

A few inorganics had maximum concentrations that exceeded screening levels in northern section surface soils. However, their HQs were relatively low, frequencies of detection were generally low, and the maximum concentrations were below nearly all of the alternative guidelines available.

The maximum concentrations of several PAHs in northern section surface soil exceeded Region 4 screening levels. All of the maximum concentrations for the PAHs were in one sample (S103), which was collected just north of the middle of the hole 7 fairway. Ten of the 12 PAHs with maximums in excess of screening levels were detected only in that sample. The other detections of PAHs were in the same order of magnitude as the Region 4 screening level, and the maximum concentrations of PAHs were lower than most of the alternate guidelines presented.

The maximum concentrations of the pesticides and daughter products 4,4'-DDE, 4,4'-DDT, and dieldrin exceeded Region 4 surface soil screening levels. Dieldrin and 4,4'-DDT were detected only in 1 of 34 samples. The only alternate guideline for 4,4'-DDE and 4,4'-DDT (combined) is orders of magnitude higher than the concentrations of these two compounds combined. No alternate guidelines were available for dieldrin, although the one detection of this compound appears to be qualitatively low (0.003 mg/kg). Other pesticides were detected and no Region 4 screening levels were available for them, but they were detected only in 1 of 34 samples at concentrations that qualitatively appear to be low (0.019 mg/kg or less).

Mercury, vanadium, three PAHs, and three pesticides had at least one HQ greater than 1.0 using maximum concentrations in the terrestrial food chain modeling. Only one organic had an HQ greater than 1.0 using average concentrations. Frequencies of detection for organics in surface soil were low. The exception was 4,4'-DDT, which had an average concentration HQ greater than 1.0, but the HQ was relatively low. Mercury was detected only in 2 of 34 surface soil samples at a maximum of 0.22 mg/kg. Aluminum and vanadium had at least one HQ greater than 1.0 using both maximum and average concentrations in the semi-aquatic food chain modeling. Also, several conservative assumptions were used in the food chain modeling. If more realistic assumptions were used, HQs would likely drop.

7.10.2 Central Section

Several inorganics and one phthalate had maximum concentrations that exceeded surface water screening levels (Phase I and Phase II samples). Detections of some of the inorganics other than the maximums exceeded Region 4 screening levels as well, indicating potential risks to aquatic receptors. Several inorganics had maximum concentrations in central section groundwater in excess of Region 4 surface water screening levels, suggesting possible discharge to surface water. Yet none of these inorganics was elevated in sediments. Again, it may be due to dilution of chemicals in groundwater upon discharge to surface water. No organics were elevated in central section surface water. In general, concentrations of chemicals in northern section Phase III surface water samples were much lower than in Phase I and Phase II samples.

Again, central section sediments do not appear to be a source of the elevated inorganics in central section surface water, but this conclusion is based on exceedances of screening levels only. Comparisons to background would be a more appropriate indicator of sediments as a source of, or sink for, surface water inorganics. The pesticide daughter product 4,4'-DDE was the only chemical in central section sediments that exceeded its Region 4 guideline. It was detected only in 1 of 13 samples at a concentration less than all of the alternative guidelines presented.

Several inorganics had maximum concentrations in central section surface soils that exceeded 2 times average background and Region 4 screening levels. The HQs were all relatively low (2.1 or less), the other detections were generally lower than their Region 4 screening levels, and the maximum concentrations were generally less than alternate guidelines.

Thirteen PAHs and pentachlorophenol had maximum concentrations in central section surface soils in excess of Region 4 screening levels. The maximum concentrations of all of these compounds were in sample S04, which was collected at the extreme western edge of OU 2. Detections of PAHs other than their maximum concentrations were much less than the maximum concentrations. Pentachlorophenol was detected in 2 of 37 samples; the second detection was an order of magnitude less than the maximum. Yet, several detections of PAHs other than the maximums and the second highest detected concentration of pentachlorophenol still exceeded Region 4 screening levels. Nevertheless, the majority of PAH detections and the second highest pentachlorophenol value were less than, or comparable to, alternate guidelines. The highest alternate guideline for total PAHs was exceeded only in sample S04.

The pesticides and daughter products 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, and dieldrin had maximum concentrations in excess of Region 4 screening levels. Similar to PAHs, the maximum concentrations of 4,4'-DDE, 4,4'-DDT, and dieldrin were in sample S04. All of the other detections of these compounds except

one (sample S30) were an order of magnitude less than the maximums. Aldrin and 4,4'-DDD were detected only in 1 of 37 samples. The only alternate guideline for total 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT was orders of magnitude higher than the maximum total for these compounds. No Region 4 or alternate guidelines were available for several compounds including some pesticides. The maximum concentrations of these compounds were in sample S04.

Using maximum and average concentrations, several inorganics had at least one HQ greater than 1.0 for the terrestrial food chain modeling. Based on frequencies of detection, magnitude of HQs, and other factors, some potential food chain risks may exist from lead and zinc, primarily risk to small mammals.

Several PAHs and pesticides/daughter products had at least one HQ greater than 1.0 using maximum concentrations. Yet, no organics had an HQ greater than 1.0 using average concentrations. Detections of PAHs other than the maximum concentrations were much less than the maximum concentrations. 4,4'-DDD, 4,4'-DDT, and 4,4'-DDE all had at least one HQ greater than 1.0 using maximum concentrations. All of the other detections of 4,4'-DDT and 4,4'-DDE, except one, were an order of magnitude less than the maximums. 4,4'-DDD was detected only in one sample. The maximum concentrations of all other pesticides and daughter products with HQs greater than 1.0 had maximum concentrations in S04 and much lower concentrations in the other samples. No chemicals of ecotoxicological significance had HQs greater than 1.0 using maximum concentrations in the semi-aquatic food chain modeling.

7.10.3 Southern Section

Several inorganics had maximum detected concentrations that significantly exceeded surface water screening levels (in the canal). The other detections of all of these inorganics were half the maximums or less, although a few other detections of these inorganics exceeded Region 4 screening levels. As a result, potential risks could be present to aquatic receptors in the canal along the southern section of OU 2. The maximum concentrations of nearly all inorganics from Phases I and Phase II were in sample SW021. Sample SW021 was collected off-site east of Tradeport Drive immediately upgradient of Lake Gillooly. However, all of these inorganics were below Region 4 screening levels in the Phase III SW-021 sample. It is possible that the elevated concentrations of inorganics in this sample are due to off-site influences, although no major sources other than Tradeport Drive itself are evident. The inorganics are more likely a result of groundwater discharge from the surficial aquifer. No organics were detected in southern section surface water.

Several inorganics had maximum concentrations in southern section groundwater in excess of Region 4 surface water screening levels. Several of these chemicals were elevated in southern section surface water, suggesting possible discharge to surface water in the canal. As with the northern and central sections of

OU 2, no analytes in southern section sediments that were elevated in surface water exceeded Region 4 screening levels. It appears that southern section groundwater could be a source of inorganics to surface water.

Several inorganics had maximum concentrations in central section surface soils that exceeded 2 times average background and Region 4 screening levels. HQs were relatively low, frequencies of detection for some of these chemicals were low, and maximum concentrations of chemicals that had alternate guidelines available were generally lower than these guidelines.

Twelve PAHs and pentachlorophenol had maximum concentrations in southern section surface soils in excess of Region 4 screening levels. The maximum concentrations of all of these compounds were in samples H28 and S02, which were collected in the middle and at the extreme western edge of OU 2, respectively. Nearly all PAH detections were limited to three samples: H28, H29, and S02. Concentrations in H29 were generally less than in H28 and S02. Sample S02 was collected near sample S04 from the central section, which had elevated concentrations of PAHs. Most of the maximums slightly exceeded some alternate guidelines. The highest alternate guideline for total PAHs was not exceeded. Pentachlorophenol was detected in 2 of 45 samples. Its maximum is orders of magnitude less than all of the alternate guidelines available.

The pesticides and daughter products 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, endrin, and dieldrin had maximum concentrations in excess of Region 4 screening levels in surface soils. For the most part, frequencies of detection were low and no clear pattern of elevated contamination exists for these compounds. Maximums for individual chemicals were scattered over several samples that were not collected near each other. This would be expected given the likely widespread use of these compounds historically. There was no widespread prevalence of exceedances throughout the site for any of these compounds. The only alternate guideline available was for total 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT, and it was orders of magnitude higher than the maximum total of these compounds. No Region 4 or alternate guidelines were available for some other pesticides, but they had low frequencies of detection and no distinct pattern of contamination was evident. No alternate guidelines were available for these compounds.

Using maximum concentrations, the inorganics aluminum, barium, and mercury had at least one HQ greater than 1.0 for the terrestrial food chain modeling. Mercury was detected only in 2 of 45 samples, minimizing the potential for widespread risks via the food chain. The maximum concentration of barium in surface soils (177 mg/kg) is much higher than the other detections; all of the other detections are less than the Region 4 surface soil screening value.

Four PAHs and two pesticides had at least one HQ greater than 1.0 using their maximum concentrations. HQs for PAHs were low (2.92 or less) and none had an HQ greater than 1.0 using average concentrations. The HQs greater than 1.0 are probably due to the elevated concentrations in sample H28, which are much higher than the other detections. Only 4,4'-DDT had an HQ greater than 1.0 using average concentrations, and it was relatively low (3.95). This reflects the fact that the other detections of this compound are much lower than the maximum. As mentioned above, no clear pattern of elevated pesticide contamination exists in the southern section of OU 2.

7.11 RISK MANAGEMENT ACTIVITIES

Subsequent to the completion of the draft RI, several risk management activities have been conducted on OU 2. This was done as part of an expedited risk management effort for OU 2. These risk management activities have mitigated the potential ecological risks from each of the hot spots of contamination for surface soil that were identified in the ERA. Figure 3-7 presents an overlay of the surface soil sampling locations for OU 2 on the areas of the OU that have been remediated. The text below describes these surface soil hot spots and related sampling locations in relation to the risk management activities that have been conducted.

Several elevated detections of PAHs were present in sample S103, which was located in the southern portion of the northern section of OU 2. Several PAHs had elevated HQs in the food chain modeling, and these risks were driven by the elevated concentrations of PAHs in S103. An IRA was conducted in the area around and including sample S103, which consisted of excavation of PAH-contaminated surface soils (Figure 3-7).

In the central section of OU 2, a hot spot of contamination existed at S04. Elevated detections of several PAHs and pesticides were present in this sample, as well as elevated lead and zinc. Food chain risks were present in the central section of OU 2 and were primarily driven by the elevated detections of these chemicals in S04. A soil cover was placed across the area represented by S04 as part of IRA activities for OU 2 (Figure 3-7). This consisted of placing a 2-foot soil cover over the area, eliminating exposure to surface soil chemicals for nearly all types of ecological receptors. The bottom 6 inches of the soil cover was obtained from the main portion of the base, while the top 1.5 feet was State of Florida "clean soil."

Potential ecological risks were present in southern section surface soils and were driven by hot spots of PAH contamination in samples H28, H29, and S02. Some food chain risks were present in the southern section and were mainly due to the hot spots of PAH contamination at the these sample locations, as well as well as by hot spots of barium (sample H14) and mercury (sample H23). A soil cover like the one mentioned above

extended over a large portion of the southern section of OU 2 that including each of the hot spots associated with ecological risks (Figure 3-7).

As discussed earlier, the southern section of OU 2 provides gopher tortoise habitat, and records of gopher tortoise activity exist for this area. To minimize the risks to the gopher tortoise from IRA activity in this area, a gopher tortoise survey was conducted by a Tetra Tech NUS ecologist in April 1999. Two active, one inactive, and 13 abandoned burrows were observed in the southern section of OU 2 during the survey. Prior to initiation of the interim remedial actions, Bechtel Jacobs Company LLC initiated a gopher tortoise trapping and relocation effort (in June 1999). Bucket traps were used to collect tortoises. One tortoise was collected on-site and one was found crossing the access road used for remedial construction equipment. Both tortoises were relocated to an adjacent area not affected by remedial activities. The trapping and relocation were conducted under a permit issued by the FGFWFC and in consultation with the FNAI.

Furthermore, a wetlands survey was conducted on the southern portion of OU 2 in December 1998 by a Tetra Tech NUS ecologist to determine if remedial activities could affect wetlands in the area. Two forested wetlands were noted in the area, but both were outside the general area of the remedial activities.

The gopher tortoise survey report, gopher tortoise trapping and relocation report, and the wetlands survey report are appended to the USEPA/FDEP comment response letter provided by the Navy for OU 2, dated August 31, 1999.

7.12 OVERALL ECOLOGICAL RISK SUMMARY AND CONCLUSIONS

The northern, central, and southern sections of OU 2 are somewhat disparate ecologically. As a result, the receptors prevalent on each portion of OU 2 vary, and difficulties arise when determining overall risks for OU 2. The northern section is mostly golf course grounds, the canal along the eastern border of OU 2, and some ponded water. The central section is comprised of the golf course and the canal as well, but contains a system of ponds and forested wetlands. The southern section is almost entirely wooded, mainly upland, with some forested wetland areas interspersed among the upland areas.

On the whole, most of the terrestrial risks are driven by hot spots of contamination, primarily in one or two adjacent samples. These include hot spots of PAH contamination in all three sections, but mainly in the southern section. Hot spot removals and a soil cover placed in the areas have reduced these risks.

Some food chain risks were present in all sections from inorganics, PAHs, and pesticides. Yet ,most of these risks were driven by localized, elevated concentrations of chemicals. For the most part, the localized, elevated detections of metals in surface soils do not appear to pose potential food chain risks at the population or community level, especially after the risk management activities were implemented. Therefore, the assessment endpoints for terrestrial receptors do not appear to be compromised and additional risk management appears to be unwarranted.

The only pervasive risks throughout the OU appear to be in the canal (Table 7-12). Concentrations of several inorganics in surface water were elevated throughout the canal's length along OU 2. Most of the elevated detections in Phase I and Phase II surface water samples were less in Phase III samples, with the exception of mercury. The elevated detections of inorganics in groundwater suggest that groundwater under the operable unit in the surficial aquifer is most likely the source. Concentrations of inorganics in sediments did not appear to be elevated in any of the waterbodies on and downgradient of OU 2, including samples collected in Lake Gillooly and immediately upgradient of the lake. It is possible that concentrations of inorganics are not elevated in canal sediments due to periodic dredging of those sediments, but the inorganic concentrations in OU 2 ponds (which could possibly receive groundwater discharge) do not appear to be elevated, and these waterbodies have not been dredged. Several of these waterbodies are wetlands. Thus, accumulation of inorganics in wetland sediments does not appear to be occurring.

TABLE 7-12

STEP 3A ECOLOGICAL RISK SUMMARY
OPERABLE UNIT 2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Location	COPCs	Medium	Suspected Source
Northern Section	Several inorganics	Surface water	Groundwater discharge
Central Section	Several inorganics	Surface water	Groundwater discharge
Southern Section	Several inorganics	Surface water	Groundwater discharge

Although elevated concentrations of inorganics, mainly mercury, were present in canal surface water during all three phases of sampling, the canal contains limited habitat in both quantity and quality. The canal empties into Lake Gillooly south of OU 2. Sampling in the lake suggests that inorganics have not migrated to the lake to any appreciable degree. For these reasons, although potential risks may be associated with canal surface water, no remedial activity or additional ecological study is recommended.

8.0 CONTAMINANT FATE AND TRANSPORT

This section discusses the origin, transport, and fate of contaminants that were detected during the RI to be present within the environmental media at OU 2. The former landfill at OU 2 is considered to be a primary source of many of the contaminants that were detected; however, the subsequent urban development of the area and the construction and maintenance of a golf course over a large portion of the site are also considered to be potential contributors for some contaminants.

The affected media at OU 2 include surface soil, surface water, sediment, and groundwater. Because landfill materials were buried in trenches or pits that intercept the water table, the most significant source of contaminants lies beneath the ground surface. A portion of the source material is in direct contact with groundwater in the surficial aquifer, and migration via the groundwater pathway is a major concern.

Phase III sampling and analyses included groundwater, surface water, and sediment samples to address data gaps and uncertainty issues (see Section 3.0). For groundwater, both Phase II and Phase III results are considered in this fate and transport analysis, with the exception that the Phase II inorganic and radiological results are superceded by the Phase III results. Combined in this manner, the groundwater data represent the most current data set without the effects of sample turbidity (mainly on inorganics and radionuclides) that occurred with the Phase II data. For surface water and sediment, the Phase III data replace only the Phase II data collected along the dredged portions of the canals; therefore, combined Phase II and III data are used as appropriate.

8.1 CONTAMINANT SOURCES

Evaluation of the data collected during the RI suggests that the landfill is the primary source for organic (i.e., VOC and SVOC) and inorganic contaminants in groundwater, for PAHs in surface soils, and for inorganic contaminants in sediment and surface water. The landfill is also possibly a secondary source for inorganics in surface soil. Organics and inorganics are being transported with groundwater flow toward the canals. Concentrations of organic contaminants above screening levels are more pronounced in the lower portion of the surficial aquifer (i.e., intermediate wells). This may be a result of waste burial beneath the water table and the

slight downward gradient in the surficial aquifer beneath the landfill. Also, the organic contaminants are likely to be more mobile in groundwater than the inorganic contaminants. The presence of a clay aquitard at the bottom of the surficial aquifer appears to provide an effective barrier to prevent deeper contaminant migration into underlying confined aquifers. Considering the age of the landfill, the reducing groundwater environment, and the short distance between the landfill and the canal, it is apparent that both organic and inorganic contaminants have been and are being discharged to the canals.

Because burning was reported to have occurred during the landfill operation, it is likely that the occurrence of PAHs in surface soils is related to the distribution of impacted soils during covering and closure of the landfill. These soils may also have been disturbed and/or redistributed during construction of the golf course. Final grading of the golf course, however, appears to have covered much of the impacted soils as evidenced by the absence of high concentrations of PAHs over most of the central areas of the golf course (see Figure 5-2). Evapotranspiration coupled with thin soil cover in some areas and a high water table may currently contribute to the migration of PAHs and of inorganics from landfill material or impacted soils to the present-day surface soils.

The RI data indicate that surface application (possibly including spillage and disposal) of pesticides at the golf course was the primary source for pesticides (and possible related inorganics) in surface soils. The high frequency of detection of pesticides in surface soils, their low frequency of detection in sediment, and their absence in surface water and groundwater are consistent with their surface application (in accordance with labeled instructions) at the golf course. The early years of operation of the golf course are likely to have included application of now-banned pesticides that are persistent in surface soils. Although pesticides are not likely to occur as dissolved species in groundwater, they are likely to occur in suspended sediment or colloidal particles suspended in the groundwater if they were present in the landfill material. The absence of pesticides in the groundwater samples, some of which contained relatively high turbidity when collected, therefore strongly suggests that these compounds are not a significant component of the landfill material. Because they are not present in groundwater, they are not present in surface water that is derived predominantly from groundwater discharge. The infrequent and widely spaced detections of pesticides in sediment, both in upstream and downstream locations, indicate that the current conditions reflect isolated and/or relic loci of contaminant transport and deposition in surface water bodies near the former landfill.

8.2 POTENTIAL ROUTES OF MIGRATION

The routes of contaminant migration depend on the past, current, and future physical conditions of the site. Between about 1960 and 1978 when the landfill was in operation, some site features are known to have been different. For instance, the southern extension of the canal that runs along the eastern perimeter of the southern portion of the landfill (i.e., wooded area) did not exist. Previous reports (e.g., Geraghty & Miller, 1986) indicate that this portion of the canal was constructed post-1986. The construction of the canal has likely impacted groundwater levels and flow direction in this portion of the site. Also, the condition of the ground surface and of surface vegetation was disrupted by the operation of the landfill.

Because details of the former site conditions and landfill operations are not known, interpretation of contaminant migration that has occurred to date is based on current conditions and the observed patterns of contaminants in environmental media. As a result, the interpretations presented below are qualitative in nature. Future land use is assumed to be consistent with current use. Therefore, the physical setting and migration pathways discussed below are based primarily on current conditions and qualitative interpretation of the past and future migration of contaminants based on their chemical and physical attributes and the environmental setting. The potential routes of contaminant migration are depicted in a conceptual model shown on Figure 8-2.

8.2.1 Physical Setting

OU 2 lies within the McCoy Annex approximately 8 miles south of the main base and immediately adjacent to the Orlando International Airport that lies to the east. Most of the land to the east, owned by the airport, was formerly owned by the Air Force. Land immediately to the north is owned by the Navy and includes residential facilities. Land to the west and south is zoned industrial, although no significant development exists. The RI conducted at OU 2 focused on the former landfill area that occupies about 99 acres. A nine-hole golf course occupies most of the northern, eastern, and central portions of the landfill area. Woods cover the remainder of the landfill area, to the south.

The surface of the golf course is relatively flat with gentle contouring used to direct surface water runoff away from the fairways and greens. The wooded area to the south is also relatively flat with poorly defined topographic variation. The banks of the canals are relatively steep.

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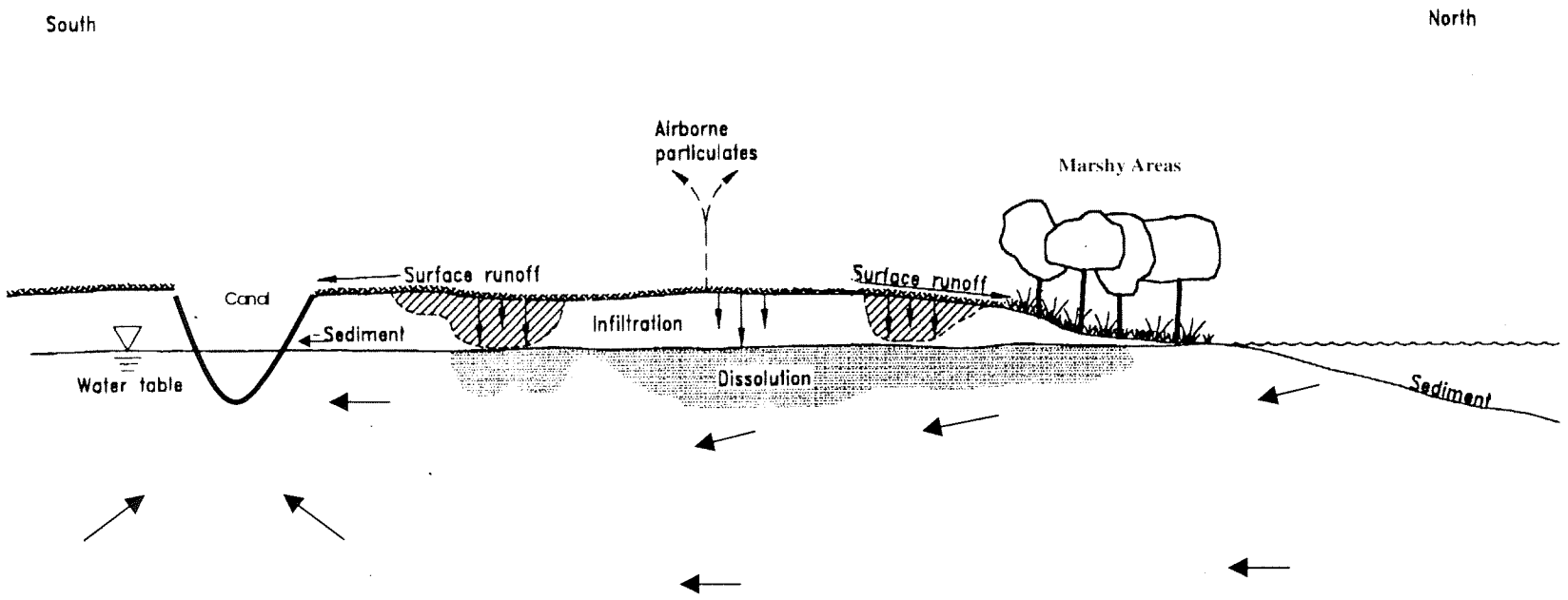

NOTES:

Vertical exaggeration exceeds horizontal.

Not to scale.

FIGURE 8-2

CONCEPTUAL MODEL OF
POTENTIAL CONTAMINANT MIGRATION
McCOY ANNEX LANDFILL
REMEDIAL INVESTIGATION

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Rev. 2
03/07/01

Man-made canals border the entire eastern perimeter of the landfill area. The southern portion of the canal adjacent to the wooded area appears to have been constructed post-1986, after closure of the landfill. The depth of the canals is sufficient to intercept the surficial aquifer water table, and groundwater discharges to the canals under most hydrologic conditions to supply a baseline flow. The banks and slopes of the canals are heavily vegetated. The canals receive surface water runoff from OU 2 and from off-site urban facilities (e.g., streets and storm drains) both upgradient and downgradient from the landfill area.

The golf course includes a number of water hazards (small ponds) and cypress swamps located between the fairways. The ponds appear to retain surface water runoff and may provide recharge to the surficial aquifer for some time following precipitation events. The site is underlain by a fine- to medium-grained sand aquifer to a depth of about 30 feet bgs. The water table was observed to be within 5 to 7 feet of the ground surface during the investigation. Primary recharge to the surficial aquifer occurs by infiltration and percolation of rainfall through the surface soils and through the buried landfill material. Some surface water recharge from the canals to the aquifer may occur for short periods during and following rainfall events, although no such events were documented during the investigation. The surficial aquifer is confined by a clay layer, typically 20 feet thick, that lies at a depth of about 30 feet bgs across the landfill area. The physical characteristics (e.g., low permeability) of this material, its apparent lateral continuity across the site, and hydrogeologic data presented in Section 2.2.3 suggest that this clay layer forms an effective barrier to prevent groundwater flow from the surficial aquifer to the underlying confined sand aquifer.

8.2.2 Migration Pathways

The surface of the landfill area is covered with vegetation. The area of the golf course is highly managed to sustain a surface cover of grasses. Peripheral areas are covered with natural vegetation that is sustained by a favorable climate (i.e., warm temperatures and adequate rainfall distributed throughout the year). Deed restrictions, because of the presence of the former landfill, and planned continued operation of the golf course should prevent significant disturbance to the surface vegetation. Therefore, current or future migration of contaminants as particulates via an airborne pathway is not considered further.

The surface runoff and infiltration of rainwater are the primary mechanisms for the migration of contaminants in surface soils. VOCs, if present in surface soil, may also migrate via volatilization and wind dispersion. Contaminants in surface soil may be eroded by surface runoff and be

carried while adsorbed to soil particles. This process facilitates lateral migration of soil contaminants primarily to low-lying areas, swales, ditches, and ultimately to ponds and canals where they may be incorporated into sediment. Dissolution of contaminants in surface soil into surface water runoff may also occur. This water is likely to flow into the canals. This process is likely at its peak during the June to September time frame when rainfall in the Orlando area is typically highest. Flow in the canals is generally to the south and southeast as it leaves the OU 2 area.

If runoff does not occur, then the primary migration mechanism for contaminants in surface soil is dissolution or leaching of contaminants with infiltration into the underlying soils or landfill material. The local soils, because of their permeable nature, provide good conditions to promote infiltration and percolation. If sufficient infiltration occurs to overcome the effects of evapotranspiration, then the contaminants may percolate to the shallow water table and be dispersed into the surficial aquifer.

The water table in the surficial aquifer is typically near the ground surface at OU 2. Because landfill materials were buried in trenches or pits that intercept the water table, the most significant contaminant migration pathway appears to be groundwater flow in the surficial aquifer. Flow in the surficial aquifer contains both horizontal and vertical components. Away from the canals, the gradients are small and contaminants are likely to migrate both horizontally and vertically. Close to the canals, the horizontal gradient increases and the vertical gradient reverses (i.e., becomes upward) as groundwater is discharged. The predominant flow direction across the landfill area is toward the canals where groundwater discharges. Because the landfill is close to the canals (i.e., less than about 100 feet in many areas), there is little likelihood that contaminant mass transported by groundwater will be greatly reduced by means of geochemical or biological processes. However, because of changes that may occur along the banks of the canals due to the sediment and surface water chemistry, there is potential for precipitation, absorption/adsorption, or dissolution of contaminants at the groundwater/surface water interface. Because the water table and landfill materials are relatively near the surface, the effects of evapotranspiration may also transport contaminants from the surficial aquifer up to the surface soils.

Surface water in the ponds and cypress swamps along the golf course is likely to recharge the surficial aquifer. Contaminated sediments that accumulate in these surface water bodies may also contribute contaminants to the groundwater recharge.

8.3 PERSISTENCE AND FATE OF CONTAMINANTS

8.3.1 Volatile Organic Compounds

A total of seven VOCs were detected in surface soils, 19 VOCs were detected in groundwater, one VOC was detected in surface water, and five VOCs were detected in sediment at OU 2 (see Tables 5-2C, 5-3E, 5-3J, 5-4B, 5-4D, 5-5B, and 5-5E). The frequency of detection of VOCs in all media was low (10 percent of samples or less) with the exception of methane in groundwater (64 percent of Phase II samples) and toluene in surface soils (13 percent of all samples). The primary VOCs detected were monocyclic aromatic (e.g., benzene, toluene) and chlorinated aliphatic (e.g., tetrachloroethene) hydrocarbon compounds. Because many of the VOCs that were detected have a relatively low distribution coefficient, Kd, there is a tendency for these chemicals to occur as dissolved species in water, as indicated by the groundwater data. Volatilization and microbial degradation are important fate processes for these compounds, particularly in warm surface soils and surface water when there is an adequate supply of oxygen and nutrients. A poor oxygen supply (due to biological degradation of organics and landfill materials) and a typical pH around 5.0 in the surficial aquifer (also a result of biological decay and generation of methane) likely limit microbial degradation in pond sediment and in the groundwater plume. Overall, VOCs are not considered to be a persistent environmental contaminant.

Methane is a common byproduct of anaerobic biological degradation of organic compounds found in landfill materials. The presence of methane in groundwater is an indication of reduced geochemical conditions, and a lowering of the natural pH of groundwater usually occurs. Such conditions are unfavorable for the biological destruction of the aromatic hydrocarbons identified above because a lower pH has an deleterious effect on the presence and activity of microbial populations in groundwater.

The VOCs detected included acetone and methylene chloride in surface soils and groundwater. Both of these compounds are common laboratory chemicals, and because each has a high vapor pressure and typically short persistence in temperate zone environments, they are probably laboratory artifacts.

8.3.2 Semivolatile Organic Compounds

Fourteen SVOCs were detected in surface soils, nine SVOCs were detected in groundwater, two SVOCs were detected in surface water, and one SVOC was detected in sediment at OU 2 (see

Tables 5-2C, 5-3E, 5-3J, 5-4B, 5-4D, 5-5B, and 5-5E). Like VOCs, the frequency of detection of SVOCs in all media was low (10 percent or less) with the exception of PAHs that were detected in about 20 percent of all surface soil samples. The few SVOC detections in surface water and sediment were found in both the upstream and downstream sample locations.

Most of the SVOCs detected in surface soils are classified as PAHs [e.g., benzo(a)pyrene]. Most of the PAHs have high molecular weights and low solubility in water. These compounds have a high sorption potential to soil, sediment, or organic matter, and these properties inhibit the leaching and volatilization processes. They are likely to be persistent in shallow soils and are transported by means of soil erosion rather than by going into solution. Biodegradation is the primary fate process for PAHs sorbed to soil or sediment.

Four of the nine SVOCs detected in groundwater during Phase II are classified as phthalate esters (e.g., dimethyl phthalate). These compounds are very stable, oily substances that are common components of plastic materials. They are also common laboratory and sampling artifacts. Like PAHs, phthalates have low water solubility, sorption is an important transport mechanism, and biodegradation and bioaccumulation are the primary fate processes. Naphthalenes (PAHs with relatively high water solubility) and phenolic compounds (highly soluble in water) that were detected in groundwater are often used in manufacturing and in the application of pesticides and herbicides that were frequently detected in surface soils (see below) at OU 2. Moving water readily transports both of these type compounds. Biodegradation is the most likely fate process.

8.3.3 Pesticides, Herbicides, and PCBs

Thirteen pesticides, one herbicide, and one PCB (Aroclor-1254) were detected in surface soils, and five pesticides were detected in sediment at OU 2 (see Tables 5-2C, 5-3E, 5-3J, 5-4B, 5-4D, 5-5B, and 5-5E). These organic compounds were not detected in groundwater or in surface water. The frequency of detection of pesticides was mostly low (10 percent of samples or less) with the exception of alpha-chlordane (12 percent of samples), gamma-chlordane (13 percent of samples), and 4,4'-DDE (25 percent of samples) in surface soils. Pesticides were infrequently detected in sediment (maximum 3 out of 22 samples). Several of the pesticides detected (e.g., DDT, endrin, heptachlor, chlordane) have been banned from use in the United States since the 1980s.

In general, many of the pesticides react like PAHs in environmental media, that is, they have a high sorption potential to soil or organic matter, low water solubility, and are resistant to volatilization and leaching. Volatilization may, however, play a role in the loss of chlordane and DDT in surface soils. Most pesticides are considered very persistent in the environment, particularly when applied to soils where they become bound to soil particles. They are generally transported by means of soil erosion. Biodegradation may be a slow but important fate process.

8.3.4 Inorganics

Twenty-two inorganics were detected in surface soils, 21 were detected in groundwater (Phase III samples), 16 were detected in surface water, and 20 were detected in sediment at OU 2 (see Tables 5-2C, 5-3E, 5-3J, 5-4B, 5-4D, 5-5B, and 5-5E). Of the inorganics detected in surface soils, silver was not detected in groundwater; and cadmium, silver, and thallium were not detected in either surface water or sediment. Many of the inorganics were detected at a high frequency in all media, and they were often detected above their natural background concentrations in surface soils; only aluminum frequently exceeded background in groundwater. Exceptions included antimony, cadmium, mercury, silver, sodium, and thallium in surface soils; arsenic, chromium, nickel, and lead in surface water; and antimony and cobalt in sediment: these were detected at a low frequency (10 percent of samples or less).

The inorganics detected in all media are considered to be persistent contaminants that do not readily biodegrade, photolyze, or hydrolyze. Their fate depends largely on the metabolic and physical or chemical processes that occur in the respective environmental media. In general, inorganics tend to sorb to soil or form insoluble complexes (e.g., oxides or hydroxides) under reducing conditions (such as are present in the surficial aquifer). They are readily transported while attached to soil particles and may accumulate in sediment deposits. Inorganics may be present in groundwater as dissolved species leached from soil or landfill material, or as naturally or contaminated colloidal material transported in suspension by the groundwater or surface water. The major fate mechanisms are adsorption to the soil matrix and bioaccumulation.

Lead, an example of an inorganic that is strongly adsorbed, was nearly ubiquitous in the surface soil and sediment samples but was detected at a much lower frequency in groundwater (as a dissolved species) and in surface water.

Many of the inorganics detected in surface soil are known to be components of pesticides (e.g., aluminum, antimony, arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead,

manganese, mercury, selenium, silver, vanadium, and zinc), although they are also naturally occurring elements in soils. The widespread occurrence of arsenic in surface soil compared to its relative absence in groundwater points to its origin from pesticides applied to the surface of the golf course.

8.4 CONTAMINANT MIGRATION

The most pronounced effects to sediment and surface water have been the discharge and deposition of inorganic contaminants to these media. Inorganics are being derived from groundwater discharge and from surface water runoff that transports impacted soil particles and/or dissolved contaminants. Contaminant transport by means of soil erosion is likely to have been more significant prior to development of the golf course. The golf course has provided good vegetative cover over much of the area where thin soil cover occurs over the landfill (see Figure 5-1D). In addition, the ongoing IRA is aimed at providing additional soil cover where landfill material is near the surface. Therefore, wind erosion and transport of soil particulates is not considered to be a significant migration pathway. Considering the age of the landfill, the reducing groundwater environment, and the short distance between the landfill and the canal, it is apparent that both organic and inorganic contaminants have been and are being discharged to the canals. Ultimately, the contaminants that are released from soil and the landfill by surface water runoff and groundwater discharge, or from impacted sediments directly to surface water, may be transported downstream via the canals to Lake Gillooly.

The leaching of contaminants from surface soil and landfill materials and their transport via groundwater to the canals is considered a prime contaminant pathway. Therefore, the processes that affect contaminant transport and retardation in the surficial aquifer have been evaluated. Contaminant transport to the deeper confined aquifer in the Hawthorn formation is considered to be insignificant based on several lines of evidence, as follows.

- The clay at the bottom of the surficial aquifer has very low permeability as evidenced by:
  - The consistent low hydraulic conductivity range in the clay interval (10E-6 to 10E-9 cm/sec) determined by the CPT pore pressure dissipation tests (see Table 2-2A).
  - The grain size/hydrometer analysis of the clay samples shows a high percentage of clay-sized particles in the clay unit that results in low effective porosity.

  - The potentiometric head elevation difference between the surficial aquifer wells and the Hawthorn wells (i.e., across the clay) is typically 30 feet.

- The thickness of the clay unit ranges between 10 to 20 feet across the landfill areas.

- The groundwater chemistry in the Hawthorn aquifer is significantly different than the overlying surficial aquifer (i.e., pH is higher and the magnesium/calcium ratio is much lower in the Hawthorn groundwater; VOCs detected in the lower portion of the surficial aquifer were not detected in the Hawthorn wells) indicating poor hydraulic connection between the units.

- Manganese was detected above the screening levels in two of the four Hawthorn wells (and in one surficial aquifer well at 616 µg/L). The Hawthorn aquifer is composed of sediments deposited in a shallow marine/near shore environment. Pyrolusite (MnO_2), one of the important ore minerals for manganese, is most often found as bog, lake, or shallow marine deposits. The occurrence of phosphate deposits is widely documented in the Hawthorn formation in Florida. Apatite, the most abundant phosphorous-bearing mineral in the earth's crust, commonly constitutes the bulk of phosphate rock. Manganese substitution for calcium in some forms of apatite is another potential source for the manganese detected in the groundwater. Therefore, the range of manganese detected in the Hawthorn wells (26.6 to 98 µg/L) is interpreted to reflect background for this aquifer and not the vertical migration of contaminants from the surficial aquifer.

The migration of contaminants through groundwater is strongly influenced by sorption, the process whereby dissolved contaminants partition from groundwater and adhere to aquifer matrix particles. Sorption results in the slowing (retardation) of contaminants relative to the groundwater seepage velocity and in the reduction (temporary or permanent) of contaminant concentrations in groundwater. Several mechanisms are involved in the process of sorption, but hydrophobic bonding, where nonpolar contaminant molecules partition from groundwater of greater polarity and sorb to an aquifer matrix of lesser polarity, is an important factor controlling the fate of organic contaminants. Two components of an aquifer that have the greatest effect on sorption are organic matter and clay minerals, and in most aquifers, the organic carbon fraction tends to control the sorption of organic contaminants.

The coefficient of retardation, R, is a parameter that is commonly used to estimate the velocity of dissolved contaminants, Vc, through an aquifer. The following aquifer characteristics and compound-specific properties are needed to determine R:

- Groundwater seepage velocity (V)
- Soil bulk density (ρd)
- Fraction of organic carbon (foc)
- Soil/water distribution coefficient (Kd)
- Organic carbon/water partition coefficient (Koc)

The groundwater velocity, V, can be estimated for the aquifer based on the hydraulic conductivity, gradient, and effective porosity. The representative hydraulic conductivity, as determined from an aquifer pumping test, is 25 feet/day, and the water table gradient across the landfill areas is typically 0.004 (see Section 2.2.3.2). Grain-size analyses of the sand unit that composes the surficial aquifer show the material to consist of well-graded sands with a low percentage of fines (i.e., SW soil classification). A site-specific value for the effective porosity was not determined; however, the USEPA (1989b) indicates that a default value of 0.2 is appropriate for SW sediments. A representative groundwater seepage velocity of 183 feet per year was calculated (hydraulic conductivity X groundwater gradient / effective porosity = 0.5 feet/day) using the preceding information.

Grain-size distribution analyses were performed on 39 subsurface soil samples that represent the surficial aquifer zone at OU 2 (Appendix C). However, bulk density and TOC analyses were not performed on these samples. Grain-size, bulk density, and TOC analyses were performed on a large number of surface soil samples (Appendix C). Based on the similarities of the grain-size ranges and distributions between the surface and subsurface samples and their similar origin (i.e., similar depositional environments), the bulk density and TOC data for surface soil samples were used to approximate these parameters for the surficial aquifer.

Surface soil bulk density at OU 2 ranged from 1.35 grams per cubic centimeter (g/cc) to 1.89 g/cc; the average (arithmetic mean) bulk density is 1.686 g/cc (see Table 5-2D). The similar origins and textures of the surface soils and the subsurface sediments suggest that the average surface soil bulk density is appropriate for the surficial aquifer. A commonly used aquifer default value found in recent literature is 1.7 g/cc (Newell, McLeod, and Gonzales, 1997).

Surface soil TOC concentrations at OU 2 ranged from 1.1 milligrams per kilogram (mg/kg) to 30,000 mg/kg; the average (arithmetic mean) TOC concentration is 14,761 mg/kg. However, surface soils normally contain higher amounts of organic carbon (plant material, decaying matter, atmospheric carbon compounds, etc.) than subsurface soils. To address this issue, a concentration equal to 50 percent of the surface soil TOC was used as the estimate for the surficial aquifer. Therefore, an *f*oc value of 0.007 was determined for the surficial aquifer (14,761 mg/kg X 0.5 X 0.000001 kg/mg = 0.0074). Typical aquifer values found in recent literature range between 0.0002 to 0.02. An *f*oc range of 0.00026 to 0.007 was determined for the fine- to coarse-grained, back-barrier (marine) sand sediments at Patrick AFB, Florida (Wiedemeier et al., 1996).

The soil/water distribution coefficient, Kd, for dissolved compounds characterizes the tendency of a compound to be sorbed to the aquifer matrix; the higher the distribution coefficient, the greater potential for sorption to the matrix. FDEP-published distribution coefficients for inorganic contaminants (metals) were used in the retardation calculations (*Technical Report: Development of Soil Cleanup Target Levels (SCTLs) for Chapter 62-777, F.A.C.*, May 26, 1999). The Kds for organic contaminants were calculated using the site-specific *f*oc value and FDEP-published Koc values.

Table 8-4 summarizes the aquifer parameters and chemical-specific properties for the COPCs in groundwater at OU 2. The R values calculated for the organic contaminants are much lower than those for metals, which supports the observed greater mobility of organic contaminants (in comparison to inorganics) that is typical for aquifers. Contaminant velocities calculated for the COPCs at OU 2 range from essentially immobile (aluminum = 0.00007 feet/day) to 0.232 feet/day (vinyl chloride). All contaminant velocities are considered to be very low. If the edge of the landfill is within 100 to 200 feet from the drainage canals (as indicated by the geophysical survey results), then vinyl chloride could reach the canals in approximately 1 to 2 years; chlorobenzene would require 8 to 16 years. In comparison, arsenic or iron, which represent the most mobile inorganic COPCs, would require 300 to 600 years to reach the canals. Because the surficial aquifer flows eastward beneath OU 2 and discharges to the canals, the canals represent the downgradient extent of the groundwater plume at OU 2.

TABLE 8-4

CONTAMINANT VELOCITY IN GROUNDWATER
OPERABLE UNIT #2

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Contaminant	*f*oc	Koc (L/kg)	Kd (L/kg)	ρd (g/cc)	Rf	Vc (ft/day)
Volatile Organics						
Benzene	0.007	59	0.435	1.686	4.67	0.107
Chlorobenzene	0.007	219	1.616	1.686	14.62	0.034
Tetrachloroethene	0.007	155	1.144	1.686	10.64	0.047
Trichloroethene	0.007	166	1.225	1.686	11.33	0.044
Vinyl chloride	0.007	18.6	0.137	1.686	2.16	0.232
cis-1,2-Dichloroethene	0.007	35.5	0.262	1.686	3.21	0.156
Metals						
Aluminum	NA	NA	1500	1.686	12643.7	0.000
Arsenic	NA	NA	29	1.686	245.43	0.002
Barium	NA	NA	41	1.686	346.57	0.001
Iron	NA	NA	25	1.686	211.71	0.002
Manganese	NA	NA	65	1.686	548.85	0.001
Vanadium	NA	NA	1000	1.686	8429.4	0.000

*f*oc - fraction organic carbon in aquifer matrix
Koc - organic carbon/water partition coefficient
Kd - soil/water distribution coefficient
ρd - soil bulk density
Rf - retardation factor = [1+(Kd X ρd/ effective porosity)]
V = groundwater seepage velocity = 0.5 ft/day
Vc - contaminant velocity = (V/Rf)
NA - not applicable (metals not retarded by organic carbon in aquifer matrix)
L/kg - liters per kilogram
g/cc - grams per cubic centimeter, equivalent to kilograms per liter
ft/day - feet per day
Source, Koc (volatiles) & Kd (metals): Florida Department of Environmental Protection, *Technical Report: Development of Soil Cleanup Target Levels (SCTLs) for Chapter 62-777, F.A.C.*, May 26, 1999

9.0 CONCLUSIONS AND RECOMMENDATIONS

9.1 CONCLUSIONS

9.1.1 Landfill Conditions

Landfill Boundaries and Soil Cover

The boundaries of the former landfill were defined by the geophysical surveys. The data suggest that there are areas of well-defined trenches and other areas of general landfill underlying a large part of the golf course and most of the wooded area to the south. The boundaries of the landfill include an area west of the tee for hole No. 5 and the northern part of the wooded area.

The existing soil cover is generally 1 to 2.5 feet thick over the present golf course. The soil cover in the undeveloped wooded area to the south of the golf course is generally fairly thick, although there was some waste material (which may be the result of unauthorized dumping) visible in some places. The IRA performed at OU 2 provided a minimum soil cover thickness of 2 feet.

Contamination

The pre-IRA soil cover in the western and southern areas of the OU was contaminated with SVOCs at concentrations above State of Florida screening levels. Over much of the golf course the soil cover was also contaminated with arsenic above screening levels. Barium and magnesium were detected above screening criteria in one sample each. TPH was found above its screening criterion in only two samples. One pesticide (dieldrin) was found above its screening criterion in only one sample. Gross alpha and gross beta were also found above screening criteria in some of the surface soil samples, but they are attributed to naturally elevated background levels of radioactive isotopes (see groundwater discussion below).

During the IRA, PAH-contaminated surface soil from two hot spot locations on the golf course was removed. The soil cover placed in the area south of the golf course addressed surface soil exceedances in this area. As a result, the sample data for these locations have been removed from the data set used in the HHRA. These data have been addressed in the uncertainty section of the ERA. As a result of the IRA, the risk to human health and the environment from contamination in surface soil in these areas has been eliminated and no further action is required.

Organic and inorganic groundwater contaminants were found above State of Florida screening criteria in the surficial aquifer, and inorganic contaminants were found above screening criteria in the upper sand unit of the underlying Hawthorn Group. VOCs and metals are the most significant types of contaminants. The area that is most impacted with organic chemicals is along the eastern part of the wooded area south of the golf course, adjacent to the canal. DPT groundwater sampling results suggest the presence of two VOC contaminant plumes in the interior of the landfill in this area. Metals, predominantly iron and, to a lesser extent, aluminum, were found above screening criteria in many samples distributed over much of the operable unit. Gross alpha and gross beta were not found above screening criteria when groundwater sample turbidity was less than 50 NTUs. Isotopic analyses of groundwater samples indicate that naturally occurring isotopes of uranium and radium are responsible for the gross alpha and gross beta detections.

Surface water in, adjacent to, and downstream of the operable unit contains organic and inorganic contaminants above State of Florida screening criteria. Only 6 of 28 samples contained organic chemicals [bis(2-ethylhexyl)phthalate and aldrin] above screening criteria. Note that bis(2-ethylhexyl)phthalate is a common laboratory contaminant and detections should be considered suspect. Metals, predominantly aluminum, iron, copper, lead, and zinc, were found above the screening criteria in many of the samples distributed over much of the operable unit. Gross alpha was also found above screening criteria in some of the samples, but as with the groundwater samples discussed above, isotopic analyses indicate it is the result of naturally elevated background levels.

Sediment in, adjacent to, and downstream of the operable unit contains inorganics, pesticides, and gross alpha at levels above State of Florida screening criteria. Metals exceeded the screening criteria in only one sample. Four of 28 sediment samples contained pesticides at levels above State of Florida screening criteria. Gross alpha was also found above screening criteria in some of the samples, but isotopic analyses indicate it is the result of naturally elevated background levels.

9.1.2 Human Health Risk Assessment Conclusions

Groundwater, surface water, and sediment were sampled during Phase III to address data gaps and uncertainty issues (see Section 3.0). For groundwater the Phase II and Phase III data were combined following the protocol that Phase III results supercede Phase II results. Combined in this manner the groundwater data represent the most current data set and avoid the effects of sample turbidity that occurred with the earlier data. Final results presented in this report were calculated from this data set.

However, for purposes of completeness, risk was calculated using the turbid wells and the results are presented in the uncertainty section in Section 6.0. For surface water and sediment, the Phase III data replaced the Phase II data collected along the dredged canals. Risk assessment results presented here were based upon these updated data sets.

Area 1

Potential risks to maintenance workers, recreational users, and hypothetical future residents were evaluated for Area 1, the northeast portion of OU 2. Noncancer risk estimates indicate potential adverse effects for hypothetical future residents only. Cancer risks exceed 1E-06 for maintenance workers and hypothetical future residents. Cancer risks for individual COPCs in the maintenance worker scenario do not exceed 1E-06. No cancer risks exceed 1E-04. Significant uncertainties that may overestimate risk are associated with these results and should be carefully considered in any risk management decisions.

Area 2/3

Potential risks to maintenance workers, recreational users, and hypothetical future residents were evaluated for Area 2/3, the central and southern portions of OU 2. Noncancer risk estimates indicate potential adverse effects for hypothetical future residents only. Cancer risks exceed 1E-06 for maintenance workers and hypothetical future residents. Cancer risks exceed 1E-04 for hypothetical future residents only. Significant uncertainties that may overestimate risk are associated with these results and should be carefully considered in any risk management decisions.

Off-site Residents, Visitors, or Trespassers

Potential risks to off-site residents, visitors, and trespassers were evaluated. Organ-specific calculations indicate adverse noncancer effects are not expected for off-site residents, visitors, or trespassers. Cancer risks for off-site residents, visitors, or trespassers exceed 1E-06 but do not exceed 1E-04 for these receptors. Significant uncertainties that may overestimate risk are associated with these results and should be carefully considered in any risk management decisions.

9.1.3 Ecological Risk Assessment Conclusions

Terrestrial and food chain risks at OU 2 are sporadic and have been significantly mitigated by risk management activities at OU 2. Some potential risks appear to be present from inorganics in canal

surface water, but these risks do not appear to be of sufficient magnitude to require additional ecological study or remedial action, especially given the relatively limited quality and quantity of habitat in the canal.

9.2 RECOMMENDATIONS

Surface soils, groundwater, surface water, and sediment all show exceedances of the State of Florida Cleanup Target Levels. In addition, the risk assessments indicate unacceptable risks for hypothetical future residents exposed to environmental media and sporadic terrestrial and food chain risks for ecological receptors. Therefore, the McCoy Annex Landfill is recommended for evaluation in an FS using the CERCLA presumptive remedy for landfills.

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