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REMEDIAL INVESTIGATION FOR OPERABLE UNIT 5 (OU 5) SITE 14 AND SITE 15 VOLUME 2 OF 2 CHAPTER 5 THROUGH REFERENCES AND APPENDICES A THROUGH D NAS CECIL FIELD FL

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REMEDIAL INVESTIGATION

OPERABLE UNIT 5, SITES 14 AND 15

VOLUME II
CHAPTER 5.0 THROUGH REFERENCES
APPENDICES A THROUGH D

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

UNIT IDENTIFICATION CODE: N60200
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SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORTH CHARLESTON, SOUTH CAROLINA
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CHAPTER 5.0

5.0 CONTAMINANT FATE AND TRANSPORT

This chapter discusses the fate and transport of contaminants detected at OU 5, Sites 14 and 15. Fate, in the context of this chapter, refers to the ultimate disposition of a given contaminant following its release into the environment. Transport refers to the mechanisms by which a given contaminant released into the environment will arrive at its fate. Fate and transport depend on the physical, chemical, and biological characteristics of the compound or element under consideration, and the environment into which the compound or element is released.

The discussion of contaminant fate and transport is divided into two sections. Section 5.1 discusses potential routes of contaminant migration at Sites 14 and 15. The site-specific persistence, fate, and transport of those compounds and elements found to pose a potential risk to human health or the environment, is discussed in Section 5.2.

Organic and inorganic compounds, assessed to pose a threat to human health or the environment, were detected in the media sampled at OU 5, Site 14 (soil, groundwater, surface water, and sediment) and Site 15 (soil, groundwater, sediment, and surface water). The contaminant fate and transport discussion will focus on those compounds detected in surface soil, groundwater, surface water, and sediment at each site that exceed USEPA or FDEP risk assessment criteria. Contaminants that exceeded USEPA or FDEP risk assessment criteria included the following:

Site 14

Media	Parameter
surface soil	aluminum, copper
surface water	beryllium, iron
groundwater	aluminum, beryllium, iron, manganese, and thallium

Site 15

Media	Parameter
surface soil	PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-*cd*)pyrene, phenanthrene), carbazole, TRPH, aluminum, antimony, arsenic and lead
subsurface soil	PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-*cd*)pyrene), and TRPH
groundwater	*bis*(2-ethylhexyl)phthalate, aluminum, antimony, iron, and thallium
surface water	arsenic, iron, lead, and TRPH
sediment	benzo(a)pyrene, dibenz(a,h)anthracene, chrysene, phenanthrene, fluoranthene, pyrene, benzo(a)anthracene, TRPH, DDT_R, and lead

5.1 POTENTIAL ROUTES OF MIGRATION.

Site 14. Contaminants of concern present in surface soil, groundwater, and surface water are limited to inorganics. Except for access roads, estimated to be approximately 2 percent of the site, Site 14 is vegetated, which prevents air entrainment of contaminated soil. Migration of airborne particulate contaminants is, therefore, not considered an important transport pathway. The primary mechanisms for contaminant migration acting on soil include surface water runoff and infiltration. Rainwater may leach contaminants from soil or may cause surface soil to migrate either by washing soil particles downward or by carrying soil particles overland to low-lying areas such as drainage ditches.

Contaminants carried downward through soil via infiltration will enter the groundwater either as suspended particulate matter or in a dissolved state. Migration of particulate matter in groundwater will be restricted by the permeability of the matrix and the rate of groundwater flow.

Migration of contaminants by overland flow is also restricted as the Site 14 drainage system is closed. Contaminants carried by overland flow will enter a drainage system that begins on the eastern perimeter of the site and ends on the western perimeter. Surface water flow in the ditches begins in the southeastern part of the site, flows north, then west, then south, and ends at the terminus of the drainage system (Figure 1-3). These ditches do not have a defined discharge to an off-site drainage system. If contaminated soil particles reach the drainage ditches, inorganic compounds may desorb to the standing water or accumulate as sediment. Transport of suspended material and dissolved inorganics in surface water will be greatest under high stream flow conditions, which at Site 14 is generally not expected since the hydraulic gradient and topography are nearly level.

Transport of contaminants from the ditches may occur only as overland flow, when surface water breeches the ditch banks. Overflow in the ditches is expected to occur in the western and southwestern part of the site, where the drainage system ends. Because Site 14 is nearly level, it is anticipated that overland flow from the ditches will be limited to the southwestern part of the site.

Due to the physical, hydraulic, and vegetative restrictions at Site 14, it would appear that the dominant transport pathway for contaminants at Site 14 is by dissolution into surface water and groundwater. Once partitioned or dissolved into an aqueous environment, contaminants may move more freely than particulate matter, but are still restricted by low flow rates and no apparent points of discharge. Off-site migration of contaminants at Site 14, then, is expected to be minimal.

Site 15. Organic and inorganic contaminants are present in soil, subsurface soil, groundwater, surface water, and sediment at Site 15. Burning of ordnance and fuel materials and disposal of burn residue would distribute contaminants primarily to the surface soil. Similarly earlier trap-and-skeet operations would result in surface soil contamination. The primary agents of contaminant migration acting on soil include overland transport by surface water runoff and infiltration. Rainwater may cause surface soil to migrate either by washing soil particles downward into the subsurface or by carrying soil particles overland to the nearest surface water body. Site 15 is covered with vegetation and most

access ways are paved. Migration of airborne contaminated particulate matter is unlikely.

If contaminated soil particles reach the streams and swales that drain the northern and southern parts of Site 15 (Figure 1-4), organic and inorganic compounds may be carried as sediment in surface water and ultimately to Yellow Water Creek.

Contaminants, nitroaromatics, from Site 15 historical activities have reached groundwater. Generally, nitroaromatics are soluble and groundwater flow appears to be the primary mechanism for transporting contaminants away from the source area. PAHs and lead; however, have not been found in groundwater and are expected to remain in the surface soil.

5.2 CONTAMINANT PERSISTENCE AND FATE.

5.2.1 Persistence and Fate of OU 5 Contaminants Human health risk assessment contaminants that exceed USEPA and FDEP risk criteria include SVOCs (primarily PAHs) and inorganics. This section presents the persistence and fate of these contaminants. The greatest number of contaminants assessed to pose risk are a group of high molecular weight (greater than 200) PAHs. Rather than address each PAH, this section will discuss two selected PAHs, phenanthrene and benzo(a)-pyrene. Phenanthrene was selected as it is representative of low molecular weight PAHs (less than 200) and the only light PAH assessed to pose risk. Benzo(a)pyrene was selected as it has the most stringent soil and groundwater health effects criteria for PAHs and an octanol-water partitioning coefficient (K_{ow}) and a soil-sediment partition coefficient (K_{oc}) representative of the group. The K_{ow} is a measure of whether a chemical will more readily be detected in an organic solvent (octanol) or in water (high value indicates preference for octanol). The K_{oc} provides an indication of a chemical's tendency to partition between particulate matter (particularly those containing organic carbon) and water, i.e., how readily a chemical may move from water to soil. A high K_{oc} value indicates the chemical will more likely be found on particulate matter. (K_{ow} and K_{ow} values area often reported as log values). Additionally, very little data exist for some of the PAHs and their behavior in the environment is inferred from data summarized for phenanthrene and benzo(a)pyrene. Other chemicals that will be discussed are *bis*(2-ethylhexyl)phthalate and carbazole.

5.2.1.1 SVOCs *Bis*(2-ethylhexyl)phthalate was assessed to pose risk in Site 15 groundwater. *Bis*(2-ethylhexyl)phthalate is not particularly volatile, strongly sorbs to particulate matter, and has a high potential for bioaccumulation (U.S. Air Force, 1989). *Bis*(2-ethylhexyl)phthalate will degrade slowly under most conditions, but metabolism by multicellular organisms is the most important fate process. *Bis*(2-ethylhexyl)phthalate may be more mobile in sandy materials than in more humic material. Due to its high log K_{oc} value (5.0), it is likely that once *bis*(2-ethylhexyl)phthalate is attached to sediment its primary transport mechanism would be as suspended particulates in surface water.

Phthalate esters may readily complex with natural organic substances (e.g., fulvic acid) to form complexes that are very soluble in water. Once in surface water, in either suspended or dissolved phase, the primary mechanism for transport of *bis*(2-ethylhexyl)phthalate is water flow. Uptake and bioaccumulation

by aquatic organisms also represent methods of transport through the environment. In groundwater, the primary transport mechanism is groundwater flow.

Data indicate that phenanthrene is sparingly soluble in water having a solubility of 1.29 mg/ℓ (USEPA, 1979) and a moderate to high log K_{oc} value of 3.72 to 4.59 (Montgomery and Welkom, 1991). As a result, phenanthrene deposited onto the ground will adsorb onto particulate matter. As with most compounds with strong sorptive properties, phenanthrene will be more strongly sorbed to more humic soil. If phenanthrene is transported from its deposition location, it will mostly likely be by movement of particulate matter. Once phenanthrene enters an aqueous environment, either surface water or groundwater, dissolution is not expected to occur and transport will be via suspended particulate matter. Photolysis may become the dominant fate mechanism once phenanthrene enters surface water. The ultimate fate of phenanthrene sorbed to particulate matter is probably biodegradation and biotransformation by benthic organisms or bio-accumulation by intake of groundwater by terrestrial flora and fauna (primarily by livestock and domesticated animals).

Benzo(a)pyrene is relatively insoluble in water and has a high log K_{oc} value (6.29). As a result, the affinity of the compound for sorption onto soil is great and it tends to remain attached to particulate matter. Any dissolved portion of the compound is thought to undergo rapid photolysis. The ultimate fate is thought to be biodegradation and biotransformation by benthic organisms; however, processes are thought to be slow, with biodegradation half-times being estimated from 290 to 900 days (USEPA, 1979).

Carbazole was detected in the surface soil at Site 15. Little data can be found regarding the fate and persistence of carbazole. However, carbazole is a creosote compound and as such can be expected to sorb strongly to particulate matter and be very persistent in the environment. Carbazole is insoluble in water and only slightly soluble in chlorinated hydrocarbons. It is estimated that once carbazole enters an aqueous environment, it will exhibit very poor partitioning properties and remain sorbed to particulate matter. Its ultimate fate may be bioaccumulation and biodegradation.

TRPH has no specific composition being a nonspecific mixture of petrochemicals, most of which will be SVOCs and VOCs. VOCs, being more volatile and having lower K_{oc} values than other TRPH chemicals, are likely to begin migration shortly after deposition of TRPH. The remaining compounds are likely to be SVOCs with fate behaviors similar to phenanthrene, benzo(a)pyrene, and carbazole. As a result of losing the more volatile components, TRPH at Site 15 may be expected to have decreasing solubility and increasing sorption properties over time. It is estimated that TRPH are somewhat persistent in the environment with biodegradation being the ultimate fate pathway.

5.2.1.2 **Inorganics** Inorganics identified as contributing a risk that exceeded USEPA and FDEP risk assessment criteria are aluminum, antimony, arsenic, beryllium, copper, iron, lead, manganese, and thallium. Unlike organics, these elements are persistent because they do not degrade naturally in the environment. Their fate depends on metabolic and physical or chemical processes prevalent at OU 5. Elevated concentrations of aluminum and iron in groundwater have been observed throughout the other sites at NAS Cecil Field. These detections of aluminum and iron have been attributed to their natural occurrence in groundwater

as a result of suspended solids. Therefore, the fate for iron and aluminum will not be addressed.

Sorption is a dominant transport mechanism for antimony. Antimony may remain in soil, sorbed to particulate matter, particularly if the soil contains clay or humic matter. Antimony is soluble and once in an aqueous environment may become very mobile. In groundwater, dissolved antimony will migrate with groundwater flow. Antimony is not strongly bioaccumulated, thus its ultimate fate in groundwater may be discharge to surface water where it may remain mobile or sorbs to particulate matter.

Arsenic is very mobile and chemical speciation, pH, and Eh can be important factors in its fate. Adsorption and desorption of arsenic in the aqueous environment may be a dominant process because arsenic can cycle through several components before reaching an ultimate fate. Ultimate fates can include sorption and bioaccumulation.

Beryllium has very low aqueous solubility and is expected to adsorb onto solids soon after it is introduced into an aqueous environment. In soil, beryllium is expected to be tightly adsorbed, thus its mobility in soil is greatly limited. Sorption, then, is the predominant fate mechanism of beryllium.

Several process determine the fate of copper in an aqueous environment. Chemical speciation and bioaccumulation can be predominant fate processes for copper. In the aqueous environment, copper exists as Cu^{+2} or, more likely, as complexes. Hydrolysis and precipitation dominate Cu^{+2}, while sorption may influence other forms of copper. Copper is an essential nutrient, and as such, is readily bioaccumulated.

Mobility of lead is low and is likely to enter an aqueous environment as particulate matter. Lead is not readily soluble in the aqueous environment and will likely remain in a particulate form. The predominant dissolved forms of lead are the free ion Pb^{+2} and hydroxide complexes. Important fate processes of dissolved forms of lead are sorption and bioaccumulation.

Thallium is a heavy metal that has an ionic and atomic radii similar to lead, which suggests that thallium behavior in an aqueous solution will be similar to that of lead. The important fate processes of dissolved thallium are sorption and bioaccumulation.

In summary, based on the persistence and fate characteristics of the contaminants of concern, it is expected that off-site migration of contaminants would be limited, that the organic contaminants may be expected to degrade over time at the site, and the inorganics would tend to be found sorbed to soil and sediment.

5.2.2 Transport of Contaminants, Site 14 This subsection presents a discussion of the anticipated migration of contaminants in Site 14 surface soil, surface water, and groundwater.

Surface soil. Because Site 14 is almost completely vegetated, the contaminants of concern, aluminum and copper, are not likely to migrate via airborne pathways. Likewise, transport via overland flow is not considered a dominant transport mechanism, except in episodic events such as flooding. Flooding was observed during the field investigation. Generally during a flooding event, water

accumulated in the central part of the site and did not migrate off-site. During continued heavy rainfall events, when flooding occurred in many locations of NAS Cecil and is considered to be uncommon, the ponded water would flow across Blue 5 Road and continue southward into a nearly flat, pine forest area. Aluminum and copper sorbed to soil would then be carried south of Blue 5 Road.

Surface Water. The surface water drainage system does not empty into another drainage system. Topography is near level. Under most conditions, surface water flow is expected to be low or not at all. Under high water and high flow conditions, surface water may overflow to the surrounding low-lying areas. Except for flood conditions, the surface water contaminants will remain in the surface water/sediment environment. Because of their sorptive properties, beryllium and iron are likely to partition from the water to particulate matter and settle in the sediment. Migration of contaminants of concern in Site 14 surface water appears, then, to be limited to the site.

Groundwater. Migration of contaminants via overland flow are dependent on episodic events. As a result, the dominant transport pathway for the contaminants of concern detected in Site 14 groundwater is groundwater flow. Water-level data indicate no dominant horizontal flow direction. Additionally, the estimated groundwater flow rate is low. Given the fact that groundwater is within a foot of the land surface, it is probable that the ditches will intercept groundwater flow, at least seasonally, and contaminants will enter the surface water and sediment environment.

The seepage velocity at Site 14 is estimated to be 5.0 ft/yr. Assuming particulate migration in the groundwater was unrestricted and a dominant horizontal flow direction existed at Site 14, contaminant flow from the center of the site to the nearest off-site location (270 feet), either north or south (perpendicular to the long axis of the site) would take approximately 54 years. Vertical flow rates at the site are unknown, but an estimated vertical flow for the surficial aquifer at NAS Cecil Field, based on a long-term recharge rate of 6 inches per year (in/yr) is 0.4 ft/yr, and flow from the surficial aquifer to the secondary aquifer is 0.2 in/yr (USGS, 1996). Flowrates increase with proximity to drainage features, such as flow streams. Site 14 is remote from any flowing water bodies, and it is anticipated that vertical flow rates at the site are less than 0.4 ft/yr. Assuming that the surficial aquifer is 100 feet thick at Site 14 with a constant flow rate of 0.4 ft/yr through the aquifer, and site contaminants are unimpeded or unaltered during transport, it would take 250 years before a contaminant reaches the base of the surficial aquifer. Because the vertical flow rate is not constant with depth, it will either increase or decrease with depth and migrate in the dominant regional horizontal flow direction, which in western Duval County is northeast (Fairchild, 1972). Migration of contaminants via groundwater flow can be conservatively estimated to take several decades.

5.2.3 Transport of Contaminants, Site 15 This subsection presents a discussion of the anticipated migration of contaminants in Site 15 soil, groundwater, surface water, and sediment.

Soil. TOC values, an indirect measure of humic content of soil, are moderate to relatively high, especially when compared to other NAS Cecil Field locations. As a result, it is predicted that PAHs, carbazole, lead, and to some extent TRPH, would be sorbed to the soil and migration from depositional locations would be

limited. Evaluation of analytical data indicates that these contaminants are restricted to particulate matter. Concentrations decrease at least an order of magnitude from surface to subsurface soil and were not detected in groundwater, which is located from a few inches to approximately 3 feet bls. Despite widespread high concentrations of lead in the surface soil, lead concentrations in the subsurface are low, being within the range of background values. These data suggest that subsurface transport of lead is unlikely. Lead and TRPH were not detected in groundwater, but were in surface water, suggesting their presence is due to either suspended particulates in the samples or that these contaminants have dissolved into the surface water from particulate matter. Likewise, PAHs and carbazole were detected in sediment. It is predicted, then, that the dominant transport mechanism for PAHs, carbazole, TRPH, and lead is via soil and, possibly, sediment migration. Because most of Site 15 is vegetated it is predicted that soil migration will be slight. The rate of sediment transport in the Site 15 streams is undetermined. However, during the field investigation high flow conditions were never noted in either stream, even during heavy rainfall events. Both streams empty into low-lying swampy areas. As a result, it is estimated that the sediment transport rate would be low and migration of PAHs from Site 15 may be minimal.

Four inorganics, aluminum, antimony, arsenic, and lead, were assessed as posing a risk in Site 15 surface soil. As discussed, it is unlikely that lead will migrate from the areas where it was detected. Arsenic may sorb to particulate matter, but can also be soluble, depending on the speciation, and can be expected to migrate from soil to water, as is indicated by its presence in surface water. Particulate movement may be a transport pathway in soil, but once it reaches surface water it may partition into the aqueous environment. Once in surface water, arsenic will probably transport with water flow or in quiescent conditions, sorb to the sediment.

Aluminum is ubiquitous in NAS Cecil Field soil and groundwater. Transport pathways for aluminum will be both migration of particulate matter over land and infiltration into the vadose zone and groundwater.

Like arsenic, antimony may be transported by either particulate movement or by infiltration. In areas where humic matter is high, particulate transport is likely to be the dominant pathway. Based on TOC results, humic matter in Site 15 soil is high, relative to other NAS Cecil Field locations, and transport of antimony via particulate movement may be important. Antimony is soluble and can move through the vadose zone into groundwater and was detected in surface soil, subsurface soil, and groundwater samples, with concentrations declining with depth. Antimony was not detected in surface water or sediment samples. Based on these results, infiltration to groundwater is expected to be the predominant transport pathway for antimony.

Groundwater. The predominant transport pathway of contaminants of concern in Site 15 groundwater is groundwater flow. *Bis*(2-ethylhexyl)phthalate, lead, and thallium are not readily soluble and may be associated with colloids. Dissolved fractions of contaminants will be transported in a downgradient direction toward a point of discharge, presumably Caldwell Branch, which is approximately 2,000 feet west of the site. Using a groundwater seepage velocity of 26 ft/yr and assuming the contaminants will migrate unimpeded or unaltered, it would take approximately 77 years for site contaminants in groundwater to discharge to Caldwell Branch.

Surface Water and Sediment. Arsenic, iron, lead, and TRPH were assessed as contaminants of concern in surface water. Arsenic and iron are soluble and as such may be transported with water flow, sorbed onto sediment, or bioaccumulated. Lead and TRPH will likely be transported via surface water flow. However, in low-flow or quiescent conditions, these contaminants may sorb to the sediment, where they may be bioaccumulated by benthic organisms.

PAHs and TRPH detected in sediment will be transported as suspended material in surface water flow. Transport over great distances will not likely occur except in high-flow conditions. In low-flow or quiescent conditions that predominant at Site 15, these contaminants will likely biodegrade or bioaccumulate.

CHAPTER 6.0

6.0 HUMAN HEALTH RISK ASSESSMENT (HHRA)

6.1 APPROACH. An HHRA has been conducted as part of the Baseline Risk Assessment for OU 5 (Site 14 and Site 15) at NAS Cecil Field. The purpose of the HHRA is to characterize the risks associated with the potential exposures to site-related chemicals. The methodology for the HHRA is described in Chapter 25 of the GIR (ABB-ES, 1996a) and consists of the following steps:

- evaluating the data;
- evaluating the data, selecting chemicals of potential concern;
- evaluating the data, exposure assessment;
- evaluating the data, toxicity assessment; and
- evaluating the data, risk characterization.

Site 14 is located in the north-central portion of the Yellow Water Weapons Area, while Site 15 is located in the southwest portion of the Yellow Water Weapons Area. Because of the distance between the sites, risks for Sites 14 and 15 will be evaluated separately. The location, physical description, and history associated with Sites 14 and 15 are described in Chapters 18.0 and 19.0 of the GIR (ABB-ES, 1996a) and Chapter 3.0 of this report. During the RI, surface soil, groundwater, surface water, and sediment samples were collected from Sites 14 and 15, and subsurface soil samples were collected from Site 15 only. Sampling locations and the sampling rationale are presented in Chapter 2.0 of this report.

6.1.1 Data Evaluation The data quality objectives (DQOs) for collecting environmental samples and conducting laboratory analyses are described in the GIR (ABB-ES, 1996a). Chemical analyses were performed in accordance with the Contract Laboratory Program Statement of Work. The analytical results were evaluated, using the national functional guidelines (USEPA, 1988a; USEPA, 1991a) to assess the laboratory's compliance with the analytical methodology. The analytical data were reviewed, validated, and evaluated using the precision, accuracy, representativeness, comparability, and completeness criteria specified in the DQOs. Based on a third party's evaluation of the analytical data's conformance with the DQOs, the data presented in this report are acceptable for use in the HHRA.

6.1.2 Selection of Human Health Chemicals of Potential Concern (HHCPCs) HHCPCs are defined as chemicals for which RI data of sufficient quality are available for use in the risk assessment. In addition, HHCPCs are potentially site related and have maximum detected concentrations that are above at least one risk-based screening concentration or regulatory or guidance criterion (where available) and, for inorganic analytes, above background screening concentrations (where available). The maximum detected concentration of each analyte identified in surface soil samples is compared to the USEPA Region III Risk-Based Concentration (RBC) (USEPA, 1995c) for residential soil, the Florida Soil Cleanup Goal (FDEP, 1995) for residential soil, and to a background screening concentration for inorganics only. The maximum detected concentration of each analyte identified in groundwater is compared to the background screening concentration (inorganics only), the USEPA Region III RBC for tap water (USEPA, 1995c) and the Florida Groundwater Guidance Concentration (FDEP, 1994). The maximum detected concentration of each analyte identified in sediment is compared to the USEPA Region III RBC (USEPA, 1996b) for residential soil and the Florida Soil Cleanup

Goal (FDEP, 1994) for residential soil. The maximum detected concentration of each analyte identified in surface water is compared to Region IV Water Quality Standards (USEPA, 1996a) and the Florida Water Quality Standards for Class III freshwater (Florida Legislature, 1995c).

6.2 SITE 14.

6.2.1 HHCPCs Based on the criteria described above, and comparison with the chemical analysis (analytical) results of media samples, HHCPCs were identified for surface soil, groundwater, surface water, and sediment at Site 14.

Surface Soil. Seven surface soil samples and one duplicate were collected and analyzed. A representative surface soil background data set was used in screening HHCPCs. Analytical results for this data set are presented in Chapter 4.0, and the screening criteria are presented in Table 6-1. Chemicals detected and HHCPCs selected in surface soil at Site 14 are presented in Table 6-1. Two inorganics (aluminum and iron) were selected as HHCPCs in surface soil.

Groundwater. Three unfiltered groundwater samples and one duplicate were collected and analyzed. Background groundwater quality was characterized (Chapter 3.0) and used in screening the contaminants detected (Table 6-2) at Site 14. The screening criteria and HHCPCs selected are presented in Table 6-2. Five inorganics (aluminum, beryllium, iron, manganese, and thallium) and one explosive (1,3,5-TNB) were selected as HHCPCs.

Surface Water. Four surface water samples and one duplicate were collected and analyzed. No background surface water screening criteria were used to select HHCPCs. Table 6-3 identifies contaminants detected and HHCPCs selected for surface water at Site 14. One volatile (acetone), one semivolatile (*bis*-[2-ethylhexyl]phthalate) and five inorganics (aluminum, beryllium, iron, vanadium, and zinc) were selected as HHCPCs.

6.2.2 Exposure Assessment The exposure assessment is conducted to assess hypothetical pathways by which humans may be exposed to chemicals present at the site. The exposure assessment uses the pathways to estimate the magnitude of actual and/or potential human exposure and the frequency and duration of exposure. This process is performed for both current and future land-use scenarios. Summaries of potential exposure pathways of chemicals detected at Site 14 are presented on Figure 6-1. The potential pathways, including medium and route of exposure, the potentially exposed population, and the rationale for pathway selection or exclusion, are provided in Table 6-4. Exposures to sediment were not evaluated because no HHCPCs were selected for this medium. Receptor-specific exposure parameters for each exposure scenario are presented in Appendix B of the GIR (ABB-ES, 1996a). Risk calculation spreadsheets in Appendix B also contain the assumed exposure parameters and quantitation of exposures.

Surface Soil. Currently, no humans reside at Site 14. Therefore, no current residential exposure will be evaluated. Site 14 is in a restricted area of the installation, but adult and child trespassers could obtain access to the site. The site maintenance worker may be exposed to contaminants in surface soil while performing site activities. Exposure of current trespassers (adult and child) and site maintenance worker to surface soil contaminants through ingestion, dermal contact, and inhalation of particulates are evaluated in the HHRA.

Table 6-1
Site 14 Surface Soil Human Health Chemicals of Potential Concern

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[1]	Range of Reporting Limits	Range of Detected Concentrations(*)[2]	Mean of Detected Concentrations[3]	Background Screening Concentrations[4]	Risk-Based Concentrations[5]	Florida Soil Cleanup Goals[6]	Analyte HHCPC? (Yes/No)	Reason[7]
Semivolatile Organic Compounds (mg/kg)									
Butylbenzylphthalate	3/7	0.395 to 0.59	0 049 to 1.7	0.69	NA	1,600	15,000	No	S,G
Di-*n*-butylphthalate	7/7	NA	2.9 to 9.0	6.0	0.0821	780	7,300	No	S,G
bis(2-Ethylhexyl)phthalate	3/7	0.395 to 0.59	0.056 to 1.3	0.49	NA	46	48	No	S,G
Pesticides and PCBs (mg/kg)									
Endosulfan II	1/7	4 to 6	0.0006	0 0006	NA	[8]47	[8]390	No	S,G
Inorganic Analytes (mg/kg)									
Aluminum	7/7	NA	185* to 8,510	2,770	3,850	7,800	75,000	Yes	
Barium	7/7	NA	1 to 5.1	3	6	550	5,200	No	B,S,G
Chromium	7/7	NA	0.59* to 7.9	2.8	3.8	[9]39	[9]290	No	S,G
Copper	5/7	5	0.91* to 163	36	ND	310	NSC	No	S
Iron	7/7	NA	79 9* to 2,480	510	630	2,300	NSC	Yes	
Lead	5/7	0.6	2 to 7.4	4	8.2	[10]400	500	No	B,S,G
Magnesium	2/7	1,000	38.9 to 83.7	61.3	282	460,468	NSC	No	B,S
Manganese	4/7	3	0.71* to 2	1	3.8	180	370	No	B,S,G
Nickel	1/7	8	1.3	1 3	ND	160	1,500	No	S,G
Potassium	3/7	1,000	13.5 to 41.1	23 5	ND	1,000,000	NSC	No	S
Vanadium	7/7	NA	1.3 to 9.1	2.8	4.8	55	490	No	S,G
Total Recoverable Petroleum Hydrocarbons (TRPH) (mg/kg)									
TRPH	7/7	NA	26 to 93	44	36.2	NSC	[11]380	No	G

See notes at end of table.

Table 6-1 (Continued)
Site 14 Surface Soil Human Health Chemicals of Potential Concern

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

[1] Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed (excluding rejected values)
[2] The value indicated by an asterisk is the average of a sample and its duplicate. For duplicate samples having one nondetect value, one-half of the contract-required quantification limit/contract-required detection limit is used as a surrogate concentration for results reported as nondetect.
[3] The mean of detected concentrations is the arithmetic mean of all samples in which the analyte was detected. It does not include those samples with "R", "U", or "UJ" validation qualifiers.
[4] The background screening value is twice the average of detected concentrations for inorganic analytes in background samples Organic values are one times the mean of detected concentration. Organic values are included for comparison purposes only.
[5] For all chemicals except the essential nutrients (calcium, magnesium, potassium, and sodium), U.S. Environmental Protection Agency (USEPA) Region III Risk-Based Concentration (RBC) table for residential surface soil exposure per January 1993 guidance ("Selecting Exposure Routes and Contaminants of Concern by Risk-Based Screening," EPA/903/R-93-001) was used for screening. Actual values are taken from the USEPA Region III RBC Tables dated May 30, 1996, which are based on an excess lifetime cancer risk of 10^{-6} and an adjusted hazard quotient of 0.1 For the essential nutrients, screening values were derived based on recommended daily allowances (see Appendix B-1 of the General Information Report [ABB-ES, 1996a]).
[6] Values are from Florida Department of Environmental Protection (FDEP) memoranda titled, "Soil Cleanup Goals for Florida" dated September 29, 1995, and "Applicability of Soil Cleanup Goals for Florida" dated January 19, 1996. Note that they are also residential values.
[7] Analyte was included or excluded from the risk assessment for the following reasons:
B = the maximum detected concentration did not exceed twice the arithmetic mean of detected concentrations at background locations and will not be considered further.
S = the maximum detected concentration did not exceed the risk-based screening concentration and will not be considered further.
G = the maximum detected concentration did not exceed the Florida guidance concentration and will not be considered further.
[8] The value is based on a mixture of Endosulfan isomers.
[9] The value is based on hexavalent chromium.
[10] The value for lead is based on the USEPA Office of Solid Waste and Emergency Response Directive No. 9355.4-12, "Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities" (USEPA, 1994) and assumes residential land use.
[11] The screening value is from FDEP's "Development of Risk-Based Soil Cleanup Target Levels," Chapter 62-770, Florida Administrative Code, February 1997.

Notes: The average of a sample and its duplicate is used for all table calculations.
Sample locations: CF14SS1, CF14SS2, CF14SS3, CF14SS4, CF14SS5, CF14SS6, CF14SS7
Duplicate sample locations: CF14SS1D
Background sample locations: CFBSS16, CFBSS17, CFBSS18, CFBSS19, CFBSS20, CFBSS21, CEFBSS9

* = see footnote 2
HHCPC = human health chemicals of potential concern.
mg/kg = milligrams per kilogram.
NA = not applicable.
PCB = polychlorinated biphenyl.
µg/kg = micrograms per kilogram.
ND = not detected in background.
NSC = no screening concentration available.

Table 6-2
Human Health Chemicals of Potential Concern in Site 14 Unfiltered Groundwater

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[1]	Range of Reporting Limits	Range of Detected Concentrations(*)[2]	Mean[3]	Background Screening Concentrations[4]	Risk-Based Concentrations[5]	Florida Guidance Concentrations[6]	Analyte HHCPC? (Yes/No)	Reason[7]
Volatile Organic Compounds (µg/ℓ)									
Toluene	1/3	1 to 2	9	9	NA	75	40	No	S,G
Explosives (µg/ℓ)									
1,3,5-Trinitrobenzene	1/3	0.2 to 0.26	1.6*	1.6	NA	0.18	50	Yes	
Inorganic Analytes (µg/ℓ)									
Aluminum	2/3	200	578 to 7,230*	3,900	776	3,700	200	Yes	
Barium	3/3	200	7.6 to 23.2	16.6	41.2	260	2,000	No	S,G,B
Beryllium	2/3	5	2.1 to 3 35*	2.7	2	0 016	4	Yes	
Calcium	3/3	5,000	230 to 3,870	1,890	380	1,100,000	NSC	No	S
Chromium	2/3	10	2.1 to 6 9*	4 5	70	[8]18	[9]100	No	S,G,B
Cobalt	1/3	50	13.7*	13.7	11.6	220	NSC	No	S
Iron	3/3	100	786 to 4,960	2,850	450	1,100	300	Yes	
Magnesium	3/3	5,000	477 to 1,180	820	1,290	119,000	NSC	No	S,B
Manganese	3/3	15	21* to 84.2	51	9.8	84	50	Yes	
Nickel	1/3	40	11 8*	11.8	32	73	100	No	S,G,B
Potassium	3/3	5,000	252 to 1,510	800	1,580	300,000	NSC	No	S,B
Sodium	3/3	5,000	6,720* to 10,500	8,510	1,150	39,000	160,000	No	S,G
Thallium	1/3	10	5.5*	5.5	ND	0.29	2	Yes	
Vanadium	2/3	50	2.6 to 9.1	5.9	96	26	49	No	S,G,B
Zinc	1/3	20	34.5*	34.5	48	1,100	5,000	No	S,G,B

See notes at end of table.

Table 6-2 (Continued)
Human Health Chemicals of Potential Concern in Site 14 Unfiltered Groundwater

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

[1] Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed (excluding rejected values).
[2] The value indicated by an asterisk is the average of a sample and its duplicate. For duplicate samples having one nondetect value, 1/2 the contract-required quantitation limit/contract-required detection limit is used as a surrogate.
[3] The mean of detected concentration is the arithmetic mean in which the analyte was detected It does not include those samples with "R", "U", or "UJ" validation qualifiers.
[4] The background screening value is twice the average of detected concentrations for inorganic analytes in background samples.
[5] For all chemicals except the essential nutrients (calcium, magnesium, potassium, and sodium), U.S. Environmental Protection Agency (USEPA) Region III Risk-Based Concentrations (RBC) table for tap water exposure per January 1993 guidance ("Selecting Exposure Routes and Contaminants of Concern by Risk-based Screening," EPA/903/R-93-001) was used for screening. Actual values are taken from the USEPA Region III RBC Tables dated May 1996, which are based on an excess lifetime cancer risk of 10^{-6} and an adjusted hazard quotient of 0.1. For the essential nutrients, screening values were derived based on recommended daily allowances (see Appendix B-1 of the General Information Report [ABB-ES, 1996a]).
[6] The values are from Florida Department of Environmental Protection "Groundwater Guidance Concentrations" dated June 1994.
[7] Analyte was included or excluded from the risk assessment for the following reasons:
B = the maximum detected concentration did not exceed twice the arithmetic mean of detected concentrations at background locations and will not be considered further.
S= the maximum detected concentration did not exceed risk-based screening concentration and will not be considered further.
G = the maximum detected concentration did not exceed Florida guidance concentration and will not be considered further.
[8] The value is based on hexavalent chromium.
[9] The value is based on trivalent chromium.

Notes: The average of a sample and its duplicates is used for all table calculations.
Sample locations: CF14MW1S through CF14MW3S
Duplicate sample locations: CF14MW3SD
Background sample locations: CFBKMW1S through CFBKMW5S, CFBKMW7S, and CFBKMW8S. Duplicate at CFBKMW4SD

* = see footnote 2.
HHCPC = human health chemicals of potential concern.
$\mu g/\ell$ = micrograms per liter.
NA = not applicable.
NSC = no screening concentration available.
ND = not detected in background.

Table 6-3
Surface Water Human Health Chemicals of Potential Concern at Site 14

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Frequency of Detection[1]	Range of Reporting Limits	Range of Detected Concentrations(*)[2]	Mean of Detected Concentrations[3]	Background Screening Concentrations[4]	Region IV Water Quality Standards[5]	Florida Surface Water Quality Standards (Class III)[6]	Analyte HHCPC? (Yes/No)	Reason[7]
Volatile Organic Compounds (µg/ℓ)									
Acetone	1/4	2	5	5	NA	NS	NS	Yes	R
Semivolatile Organic Compounds (µg/ℓ)									
bis(2-Ethylhexyl)phthalate	3/4	10	2 to 43	16	NA	1 8	NS	Yes	
Pesticides and PCBs (µg/ℓ)									
Endrin	1/4	0.1	0.0063	0.0063	NA	0.76	NS	No	S
Inorganic Analytes (µg/ℓ)									
Aluminum	4/4	NA	254 to 634	434	NA	NS	NS	Yes	R
Barium	4/4	NA	6.7* to 12.9	9.7	NA	2,000	NS	No	S
Beryllium	1/4	5	2*	2	NA	NS	0.13	Yes	
Calcium	4/4	NA	1,050* to 11,000	3,900	NA	1,055,398	NS	No	S
Copper	3/4	25	5 7 to 10.2	7.9	NA	1,300	NS	No	S
Iron	4/4	NA	158 to 658	432	NA	300	NS	Yes	
Magnesium	4/4	NA	553* to 1,040	840	NA	118,807	NS	No	S
Manganese	4/4	NA	7 7 to 44.1	18 5	NA	50	NS	No	S
Nickel	1/4	40	3 3	3.3	NA	610	NS	No	S
Potassium	3/4	5,000	64 6 to 141	104	NA	297,010	NS	No	S
Sodium	4/4	NA	2.290* to 4,080	3,160	NA	396,022	NS	No	S
Vanadium	2/4	50	2 1 to 2.5	2 3	NA	NS	NS	Yes	R
Zinc	1/4	20	90.3	90.3	NA	NS	NS	Yes	R

See notes at end of table.

Table 6-3 (Continued)
Surface Water Human Health Chemicals of Potential Concern at Site 14

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

[1] Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed (excluding rejected values)
[2] A value indicated by an asterisk is the average of a sample and its duplicate For duplicate samples having one nondetect value, 1/2 the contract-required quantitation limit/contract-required detection limit is used as a surrogate.
[3] The mean of detected concentrations is the arithmetic mean of all samples in which the analyte was detected. It does not include those samples with "R", "U", or "UJ" validation qualifiers.
[4] The background screening value is twice the average of detected concentrations for inorganic analytes in background samples. This screening criterion is not applicable for surface water because background or upgradient data were not obtained.
[5] The value is from U.S. Environmental Protection Agency Region IV Water Quality Standards, dated January 1996 For essential nutrients (calcium, magnesium, potassium, and sodium), the water quality values were derived based on recommended daily allowances.
[6] The values are from Florida Administrative Code, Chapter 62-302, for Class III freshwater bodies (for recreational use) dated January 1, 1995. Only values protective of human health were used for screening.
[7] Analyte was included or excluded from the risk assessment for the following reasons:
S = the maximum detected concentration did not exceed the Region IV Water Quality Standard and will not be considered further.
R = no screening value is available, analyte is selected as HHCPC.

Notes. The average of a sample and its duplicate is used for all table calculations.
Sample locations: CF14SW1, CF14SW2, CF14SW3, CF14SW4
Duplicate sample locations: CF14SW3SD

* = see footnote 2.
HHCPC = human health chemical of potential concern.
$\mu g/\ell$ = micrograms per liter.
NA = not applicable.
NS = no standard available.
PCB = polychlorinated biphenyl.

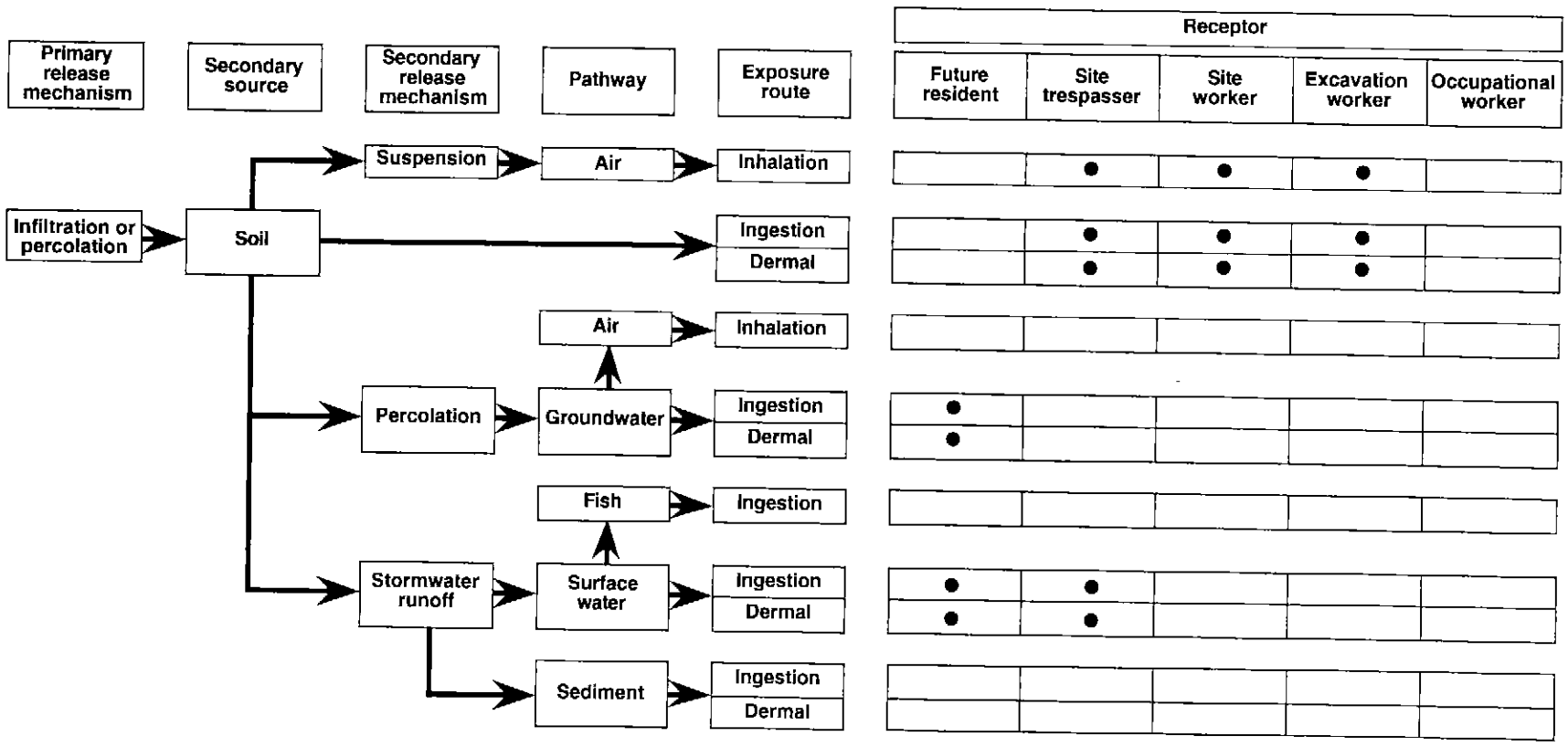


FIGURE 6-1
SITE 14, COMPLETE EXPOSURE PATHWAYS
FOR HUMAN RECEPTORS

REMEDIAL INVESTIGATION
OPERABLE UNIT 5

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

2525-04 FIG 6-1 FINAL 100297MAW

Table 6-4
Potential Exposure Pathways at Site 14

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Medium of Exposure	Route of Exposure	Potentially Exposed Population	Selected for Evaluation?	Reason for Selection or Evaluation
Current Land Use				
Surface Soil	Dermal contact with soil, ingestion of soil, and inhalation of fugitive dust.	Resident (adult and child)	No	No humans currently reside at Site 14. Adolescents and adults may be exposed to contaminants in the surface soil while trespassing. The site maintenance workers may be exposed to contaminants in surface soil while performing routine site activities.
		Trespasser (adult and adolescent)	Yes	
		Occupational worker (adult)	No	
		Site maintenance worker (adult)	Yes	
		Excavation worker (adult)	No	
Groundwater	Ingestion of groundwater as drinking water.	Resident (adult)	No	There are no current exposures to groundwater.
Surface Water	Ingestion and dermal contact with surface water	Trespasser (adult and adolescent)	Yes	Adolescents and adults may be exposed to contaminants in surface water while trespassing
Future Land Use				
Surface Soil	Dermal contact with soil, ingestion of soil, and inhalation of fugitive dust.	Resident (child and adult)	Yes	If Site 14 is developed for residential use, residents could be exposed to chemicals in surface soil. Exposure of trespassers, occupational workers, site maintenance workers, and excavation workers to chemicals in surface soil is possible.
		Trespasser (adolescent and adult)	Yes	
		Occupational worker (adult)	Yes	
		Site maintenance worker (adult)	Yes	
		Excavation worker (adult)	Yes	
Groundwater	Ingestion of groundwater as drinking water and inhalation of volatiles while showering.	Resident (adult and child)	Yes	If Site 14 is developed for residential use, drinking water wells in the surficial aquifer could be influenced by contaminants in the groundwater associated with Site 14. Therefore, future residents could be exposed to contaminants in the surficial aquifer.
Surface Water	Ingestion and dermal contact with surface water.	Resident (adult and child)	Yes	If Site 14 is developed for residential use. residents could be exposed to contaminants in surface water. Trespassers could be exposed to chemicals in surface water while wading.
		Trespasser (adult and adolescent)	Yes	

It is possible that Site 14 may eventually be developed for residential use. Therefore, future residential exposures to contaminants in surface soil are evaluated in this HHRA.

Since there are no buildings presently at the site, occupational worker exposure will only be considered as part of future land use. Possible future exposure scenarios include excavation activities such as installation of utility lines, and site maintenance such as mowing the grass. Site 14 is in a restricted area of the installation, but adult and adolescent trespassers could obtain access to the site. Exposures of future residents (adult and child), future occupational workers, current and future site maintenance workers, future excavation workers, and current and future trespassers (adult and child) to surface soil contaminants through ingestion, dermal contact, and inhalation of particulates are evaluated in the HHRA.

Groundwater. Currently, no humans reside at Site 14 and groundwater is not used for any potable or nonpotable purpose. However, in the event that the area were developed for residential use, exposure to chemicals in groundwater could be a complete pathway. Therefore, possible future domestic use of the surficial aquifer (adult ingestion and child ingestion) is evaluated in the HHRA.

Surface Water. The small ditch usually contains standing water. Although access is limited, current trespassers could obtain access to Site 14. Exposure of trespassers (adult and child) to chemicals in surface water through ingestion and dermal contact are evaluated in the HHRA.

Exposure Point Concentrations (EPCs). EPCs for surface soil, groundwater, and surface water were developed according to the methodology in the GIR (ABB-ES, 1996a). The EPCs for analytes selected as HHCPCs for surface soil, groundwater, and surface water are presented in Tables 6-5, 6-6, and 6-7, respectively. The EPCs were used together with receptor-specific exposure parameters to quantify exposures to the HHCPCs as shown in the risk calculation spreadsheets in Appendix B.

6.2.3 Toxicity Assessment The purpose of the toxicity assessment is to identify the adverse effects that are associated with exposure to each HHCPC and to identify the relationship between the level of exposure and the severity or the likelihood of adverse effects. The toxicity assessment methodology is discussed in the GIR (ABB-ES, 1996a). The GIR and Appendix A of this report contain brief toxicity summaries for HHCPCs identified in surface soil, groundwater, and surface water at Site 14. Appendix A of this report also contains dose-response information for the HHCPCs. Dose-response values used in this HHRA were current as of August 1996 for Integrated Risk Information System (IRIS) and November 1995 for Health Effects Assessment Summary Tables (HEAST). This information is used in the risk characterization (Subsection 6.2.4) to estimate the excess lifetime cancer risk (ELCR) for carcinogens and the noncancer risk or hazard index (HI) for all HHCPCs. Uncertainties associated with chemical-specific toxicity values are discussed in Subsection 6.2.5.

6.2.4 Risk Characterization Risk characterization involves the integration of the exposure and toxicity assessments into a qualitative expression of potential human health risk associated with HHCPC exposure. Both excess lifetime carcinogenic and noncarcinogenic risks are estimated for each HHCPC and each complete exposure pathway selected for evaluation in the exposure assessment, as

Table 6-5
Exposure Point Concentrations for Human Health Chemicals of Potential Concern for Surface Soil at Site 14

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[1]	Maximum Detected Concentrations	95% UCL[2]	Exposure Point Concentrations[3]
Inorganic Analytes (mg/kg)				
Aluminum	7/7	8,510	NC	8,510
Iron	7/7	2,480	NC	2,480

[1] Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed (excluding rejected values).
[2] 95% UCL of the arithmetic mean is calculated using all samples. One-half the contract-required quantitation limit/contract-required detection limit is used as a surrogate for sample results reported as nondetects. The UCL is not calculated when there are less than 10 total samples.
[3] Exposure point concentration is the lower concentration of either the 95% UCL or maximum detected concentration.

Notes: % = percent.
UCL = upper confidence limit (see footnote 2).
mg/kg = milligrams per kilogram.
NC = not calculated.

Table 6-6
Exposure Point Concentrations for Human Health Chemicals of Potential Concern for Unfiltered Groundwater at Site 14

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[1]	Maximum Detected Concentrations	Arithmetic Mean[2]	Exposure Point Concentrations[3]
Explosives (μg/ℓ)				
1,3,5-Trinitrobenzene	1/3	1.6	0.61	0.61
Inorganic Analytes (μg/ℓ)				
Aluminum	2/3	7,230	2,640	2,640
Beryllium	2/3	3.4	2.7	2.7
Iron	3/3	4,960	2,850	2,850
Manganese	3/3	84.2	51	51
Thallium	1/3	5.5	5.2	5.2

[1] Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed.
[2] Arithmetic mean of all samples calculated using one-half the contract-required quantitation limit and contract-required detection limit for nondetects.
[3] Exposure point concentration equals the arithmetic mean. If the maximum detected concentration is less than the arithmetic mean, the maximum detected concentration will be used as the exposure point concentration.

Note: μg/ℓ = micrograms per liter.

Table 6-7
Exposure Point Concentrations for Human Health Chemicals of Potential Concern Surface Water at Site 14

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[1]	Maximum Detected Concentrations	95% UCL[2]	Exposure Point Concentrations[3]
Volatile Organic Compounds (μg/ℓ)				
Acetone	1/4	5	NC	5
Semivolatile Organic Compounds (μg/ℓ)				
bis(2-Ethylhexyl)phthalate	3/4	43	NC	43
Inorganic Analytes (μg/ℓ)				
Aluminum	4/4	634	NC	634
Beryllium	1/4	2	NC	2
Iron	4/4	658	NC	658
Vanadium	2/4	2.5	NC	2.5
Zinc	1/4	90.3	NC	90.3

[1] Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed.
[2] 95% UCL calculated on the arithmetic mean of all samples using one-half the contract-required quantitation limit and contract-required detection limit for nondetects.
[3] Exposure point concentration equals 95% UCL unless the maximum detected concentration is less than the 95% UCL. The UCL is not calculated when there are less than 10 total samples.

Notes: % = percent.
UCL = upper confidence limit
μg/ℓ = micrograms per liter.
NC = not calculated.

described in the GIR (ABB-ES, 1996a). Risk estimates for potential exposures to surface soil, groundwater, and surface water under current and future land-use assumptions are discussed. Table 6-8 summarizes the ELCR and noncancer risk under current land-use conditions for Site 14. Table 6-9 summarizes the ELCR and noncancer risk under future land-use assumptions for Site 14. Figures 6-2 through 6-6 summarize the ELCRs and HIs associated with current and future land use for Site 14.

Surface Soil. The risk calculations for surface soil exposure are shown in Tables B.14.1 through B.14.14 in Appendix B to this report. No carcinogens were selected as HHCPCs. Figure 6-2 presents an HI summary for current and future land use. Noncancer HI values are below the USEPA's and FDEP's HI threshold of 1 for all receptors under current and future land use.

Groundwater. The risk calculations for groundwater exposure are shown in Tables B.14.15 and B.14.16 in Appendix B to this report. Currently, there are no potable supply wells at the site; thus, there is no human exposure to groundwater. Figures 6-3 and 6-4 present ELCRs and HIs, respectively, for future land use. Future aggregate (child and adult) resident ingestion risk for unfiltered groundwater is 2×10^{-4} (2 in 10,000). This ELCR exceeds the USEPA's allowable risk range (1 in 10,000 to 1 in 1,000,000). The predominant risk driver is beryllium (1×10^{-4} for adult).

The HI for groundwater ingestion is 2 for the adult resident and 5 for the child resident. These HIs exceed the USEPA's target HI of 1. For the potential future adult resident, the major contributors to this HI are thallium (hazard quotient [HQ] = 1.8) and iron (HQ = 0.26).

For the future child resident, the HI is 5. The major contributors to this HI are thallium (HQ = 4.2), iron (HQ = 0.61), and aluminum (HQ = 0.17). If the medium-specific HI exceeds USEPA's target of 1, the HQs can be segregated by target organ effects to determine if the target organ-specific HIs exceed 1. However, the HQ of thallium exceeds 1, so segregation of the HQs is not useful.

Based on the HI values and the possibility that the concentrations of the predominant risk contributors are due to their naturally occurring presence in suspended soil particles, the health risks associated with potential future use of groundwater as drinking water appear to be acceptable. Since there is no current use of groundwater, there is no risk of concern associated with groundwater under current land use.

Surface Water. The risk calculations for surface water exposure assumptions are shown in Tables B.14.17 through B.14.20 in Appendix B to this report. Figures 6-5 and 6-6 present a summary of ELCRs and HIs, respectively. Under current and future land use, risks for all receptors are within the USEPA's acceptable risk range, but exceeded the FDEP target risk of 1×10^{-6}. The current ELCR associated with surface water (ingestion, dermal contact) is 1×10^{-5} for an aggregate (combined adult and child) trespasser. The future risk associated with surface water (ingestion, dermal contact) is 3×10^{-5} for an aggregate (combined adult and child) resident. The major contributors to this risk are *bis*(2-ethylhexyl)-phthalate and beryllium.

Table 6-8
Current Land Use Risk Summary for Site 14

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Land Use	Exposure Route	HI	ELCR
Current Land Use			
Surface Soil:			
Adult Trespasser:	Incidental ingestion	0.004	NE
	Dermal contact	0.005	NE
	Inhalation of particulates	ND	NE
	Total Adult Trespasser:	0.008	NE
Adolescent Trespasser.	Incidental ingestion	0.005	NE
	Dermal contact	0.006	NE
	Inhalation of particulates	ND	NE
	Total Adolescent Trespasser:	0.01	NE
	Total Risk to Trespasser (Adult and Adolescent) Exposed to Surface Soil:	NC	NE
Site Maintenance Worker:	Incidental ingestion	0.001	NE
	Dermal contact	0.003	NE
	Inhalation of particulates	ND	NE
	Total Site Maintenance Worker:	0.004	NE
Excavation Worker:	Incidental ingestion	0.01	NE
	Dermal contact	0.003	NE
	Inhalation of particulates	ND	NE
	Total Excavation Worker:	0.01	NE
Surface Water:			
Adult Trespasser:	Incidental ingestion	0.0003	1×10^{-7}
	Dermal contact	0.02	8×10^{-6}
	Total Adult Trespasser:	0.02	8×10^{-6}
Adolescent Trespasser:	Incidental ingestion	0.0004	9×10^{-8}
	Dermal contact	0.02	5×10^{-6}
	Total Adolescent Trespasser:	0.02	5×10^{-6}
	Total Risk to Trespasser (Adult and Adolescent) Exposed to Surface Water:	NC	1×10^{-5}

Notes: HI = hazard index.
ELCR = excess lifetime cancer risk.
NE = No carcinogenic human health chemical of potential concern (HHCPCs) selected. therefore not evaluated.
ND = No dose-response data for this exposure route were available for HHCPCs in this medium.
NC = Not calculated because child and adult HIs are not additive.
1×10^{-7} = 1 in 10,000,000 or 1E -07.

Table 6-9
Future Land Use Risk Summary for Site 14

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Land Use	Exposure Route	HI	ELCR
Future Land Use			
Surface Soil.			
Adult Trespasser:	Incidental ingestion	0.004	NE
	Dermal contact	0.005	NE
	Inhalation of particulates	ND	NE
	Total Adult Trespasser·	0.008	NE
Adolescent Trespasser:	Incidental ingestion	0 005	NE
	Dermal contact	0.006	NE
	Inhalation of particulates	ND	NE
	Total Adolescent Trespasser:	0.01	NE
	Total Risk to Trespasser (Adult and Adolescent) Exposed to Surface Soil:	NC	NE
Adult Resident·	Incidental ingestion	0.03	NE
	Dermal contact	0.04	NE
	Inhalation of particulates	ND	NE
	Total Adult Resident.	0.07	NE
Child Resident:	Incidental ingestion	0.3	NE
	Dermal contact	0.06	NE
	Inhalation of particulates	ND	NE
	Total Child Resident:	0.3	NE
	Total Risk to Resident (Adult and Adolescent) Exposed to Surface Soil:	NC	NE
Occupational Worker	Incidental ingestion	0.01	NE
	Dermal contact	0.01	NE
	Inhalation of particulates	ND	NE
	Total Occupational Worker:	0.02	NE
Site Maintenance Worker:	Incidental ingestion	0.001	NE
	Dermal contact	0.003	NE
	Inhalation of particulates	ND	NE
	Total Site Maintenance Worker:	0.004	NE
Excavation Worker:	Incidental ingestion	0.01	NE
	Dermal contact	0.003	NE
	Inhalation of particulates	ND	NE
	Total Excavation Worker:	0.01	NE

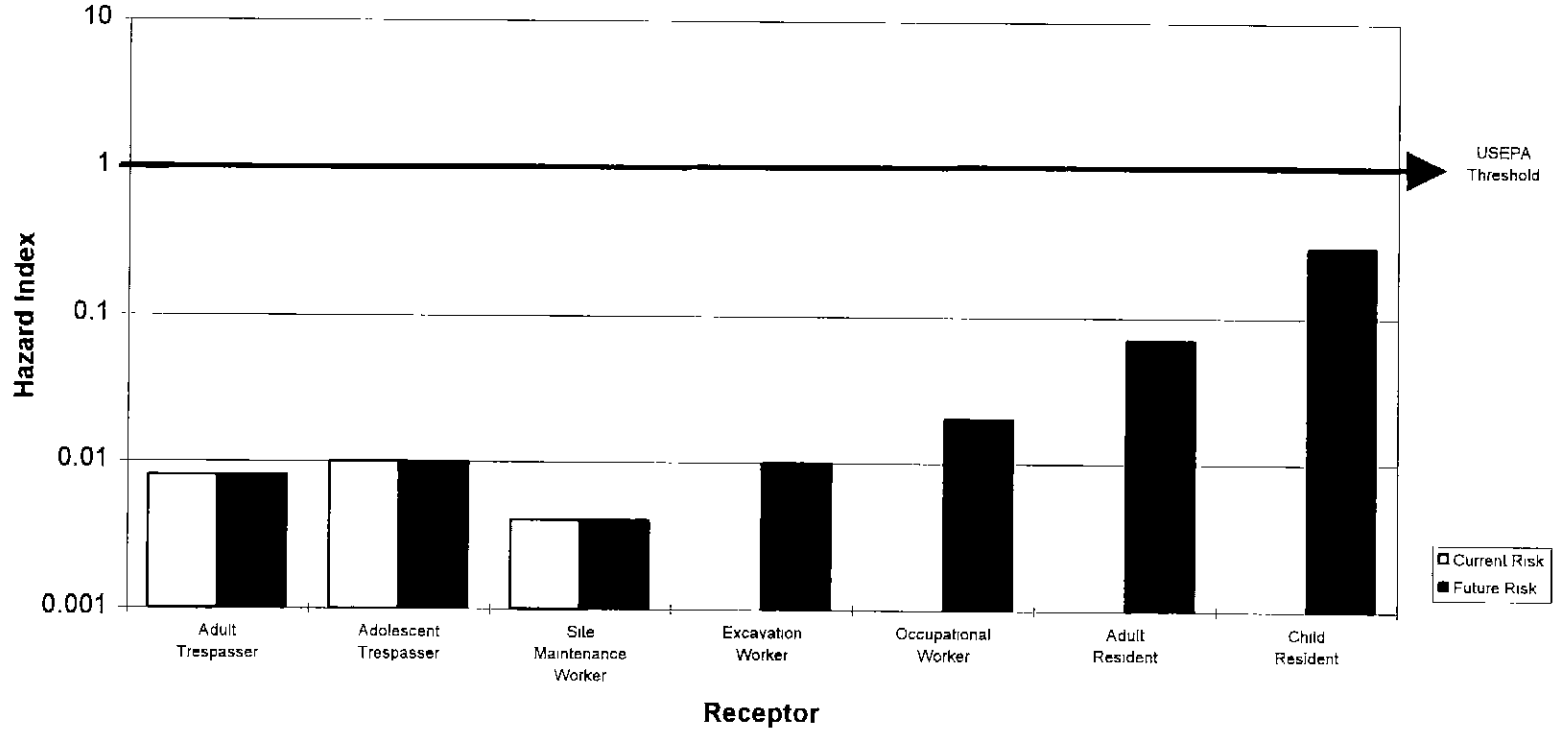
See notes at end of table.

Table 6-9 (Continued)
Future Land Use Risk Summary for Site 14

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Land Use	Exposure Route	HI	ELCR
Groundwater:			
Adult Resident:	Ingestion of groundwater as drinking water	2	1×10^{-4}
	Total Adult Resident:	2	1×10^{-4}
Child Resident·	Ingestion of groundwater as drinking water	5	6×10^{-5}
	Total Child Resident:	5	6×10^{-5}
	Total Risk to Resident (Adult and Child) Exposed to Groundwater·	NC	2×10^{-4}
Surface Water:			
Adult Trespasser:	Incidental ingestion	0.0003	1×10^{-7}
	Dermal contact	0.02	8×10^{-6}
	Total Adult Trespasser:	0.02	8×10^{-6}
Adolescent Trespasser:	Incidental ingestion	0.0004	9×10^{-8}
	Dermal contact	0.02	5×10^{-6}
	Total Adolescent Trespasser.	0.02	5×10^{-6}
	Total Risk to Trespasser (Adult and Adolescent) Exposed to Surface Water:	NC	1×10^{-5}
Adult Resident:	Incidental ingestion	0.0006	3×10^{-7}
	Dermal contact	0.04	2×10^{-5}
	Total Adult Resident:	0.04	2×10^{-5}
Child Resident·	Incidental ingestion	0.01	2×10^{-6}
	Dermal contact	0.07	8×10^{-6}
	Total Child Resident:	0.08	1×10^{-5}
	Total Risk to Resident (Adult and Child) Exposed to Surface Water:	NC	3×10^{-5}

Notes: HI = hazard index.
ELCR = excess lifetime cancer risk.
NE = No carcinogenic human health chemical of potential concern (HHCPCs) were selected in this medium, therefore cancer risk was not evaluated.
ND = No dose-response data for this exposure route were available for HHCPCs in this medium.
NC = Not calculated because child and adult HIs are not additive.
1×10^{-4} = 1 in 10,000 or 1E -04



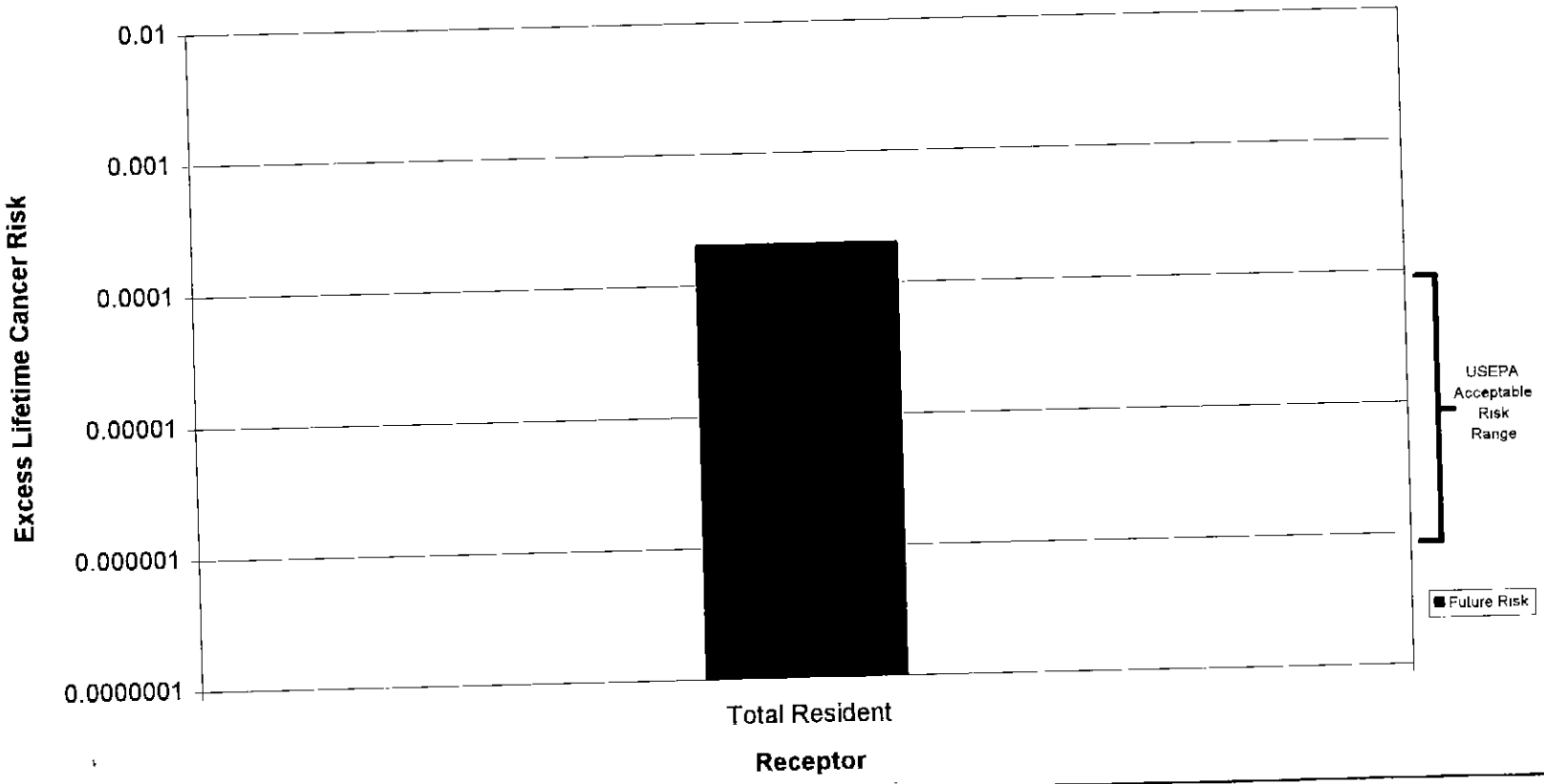
NOTE:
USEPA = U S. Environmental Protection Agency

FIGURE 6-2
SITE 14
SURFACE SOIL NONCANCER RISK SUMMARY

REMEDIAL INVESTIGATION
OPERABLE UNIT 5

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

2523-04 FIG 6-2 FRAME 100697MAW
GRAPH: G:\USERS\DESIGN\MWTEMP\CECIL\SITE142.XLS



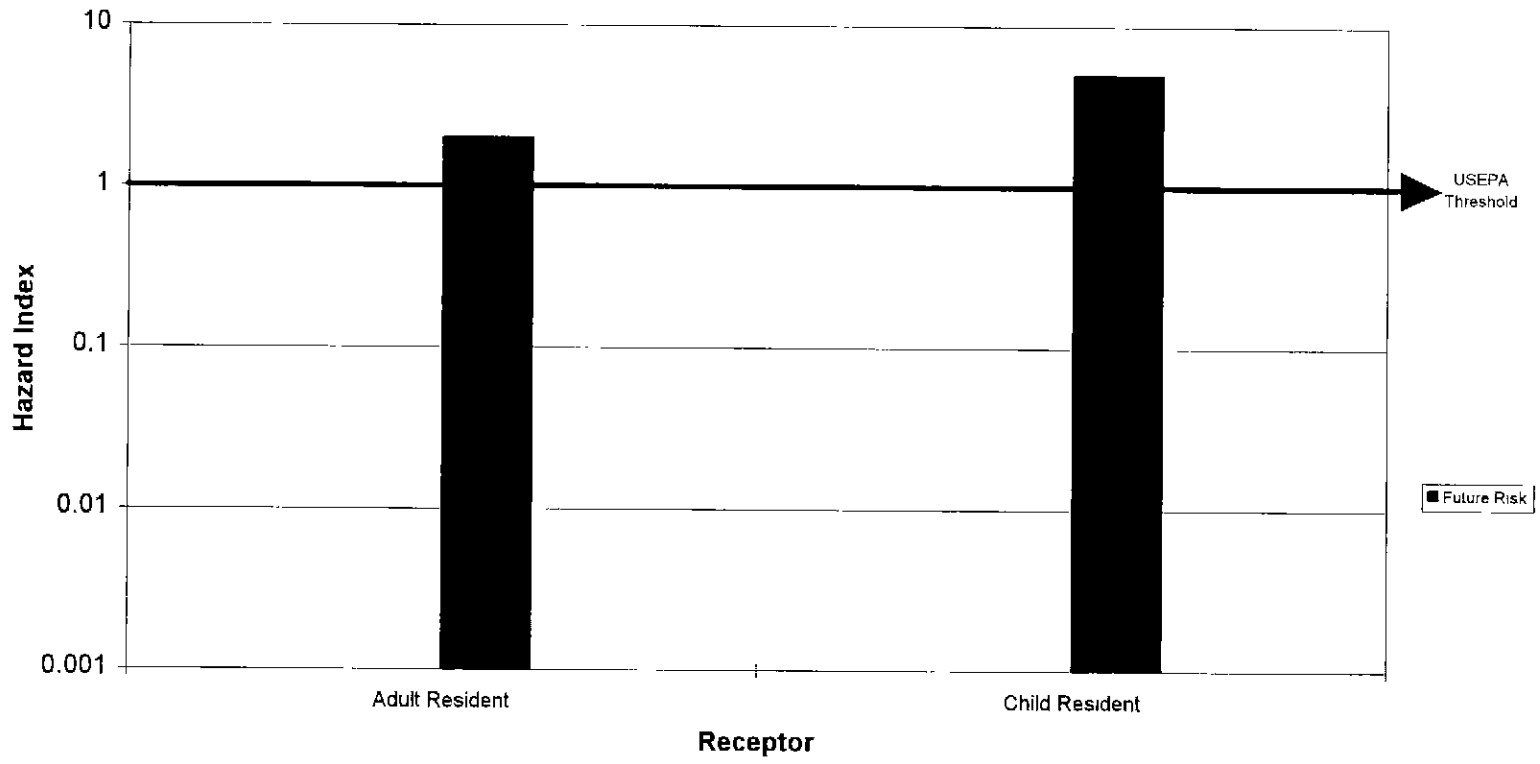
NOTE:
USEPA = U.S. Environmental Protection Agency

FIGURE 6-3
SITE 14
GROUNDWATER CANCER RISK

REMEDIAL INVESTIGATION
OPERABLE UNIT 5

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

2523-04 FIG 6-3 FRAME 100697MAW
GRAPH G:\USERS\DESIGN\MWTEMP\CECIL\SITE142.XLS



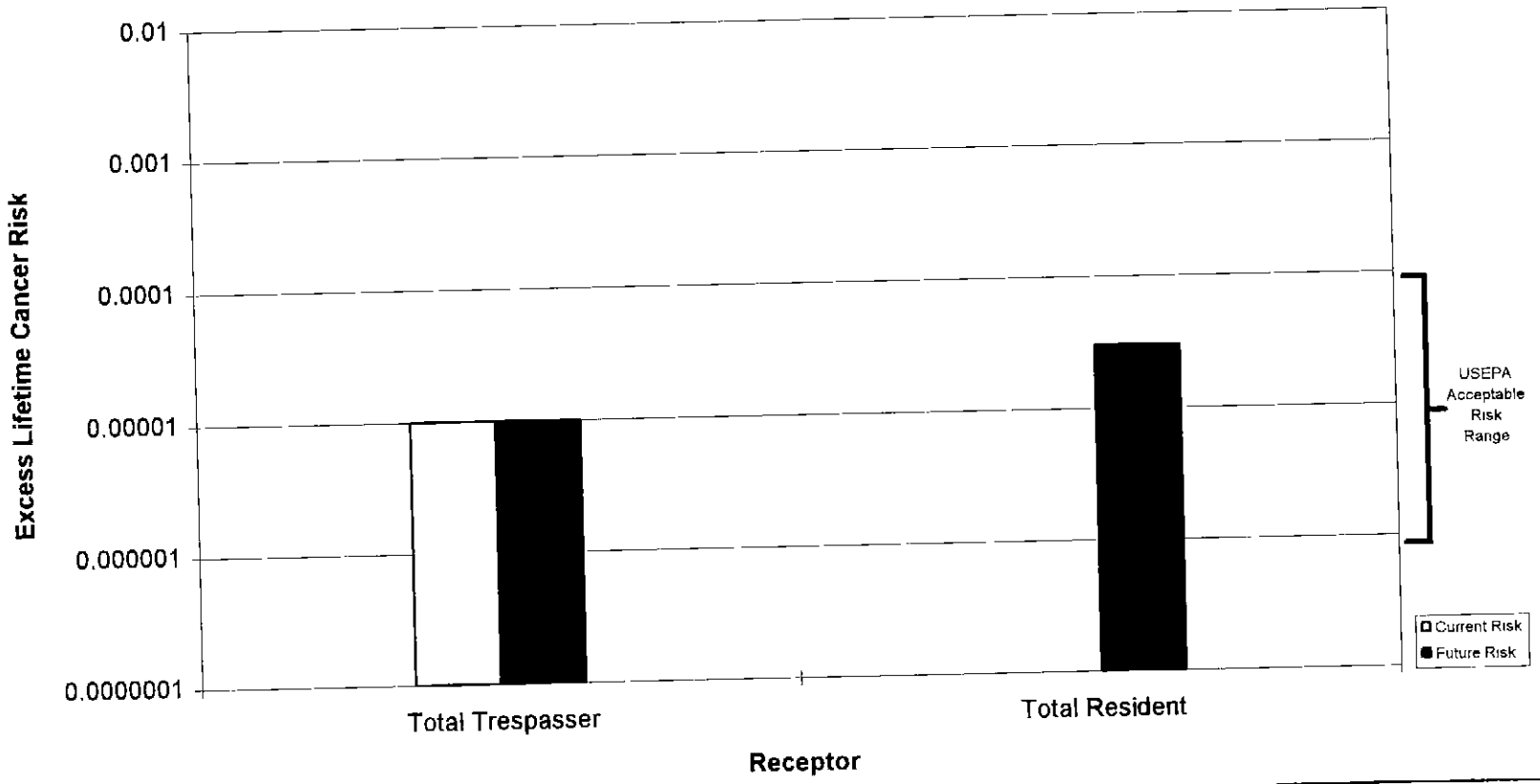
NOTE:
USEPA = U.S. Environmental Protection Agency

FIGURE 6-4
SITE 14
GROUNDWATER NONCANCER
RISK SUMMARY

REMEDIAL INVESTIGATION
OPERABLE UNIT 5

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

2523-04 FIG 6-4 FRAME 100697MAW
GRAPH. G:\USERS\DESIGN\MWTEMP\CECIL\SITE142 XLS



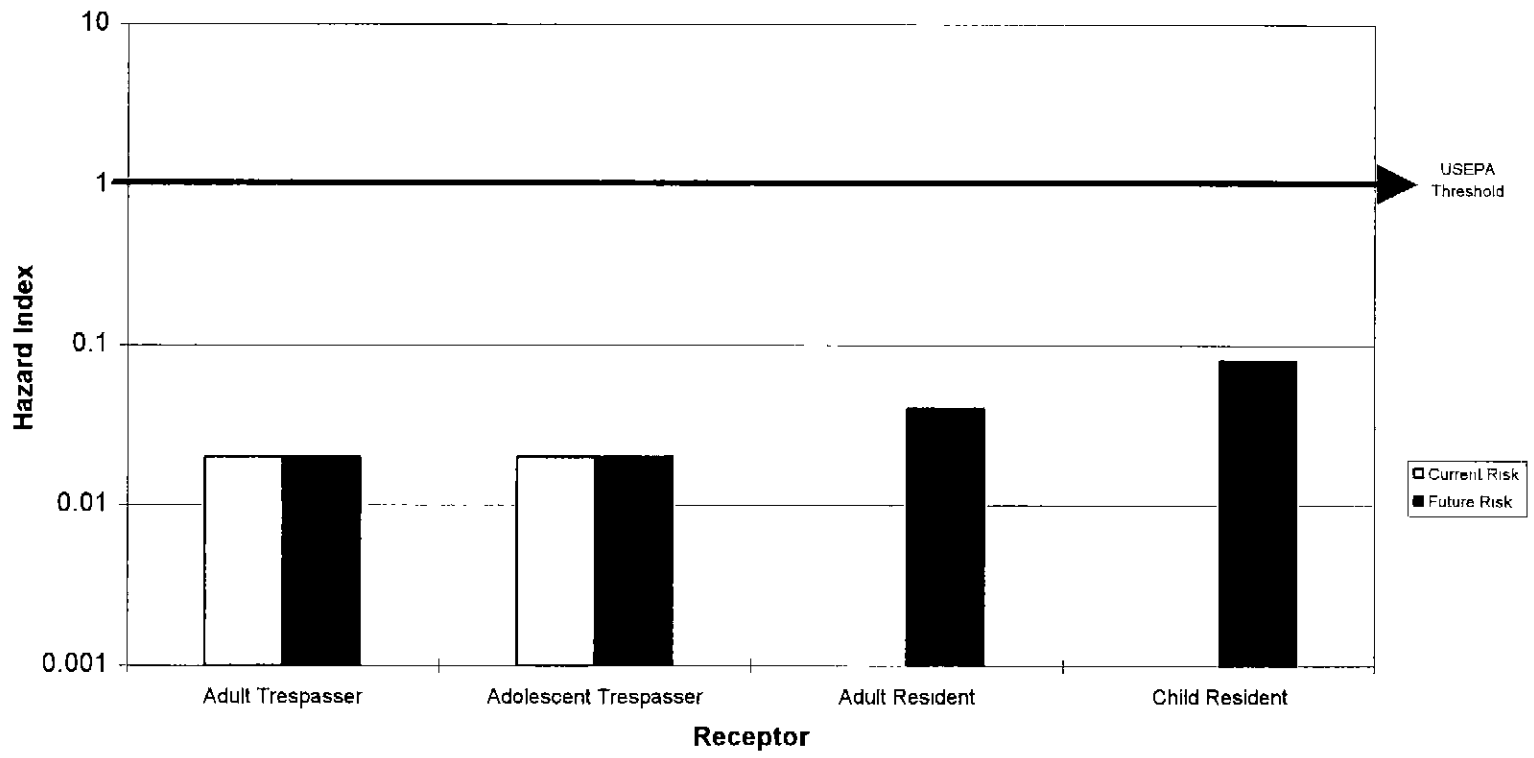
NOTE:
USEPA = U.S. Environmental Protection Agency

FIGURE 6-5
SITE 14
SURFACE WATER CANCER RISK SUMMARY

REMEDIAL INVESTIGATION
OPERABLE UNIT 5

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

2523-04 FIG 6-5 FRAME 100697MAW
GRAPH, G:\USERS\DESIGN\MWTEMP\CECIL\SITE142.XLS



NOTE:
USEPA = U S. Environmental Protection Agency

FIGURE 6-6
SITE 14
SURFACE WATER NONCANCER
RISK SUMMARY

REMEDIAL INVESTIGATION
OPERABLE UNIT 5

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

2523-04 FIG 6-6 FRAME 100697MAW
GRAPH. G:\USERS\DESIGN\MWTEMP\CECIL\SITE142 XLS

Additional samples were collected at sample locations SW1 and SW3 at Site 14. SW1 was analyzed for *bis*(2-ethylhexyl)phthalate only and SW3 was analyzed for beryllium only. *Bis*(2-ethylhexyl)phthalate and beryllium were not detected at either location. These supplemental data were not included in the risk assessment.

The surface water HIs for all current and potential future land-use assumptions do not exceed the USEPA and FDEP threshold HI of 1.

6.2.5 Uncertainty Analysis General uncertainties associated with the collection, analysis, and evaluation of data; exposure assessment; toxicity assessment; and the risk estimation process are discussed in the GIR (ABB-ES, 1996a). Site-specific uncertainties that are important for the interpretation of the calculated risk estimates for surface soil, groundwater, and surface water at Site 14 are discussed below.

- The results from TRPH analysis represent a composite of many different naturally occurring and petroleum compounds. The toxicity associated with TRPH will vary depending on the chemical composition of the petroleum represented by the TRPH value. The toxicity value used in the HHRA represents a conservative surrogate value derived from pyrene. This surrogate value may overestimate the risk posed by TRPH at the site.

- Iron, thallium, and aluminum are naturally occurring constituents in soil. It is likely that the concentrations of these three metals in groundwater are due to suspended soil particulates in the unfiltered monitoring well samples rather than groundwater contamination, because these elements are not expected to be waste constituents of ordnance disposal activities.

- There are no primary MCLs available for iron, aluminum, and manganese. Secondary MCLs were developed for taste, aesthetic, and economic, but not health, reasons. Although EPCs for iron, aluminum, and manganese in Site 14 groundwater exceed the Florida Groundwater Guidance concentrations, it does not necessarily imply that these constituents pose a health risk.

- The central tendency of carcinogenic risk from the potential future receptors at Site 14 that exceed USEPA risk range was evaluated. The central tendency analysis was conducted using the same exposure point concentration as in the RME scenario, but mean or median values for exposure parameters. The objective of this analysis is to estimate the 50 percentile risk to provide a more probable risk level (USEPA, 1995b). Central tendency risk was evaluated only for Site 14 groundwater.

  The central tendency carcinogenic risk results for potential future residential receptors exposed to groundwater, using average exposure parameters, are presented in Tables B.14.22 and B.14.23 in Appendix B of this report. The central tendency parameters differ from the RME exposure scenario by using a 50 percentile drinking water ingestion rate, median exposure duration. The central tendency aggregate residential cancer risk is 4×10^{-5}, which is within the USEPA risk range.

However, the central tendency noncarcinogenic risk is HI = 2 for the adult resident and HI = 4 for the child resident.

The cancer risk range 4×10^{-5} to 2×10^{-5} and noncancer risk range of 2 to 5, presented by the central tendency and RME exposure scenarios for potential future residential receptors, are useful as information to provide perspective for risk management and compliance with USEPA guidance (USEPA, 1995).

- Some uncertainty is associated with future land use at Site 14. The proposed future land use at Site 14 is for a recreational park, which would include such activities as horseback riding, hiking, etc. The exclusion of a future recreational scenario in the HHRA would result in underestimated risks.

6.2.6 Remedial Goal Options (RGOs) RGOs and available criteria are intended to provide the basis for the development of remedial alternatives in the FS, which follows the RI in the event there are unacceptable health risks. These RGOs represent various media-specific risk levels if contaminants remain onsite at a designated concentration and under the assumed exposure and toxicity conditions used in this assessment. The RGO values are not actual or proposed cleanup levels, but are provided to assist risk-management decision-making.

Tables of RGOs are presented for each medium with a total ELCR greater than 10^{-4} or an HI greater than 1 in accordance with USEPA guidance and for media with chemicals whose EPCs exceed Florida standards. The RGO concentrations are calculated using the assumed conditions representing the highest estimated risk for a given medium. For media meeting the criteria described above, RGOs are developed for each chemical with a total ELCR greater than 1×10^{-6} or HQ greater than 0.1.

Surface Soil. The risks associated with surface soil at Site 14 did not exceed USEPA risk management criteria. TRPH are presented in Table 6-10 because the EPC exceeded the Florida Soil Cleanup Goal, which is a technology-based criterion for thermal treatment of petroleum-contaminated soils.

Groundwater. The ELCR associated with groundwater at Site 14 exceeded the USEPA's allowable cancer risk range of 1 in 10,000 to 1 in 1,000,000 and the USEPA's threshold HI of 1. The cancer risk for beryllium exceeded 1×10^{-6}. The HQs for aluminum, iron, manganese, and thallium exceeded 0.1. The EPCs of aluminum, iron, manganese, and thallium exceeded the Florida Guidance Concentrations and the Federal MCLs. Table 6-11 presents the RGOs for these analytes.

Surface Water. The risks associated with surface water did not exceed USEPA risk management criteria. RGOs were developed for beryllium and iron because the EPCs exceeded the Florida Surface Water Quality Standards. Table 6-12 presents the RGOs for these analytes.

6.3 SITE 15.

6.3.1 HHCPCs Based on the criteria presented in Subsection 6.1.2 and the analytical results of media samples collected at Site 15, HHCPCs were identified for surface and subsurface soils, groundwater, surface water, and sediment. The

Table 6-10
Summary of Remedial Goal Options for Surface Soil Associated with Site 14

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Range of Detected Concentrations (mg/kg)	Exposure Point Concentrations (mg/kg)	Total Excess Lifetime Cancer Risk			Total Hazard Index			Florida Soil Cleanup Goals (Residential)[1]	Florida Soil Cleanup Goals (Leaching)[2]	Background Screening Concentrations[3]
			10^{-4}	10^{-5}	10^{-6}	3	1	0.1			
TRPH	26 to 93	93	NA	NA	NA	NC	NC	NC	[4]380	NC	NA

[1] Technology-based criterion for thermal treatment of petroleum contaminated residential soil, from Florida Department of Environmental Protection (FDEP) memoranda "Soil Cleanup Goals for Florida," dated September 29, 1995, and "Applicability of Soil Cleanup Goals for Florida," dated January 19, 1996.
[2] Values are from the FDEP memorandum "Soil Cleanup Goals for Florida," dated September 29, 1995
[3] The background screening value is twice the average of detected concentrations for inorganic analytes in background samples.
[4] The screening value is from FDEP's "Development of Risk-Based Soil Cleanup Target Levels," Chapter 62-770, Florida Administrative Code, February 1997.

Notes: mg/kg = milligrams per kilogram
TRPH = total recoverable petroleum hydrocarbons.
NA = not applicable.
NC = not calculated, because total hazard index is less than 0.1.

Table 6-11
Remedial Goal Options for Unfiltered Groundwater at Site 14

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Range of Detected Concentrations ($\mu g/\ell$)	Exposure Point Concentrations ($\mu g/\ell$)	Total Excess Lifetime Cancer Risk (Based on Cancer Risk to Resident)			Total Hazard Index (Based on Risk to Child Resident)			Florida Primary and Secondary Standards[1]	Federal MCLs and Secondary MCLs[2]	Background Screening Concentrations[3]
			10^{-4}	10^{-5}	10^{-6}	3	1	0.1			
Aluminum	578 to 7,230	2,640	NA	NA	NA	NR	NR	1,550	[4]200	[4]50	776
Beryllium	2.1 to 3.4	2.7	1.6	0.16	0.016	NA	NA	NA	4	4	2
Iron	786 to 4,960	2,850	NA	NA	NA	NR	NR	468	[4]300	[4]300	450
Manganese	21 to 84.2	51	NA	NA	NA	NC	NC	NC	[4]50	[4]50	9.8
Thallium	5.5	5.2	NA	NA	NA	3.6	1.2	0.12	2	2	ND

[1] Florida Department of Environmental Protection, "Ground Water Guidance Concentrations" (June 1994).
[2] The Federal MCLs are identified in U.S. Environmental Protection Agency Drinking Water Regulations and Health Advisories (October 1996) Secondary MCLs are not health risk-based criteria.
[3] The background screening value is twice the average of detected concentrations for inorganic analytes in background samples.
[4] Secondary MCL

Notes: $\mu g/\ell$ = micrograms per liter.
MCL = maximum contaminant level.
NA = not applicable.
NR = the remedial goal option exceeds the exposure point concentration; no action is required to achieve this risk level.
NC = not calculated.
ND = not detected in background.

Table 6-12
Remedial Goal Options for Surface Water at Site 14

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Range of Detected Concentrations ($\mu g/\ell$)	Exposure Point Concentrations ($\mu g/\ell$)	Total Excess Lifetime Cancer Risk			Total Hazard Index			Florida Surface Water Quality Standards[1]	Region IV Water Quality Standards[2]	Background Screening Concentrations
			10^{-4}	10^{-5}	10^{-6}	3	1	0.1			
Beryllium	2	2	NA	NA	NA	NA	NA	NA	0.13	NS	NA
Iron	158 to 658	658	NA	NA	NA	NA	NA	NA	NS	300	NA

[1] Values are from Florida Administrative Code, Chapter 62-302, for Class III freshwater bodies (for recreational use), January 1995.
[2] Values, based on taste, aesthetic, and economic but not health risk reasons, are from the U.S. Environmental Protection Agency Region IV Water Quality Standards, January 1996.

Notes. $\mu g/\ell$ = micrograms per liter.
NA = not applicable.
NS = no screening value

criteria presented for surface soil were also applied to subsurface soil analytical results to select HHCPCs.

Surface Soil. Forty-seven samples and five duplicate samples were collected from Site 15. A representative surface soil background data set was used in screening HHCPCs. A summary of chemicals detected in surface soil and HHCPCs selected is presented in Table 6-13. Twelve semivolatiles (benzo(a)anthracene, benzo(a)-pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, carbazole, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-*cd*)pyrene, phenanthrene, pyrene); three inorganic analytes (antimony, arsenic, lead), TRPH, and one explosive (HMX) were selected as HHCPCs in surface soil.

Subsurface Soil. Fifteen subsurface soil samples were collected from Site 15. A representative subsurface soil background data set was used in screening HHCPCs. A summary of chemicals detected in subsurface soil and HHCPCs selected is presented in Table 6-14. Seven semivolatiles (benzo(a)anthracene, benzo(a)-pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)-anthracene, indeno(1,2,3-*cd*)pyrene) and TRPH were selected as HHCPCs in subsurface soil.

Groundwater. Eight groundwater samples and one duplicate sample were collected from Site 15. Background groundwater quality was characterized (Chapter 3.0) and used in screening the contaminants detected at Site 15. A summary of chemicals detected in groundwater at Site 15 and selected HHCPCs is presented in Table 6-15. Groundwater samples were collected using the low-flow method described in Subsection 2.8.4 of the RI/FS for OU 3, 4, and 5 (ABB-ES, 1994a). One semivolatile (*bis*(2-ethylhexyl)phthalate), three pesticides (4,4-DDD, 4,4-DDE, 4,4-DDT), five inorganics (aluminum, antimony, beryllium, iron, thallium), and one explosive (RDX) were selected as HHCPCs in groundwater.

Surface Water. Three surface water samples and one duplicate were collected from Site 15. A summary of chemicals detected in surface water and selected HHCPCs is presented in Table 6-16. Background screening criteria were not used because upgradient or background surface water samples were not collected. Four explosives (1,3,5-TNB, 3-nitrotoluene, 4-nitrotoluene, tetryl), five inorganics (aluminum, arsenic, iron, lead, vanadium), and TRPH were selected as HHCPCs in surface water.

6.3.2 Exposure Assessment The exposure assessment is conducted to assess hypothetical pathways by which humans may be exposed to chemicals present at the site. The exposure assessment uses the hypothetical pathways to estimate the magnitude of actual and/or potential human exposure, and the frequency and duration of exposure. This process is performed for both current and future land-use assumptions. Summaries of potential exposure pathways to chemicals detected at Site 15 are presented on Figure 6-7. The potential pathways, including medium and route of exposure, the potentially exposed population, and the rationale for pathway selection or exclusion, are provided in Table 6-17.

Receptor-specific exposure parameters for each exposure scenario are presented in Appendix B of the GIR (ABB-ES, 1996a). Risk calculation spreadsheets in Appendix B of this report also contain the assumed exposure parameters and quantitation of exposures.

Table 6-13
Human Health Chemicals of Potential Concern in Surface Soil at Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[1]	Range of Reporting Limits	Range of Detected Concentrations[2]	Mean of Detected Concentrations[3]	Background Screening Concentrations[4]	Risk-Based Concentrations[5]	Florida Soil Cleanup Goals[6]	Analyte HHCPC? (Yes/No)	Reason[7]
Volatile Organic Compounds (µg/kg)									
Acetone	1/35	11 to 18	6	6	NA	780,000	260,000	No	S,G
Xylenes (total)	1/35	5 to 12	2	2	NA	16,000,000	13,000,000	No	S,G
Semivolatile Organic Compounds (µg/kg)									
2-Methylnaphthalene	3/41	370 to 1,800	22 to 3,700	1,300	NA	[8]310,000	960,000	No	S,G
Acenaphthene	15/41	370 to 590	31 to 17,000	4,000	NA	470,000	2,800,000	No	S,G
Anthracene	17/41	370 to 590	20 to 54,000	13,000	NA	2,300,000	20,000,000	No	S,G
Benzo(a)anthracene	26/41	370 to 590	52 to 340,000	54,000	NA	880	1,400	Yes	
Benzo(a)pyrene	29/41	370 to 590	54 to 340,000	47,000	NA	88	100	Yes	
Benzo(b)fluoranthene	31/41	370 to 590	41 to 510,000	64,000	NA	880	1,400	Yes	
Benzo(g,h,i)perylene	23/41	370 to 590	28 to 180,000	26,000	NA	[9]230,000	14,000	Yes	
Benzo(k)fluoranthene	26/41	370 to 590	31 to 160,000	27,000	NA	8,800	14,000	Yes	
bis(2-Ethylhexyl)phthalate	9/32	370 to 3,700	21 to 520	220	NA	46,000	48,000	No	S,G
Butylbenzylphthalate	6/32	370 to 3,700	160 to 440	290	NA	1,600,000	15,000,000	No	S,G
Carbazole	14/36	370 to 590	21 to 43,000	9,000	NA	32,000	42,000	Yes	
Chrysene	28/41	370 to 590	54 to 400,000	58,000	NA	88,000	140,000	Yes	
Dibenzo(a,h)anthracene	18/41	370 to 590	22 to 54,000	12,000	NA	88	100	Yes	
Dibenzofuran	9/36	370 to 1,800	35 to 8,000	2,600	NA	31,000	240,000	No	S,G
Di-*n*-butylphthalate	26/32	370 to 1,800	65 to 6,600	2,200	2450	780,000	7,300,000	No	S,G
Fluoranthene	31/41	370 to 590	39 to 660,000	81,000	NA	310,000	2,900,000	Yes	

See notes at end of table.

Table 6-13 (Continued)
Human Health Chemicals of Potential Concern in Surface Soil at Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[1]	Range of Reporting Limits	Range of Detected Concentrations[2]	Mean of Detected Concentrations[3]	Background Screening Concentrations[4]	Risk-Based Concentrations[5]	Florida Soil Cleanup Goals[6]	Analyte HHCPC? (Yes/No)	Reason[7]
Semivolatile Organic Compounds (µg/kg) (continued)									
Fluorene	12/41	370 to 1,000	43 to 9,000	3,000	NA	310,000	2,400,000	No	S,G
Indeno(1,2,3-*cd*)pyrene	26/41	370 to 590	25 to 160,000	25,000	NA	880	1,400	Yes	
Naphthalene	15/41	370 to 1,000	24 to 17,000	4,000	NA	310,000	1,300,000	No	S,G
Phenanthrene	28/41	370 to 590	29 to 270,000	39,000	NA	[9]230.000	1,700,000	Yes	
Pyrene	30/41	370 to 590	38 to 500,000	64,000	NA	230,000	48,000	Yes	
Pesticides and PCBs (µg/kg)									
4,4-DDE	3/27	3.7 to 370	0.16 to 1.3	0 7	ND	1,900	3.000	No	S,G
4,4-DDT	3/26	3.7 to 370	0.69 to 21	9	NA	1,900	3,100	No	S,G
Dieldrin	1/27	3.7 to 370	0.37	0.37	NA	40	70	No	S,G
Endosulfan II	3/25	3.7 to 370	0.74 to 2 1*	1.2	NA	[10]47,000	390,000	No	S,G
Endrin aldehyde	1/27	3.7 to 370	2.7	2.7	NA	[11]2,300	23,000	No	S,G
Methoxychlor	1/27	4.6 to 1,800	49	49	NA	39,000	380,000	No	S,G
Inorganic Analytes (mg/kg)									
Aluminum	34/35	40	88 to 7,140	1,120	4,036	7,800	75,000	No	S,G
Antimony	23/44	12	0 46 to 2,400	160	ND	3 1	26	Yes	
Arsenic	26/44	2	0.95 to 451	32	ND	0.43	0.8	Yes	
Barium	34/35	40	0 88 to 107	15	9	550	5,200	No	S,G
Cadmium	6/35	1	0 3 to 0.92	0.6	ND	3.9	37	No	S,G
Calcium	26/35	1,000	38.3 to 102,000	5,000	ND	1,000,000	ND	No	S
Chromium	8/35	2	1.6 to 26.9	5.4	ND	[12]39	[12]290	No	S,G

See notes at end of table.

Table 6-13 (Continued)
Human Health Chemicals of Potential Concern in Surface Soil at Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[1]	Range of Reporting Limits	Range of Detected Concentrations[2]	Mean of Detected Concentrations[3]	Background Screening Concentrations[4]	Risk-Based Concentrations[5]	Florida Soil Cleanup Goals[6]	Analyte HHCPC? (Yes/No)	Reason[7]
Inorganic Analytes (mg/kg) (continued)									
Cobalt	6/32	10	0 27 to 2.7*	0.7	ND	470	4,700	No	S,G
Copper	9/35	5	1.1 to 21.2	4.3	ND	310	ND	No	S
Cyanide	3/35	0 5	0.24* to 0.27	0.25	ND	[13]160	1,600	No	S,G
Iron	33/35	20	74 5 to 1,340	320	1,390	2,300	ND	No	S,B
Lead	55/55	NA	0.97 to 7,510	730	5	[14]400	500	Yes	
Magnesium	9/34	1,000	60.6 to 631	213	1,456	460,468	ND	No	S,B
Manganese	23/35	3	0.45 to 32.2	6.5	14	180	370	No	S,G
Mercury	3/35	0.1	0.2 to 0.5*	0.3	1	2.3	23	No	S,G,B
Nickel	11/34	8	0.69 to 2.2	1 2	ND	160	1,500	No	S,G
Potassium	12/35	1,000	21.7 to 40.2	31	ND	1,000,000	ND	No	S
Selenium	1/33	1	1.7	1.7	2	39	390	No	S,G,B
Silver	1/35	2	0.62	0 62	ND	39	390	No	S,G
Sodium	13/34	1,000	133* to 502	265	ND	1,000,000	NA	No	S
Vanadium	31/35	10	0.28 to 5.2	1.5	5	55	490	No	S,G
Zinc	1/35	4	32.6	32.6	ND	2,300	23,000	No	S,G
Total Recoverable Petroleum Hydrocarbons (TRPH) (mg/kg)									
TRPH	29/35	11 to 54	11* to 450	86	NA	NSC	[15]380	Yes	

See notes at end of table.

Table 6-13 (Continued)
Human Health Chemicals of Potential Concern in Surface Soil at Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[1]	Range of Reporting Limits	Range of Detected Concentrations[2]	Mean of Detected Concentrations[3]	Background Screening Concentrations[4]	Risk-Based Concentrations[5]	Florida Soil Cleanup Goals[6]	Analyte HHCPC? (Yes/No)	Reason[7]
Explosive Compounds (mg/kg)									
3-Nitrotoluene	1/37	0 5 to 5	5 08	5 1	NA	78	NA	No	S
4-Nitrotoluene	2/37	0.5 to 5	1.17 to 4.34	2.8	NA	78	NA	No	S
HMX	1/37	0.5 to 5	3.00	3.00	NA	NSC	NA	Yes	R

[1] Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed (excluding rejected values)
[2] The value indicated by an asterisk is the average of a sample and its duplicate. For duplicate samples having one nondetect value, one-half of the contract-required quantification limit/contract-required detection limit is used as a surrogate concentration for results reported as nondetect.
[3] The mean of detected concentrations is the arithmetic mean of all samples in which the analyte was detected. It does not include those samples with "R", "U", or "UJ" validation qualifiers.
[4] The background screening value is twice the average of detected concentrations for inorganic analytes in background samples. Organic values are one times the mean of detected concentration. Organic values are included for comparison purposes only.
[5] For all chemicals except the essential nutrients (calcium, magnesium, potassium, and sodium), U.S. Environmental Protection Agency (USEPA) Region III Risk-Based Concentration (RBC) table for residential surface soil exposure per January 1993 guidance ("Selecting Exposure Routes and Contaminants of Concern by Risk-Based Screening," EPA/903/R-93-001) was used for screening. Actual values are taken from the USEPA Region III RBC Tables dated May 30, 1996, which are based on an excess lifetime cancer risk of 10^{-6} and an adjusted hazard quotient of 0.1. For the essential nutrients, screening values were derived based on recommended daily allowances (see Appendix B-1 of the General Information Report [ABB-ES, 1996a]).
[6] Values are from residential cleanup goals in Florida Department of Environmental Protection (FDEP) memoranda, "Soil Cleanup Goals for Florida" dated September 29, 1995, and "Applicability of Soil Cleanup Goals for Florida" dated January 19, 1996. Note that they are also residential values
[7] Analyte was included or excluded from the risk assessment for the following reasons:
B = the maximum detected concentration did not exceed twice the arithmetic mean of detected concentrations at background locations and will not be considered further.
S = the maximum detected concentration did not exceed the risk-based screening concentration and will not be considered further
G = the maximum detected concentration did not exceed the Florida guidance concentration and will not be considered further.
R = no screening value is available, analyte is selected as HHCPC.

Notes continued on next page

Table 6-13 (Continued)
Human Health Chemicals of Potential Concern in Surface Soil at Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

[8] The value is based on naphthalene as a surrogate.
[9] The value is based on pyrene as a noncarcinogenic surrogate polynuclear aromatic hydrocarbons.
[10] The value is based on a mixture of Endosulfan isomers.
[11] The value is based on endrin.
[12] The value is based on hexavalent chromium.
[13] The value is based on the free radical cyanide form.
[14] The value for lead is based on the USEPA Office of Solid Waste and Emergency Response Directive No 9355.4-12, "Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities" (USEPA, 1994).
[15] The screening value is from FDEP's "Development of Risk-Based Soil Cleanup Target Levels," Chapter 62-770, Florida Administrative Code, February 1997.

Notes: The average of a sample and its duplicate is used for all table calculations.
Samples: CF15SS1 through CF15SS43, CF15SS45 through CF15SS48, CF15SS49 and CF15SS50 (PAHs only), CF15SS51 through CF15SS59 (arsenic and antimony only), and CF15SS60 through CF15SS73 (lead only).
Duplicate samples: CF15SS2D, CF15SS3D, CF15SS10D, CF15SS20D, CF15SS26D.
Background samples: CFBSS16, CFBSS17, CFBSS18, CFBSS19, CFBSS20, CFBSS21, CEFBSS9

HHCPC = human health chemicals of potential concern.
μg/kg = micrograms per kilogram.
NA = not applicable.
PCB = polychlorinated biphenyl.
DDE = dichlorodiphenyldichloroethene.
ND = not detected in background.
DDT = dichlorodiphenyltrichloroethane.
* = see footnote 2.
mg/kg = milligrams per kilogram.
HMX = cyclotetramethylenetetranitramine.
NSC = no screening concentration available.

Table 6-14
Human Health Chemicals of Potential Concern in Subsurface Soil at Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[1]	Range of Reporting Limits	Range of Detected Concentrations(*)[2]	Mean of Detected Concentrations[3]	Background Screening Concentrations[4]	Risk-Based Concentrations[5]	Florida Soil Cleanup Goals[6]	Analyte HHCPC? (Yes/No)	Reason[7]
Volatile Organic Compounds (µg/kg)									
Acetone	2/12	12 to 13	7.5* to 13	10	NA	20,000,000	1,800,000	No	S,G
Xylenes (total)	3/12	6 to 12	3 to 4	3	NA	10,000,000	92,000,000	No	S,G
Semivolatile Organic Compounds (µg/kg)									
2-Methylnaphthalene	2/21	330 to 10,550	51 to 110	81	NA	[8]8,200,000	8,800,000	No	S,G
Acenaphthene	3/21	330 to 10,500	350 to 1,350*	880	NA	12,000,000	30,000,000	No	S,G
Anthracene	4/21	330 to 10,500	32 to 5,400*	2,200	NA	61,000,000	300,000,000	No	S,G
Benzo(a)anthracene	16/21	330 to 10,500	30 to 34,000*	4,400	NA	7,800	4,900	Yes	
Benzo(a)pyrene	16/21	330 to 10,500	35 to 32,500*	4,500	NA	780	500	Yes	
Benzo(b)fluoranthene	16/21	330 to 10,500	45 to 47,000*	6,700	NA	7,800	5,000	Yes	
Benzo(g,h,i)perylene	12/21	330 to 10,500	34 to 12,500*	1,800	NA	NSC	50,000	No	G
Benzo(k)fluoranthene	12/21	330 to 10,500	40 to 20,500*	3,500	NA	78,000	48,000	Yes	C
Butylbenzylphthalate	1/12	330 to 10,550	56	56	NA	41,000,000	310,000,000	No	S,G
Carbazole	4/12	330 to 10,500	27 to 4,300*	1,800	NA	290,000	120,000	No	S,G
Chrysene	16/21	330 to 10,500	40 to 37,500*	5,000	NA	780,000	500,000	Yes	C
Di-*n*-butylphthalate	8/12	330 to 10,500	99 to 4,950*	2,340	NA	20,000,000	140,000,000	No	S,G
Dibenz(a,h)anthracene	7/21	330 to 10,500	28 to 5,200	1,400	NA	780	500	Yes	
Dibenzofuran	2/12	330 to 10,500	85 to 3,480*	1,780	NA	820,000	3,500,000	No	S,G
Fluoranthene	16/21	330 to 10,500	39 to 60,500*	7,000	NA	8,200,000	48,000,000	No	S,G
Fluorene	2/21	330 to 10,500	110 to 705*	408	NA	8,200,000	30,000,000	No	S,G

See notes at end of table.

Table 6-14 (Continued)
Human Health Chemicals of Potential Concern in Subsurface Soil at Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[1]	Range of Reporting Limits	Range of Detected Concentrations(*)[2]	Mean of Detected Concentrations[3]	Background Screening Concentrations[4]	Risk-Based Concentrations[5]	Florida Soil Cleanup Goals[6]	Analyte HHCPC? (Yes/No)	Reason[7]
Semivolatile Organic Compounds (µg/kg) (Continued)									
Indeno(1,2,3-*cd*)pyrene	12/21	330 to 10,500	24 to 13,000	2,500	NA	7,800	5,000	Yes	
Naphthalene	5/21	330 to 10,500	64 to 980*	430	NA	8,200,000	12,000,000	No	S,G
Phenanthrene	12/21	330 to 10,500	33 to 26,500*	3,700	NA	NSC	21,000,000	No	G
Pyrene	17/21	330 to 10,500	41 to 50,000*	5,000	NA	6,100,000	41,000,000	No	S,G
bis(2-Ethylhexyl)phthalate	2/12	330 to 10,550	53 to 130*	90	NA	410,000	110,000	No	S,G
Inorganic Analytes (mg/kg)									
Aluminum	12/12	NA	1.41 to 2,320*	1,290	1,590	100,000	NA	No	S
Antimony	4/12	0.012 to 12	0.93 to 4.2	2.2	ND	82	220	No	S,G
Barium	11/12	0.04 to 40	0.0013 to 17.4	7.1	2.4	14,000	84,000	No	S,G
Calcium	9/12	1 to 1,000	0.063 to 2,510	990	ND	1,000,000	NA	No	S
Chromium	3/12	0.002 to 2	1.45* to 2.7	2.1	1.7	[8]1,000	[9]430	No	S,G
Cobalt	1/12	0.01 to 10	0.35	0.35	ND	12,000	110,000	No	S,G
Iron	12/12	NA	0.191 to 298	151	497	61,000	NA	No	S
Lead	12/12	NA	0.0015 to 27.8	9.3	1.7	[10]400	1,000	No	S,G
Manganese	8/12	0.003 to 3	0 89 to 3	2	2.4	4,700	5,500	No	S,G
Nickel	8/12	0.008 to 8	0.73 to 1.35*	0.94	ND	4,100	26,000	No	S,G
Potassium	2/12	1 to 1,000	22.7 to 27.6	25 2	ND	1,000,000	NA	No	S
Sodium	3/12	1 to 1,000	0.156 to 376*	89	181	1,000,000	NA	No	S
Vanadium	12/12	NA	0.49 to 2.2	1.1	1.8	1,400	4,800	No	S,G
Total Recoverable Petroleum Hydrocarbons (TRPH) (mg/kg)									
TRPH	8/12	12 to 13	12 to 60	31	NA	NSC	[11]2,700	No	

See notes at end of table.

Table 6-14 (Continued)
Human Health Chemicals of Potential Concern in Subsurface Soil at Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

[1] Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed (excluding rejected values)
[2] The value indicated by an asterisk is the average of a sample and its duplicate. For duplicate samples having one nondetect value, one-half of the contract-required quantification limit/contract-required detection limit is used as a surrogate concentration for results reported as nondetect.
[3] The mean of detected concentrations is the arithmetic mean of all samples in which the analyte was detected. It does not include those samples with "R", "U", or "UJ" validation qualifiers.
[4] The background screening value is twice the average of detected concentrations for inorganic analytes in background samples. Organic values are one times the mean of detected concentration. Organic values are included for comparison purposes only.
[5] For all chemicals except the essential nutrients (calcium, magnesium, potassium, and sodium), U.S Environmental Protection Agency (USEPA) Region III Risk-Based Concentration (RBC) table for industrial surface soil exposure per January 1993 guidance ("Selecting Exposure Routes and Contaminants of Concern by Risk-Based Screening," EPA/903/R-93-001) was used for screening. Actual values are taken from the USEPA Region III RBC Tables for industrial soil dated May 30, 1996, which are based on an excess lifetime cancer risk of 10^{-6} and an adjusted hazard quotient of 0.1. For the essential nutrients, screening values were derived based on recommended daily allowances (See Appendix B-1 of the General Information Report [ABB-ES, 1996a])
[6] Values are for industrial soil from Florida Department of Environmental Protection (FDEP) memoranda, "Soil Cleanup Goals for Florida" dated September 29, 1995, and "Applicability of Soil Cleanup Goals for Florida" dated January 1996.
[7] Analyte was included or excluded from the risk assessment for the following reasons:
S = the maximum detected concentration did not exceed the risk-based screening concentration and will not be considered further.
G = the maximum detected concentration did not exceed the Florida guidance concentration and will not be considered further
C = the analyte is a member of a chemical class that contains other HHCPCs (i.e., carcinogenic polynuclear aromatic hydrocarbons [PAHs])
[8] RBC value for this PAH is not available, the RBC value for naphthalene is used as a surrogate.
[9] The value is based on hexavalent chromium
[10] The value for lead is based on the USEPA Office of Solid Waste and Emergency Response Directive No. 9355 4-12, "Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities" (USEPA, 1994).
[11] The screening value is from FDEP's "Development of Risk-Based Soil Cleanup Target Levels," Chapter 62-770, Florida Administrative Code, dated February 1997.

Notes: The average of a sample and its duplicate is used for all table calculations.
Samples: CF15SB7, CF15SB8, CF15SB9, CF15SB10, CF15SB11, CF15SB12, CF15SB13, CF15SB17, CF15SB18, CF15SB19, CF15SB21, CF15SB25, CF15SB43, CF15SB44, CF15SB45, and CF15SB49 through CF15SB56 (PAHs only)
Duplicate samples: CF15SB7D, CF15SB10D
Background samples: BBMS2S2, BBMS2S6, BBMS2S8, BBMS4S2, BBMS4S4, CFBSB4, CFBSB5, CFBSB6

* = see footnote 2.
HHCPC = human health chemicals of potential concern.
µg/kg = micrograms per kilogram
NA = not applicable.
mg/kg = milligrams per kilogram.
ND = not detected in background.

Table 6-15
Human Health Chemicals of Potential Concern in Unfiltered Groundwater at Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[1]	Range of Reporting Limits	Range of Detected Concentrations	Mean of Detected Concentrations[2]	Background Screening Concentrations[3]	Risk-Based Concentrations[4]	Florida Guidance Concentrations[4]	Analyte HHCPC? (Yes/No)	Reason[7]
Semivolatile Organic Compounds (µg/ℓ)									
Naphthalene	1/8	10	0.5	0.5	NA	150	6.8	No	S,G
bis(2-Ethylhexyl) phthalate	4/8	10	1 to 220	60	NA	4.8	6	Yes	
Pesticides and PCBs (µg/ℓ)									
4,4-DDD	1/8	0.1	0 029	0.029	NA	0.28	0.1	Yes	C
4,4-DDE	1/8	0.1	0.26	0.26	NA	0.2	0.1	Yes	
4,4-DDT	1/8	0 1	0.034	0.034	NA	0 2	0.1	Yes	C
Inorganic Analytes (µg/ℓ)									
Aluminum	8/8	NA	205 to 635	418	776	3,700	200	Yes	
Antimony	2/8	60	2 to 2.2	2	ND	1.5	6	Yes	
Barium	8/8	NA	14.3 to 28.7	20.5	41.2	260	2,000	No	S,G,B
Beryllium	1/8	5	1	1	2	0.016	4	Yes	
Calcium	2/8	5,000	5,620 to 6,380	6,000	380	1,055,398	NSC	No	S
Cobalt	3/8	50	1.4 to 1.7	1.5	11.6	220	NSC	No	S,B
Copper	6/8	25	4.7 to 9.3	7.1	134	150	1,000	No	S,G,B
Cyanide	2/8	10	3.1 to 3.8	3.5	ND	73	200	No	S,G
Iron	8/8	NA	633 to 3,140	1,750	450	1,100	300	Yes	
Magnesium	8/8	NA	598 to 1.500	1,100	1,290	118,807	NSC	No	S

See notes at end of table.

Table 6-15 (Continued)
Human Health Chemicals of Potential Concern in Unfiltered Groundwater at Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[1]	Range of Reporting Limits	Range of Detected Concentrations	Mean of Detected Concentrations[2]	Background Screening Concentrations[3]	Risk-Based Concentrations[4]	Florida Guidance Concentrations[4]	Analyte HHCPC? (Yes/No)	Reason[7]
Inorganic Analytes (µg/ℓ) (continued)									
Manganese	8/8	NA	8.4 to 49.6	21.2	9.8	84	50	No	S,G
Nickel	1/8	40	17 5	17.5	32	73	100	No	S,G,B
Potassium	1/8	5,000	2,010	2,010	1,580	297,016	NSC	No	S
Sodium	5/8	5,000	5,510 to 10,800	7,900	1,150	396,022	160,000	No	S,G
Thallium	2/8	10	5 to 6.1	6	ND	[8]0.29	2	Yes	
Vanadium	1/8	50	1.8	1.8	96	26	49	No	S,G,B
Zinc	3/8	20	92 to 246	145	48	1,100	5,000	No	S,G
Explosive Compounds (µg/ℓ)									
3-Nitrotoluene	8/8	NA	1.87 to 3 39	2.5	NA	6.1	NSC	No	S
Nitrobenzene	1/8	0.2	0.228	0.228	NA	0.34	NSC	No	S
RDX	2/8	0.4	0.404 to 0.451	0.428	NA	0.31	10	Yes	

See notes at end of table.

Table 6-15 (Continued)
Human Health Chemicals of Potential Concern in Unfiltered Groundwater at Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

[1] Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed (excluding rejected values).
[2] The value indicated by an asterisk is the average of a sample and its duplicate. For duplicate samples having one nondetect value, 1/2 the contract-required quantitation limit/contract-required detection limit is used as a surrogate concentration for results reported as nondetect
[3] The mean of detected concentrations is the arithmetic mean of all samples in which the analyte was detected. It does not include those samples with "R", "U", or "UJ" validation qualifiers.
[4] The background screening value is twice the average of detected concentrations for inorganic analytes in background samples.
[5] For all chemicals except the essential nutrients (calcium, magnesium, potassium, and sodium), U.S. Environmental Protection Agency (USEPA) Region III Risk-Based Concentration (RBC) table for tap water exposure per January 1993 guidance ("Selecting Exposure Routes and Contaminants of Concern by Risk-based Screening," EPA/903/R-93-001) was used for screening. Actual values are taken from the USEPA Region III RBC Tables dated October 4, 1995, which are based on an excess lifetime cancer risk of 10^{-6} and an adjusted hazard quotient of 0 1. For the essential nutrients, screening values were derived based on recommended daily allowances (see Appendix B-1 of the General Information Report [ABB-ES, 1996a]).
[6] The values are from Florida Department of Environmental Protection "Groundwater Water Guidance Concentrations," dated June 1994.
[7] Analyte was included or excluded from the risk assessment for the following reasons:
B = the maximum detected concentration did not exceed twice the arithmetic mean of detected concentrations at background locations and will not be considered further.
S = the maximum detected concentration did not exceed the risk-based screening concentration and will not be considered further
G = the maximum detected concentration did not exceed the Florida guidance concentration and will not be considered further.
C = the analyte is a member of a chemical class that contains other HHCPCs.
[8] Value is based on thallium chloride

Notes: The average of a sample and its duplicate is used for all table calculations.
Sample locations: CF15MW1S, CF15MW2S, CF15MW3S, CF15MW4S, CF15MW5S, CF15MW6S, CF15MW7S, CF15MW8S,
Duplicate sample locations: CF15MW5SD
Background sample locations. CFBKMW1S through CFBKMW5S, CFBKMW7S. and CFBKMW8S. Duplicate at CFBKMW4SD

HHCPC = human health chemicals of potential concern.
$\mu g/\ell$ = micrograms per liter.
NA = not applicable.
PCB = polychlorinated biphenyl.
DDD = dichlorodiphenyldichloroethane.
DDE = dichlorodiphenyldichloroethene.
DDT = dichlorodiphenyltrichloroethane.
ND = not detected in background.
NSC = no screening concentration available.
RDX = cyclotrimethylenenitramine.

Table 6-16
Human Health Chemicals of Potential Concern in Surface Water at Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Frequency of Detection[1]	Range of Reporting Limits	Range of Detected Concentrations	Mean of Detected Concentrations[2]	Background Screening Concentrations[3]	Region IV Water Quality Standards[4]	Florida Surface Water Quality Standards (Class III)[5]	Analyte HHCPC? (Yes/No)	Reason[6]
Explosive Compounds (µg/ℓ)									
1,3,5-Trinitrobenzene	1/3	0.4 to 0.65	6.73	6.73	NA	NSC	NSC	Yes	R
3-Nitrotoluene	1/3	0.8 to 1.29	4.95	4.95	NA	NSC	NSC	Yes	R
4-Nitrotoluene	3/3	NA	0.79* to 46.1	16	NA	NSC	NSC	Yes	R
Tetryl	2/3	0.645 to 0.8	18.4*	18.4	NA	NSC	NSC	Yes	R
Total Inorganic Analytes (µg/ℓ)									
Aluminum	3/3	NA	444* to 649	560	NA	NSC	NSC	Yes	R
Arsenic	3/3	NA	4.4* to 12	7	NA	0.018	NSC	Yes	
Barium	3/3	NA	10.1* to 17.1	13	NA	2,000	NSC	No	S
Calcium	3/3	NA	620 to 4,510*	2,410	NA	1,055,398	NSC	No	S
Copper	1/3	25	11*	11	NA	1,300	NSC	No	S
Iron	3/3	NA	613* to 1,980	1,320	NA	300	NSC	Yes	
Lead	7/7	NA	91 to 398	270	NA	NSC	NSC	Yes	R
Magnesium	3/3	NA	429 to 503	477	NA	118,807	NSC	No	S
Potassium	1/3	5,000	1,430*	1,430	NA	297,010	NSC	No	S
Sodium	3/3	NA	4,000 to 4,440*	4,210	NA	396,022	NSC	No	S
Vanadium	1/3	50	3.3	3 3	NA	NSC	NSC	Yes	R
Total Recoverable Petroleum Hydrocarbons (TRPH) (mg/ℓ)									
TRPH	1/3	0.5	0.6	0.6	NA	NSC	NSC	Yes	R

See notes at end of table.

Table 6-16 (Continued)
Human Health Chemicals of Potential Concern in Surface Water at Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

[1] Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed (excluding rejected values).
[2] A value indicated by an asterisk is the average of a sample and its duplicate. For duplicate samples having one nondetect value, 1/2 the contract-required quantitation limit/contract-required detection limit is used as a surrogate concentration for results reported as nondetect.
[3] The mean of detected concentrations is the arithmetic mean of all samples in which the analyte was detected. It does not include those samples with "R", "U", or "UJ" validation qualifiers.
[4] The background screening value is twice the average of detected concentrations for inorganic analytes in background samples.
[5] The value is from U.S. Environmental Protection Agency Region IV Water Quality Standards, dated January 1996.
[6] The values are from Florida Administrative Code, Chapter 62-302, for Class III freshwater bodies (for recreational use) dated January 1, 1995. Only values protective of human health were used for screening.
[7] Analyte was included or excluded from the risk assessment for the following reasons:
S = the maximum detected concentration did not exceed the Region IV Water Quality Standard and will not be considered further.
R = no screening value is available, analyte is selected as HHCPC.

Notes: The average of a sample and its duplicate is used for all table calculations.
Sample locations: CF15SW1 through CF15SW7
Duplicate sample locations: CF15SW3D

HHCPC = human health chemical of potential concern.
$\mu g/\ell$ = micrograms per liter.
NA = not applicable.
NSC = no screening concentration available.
* = see footnote 2.
tetryl = trinitrophenylmethylnitramine.
mg/ℓ = milligrams per liter.

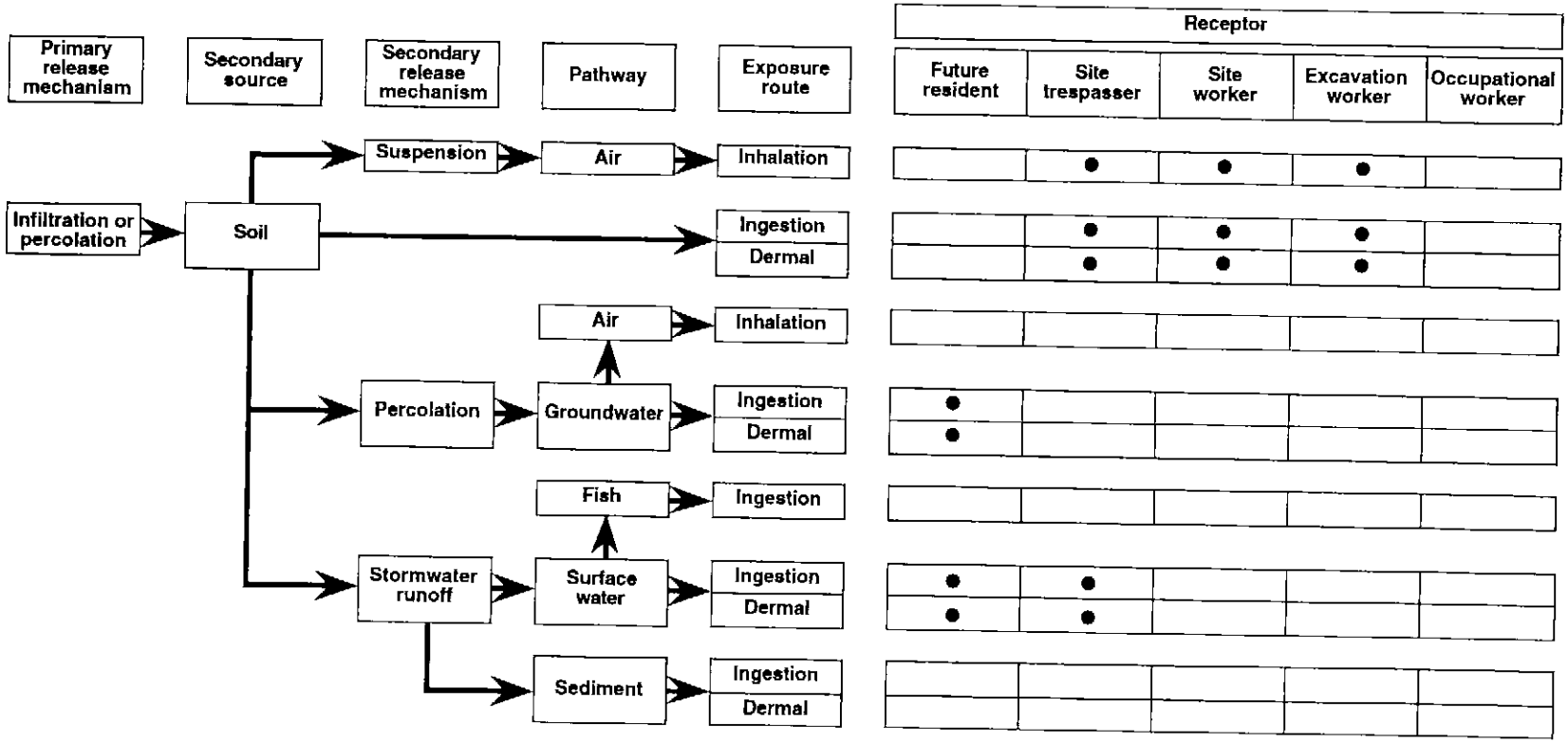


FIGURE 6-7
SITE 15, COMPLETE EXPOSURE PATHWAYS
FOR HUMAN RECEPTORS

REMEDIAL INVESTIGATION
OPERABLE UNIT 5

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

2523-04 FIG 6-7 FINAL 100697MAW

Table 6-17
Potential Exposure Pathways at Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Medium of Exposure	Route of Exposure	Potentially Exposed Population	Selected for Evaluation?	Reason for Selection or Evaluation
Current Land Use				
Surface Soil	Dermal contact with soil, ingestion of soil, and inhalation of fugitive dust.	Resident (adult and child)	No	No humans currently reside at Site 15.
		Trespasser (adult and adolescent)	Yes	Adolescents and adults may be exposed to contaminants in the surface soil while trespassing.
		Occupational worker (adult)	No	
		Site maintenance worker (adult)	Yes	The site maintenance workers may be exposed to contaminants in surface soil while performing routine site activities.
		Excavation worker (adult)	No	
Subsurface Soil	Dermal contact with soil, ingestion of soil, and inhalation of fugitive dust.	Excavation worker (adult)	No	An excavation worker could be exposed to soils during excavation activities, but no excavation activities are ongoing.
Groundwater	Ingestion of groundwater as drinking water.	Resident (adult)	No	There are no current exposures to groundwater.
Surface Water	Ingestion and dermal contact with surface water.	Trespasser (adult and adolescent)	Yes	Adolescents and adults may be exposed to contaminants in surface water while trespassing
Sediment	Ingestion and dermal contact with sediment.	Trespasser (adult and adolescent)	No	Adolescents and adults are not exposed to sediment because sediments are always covered with surface water, so there is no direct exposure.

See notes at end of table.

Table 6-17 (Continued)
Potential Exposure Pathways at Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Medium of Exposure	Route of Exposure	Potentially Exposed Population	Selected for Evaluation?	Reason for Selection or Evaluation
Future Land Use				
Surface Soil	Dermal contact with soil, ingestion of soil, and inhalation of fugitive dust.	Resident (child and adult) Trespasser (adolescent and adult) Occupational worker (adult) Site maintenance worker (adult) Excavation worker (adult)	Yes Yes Yes Yes Yes	If Site 15 is developed for residential use, residents could be exposed to chemicals in surface soil. Exposure of trespassers, occupational workers, site maintenance workers, and excavation workers to chemicals in surface soil are possible.
Subsurface Soil	Dermal contact with soil, ingestion of soil, and inhalation of fugitive dust.	Excavation worker (adult)	Yes	An excavation worker could be exposed to subsurface soil during excavation activities.
Groundwater	Ingestion of groundwater as drinking water and inhalation of volatiles while showering	Resident (adult and child)	Yes	If Site 15 is developed for residential use, drinking water wells in the surficial aquifer could be influenced by contaminants in the groundwater associated with Site 15. Therefore, future residents could be exposed to contaminants in the surficial aquifer.
Surface Water	Ingestion and dermal contact with surface water.	Resident (adult and child) Trespasser (adult and adolescent)	Yes Yes	If Site 15 is developed for residential use, residents could be exposed to contaminants in surface water. Trespassers could be exposed to chemicals in surface water while wading.
Sediment	Ingestion and dermal contact with sediment.	Resident (adult and child) Trespasser (adult and adolescent)	No No	Sediments are always covered with surface water, so there is no direct exposure.

Surface Soil. Currently, no humans reside at Site 15. Therefore, no current residential exposure will be evaluated. Site 14 is in a restricted area of the installation, but adult and child trespassers could obtain access to the site. The site maintenance worker may be exposed to contaminants in surface soil while performing site activities. Exposure of current trespassers (adult and child) and site maintenance worker to surface soil contaminants through ingestion, dermal contact, and inhalation of particulates are evaluated in the HHRA. Site 15 may be developed eventually for residential land use. Therefore, future residential exposures to contaminants in surface soil are evaluated in this HHRA.

Since there are no buildings presently at the site, occupational workers will be only considered as part of future land use. Possible future exposure conditions include excavation activities, such as installation of utility lines, and site maintenance, such as mowing the grass. Exposures of future residents (adult and child), future occupational workers, future site maintenance workers, future excavation workers, and future trespassers (adult and child) to surface soil contaminants through ingestion, dermal contact, and inhalation of particulates are evaluated in the HHRA.

Subsurface Soil. There are no current exposures to subsurface soil because no excavation or construction activities are ongoing at Site 15. However, if Site 15 is developed for residential or industrial use or if excavation activities occur in the future, an excavation worker could be exposed to contaminants in subsurface soil. Therefore, exposure of this receptor to subsurface soil (incidental ingestion, dermal contact, and inhalation of fugitive dust) is evaluated in the HHRA.

Groundwater. Currently, no humans reside at Site 15 and groundwater is not used for any potable or nonpotable purpose. However, in the event that areas hydraulically downgradient are developed for residential use, exposure to chemicals in groundwater could become a complete pathway. Therefore, hypothetical future domestic use of the surficial aquifer (adult ingestion and child ingestion) is evaluated in the HHRA.

Surface Water. The small ditch usually contains standing water. Although access is limited, current trespassers could obtain access to Site 15. Exposure of trespassers (adult and child) to chemicals in surface water through ingestion and dermal contact are evaluated in the HHRA.

Sediment. Exposures to sediment are not likely to be substantial because the small ditches usually contain standing or flowing water, so there is no direct exposure.

EPCs. EPCs for Site 15 media were developed according to the methodology in the GIR (ABB-ES, 1996a). The EPCs for surface soil, subsurface soil, groundwater, surface water, and sediment are presented in Tables 6-18, 6-19, 6-20, and 6-21, respectively. The EPCs were used together with receptor-specific exposure parameters to quantify exposures to the HHCPCs, as shown in the risk calculation spreadsheets in Appendix B.

6.3.3 Toxicity Assessment The purpose of the toxicity assessment is to identify the adverse effects that are associated with exposure to each HHCPC and to identify the relationship between the level of exposure and the severity or the likelihood of adverse effects. The toxicity assessment methodology is discussed

Table 6-18
Exposure Point Concentrations for Human Health Chemicals of Potential Concern in Surface Soil at Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[1]	Maximum Detected Concentrations	95% UCL[2]	Exposure Point Concentrations[3]
Semivolatile Organic Compounds (mg/kg)				
Benzo(a)anthracene	26/41	340	340	340
Benzo(a)pyrene	29/41	340	400	340
Benzo(b)fluoranthene	31/41	510	860	510
Benzo(k)fluoranthene	26/41	160	130	130
Benzo(g,h,i)perylene	23/41	180	54	54
Carbazole	14/36	43	6.6	6.6
Chrysene	28/41	400	460	400
Dibenzo(a,h)anthracene	18/41	54	13	13
Fluoranthene	31/41	660	1,200	660
Indeno(1,2,3-*cd*)pyrene	26/41	160	100	100
Phenanthrene	28/41	270	260	260
Pyrene	30/41	500	700	500
Inorganic Analytes (mg/kg)				
Antimony	23/44	2,400	74	74
Arsenic	26/44	451	22	22
Lead	55/55	7,510	4,200	4,200
Total Recoverable Petroleum Hydrocarbons (TRPH) (mg/kg)				
TRPH	29/35	450	130	130
Explosives (mg/kg)				
HMX	1/37	3.00	1.1	1.1

[1] Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed (excluding rejected values).
[2] 95% UCL of the arithmetic mean of log normal distribution is calculated using all samples. One-half the contract-required quantitation limit/
contract-required detection limit is used as a surrogate for sample results reported as nondetect.
[3] Exposure point concentration is the lower of either the 95% UCL concentration or maximum detected concentration. The UCL is not calculated when there are less than 10 total samples

Notes: % = percent.
UCL = upper confidence limit (see footnote 2).
mg/kg = milligrams per kilogram.
HMX = cyclotetramethylenetetranitramine.

Table 6-19
Exposure Point Concentrations for Human Health Chemicals of Potential Concern in Subsurface Soil at Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[1]	Maximum Detected Concentrations	95% UCL[2]	Exposure Point Concentrations[3]
Semivolatile Organic Compounds (mg/kg)				
Benzo(a)anthracene	16/21	34	10.7	10.7
Benzo(a)pyrene	16/21	32.5	10.5	10.5
Benzo(b)fluoranthene	16/21	47	17	17
Benzo(k)fluoranthene	12/21	20.5	3.8	3.8
Chrysene	16/21	37.5	11	11
Dibenzo(a,h)anthracene	7/21	5.2	0.93	0.93
Indeno(1,2,3-*cd*)pyrene	12/21	13	2.8	2.8

[1] Frequency of detection is the number of samples in which the analyte was detected over the total number of samples analyzed (excluding rejected values).
[2] 95% UCL of the arithmetic mean of log normal distribution is calculated using all samples. One-half the contract-required quantitation limit/contract-required detection limit is used as a surrogate for sample results reported as nondetect.
[3] Exposure point concentration is the lower concentration of either the 95% UCL or maximum detected concentration The UCL is not calculated when there are less than 10 total samples.

Notes: % = percent.
UCL = upper confidence limit (see footnote 2).
mg/kg = milligrams per kilogram.

Table 6-20
Exposure Point Concentrations for Human Health Chemicals of Potential Concern in Unfiltered Groundwater at Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[1]	Maximum Detected Concentrations	Arithmetic Mean[2]	Exposure Point Concentrations[3]
Semivolatile Organic Compounds (µg/ℓ)				
bis(2-Ethylhexyl)phthalate	4/8	220	33	33
Pesticides and PCBs (µg/ℓ)				
4,4-DDD	1/8	0.029	0.05	0.029
4,4-DDE	1/8	0.26	0.06	0.06
4,4-DDT	1/8	0.034	0.05	0.034
Inorganic Analytes (µg/ℓ)				
Aluminum	8/8	635	427	427
Antimony	2/8	2.2	23	2.2
Beryllium	1/8	1	2	1
Iron	8/8	3,140	1,750	1,750
Thallium	2/8	6.1	5.2	5.2
Explosives (µg/ℓ)				
RDX	2/8	0.451	0.24	0.24

[1] Frequency of detection is the number of samples in which the analyte was detected over the number of samples analyzed.
[2] Arithmetic mean of all samples calculated using one-half the contract-required quantitation limit and contract-required detection limit for nondetects.
[3] Exposure point concentration equals the arithmetic mean. If the maximum detected concentration is less than the arithmetic mean, the maximum detected concentration is the exposure point concentration.

Notes: µg/ℓ = micrograms per liter.
PCB = polychlorinated biphenyl.
DDD = dichlorodiphenyldichloroethane.
DDE = dichlorodiphenyldichloroethene.
DDT = dichlorodiphenyltrichloroethane.
RDX = cyclotrimethylenenitramine.

Table 6-21
Exposure Point Concentrations for Human Health Chemicals of Potential Concern in Surface Water at Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[1]	Maximum Detected Concentrations	95% UCL[2]	Exposure Point Concentrations[3]
Explosive Compounds (µg/ℓ)				
1,3,5-Trinitrobenzene	1/3	6.73	NC	6.73
3-Nitrotoluene	1/3	4.95	NC	4.95
4-Nitrotoluene	3/3	46.1	NC	46.1
Tetryl	2/3	18.4	NC	18.4
Total Inorganics Analytes (µg/ℓ)				
Aluminum	3/3	649	NC	649
Arsenic	3/3	12	NC	12
Iron	3/3	1980	NC	1980
Lead	7/7	400	450	400
Vanadium	1/3	3.3	NC	3.3
Total Recoverable Petroleum Hydrocarbons (TRPH) (mg/ℓ)				
TRPH	1/3	0.6	NC	0.6

[1] Frequency of detection is the number of samples in which the analyte was detected over the number of samples analyzed
[2] 95% UCL calculated on the arithmetic mean of all samples using one-half the contract-required quantitation limit and contract-required detection limit for nondetects.
[3] Exposure point concentration equals 95% UCL unless the maximum detected concentration is less than the 95% UCL. The UCL is not calculated when there are less than 10 total samples.

Notes: % = percent.
UCL = upper confidence limit.
µg/ℓ = micrograms per liter.
tetryl = trinitrophenylmethylnitramine.
NC = not calculated.
mg/ℓ = milligrams per liter.

in the GIR (ABB-ES, 1996a). The GIR contains brief toxicity summaries for HHCPCs identified at Site 15. Appendix A of this report contains dose-response information for the HHCPCs. Dose-response values used in this HHRA were current as of August 1996 for IRIS and November 1995 for HEAST. This information is used in the risk characterization (Subsection 6.3.4) to estimate the ELCR for carcinogens and the noncancer risk or HI for all HHCPCs. Uncertainties associated with chemical-specific toxicity values are discussed in Subsection 6.3.5.

6.3.4 Risk Characterization Risk characterization integrates the exposure and toxicity assessments into a qualitative expression of potential human health risk associated with HHCPC exposure. Both ELCR and noncarcinogenic risks are estimated for each HHCPC and each complete exposure pathway selected for evaluation in the exposure assessment, as described in the GIR (ABB-ES, 1996a). Risk estimates for potential exposures to surface soil, subsurface soil, groundwater, surface water, and sediment under current and future land-use assumptions are discussed in Paragraphs 6.3.4.1 through 6.3.4.5. Table 6-22 summarizes the ELCR and noncancer risk under a current land use. Table 6-23 summarizes the ELCR and noncancer risk under future land-use assumptions. Figures 6-8 through 6-13 summarize the ELCRs and HIs associated with current and future land use for Site 15.

Surface Soil. The risk calculations for surface soil exposure are shown in Tables B.15.1 through B.15.14 in Appendix B of this report. Figures 6-8 and 6-9 presents the ELCRs and HIs, respectively, associated with current and future land use. For current land use, the ELCRs associated with surface soil (ingestion, dermal, and fugitive dust inhalation) are 5×10^{-4} for an aggregate (combined adult and child) trespasser, and 2×10^{-4} for a site maintenance worker, which exceed the USEPA acceptable risk range of 1×10^{-4} to 1×10^{-6}. The major contributors to the trespasser and site maintenance worker ELCR are five PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-*cd*)pyrene).

For potential future land use, the ELCRs associated with surface soil (ingestion, dermal, and fugitive dust inhalation) are 7×10^{-3} for an aggregate (combined adult and child) resident, 5×10^{-4} for an aggregate (combined adult and child) trespasser, 9×10^{-4} for an occupational worker, 2×10^{-4} for a site maintenance worker, and 3×10^{-5} for an excavation worker. These risks are within or exceed the USEPA's acceptable risk range. The major contributors to these risks are seven PAHs and arsenic.

The noncancer risks associated with surface soil ingestion, dermal contact, and fugitive dust inhalation under current land use for the adolescent trespasser, adult trespasser, and site worker are below the USEPA's threshold HI of 1.

Under potential future land use, the noncancer risk associated with surface soil ingestion, dermal contact, and fugitive dust inhalation by adult and child resident (HI=2 and HI=6, respectively) exceeds the target HI of 1. Antimony for the adult and child (HQ=1.7 and HQ=4.6, respectively) is the major contributor to this risk. If the medium-specific HI exceeds the USEPA's target of 1, the HQs can be segregated by target organ effects to determine if the target organ-specific HIs exceed 1.

Table 6-22
Current Land-Use Risks for Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Land Use	Exposure Route	HI	ELCR
Current Land Use			
Surface Soil:			
Adult Trespasser.	Incidental ingestion	0.05	2×10^{-4}
	Dermal contact	0.2	1×10^{-4}
	Inhalation of particulates	ND	2×10^{-9}
	Total Adult Trespasser:	0.2	3×10^{-4}
Adolescent Trespasser:	Incidental ingestion	0 08	1×10^{-4}
	Dermal contact	0.2	6×10^{-5}
	Inhalation of particulates	ND	1×10^{-9}
	Total Adolescent Trespasser:	0.3	2×10^{-4}
	Total Risks to Trespasser (Adult and Adolescent) Exposed to Surface Soil:	NC	5×10^{-4}
Site Maintenance Worker:	Incidental ingestion	0.02	7×10^{-5}
	Dermal contact	0.1	9×10^{-5}
	Inhalation of particulates	ND	4×10^{-9}
	Total Site Maintenance Worker:	0.1	2×10^{-4}
Surface Water:			
Adult Trespasser:	Incidental ingestion	0.003	2×10^{-7}
	Dermal contact	0 7	1×10^{-7}
	Total Adult Trespasser:	0.7	4×10^{-7}
Adolescent Trespasser:	Incidental ingestion	0.005	2×10^{-7}
	Dermal contact	0.8	8×10^{-8}
	Total Adolescent Trespasser:	0.8	3×10^{-7}
	Total Risk to Trespasser (Adolescent and Adult) Exposed to Surface Water:	NC	7×10^{-7}

Notes: HI = hazard index equals sum of hazard quotients.
ELCR = excess lifetime cancer risk.
ND = No dose-response data for this exposure route were available for human health chemical of potential concern in this medium.
NC = Not calculated because child and adult HIs are not additive.

Table 6-23
Future Land-Use Risks for Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Land Use	Exposure Route	HI	ELCR
Future Land Use			
Surface Soil:			
Adult Trespasser:	Incidental ingestion	0.05	2×10^{-4}
	Dermal contact	0.2	1×10^{-4}
	Inhalation of particulates	ND	2×10^{-9}
	Total Adult Trespasser:	0.2	3×10^{-4}
Adolescent Trespasser:	Incidental ingestion	0.08	1×10^{-4}
	Dermal contact	0.2	6×10^{-5}
	Inhalation of particulates	ND	1×10^{-9}
	Total Adolescent Trespasser:	0 3	2×10^{-4}
	Total Risk to Trespasser (Adolescent and Adult) Exposed to Surface Soil:	NC	5×10^{-4}
Adult Resident:	Incidental ingestion	0.4	2×10^{-3}
	Dermal contact	1	1×10^{-3}
	Inhalation of particulates	ND	9×10^{-9}
	Total Adult Resident:	2	3×10^{-3}
Child Resident:	Incidental ingestion	4	4×10^{-3}
	Dermal contact	2	4×10^{-4}
	Inhalation of particulates	ND	8×10^{-8}
	Total Child Resident:	6	4×10^{-3}
	Total Risk to Resident (Adolescent and Adult) Exposed to Surface Soil:	NC	7×10^{-3}
Occupational Worker:	Incidental ingestion	0.1	6×10^{-4}
	Dermal contact	0.4	3×10^{-4}
	Inhalation of particulates	ND	3×10^{-8}
	Total Occupational Worker:	0.6	9×10^{-4}
Site Maintenance Worker:	Incidental ingestion	0.02	7×10^{-5}
	Dermal contact	0.1	9×10^{-5}
	Inhalation of particulates	ND	4×10^{-9}
	Total Site Maintenance Worker:	0.1	2×10^{-4}
Excavation Worker:	Incidental ingestion	0.2	3×10^{-5}
	Dermal contact	0.1	3×10^{-5}
	Inhalation of particulates	ND	5×10^{-10}
	Total Excavation Worker:	0.3	3×10^{-5}

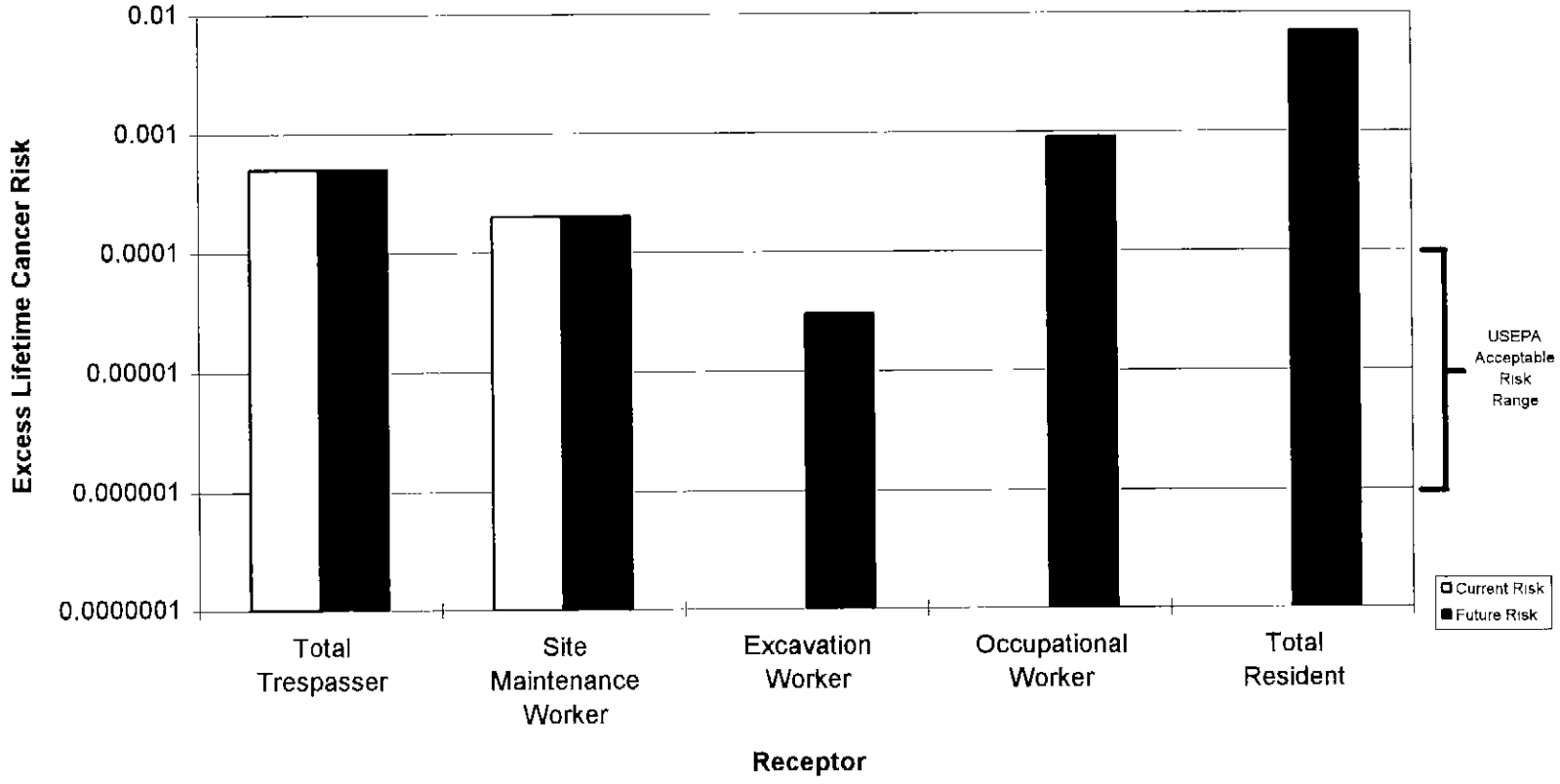
See notes at end of table.

Table 6-23 (Continued)
Future Land-Use Risks for Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Land Use	Exposure Route	HI	ELCR
Subsurface Soil:			
Excavation Worker.	Incidental ingestion	ND	9×10^{-7}
	Dermal contact	ND	1×10^{-7}
	Inhalation of particulates	ND	1×10^{-9}
	Total Excavation Worker:	ND	1×10^{-6}
Groundwater:			
Adult Resident:	Ingestion of groundwater as drinking water	2	5×10^{-5}
	Total Adult Resident:	2	5×10^{-5}
Child Resident:	Ingestion of groundwater as drinking water	5	3×10^{-5}
	Total Child Resident:	5	3×10^{-5}
	Total Risks to Resident (Adult and Child) Exposed to Groundwater:	NC	8×10^{-5}
Surface Water:			
Adult Trespasser:	Incidental ingestion	0.01	2×10^{-7}
	Dermal contact	0.7	1×10^{-7}
	Total Adult Trespasser:	0.7	4×10^{-7}
Adolescent Trespasser:	Incidental ingestion	0.01	2×10^{-7}
	Dermal contact	0.8	8×10^{-8}
	Total Adolescent Trespasser:	0.8	3×10^{-7}
	Total Risk to Trespasser (Adult and Adolescent) Exposed to Surface Water:	NC	7×10^{-7}
Adult Resident:	Incidental ingestion	0.02	6×10^{-7}
	Dermal contact	1	4×10^{-7}
	Total Adult Resident:	1	1×10^{-6}
Child Resident:	Incidental ingestion	0.5	4×10^{-6}
	Dermal contact	2	1×10^{-7}
	Total Child Resident:	3	4×10^{-6}
	Total Risk to Resident (Adult and Child) Exposed to Surface Water:	NC	5×10^{-6}

Notes: HI = hazard index.
ELCR = excess lifetime cancer risk.
NC = Not calculated because child and adult HIs are not additive.
ND = No dose-response data for this exposure route were available for human health chemical of potential concerns in this medium.



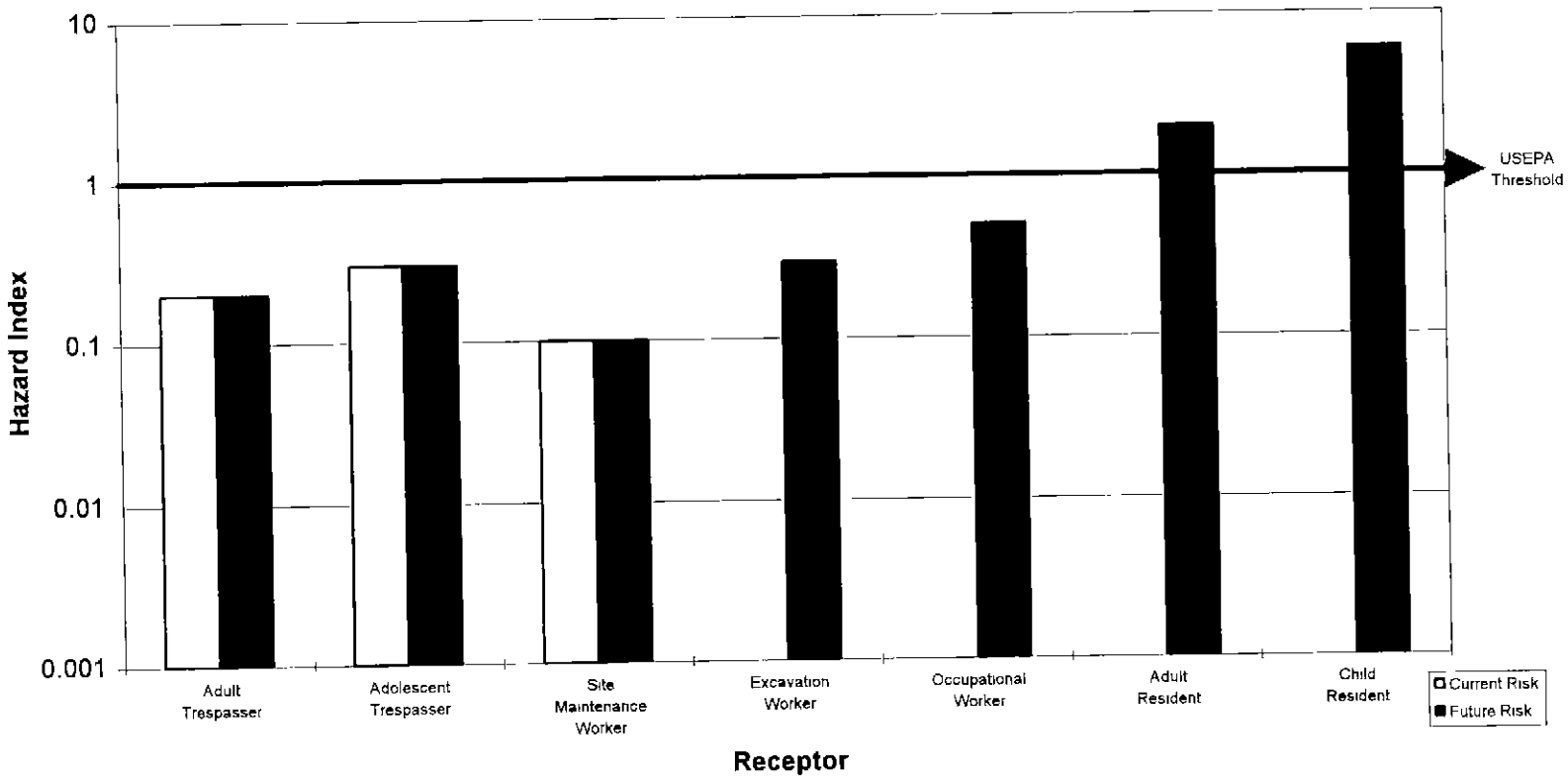
NOTE:
USEPA = U.S. Environmental Protection Agency

FIGURE 6-8
SITE 15
SURFACE SOIL CANCER RISK SUMMARY

REMEDIAL INVESTIGATION
OPERABLE UNIT 5

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

2523-04 FIG 6-8 FRAME 100697MAW
GRAPH: G:\USERS\DESIGN\MWTEMP\CECIL\SITE15.XLS



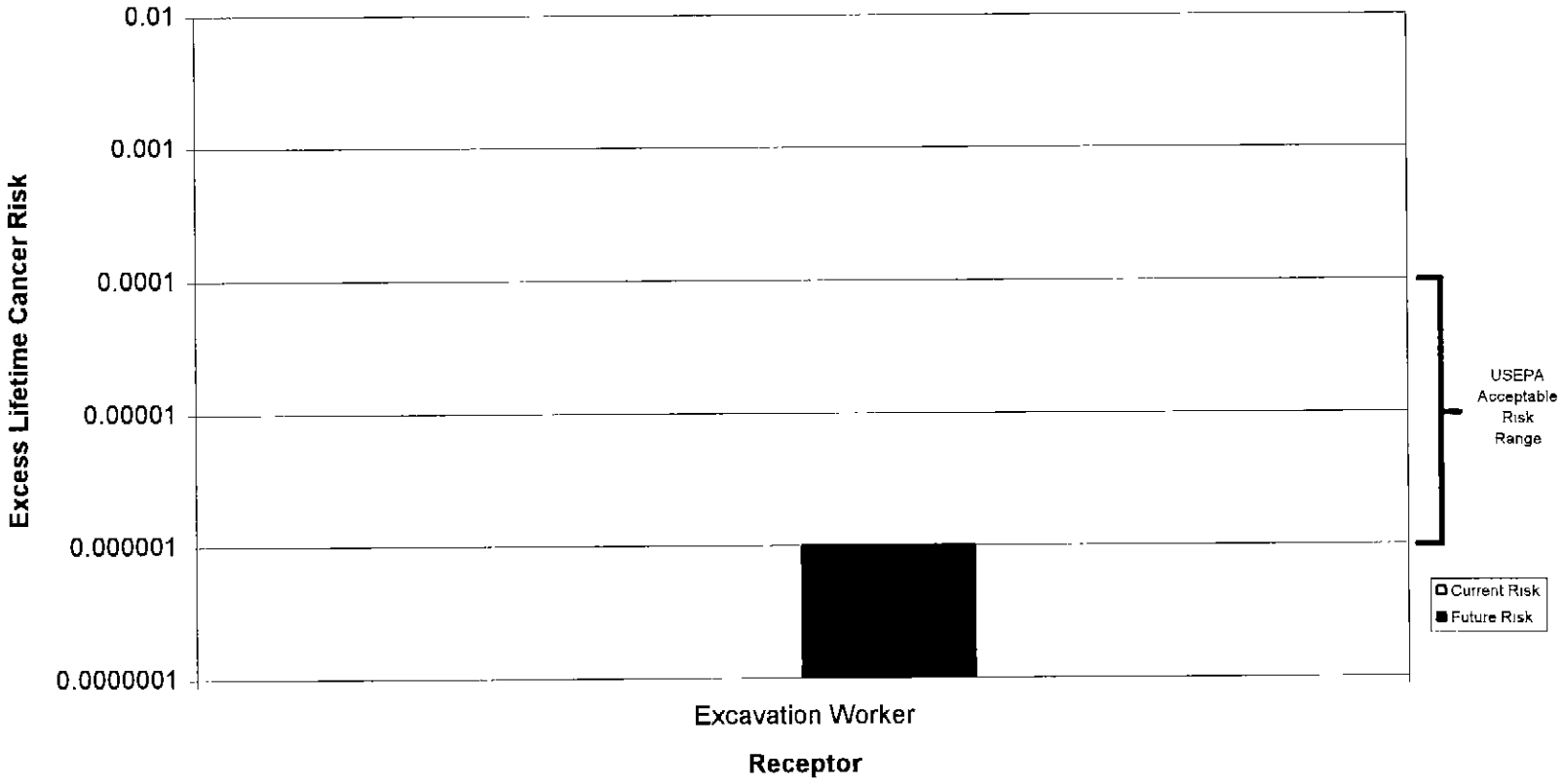
NOTE:
USEPA = U.S. Environmental Protection Agency

FIGURE 6-9
SITE 15
SURFACE SOIL NONCANCER
RISK SUMMARY

REMEDIAL INVESTIGATION
OPERABLE UNIT 5

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

2523-04 FIG 6-9 FRAME 111896MAW
GRAPH G:\USERS\DESIGN\MWTEMP\CECIL\SITE15 XLS



NOTE:
USEPA = U.S. Environmental Protection Agency

FIGURE 6-10
SITE 15
SUBSURFACE SOIL CANCER RISK SUMMARY

REMEDIAL INVESTIGATION
OPERABLE UNIT 5

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

2523-04 FIG 6-10 FRAME 100697MAW
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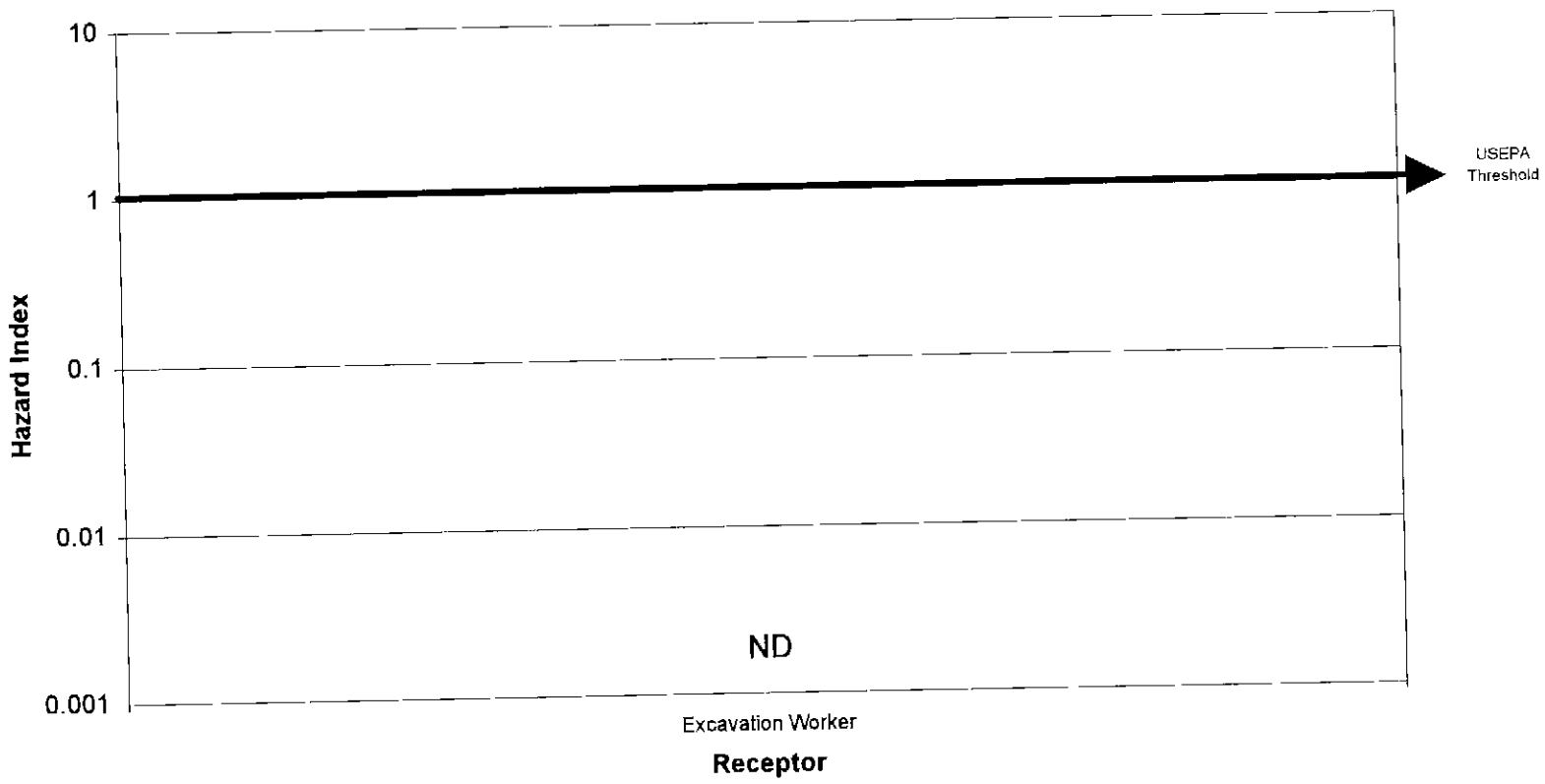


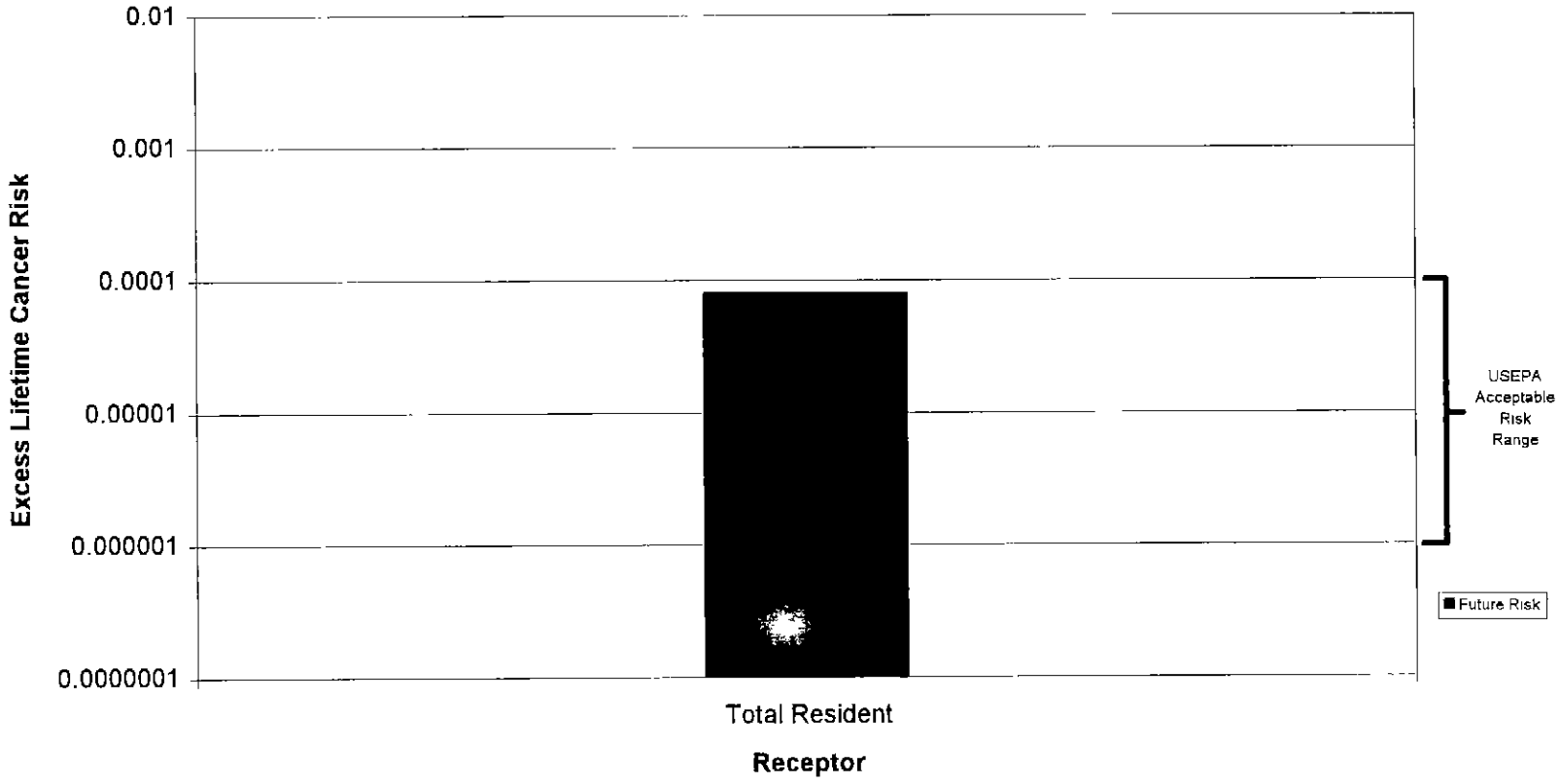
NOTES:
USEPA = U S. Environmental Protection Agency
ND = No dose-response data available; not estimated

FIGURE 6-11
SITE 15
SUBSURFACE SOIL NONCANCER
RISK SUMMARY

REMEDIAL INVESTIGATION
OPERABLE UNIT 5

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

2523-04 FIG 6-11 FRAME 100697MAW
GRAPH: G:\USERS\DESIGN\MWTEMP\CECIL\SITE15.XLS



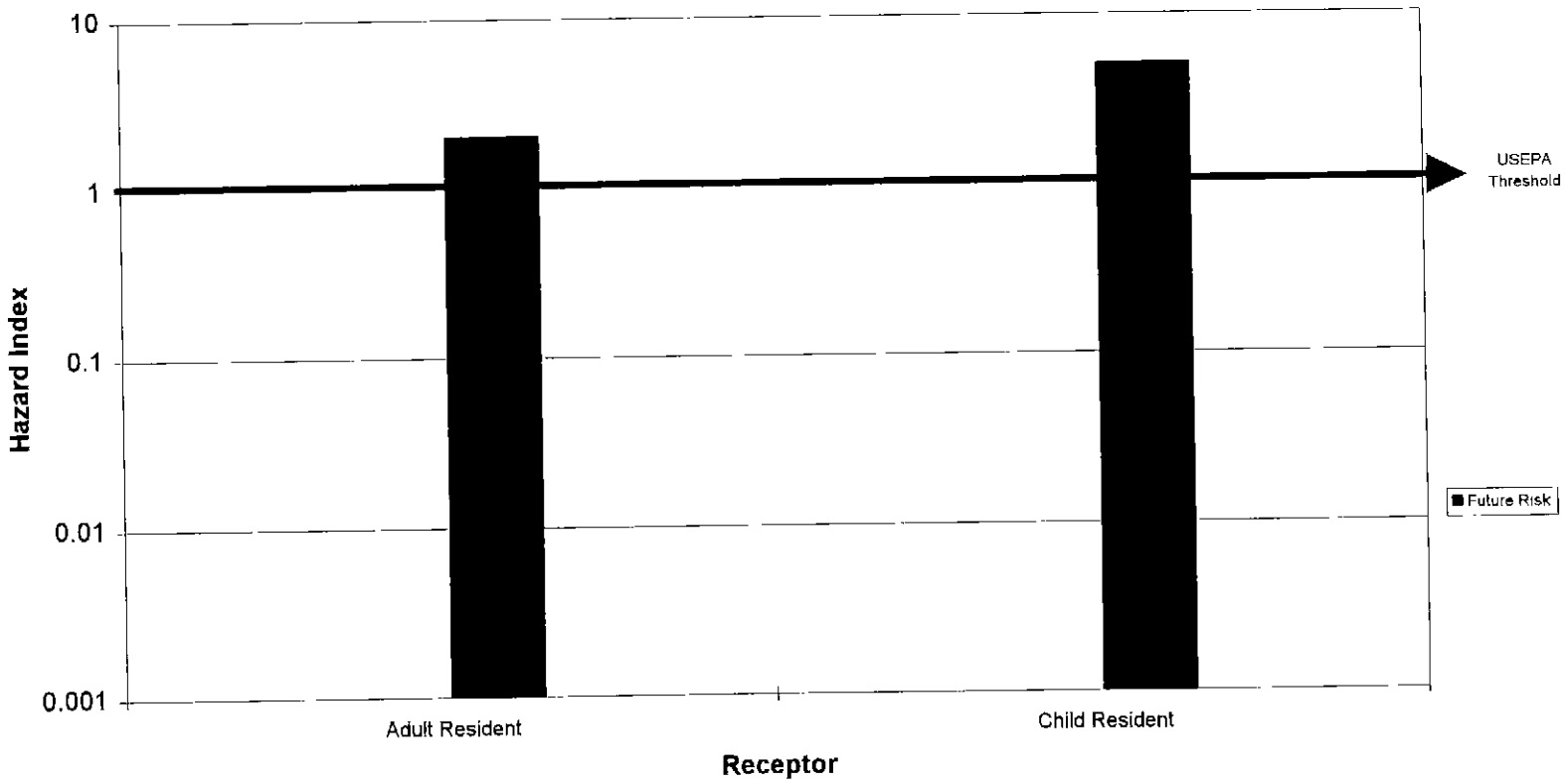
NOTE:
USEPA = U.S. Environmental Protection Agency

FIGURE 6-12
SITE 15
GROUNDWATER CANCER RISK
SUMMARY

REMEDIAL INVESTIGATION
OPERABLE UNIT 5

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

2523-04 FIG 6-12 FRAME 100697MAW
GRAPH: G:\USERS\DESIGN\MWTEMP\CECIL\SITE15.XLS



NOTE:
USEPA = U.S. Environmental Protection Agency

FIGURE 6-13
SITE 15
GROUNDWATER NONCANCER
RISK SUMMARY

REMEDIAL INVESTIGATION
OPERABLE UNIT 5

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

2523-04 FIG 6-13 FRAME 100697MAW
GRAPH G:\USERS\DESIGN\MWTEMP\CECIL\SITE15 XLS

Noncancer risks associated with surface soil ingestion, dermal contact, and fugitive dust inhalation by all other potential future receptors (adolescent trespasser, adult trespasser, occupational worker, site worker, and excavation worker) are below the USEPA's threshold HI of 1.

Subsurface Soil. The risk calculations for subsurface soil are shown in Tables B.15.15 and B.15.16 in Appendix B of this report. Figures 6-10 and 6-11 present a summary of ELCRs and HIs, respectively. There are no current land-use exposures to subsurface soil. Under potential future land use, the ELCR associated with subsurface soil ingestion, dermal contact, and fugitive dust inhalation to an excavation worker is 1×10^{-6}, which is within the USEPA's allowable risk range.

The noncancer risk associated with subsurface soil ingestion, dermal contact, and fugitive dust inhalation under potential future land use (excavation worker) does not exceed the USEPA's threshold HI of 1.

Groundwater. The risk calculations for groundwater exposure are shown in Tables B.14.17 and B.14.18 in Appendix B to this report. Figures 6-12 and 6-13 present a summary of ELCRs and HIs, respectively. Currently, there are no potable supply wells at the site; thus, there is no human exposure to groundwater. Future aggregate (child and adult) resident ingestion of unfiltered groundwater has an ELCR of 8×10^{-5}. The ELCR is within the USEPA's allowable risk range (1×10^{-4} to 1×10^{-6}).

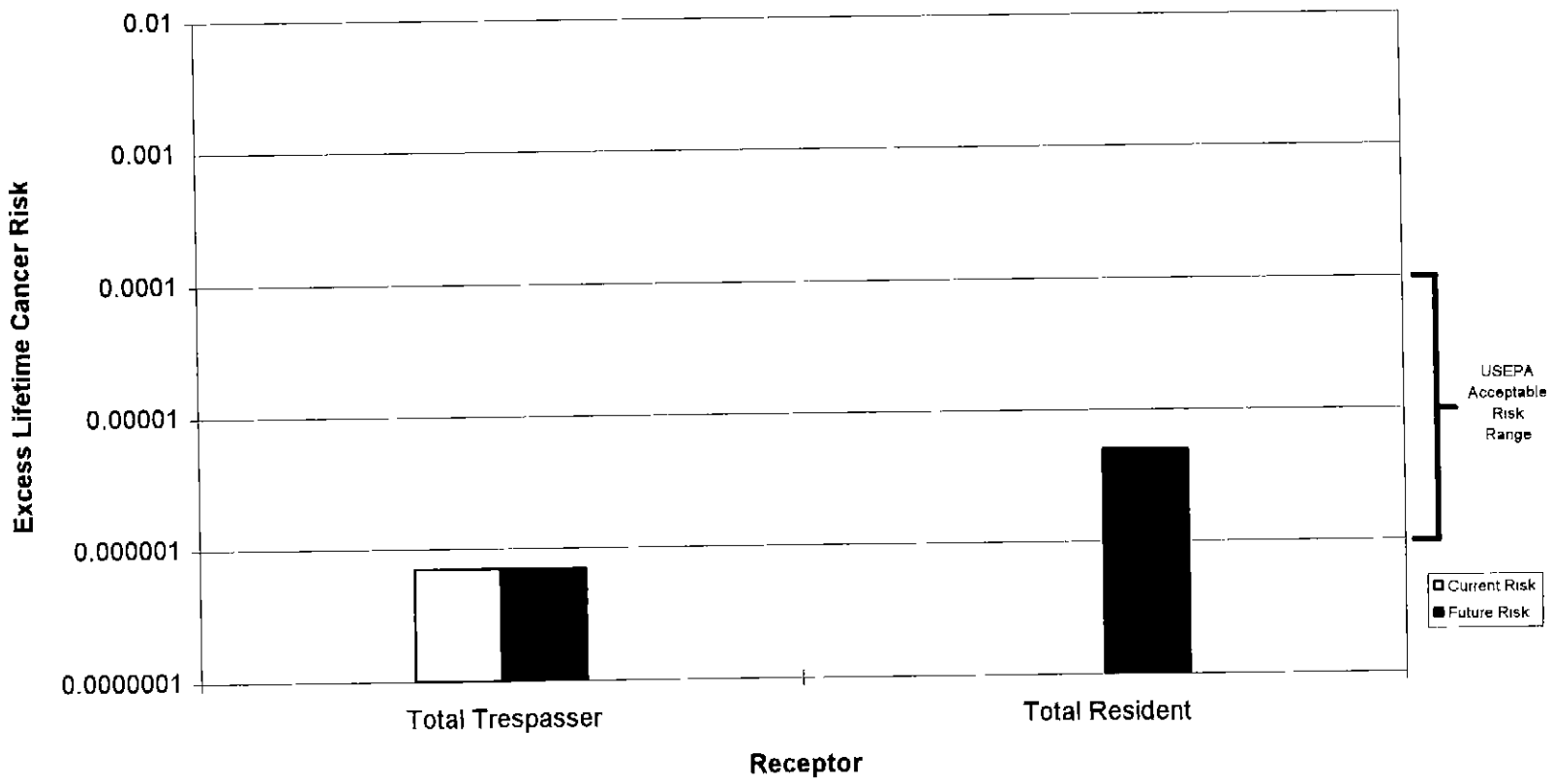
The noncancer risks associated with groundwater ingestion are 2 for the adult resident and 5 for the child resident; both of which exceed the USEPA's threshold HI of 1. Major contributors to the risk for child resident are thallium (HQ=4.2), iron (HQ=0.16), and antimony (HQ=0.15). It is likely that the concentrations of these metals in groundwater are due to suspended solids. If the medium-specific HI exceeds the USEPA's target of 1, the HQs can be segregated by target organ effects to determine if the target organ-specific HIs exceed 1.

The thallium EPC (5.2 $\mu g/\ell$) exceeds the MCL of 2 $\mu g/\ell$ and the Florida groundwater guidance concentration of 2 $\mu g/\ell$ (primary standard).

Surface Water. The risk calculations for surface water exposure scenarios are shown in Tables B.15.19 through B.15.22 in Appendix B to this report. Figures 6-14 and 6-15 presents a summary of ELCR and HIs, respectively. For current and future land use, ELCRs for all receptors (adult trespasser, adolescent trespasser, adult resident and child resident) are within or below the USEPA's acceptable risk range.

Under current land use, the noncancer risks associated with surface water (ingestion and dermal contact) do not exceed the USEPA's threshold HI of 1 for the trespasser (adult and child).

Under future land use, the noncancer risks associated with surface water (ingestion and dermal contact) do not exceed the USEPA's threshold HI of 1 for the adult trespasser, adolescent trespasser, and adult resident. The HI for child resident is 3, which exceeds the USEPA target HI of 1. The major contributor to this HI is TRPH (HQ=2.3).



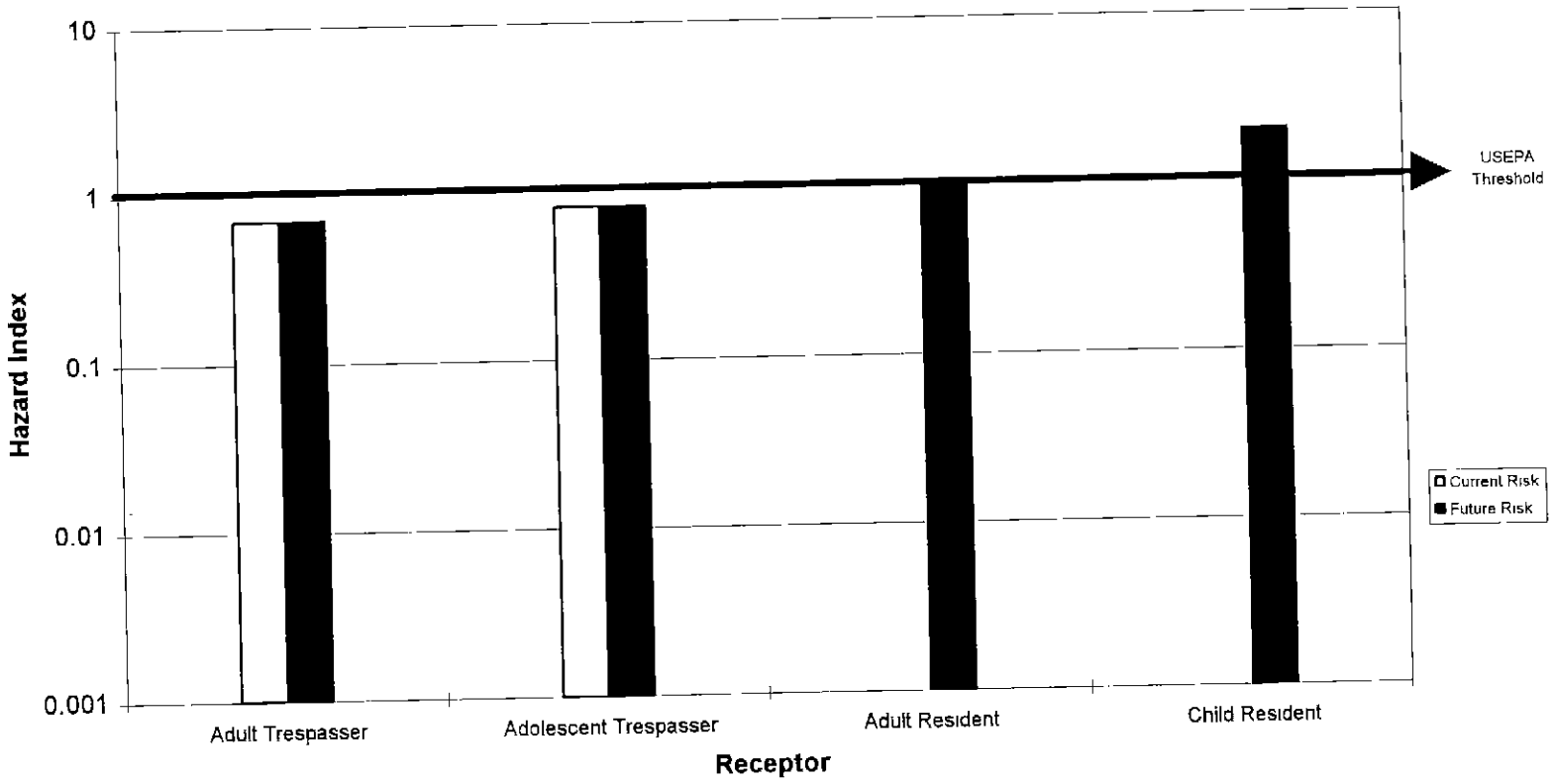
NOTE:
USEPA = U.S. Environmental Protection Agency

FIGURE 6-14
SITE 15
SURFACE WATER CANCER RISK SUMMARY

REMEDIAL INVESTIGATION
OPERABLE UNIT 5

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

2523-04 FIG 6-14 FRAME 100697MAW
GRAPH: G:\USERS\DESIGN\MWTEMP\CECIL\SITE15 XLS



NOTE:
USEPA = U.S. Environmental Protection Agency

FIGURE 6-15
SITE 15
SURFACE WATER NONCANCER
RISK SUMMARY

REMEDIAL INVESTIGATION
OPERABLE UNIT 5

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

2523-04 FIG 6-15 FRAME 100697MAW
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6.3.5 Uncertainty Analysis General uncertainties associated with the collection, analysis, and evaluation of data; exposure assessment; toxicity assessment; and the risk estimation process are discussed in the GIR (ABB-ES, 1996a). Site-specific uncertainties that are important for the interpretation of the calculated risk estimates for surface soil, groundwater, and surface water at Site 15 are discussed below.

- The results from TRPH analysis represent a composite concentration of naturally occurring and petroleum compounds. The toxicity associated with TRPH will vary depending on the chemical composition of the petroleum represented by the TRPH value. The toxicity value used in the HHRA represents a conservative surrogate value. This surrogate value may overestimate the risk posed by TRPH at the site.

- Iron, thallium, and aluminum are naturally occurring constituents in soil. It is likely that the concentrations of these three metals in groundwater are due to suspended soil particulates in the unfiltered monitoring well samples rather than groundwater contamination, because these elements are not expected to be waste constituents of ordnance disposal activities.

- There are no primary MCLs available for iron and aluminum. Secondary MCLs were developed for taste, aesthetic, and economic, but not for health, reasons. Although EPCs for iron and aluminum in Site 15 groundwater exceed the Florida Groundwater Guidance concentrations, it does not imply that these constituents pose a health risk.

- At Site 15, four additional samples (SW4, SW5, SW6, and SW7) were collected and analyzed for lead only. The maximum detected concentration was 400 $\mu g/\ell$. There is some uncertainty associated with lead because there are no dose-response values available. Risk from exposure to lead is not quantitatively evaluated.

- The central tendency of carcinogenic risk from the potential future receptors at Site 15 for surface soil (resident, trespasser, occupational worker, site maintenance worker), groundwater, and surface water, that exceed USEPA risk range were evaluated. The central tendency analysis was conducted using the same exposure point concentration as in the RME scenario, but mean or median values for exposure parameters. The objective of this analysis is to estimate the 50 percentile risk to provide a more probable risk level (USEPA, 1995b).

  The central tendency carcinogenic risk results for potential future receptors using same exposure point concentration as RME scenario but median or average exposure parameters are presented in Tables B.15.23 and B.15.32 in Appendix B of this report. The central tendency parameters differ from the RME exposure scenario by using a mean ingestion rate, median dermal surface area, exposure frequency, surface area, adherence factor, and exposure duration.

  Surface Soil
  The central tendency aggregate residential cancer risk is 1×10^{-4}, which is at the USEPA risk range. The central tendency trespasser cancer

risk is 6×10^{-5}, which is within the USEPA risk range. The central tendency risk for the occupational worker and site maintenance worker are 2×10^{-5} and 2×10^{-5}, respectively, both are within the USEPA risk range.

Groundwater
The central tendency aggregate residential cancer risk is 1×10^{-5}, which is within the USEPA risk range. The central tendency noncarcinogenic risk is 1 for the adult resident, which is at the USEPA target level. The central tendency noncarcinogenic risk is 4 for the child resident.

Surface Water
The central tendency aggregate residential noncancer risk for the adult and child resident are 0.06 and 0.1, respectively. Both are below the USEPA target risk level.

The risk ranges presented by the RME and central tendency exposure scenarios for potential future residential receptors are useful as information to provide perspective for risk management and compliance with USEPA guidance (USEPA, 1995).

6.3.6 RGOs RGOs and available criteria are intended to provide the basis for development of remedial alternatives in the FS if current risk is not acceptable. These RGOs represent various media-specific risk levels if the contaminants remained onsite at a designated concentration and under the conditions specified in this report. The RGO values are not actual or proposed cleanup levels, but are provided to assist risk-management decision making in the FS.

RGOs are presented for each medium with a total ELCR greater than 10^{-4} or an HI greater than 1 in accordance with USEPA guidance and for media with chemicals whose EPCs exceed Florida standards. One RGO table is presented for each medium. The RGO concentrations are calculated using the highest estimated risk for a given medium. For media meeting the criteria described above, RGOs are developed for each chemical with total ELCR greater than 1×10^{-6} or HQ greater than 0.1.

Surface Soil. The ELCR associated with surface soil at Site 15 exceeded the USEPA's allowable risk range of 1 in 10,000 to 1 in 1,000,000, and the USEPA's threshold HI of 1. The ELCR for seven PAHs and arsenic exceeded 1×10^{-6}. The HQs for antimony, arsenic, fluoranthene, and pyrene exceeded 0.1. The EPCs of 12 PAHs, arsenic, lead, and TRPH exceeded Florida Soil Cleanup Goals. Table 6-24 presents the RGOs for these analytes.

Subsurface Soil. The risks associated with subsurface soil at Site 15 did not exceed USEPA risk management criteria. RGOs were developed for six PAHs because the EPCs exceeded Florida Soil Cleanup Goals. Table 6-25 presents the RGOs for these analytes.

Groundwater. The HI associated with groundwater at Site 15 exceeded the USEPA's threshold HI of 1. The HQs for *bis*(2-ethylhexyl)phthalate, aluminum, antimony, iron, and thallium exceeded 0.1. The EPCs of *bis*(2-ethylhexyl)phthalate, aluminum, iron, and thallium exceeded the Florida Guidance Concentrations. Table 6-26 presents the RGOs for these analytes.

Table 6-24
Surface Soil Remedial Goal Options at Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Range of Detected Concentrations	Exposure Point Concentrations	Total Excess Lifetime Cancer Risk (Based on Risk to Resident, Adult and Child			Total Hazard Index (Based on Risk to Child Resident)			Florida Soil Cleanup Goals[1] (Residential)	Florida Soil Cleanup Goals (Leaching)	Background Screening Concentrations[2]
			10^{-4}	10^{-5}	10^{-6}	3	1	0.1			
Semivolatile Organic Compounds (mg/kg)											
Benzo(a)anthracene	0.052 to 340	340	70	7	0.7	NA	NA	NA	1.4	29	NA
Benzo(a)pyrene	0.054 to 340	340	7	0.7	0.07	NA	NA	NA	0.1	3 7	NA
Benzo(b)fluoranthene	0.041 to 510	510	70	7	0.7	NA	NA	NA	1.4	71	NA
Benzo(g,h,i)perylene	0.028 to 180	54	NA	NA	NA	NA	NA	NA	14	320	NA
Benzo(k)fluoranthene	0.031 to 160	130	700	70	7	NA	NA	NA	14	44	NA
Carbazole	0.021 to 43	6.6	NA	NA	NA	NA	NA	NA	42	0.4	NA
Chrysene	0.054 to 400	400	7,000	700	70	NA	NA	NA	140	31	NA
Dibenzo(a,h)anthracene	0.022 to 54	13	7	0.7	0 07	NA	NA	NA	0 1	7.2	NA
Fluoranthene	0.039 to 660	660	NA	NA	NA	NR	NR	300	2,900	280	NA
Indeno(1,2,3-*cd*)pyrene	0.025 to 160	100	70	7	0.7	NA	NA	NA	1.4	17	NA
Phenanthrene	0.029 to 270	270	NA	NA	NA	NA	NA	NA	1,700	2.8	NA
Pyrene	0.038 to 500	500	NA	NA	NA	NR	NR	200	48	290	NA
Inorganic Analytes (mg/kg)											
Antimony	0.46 to 301	74	NA	NA	NA	NR	16	1.6	26	NC	NA
Arsenic	0.95 to 96.5	22	NR	4	0.4	NR	NR	2.3	0.8	NC	NA
Lead	0.97 to 7,510	4,200	NA	NA	NA	NA	NA	NA	500	NC	5

See notes at end of table.

Table 6-24 (Continued)
Surface Soil of Remedial Goal Options at Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Range of Detected Concentrations	Exposure Point Concentrations	Total Excess Lifetime Cancer Risk (Based on Risk to Resident, Adult and Child			Total Hazard Index (Based on Risk to Child Resident)			Florida Soil Cleanup Goals[1] (Residential)	Florida Soil Cleanup Goals (Leaching)	Background Screening Concentrations[2]
			10^{-4}	10^{-5}	10^{-6}	3	1	0.1			
Total Recoverable Petroleum Hydrocarbons (TRPH) (mg/kg)											
TRPH	11 to 450	130	NA	NA	NA	NC	NC	NC	[3]380	NC	NA
Explosive (μg/kg)											
HMX	3.00	1.1	NA	NA	NA	NC	NC	NC	ND	NC	NA

[1] Values are for residential soil, from Florida Department of Environmental Protection (FDEP) memoranda titled "Soil Cleanup Goals for Florida," dated September 29, 1995, and "Applicability of Soil Cleanup Goals for Florida," dated January 19, 1996. The technology-based (not health-based) criterion is from FDEP's "Soil Treatment Facilities" (Florida Administrative Code, Chapter 62-775), dated November 1992.
[2] The background screening value is twice the average of detected concentration for inorganics.
[3] The screening value is from FDEP's "Development of Risk-Based Soil Cleanup Target Levels," Chapter 62-770, Florida Administrative Code, dated February 1997.

Notes: μg/kg = micrograms per kilogram.
NA = not applicable.
NR = the remedial goal option exceeds the exposure point concentration; no action is necessary to achieve this risk.
mg/kg = milligrams per kilogram.
NC = not calculated.
HMX = cyclotetramethylenetetranitramine.

Table 6-25
Subsurface Soil Remedial Goal Options for Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Range of Detected Concentrations	Exposure Point Concentrations	Total Excess Lifetime Cancer Risk (Based on Risk to Excavation Worker)			Total Hazard Index (Based on Risk to Excavation Worker)			Florida Soil Cleanup Goals[1] (industrial)	Florida Soil Cleanup Goals (Leaching)	Background Screening Concentra-tions
			10^{-4}	10^{-5}	10^{-6}	3	1	0.1			
Semivolatile Organic Compounds (μg/kg)											
Benzo(a)anthracene	30 to 34,000	10,700	NA	NA	NA	NA	NA	NA	4,900	29,000	NA
Benzo(a)pyrene	35 to 32,500	10,500	NA	NA	NA	NA	NA	NA	500	3,700	NA
Benzo(b)fluoranthene	45 to 47.000	17,000	NA	NA	NA	NA	NA	NA	5,000	71,000	NA
Chrysene	40 to 37,500	11,000	NA	NA	NA	NA	NA	NA	500,000	31,000	NA
Dibenzo(a,h)anthracene	28 to 5,200	930	NA	NA	NA	NA	NA	NA	500	7,200	NA
Indeno(1,2,3-cd)pyrene	24 to 13,000	2,800	NA	NA	NA	NA	NA	NA	5,000	17,000	NA

[1] Values are for industrial soil, from Florida Department of Environmental Protection (FDEP) memoranda titled "Soil Cleanup Goals for Florida," dated September 29, 1995, and "Applicability of Soil Cleanup Goals for Florida," dated January 19, 1996. The technology-based (not health-based) criterion is from FDEP's "Soil Treatment Facilities" (Florida Administrative Code, Chapter 62-775), dated November 1992.
[2] Values are from the FDEP memorandum "Soil Cleanup Goals for Florida," dated September 29, 1995.

Notes: μg/kg = micrograms per kilogram.
NA = not applicable.

Table 6-26
Unfiltered Groundwater Remedial Goal Options for Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Range of Detected Concentrations	Exposure Point Concentrations	Total Excess Lifetime Cancer Risk			Total Hazard Index			Florida Primary and Secondary Standards[1]	Federal MCLs and Secondary MCLs[2]	Background Screening Concentrations[3]
			10^{-4}	10^{-5}	10^{-6}	3	1	0.1			
Semivolatile Organic Compounds (μg/ℓ)											
bis(2-Ethylhexyl)phthalate	1 to 220	32.9	NA	NA	NA	NR	NR	30	6	6	NA
Inorganic Analytes (μg/ℓ)											
Aluminum	205 to 635	427	NA	NA	NA	NA	NA	NA	[4]200	[4]50	776
Antimony	2 to 2.2	2.2	NA	NA	NA	NR	NR	0.63	6	6	ND
Iron	663 to 3,140	1,750	NA	NA	NA	NR	NR	470	[4]300	[4]300	450
Thallium	5 to 6.1	5 2	NA	NA	NA	3.6	1.2	0.12	2	2	ND

[1] Florida Department of Environmental Protection, "Ground Water Guidance Concentrations" (June 1994).
[2] The Federal MCLs are identified in U S. Environmental Protection Agency Drinking Water Regulations and Health Advisories (February 1996).
[3] The background screening value is twice the average of detected concentrations for inorganics.
[4] Secondary MCLs.

Notes: MCL = maximum contaminant level.
μg/ℓ = micrograms per liter.
NA = not applicable.
NR = the remedial goal option exceeds the exposure point concentration; no action is necessary to achieve this risk.
ND = not detected in background.

Surface Water. The risks associated with surface water exceeded the USEPA's threshold HI of 1 for the potential future child resident. The HQ for TRPH exceeded 0.1 and arsenic and iron exceeded Region IV Water Quality Standards. Table 6-27 presents the RGOs for these analytes. FDEP's Surface Water Quality Standard for oil and grease is 5 mg/ℓ.

Table 6-27
Surface Water Remedial Goal Options for Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Range of Detected Concentrations	Exposure Point Concentrations	Total Excess Lifetime Cancer Risk			Total Hazard Index			Florida Surface Water Quality Standards[1]	Region IV Water Quality Standards[2]	Background Screening Concentrations
			10^{-4}	10^{-5}	10^{-6}	3	1	0.1			
Inorganic Analytes (μg/ℓ)											
Arsenic	4.4 to 12	12	NA	NA	NA	NA	NA	NA	NS	0.018	NA
Iron	613 to 1,980	1,980	NA	NA	NA	NA	NA	NA	NS	300	NA
Total Recoverable Petroleum Hydrocarbons (TRPH) (mg/ℓ)											
TRPH	0.6	0.6	NA	NA	NA	0.78	0.26	0.026	NS	NS	NA

[1] Values are from Florida Administrative Code, Chapter 62-302, for Class III freshwater bodies (for recreational use), January 1995.
[2] Values are from the U.S. Environmental Protection Agency Region IV Water Quality Standards, January 1996.

Notes: μg/ℓ = micrograms per liter.
NA = not applicable.
NS = no screening value.
mg/ℓ = milligrams per liter.

CHAPTER 7.0

7.0 ECOLOGICAL RISK ASSESSMENT (ERA)

This ERA evaluates actual and potential adverse effects to ecological receptors associated with exposure to contamination from OU 5 at NAS Cecil Field. The ERA for OU 5 was completed in accordance with the methodologies described in Chapter 24.0 of the NAS Cecil Field GIR (ABB-ES, 1996a) and current guidance materials for ERAs at Superfund sites including the following:

- *Risk Assessment Guidance for Superfund, Environmental Evaluation Manual* (USEPA, 1989a)
- *Ecological Assessment of Hazardous Waste Sites, A Field and Laboratory Reference* (USEPA, 1989b)
- *Ecological Assessment of Superfund Sites, An Overview* (USEPA, 1991b)
- *Framework for Ecological Risk Assessment* (USEPA, 1992a) and
- *Ecological Risk Assessment Guidance for Superfund, Process for Designing and Conducting Ecological Risk Assessments* (USEPA, 1997b)

Recent risk assessment guidance including the USEPA "Eco Update" bulletins (issued since 1991) and recent publications (e.g., Maughan, 1993; Suter, 1993) were also consulted.

OU 5 consists of Site 14 (the Blue 5 Ordnance Disposal Area) and Site 15 (the Blue 10 Ordnance Disposal Area). Historical practices associated with Sites 14 and 15 may potentially result in the release of various chemicals into site media. Discussions of the general site histories and their layout is provided in Chapter 1.0, followed by discussions of the nature and extent of contamination (Chapter 4.0) and contaminant fate and transport mechanisms (Chapter 5.0). The ERAs for Sites 14 and 15 are presented in Sections 7.1 and 7.2, respectively.

7.1 SITE 14. The Site 14 ERA includes a Site Characterization (Subsection 7.1.1), Problem Formulation (Subsection 7.1.2), Hazard Assessment and Selection of ecological contaminants of potential concern (ECPCs) (Subsection 7.1.3), Exposure Assessment (Subsection 7.1.4), Ecological Effects Assessment (Subsection 7.1.5), Risk Characterization (Subsection 7.1.6), Uncertainty Analysis (Subsection 7.1.7), and Summary (Subsection 7.1.8).

7.1.1 Site Characterization Site 14, the Blue 5 Ordnance Disposal Area, is located in the north-central portion of the Yellow Water Weapons Area. The site is situated in a remote portion of NAS Cecil Field; no actively used structures exist at the site. In September 1995, ABB-ES ecologists visited Site 14 to characterize the habitats that exist at the site and determine appropriate receptors in support of the ERA. ABB-ES ecologists walked along transects through the site identifying characteristic flora and fauna for each habitat. Figure 2-8 of the NAS Cecil Field Basewide Ecological Assessment Report (BEAR) (ABB-ES, 1996b) provides an overview of the habitats present at Site 14.

The site characterization is divided into four paragraphs: 7.1.1.1 discusses the vegetative cover at Site 14, 7.1.1.2 characterizes the wildlife habitat, 7.1.1.3

discusses aquatic habitat, and 7.1.1.4 provides a summary of rare, threatened, endangered, or commercially exploited species that may potentially be found at Site 14.

7.1.1.1 **Vegetative Cover** Vegetative communities identified at Site 14 include mesic (i.e., dry) and wet slash pine flatwoods (*Pinus elliottii*), disturbed uplands, wet meadow, scrub-shrub marsh, and manmade drainage ditches. These communities, which are surrounded by more mature planted pine flatwoods, are shown on Figure 2-8 of the NAS Cecil Field BEAR (ABB-ES, 1996b). The water table is within 0 to 1 foot of the ground surface at Site 14 throughout the year. No well defined drainage pathways exist at Site 14; however, there are several areas that may be described as wet or swampy.

Planted pine flatwoods are the dominant habitat found at Site 14; these disturbed habitats contain young stands of slash pine with a sparse canopy. The pine flatwood community has encroached upon Site 14 since activities ceased in 1977. The understory of these flatwoods is variable, composed of a thick shrub layer of hollies and in places dominated by graminoids (e.g., grasses and sedges) elsewhere. Soil saturation in the flatwoods is variable with conditions ranging from mesic to saturated. Shrubs found in the understory of the planted pine flatwoods of Site 14 include southern bayberry (*Myrica cerifera*), (i.e., leafy, not woody) tall gallberry holly (*Ilex glabra*). and saw palmetto (*Serenoa repens*). Herbaceous plants observed in the flatwoods at Site 14 include sedges (*Scirpus* sp.), water hemlock (*Cicuta* sp.), sand blackberry (*Rubus cuneifolius*), St. Johnswort (*Hypericum* sp.), redroot (*Lachnanthes caroliniana*), foxtail clubmoss (*Lycopodium alopecuroides*) (listed by the Florida Department of Agriculture and Consumer Services as threatened), and rabbit tobacco (*Gnaphalium obtusifolium*).

Disturbed upland areas, which are best characterized as overgrown fields, are dominated by graminoids and other herbaceous plants. These areas are sparsely vegetated with shrubs and generally have no arboreal (tree) canopy. Southern bayberry dominated the shrub layer of the disturbed uplands at Site 14. Herbaceous plants found in the disturbed uplands of Site 14 include graminoids, rattlebox (*Sesbania* sp.), acacia (*Acacia* sp.), dog fennel (*Eupatorium capitatum*), and ragweed (*Ambrosia artemisiifolia*). In addition, muscadine grape (*Vitis rotundifolia*) (a climbing vine) was also found in the disturbed uplands at Site 14.

The wet meadow at Site 14 is a disturbed wetland, similar in general appearance to the planted pine flatwoods with a canopy consisting of occasional slash pine, southern bayberry, and other hollies. However, the herbaceous layer is largely represented by hydrophytic plants (i.e., adapted to aquatic environments), including sedges, foxtail clubmoss, hooded pitcher plant (*Saracenia minor*) (listed by the Florida Department of Agriculture and Consumer Services as threatened), seedbox (*Ludwigia alternifolia*), agalinis (*Agalinis* sp.), bog buttons (*Lachnocaulon* sp.), sundew (*Drosera* sp.), several species of bladderwort (*Utricularia cornuta* and *U. purpurea*), tickseed (*Coreopsis gladiata*), buttonweed (*Diodia virginiana*), asters (*Aster* sp.), and various species of meadow beauty (*R. virginiana* and *R. mariana*). Some herbaceous plants found in the wet meadow of Site 14 commonly found in drier habitats include blazing star (*Liatris tenuifolia*), ragweed, dog fennel, and rabbit tobacco.

A small scrub-shrub marsh exists in the southwestern portion of the site; water from the ditches eventually drain into this marsh. The marsh has little to no

arboreal canopy (except for an occasional slash pine). Herbaceous plants species found in the Site 14 scrub-shrub marsh include twig rush (*Cladium* sp.), sedges (*Carex* sp.), St. Johnswort, yellow-eyed grass (*Xyris* sp.), common dodder (*Cuscuta* sp.), white-bracted sedge (*Dichromena colorata*), meadow beauty (*Rhexia lutea*) and the hooded pitcher plant.

The ephemeral (i.e., intermittently flowing) drainage ditches that surround Site 14 are approximately 8 feet in width, 6 to 8 inches deep, have little to no flow, with a sandy bottom that is vegetated in places. Due to the ephemeral nature of the ditches, the varied plant life observed at Site 14 includes myrtle-leafed holly (*I. myrtifolia*), twig rush, sedges (*Carex* sp., *Scirpus* sp., and *Cyperus* sp.), hatpins (*Eriocaulon* sp.), yellow-topped aster (*Aster* sp.), and blazing star.

7.1.1.2 Wildlife Habitat Characterization It is likely that the terrestrial invertebrate biomass at Site 14 serves as a forage base for a variety of wildlife species, including amphibians, reptiles, small birds, and small mammals. Predatory birds and mammals that inhabit the surrounding pine flatwoods areas may be attracted to the site in search of prey.

Species of mole salamander (*Ambystoma* spp.) spend at least part of the year in pine woodlands (such as the young pine flatwoods at Site 14), and a number of other salamanders, frogs (including members of the genera *Hyla*, *Rana*, and *Pseudacris*), and toads (*Bufo* spp.) may also occur in this habitat. Several lizard species, colubrid snakes, and turtles may also be found in disturbed pine forest communities (Ashton and Ashton, 1988).

Depending upon the vegetative association, southeastern pine forests provide habitat for a diverse array of birds, including insectivorous gleaners of pine needles and bark, flycatchers, seed-eaters, nocturnal and diurnal aerial predators, and graminivore (Wolfe et al., 1988). The pine flatwoods in and surrounding Site 14 are likely to host such an assemblage. Birds of prey such as vultures, owls, and hawks (*Buteo* sp.) may nest in these woodland areas and search for prey items in more open regions.

Mammals that may occur in pine flatwoods include the rabbit (*Sylvilagus floridanus*), the hispid cotton rat (*Sigmodon hispidus*) and cotton mouse (*Peromyscus gossypinus*), as well as the armadillo (*Dasypus novemcinctus*). Predatory mammals such as the red fox (*Vulpes vulpes*) and gray fox (*Urocyon cinereoargenteus*) may feed on small mammals in these areas, and white-tailed deer (*Odocoileus virginianus*) may forage here.

The habitat provided as Site 14 may also host such reptiles as the box turtle (*Terrapene carolina*), six-lined racerunner (*Cnemidophorus sexlineatus*), black racer (*Coluber constrictor*) and coachwhip (*Masticophus flagellum*). Birds likely to forage at Site 14 include the turkey vulture (*Cathartes aura*), mourning dove (*Zenaida macroura*), and bobwhite (*Colinus virginianus*). The least shrew (*Cryptotis parva*), cotton rat, harvest mouse (*Reithrodontomys humulis*), and spotted skunk (*Spilogale putorius*) are among mammals typically found in this habitat (Florida Natural Areas Inventory Program, 1990).

Few signs of mammals were observed during the September 1995 site characterization survey; however, the northwestern portion of Site 14 showed signs of wild boar (*Sus scrofa*) activity (i.e., trampled and uprooted vegetation). In

addition, turkey vultures (*Cathartes aura*), Carolina chickadees (*Parus carolinensis*), and a belted kingfisher (*Ceryle alcyon*) were observed at the site.

7.1.1.3 **Aquatic Habitat** Limited aquatic habitat is present in the ditches, scrub-shrub swamp, and wet meadow at Site 14. No fish are expected to inhabit these aquatic habitats; however, amphibians and invertebrates may utilize these ditches to fulfill portions of their life cycles. Standing water observed in the ditches, swamp, and wet meadow in September 1995 may be related to rainfall or may be groundwater that has discharged to the surface. No other water bodies in the vicinity of Site 14 are known to receive groundwater discharging from Site 14

7.1.1.4 **Rare, Threatened, and Endangered Species** Two plant species listed as threatened by the Florida Department of Agriculture (the hooded pitcher plant and foxtail clubmoss) are known to exist at Site 14; in addition, a species of sundew was also observed at Site 14. It is possible that Site 14 would provide suitable habitat for a variety of federally or State-listed species. Rare, threatened, endangered, or commercially exploited species that may occur at NAS Cecil Field are presented in Table 2-2 of the NAS Cecil Field BEAR (ABB-ES, 1996b).

7.1.2 **Problem Formulation** Problem formulation is the initial step of the ERA process. Based on the site characterization, ecological receptors and exposure pathways have been identified. In addition, the assessment and measurement endpoints used to evaluate and measure risks to ecological receptors have also been selected.

7.1.2.1 **Identification of Receptors** Terrestrial and aquatic flora and fauna potentially occurring at NAS Cecil Field are presented in the GIR (ABB-ES, 1996a). Wildlife receptors, including omnivorous small mammals and predatory mammals and omnivorous and predatory birds, are expected to be found in the terrestrial habitats present at Site 14. Additional terrestrial receptors present at Site 14 would include plants and terrestrial invertebrates. Aquatic receptors present at the site and adjacent shallow wetlands would include invertebrates, amphibians, and plants; however, the ditches only contain water intermittently and do not provide habitat for fish. The flora and fauna observed at Site 14 are discussed in the site characterization (Subsection 7.1.1).

Site 14 is located in a remote portion of NAS Cecil Field. The site is surrounded by mature planted slash pine and intermingled wetland habitat patches, which together comprise a relatively undisturbed area of over 1,450 acres. Habitat conditions vary from wet to mesic depending on local topography. The site, as defined in Section 7.1, is approximately 22 acres. One half of the site is vegetated with a herbaceous layer of grasses, intermixed with small shrubs and saplings, which provide the majority of cover at the site, with young slash pine trees sparsely covering the remainder.

Diversity and density of avian species is dependent on plant community physiognomy, species composition, and successional stage (Allen et al., 1996). A young stand typically has a high number of avian species; however, as the trees mature (i.e., to pole size), species density and diversity decreases. Diversity and density typically rebounds and is highest when the trees reach maturity and a diverse understory has developed. The more mature planted pine habitat that surrounds Site 14 would likely support a diverse bird community.

Small mammals prefer habitats with abundant herbaceous growth, which is typical of young-age class planted pine forests (Allen et al., 1996). This would suggest that small mammals would be more abundant within Site 14, which contains dense herbaceous and open canopy habitats, as compared to the mature pine forests that surround the site. Predatory mammals, such as the red fox, would likely use the site to forage for prey items such as small mammals.

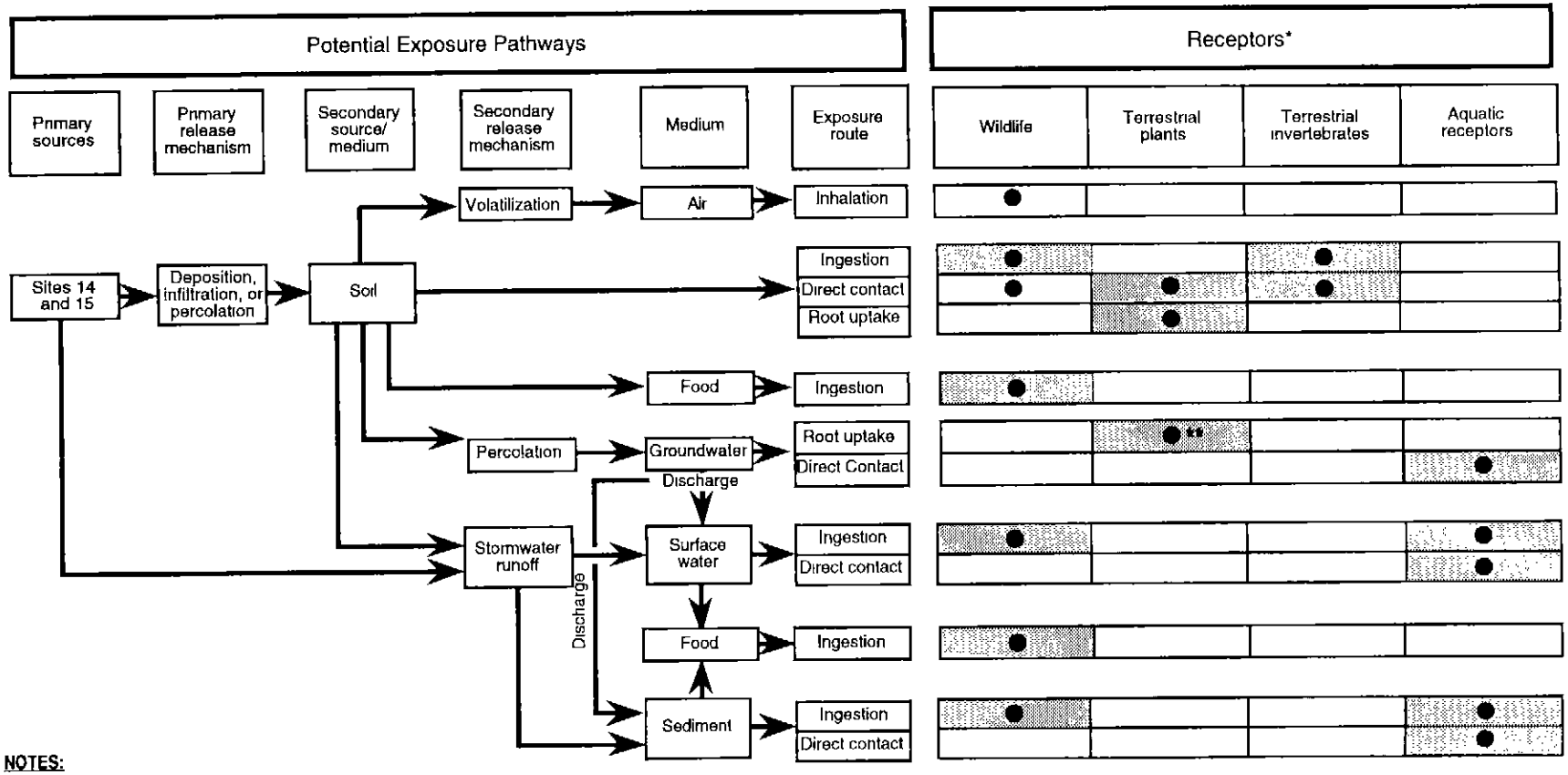
7.1.2.2 Identification of Exposure Pathways Exposure pathways are identified for four groups of ecological receptors (terrestrial wildlife, terrestrial plants, terrestrial invertebrates, and aquatic receptors). The exposure pathway includes a source of contamination, potentially contaminated media, and an exposure route. The exposure pathways from the Site 14 waste source to ecological receptors are depicted in the contaminant pathway model on Figure 7-1. The model depicts all potential exposure pathways; however, only those pathways that are quantitatively evaluated in this ERA are indicated by shading. This limitation focuses the risk evaluation on the pathways for which (1) contaminant exposures are the highest and most likely to occur and (2) there are adequate data pertaining to the receptors, contaminant exposures, and toxicity for completion of risk analyses. Exposure pathways evaluated include portions of food chains (e.g., surface soil → primary producer → primary consumer → secondary consumer → tertiary consumer) as well as other direct and indirect exposures. Exposure pathways that are not shaded are either evaluated qualitatively or are not evaluated in this ERA.

Terrestrial Wildlife. The wildlife exposure routes that are believed to contribute the highest potential contaminant exposures include ingestion of soil and food items that are contaminated as a result of accumulation of constituents from site media. In addition, other potential contaminant exposures to wildlife receptors may occur from ingestion of chemicals in surface water and sediment. An assumption is made that fur, feathers, or chitinous exoskeleton limit the transfer of contamination; therefore, exposures related to dermal contact are not evaluated as part of this ERA. Exposures related to inhalation are not evaluated because this pathway is generally considered an insignificant route of exposure except in unusual circumstances, such as following a spill or release. Potential contaminant exposures for reptiles and amphibians exist at Site 14, but are not evaluated due to a lack of data relating contaminant exposures to adverse responses for these taxa.

Terrestrial Plants and Invertebrates. Terrestrial plants and soil invertebrates may be exposed to contamination in surface soil by direct contact with and root uptake (plants) or ingestion (invertebrates) of soil. Terrestrial plants may also be exposed to contamination in shallow groundwater where roots reach a zone of saturation.

Aquatic Receptors. Exposure pathways for aquatic receptors at Site 14 include direct contact with and ingestion of surface water and sediment in the drainage ditches, and wet meadow, and direct contact with groundwater as it discharges to these habitats.

7.1.2.3 Evaluation of Potential Ecological Effects A preliminary review of the analytes detected in surface soil, surface water, sediment, and groundwater was conducted to focus the ERA for Site 14. The following sections identify the types of contaminants that are most likely to pose risks to ecological receptors at the site.



NOTES:
ERA = ecological risk assessment
OU = operable unit

* Shading indicates the exposure pathways that are quantitatively evaluated for receptors in the OU 5, Sites 14 and 15 ERA. Nonshaded pathways are evaluated qualitatively, not evaluated due to the lack of toxicity information, not evaluated because it is not considered a significant pathway, or evaluated under a different operable unit.
** This is only a potential exposure pathway at Site 14

FIGURE 7-1
CONTAMINANT PATHWAY MODEL FOR ECOLOGICAL RECEPTORS

REMEDIAL INVESTIGATION
OPERABLE UNIT 5

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

8500-52 FIG 7-1 112296MAW

The analytes detected in surface soil, surface water, sediment, and groundwater are presented in Section 4.0 of this report. All of the analytes detected in the different media were reviewed and screened for toxicological benchmarks, known toxicological properties, background concentrations, and bioaccumulation potential. The frequency of detection and types of media in which an analyte was detected were also considered. This review identified a subset of probable risk drivers, which are presented in the following subsections.

Surface Soil. Phthalate ester compounds were detected in most surface soil samples and were also detected frequently in surface water and sediment samples. Phthalate ester compounds do not readily bioaccumulate in ecological food chains; therefore, higher trophic level exposures (e.g., predatory birds and mammals) are not anticipated to result in adverse ecological effects. The primary toxic effects associated with exposure to phthalate ester compounds are acute toxicity and chronic reproductive effects in small mammals. The pesticide endosulfan II was detected in one surface soil sample at a low concentration and was not detected in any other media at Site 14. It is unlikely, therefore, that this contaminant would cause significant ecological effects to wildlife receptor populations. Inorganic analytes that would most likely affect wildlife populations include aluminum and copper, which were detected in most of the surface soil samples. As these analytes do not accumulate significantly in biological tissue, wildlife exposures to small mammals are of greatest concern. Chronic exposures to aluminum and copper have been shown to result in reduced body weight gain and decreased litter size in small mammals. These analytes may also cause phytotoxicity and acute toxicity in plants and invertebrates.

Surface Water. Acetone and the pesticide endrin were detected in one out of four surface water samples at low concentrations, and both are unlikely to pose substantial ecological risk to aquatic organisms or semiaquatic wildlife. *Bis*(2-ethylhexyl)phthalate was the only phthalate ester detected in surface water; it was also detected in surface soil and sediment. Exposure to *bis*(2-ethylhexyl)-phthalate in surface water may cause reproductive effects in amphibians, and semiaquatic wildlife could have reproductive effects such as reduced litter size. The inorganic analytes aluminum and copper were detected at concentrations that exceed screening benchmark values in most surface water samples and appear to be the greatest threat to aquatic receptors. Salmonid fish, such as trout, are believed to be particularly sensitive to aluminum exposures, with adverse reproductive effects reported at concentrations similar to those detected in surface water. However, the aquatic habitat at the site does not support fish species, and the aquatic receptors that may occur are considerably less sensitive than fish.

Sediment. Only low-level VOCs (i.e., acetone and 2-butanone) were detected in sediment and are unlikely to pose a threat to ecological receptors. A number of phthalate ester compounds were detected in nearly all of the samples collected. Effects to semiaquatic wildlife may include reproductive effects such as reduced litter size. Exposure of aquatic receptors to phthalate ester compounds in sediment are unknown, as sediment toxicity data for these compounds are not readily available. Inorganics do not appear sufficiently elevated above screening benchmarks to pose a threat to aquatic receptors.

Groundwater. Toluene was the only VOC detected in groundwater and would not likely be a primary risk contributor, as it was detected at a low frequency and at a low concentration. The explosive compound 1,3,5-TNB is also not considered

to be a primary risk driver for similar reasons. Of the inorganic analytes detected in groundwater, aluminum is the analyte most likely to pose a potential ecological risk at Site 14. Aluminum was detected regularly in the groundwater at elevated concentrations (i.e., in excess of surface water benchmarks) and in other media sampled at the site. Plants exposed to aluminum in groundwater may result in phytotoxic effects such as a reduction in seedling establishment.

7.1.2.4 Identification of Endpoints The assessment and measurement endpoints and COPCs selected for the Site 14 ERA are listed in Table 7-1. Assessment endpoints represent the ecological component to be protected, whereas the measurement endpoints approximate or provide a measure of the achievement of the assessment endpoint. The general assessment and measurement endpoints selected for the Site 14 ERA are listed in Table 24-1 of the GIR (ABB-ES, 1996a). The specific assessment endpoints for the receptor groups most likely at risk at Site 14 are presented below.

Wildlife Receptors. Wildlife receptors could be exposed to contamination in surface soil, sediment, and surface water via direct (e.g., direct contact and incidental ingestion) and indirect (e.g., consumption of contaminated prey items) exposure pathways. As discussed in Paragraph 7.1.2.3, the contaminants of greatest concern in these media include phthalate esters, aluminum, and copper. Due to the fact that these contaminants are not known to bioaccumulate substantially, small mammals and ground foraging birds are anticipated to be at the greatest potential risk. Large predatory birds and mammals such as the great horned owl and red fox would only forage at the site a certain percentage of time and, without a bioaccumulation hazard, are expected to receive much lower exposure doses than smaller organisms with greater site fidelity. The primary adverse effects associated with wildlife exposure to phthalate esters, aluminum, and copper are related to reproductive effects following prolonged (i.e., chronic) exposures. Consequently, the specific assessment endpoint selected for terrestrial wildlife at Site 14 is a substantial reduction (i.e., greater than 50 percent) in small mammal (e.g., shrew) and bird (e.g. woodcock) subpopulation from reproductive impairment due to phthalate ester, aluminum and copper exposure.

Terrestrial Plants and Soil Invertebrates. Terrestrial plants and soil invertebrates could be exposed to contamination in surface soil and groundwater (due to a high water table at Site 14) via direct contact, ingestion (invertebrate only) and root uptake (plants only) exposure pathways. As discussed in Paragraph 7.1.2.3, the contaminants of greatest ecological concern in these media are aluminum and copper. The primary phytotoxic effects associated with aluminum and copper are reduced seedling establishment and growth reduction; these inorganics are also known to be acutely toxic to soil invertebrates. These contaminants do not bioaccumulate and are regulated by most organisms; therefore, sublethal effects following chronic exposures exposure to aluminum and copper are unlikely. Consequently, the specific assessment endpoints selected for plants and invertebrates at Site 14 are the protection of plant and invertebrate subpopulations from reduced seedling establishment and reduced root and shoot growth and acute toxicity due to aluminum and copper exposure.

Aquatic Organisms. Aquatic organisms could be exposed to contamination in surface water, sediment, and groundwater via direct contact and incidental ingestion exposure pathways. As discussed in Paragraph 7.1.2.3, the contaminants of greatest concern are phthalate esters, aluminum, and copper. Due to the fact

Table 7-1
Endpoints for Ecological Assessment, Site 14

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Medium	Primary ECPCs	Receptor	Assessment Endpoint	Measurement Endpoint
Surface Soil	Phthalate esters, aluminum, and copper	Wildlife	Substantial reduction (i.e., greater than 50 percent) in small mammal and bird subpopulations from reproduction impairment due to phthalate ester, aluminum, and copper exposure	Oral contaminant doses (mg/kg BW-day) based on measured adverse effects on growth, reproduction, or survival (e g., LD_{50} studies) of mammalian or avian laboratory test populations.
	Aluminum, and copper	Terrestrial invertebrates	Substantial reduction of invertebrate subpopulations from acute toxicity from aluminum, and copper exposure.	Contaminant concentrations in surface soil (mg/kg) that measure adverse effects on survival (e.g , LC_{50} studies) of terrestrial invertebrates. When no survival studies are available, measured adverse effects on reproduction and growth are used.
	Aluminum, and copper	Terrestrial plants	Substantial reduction of plant subpopulations from reduced seedling establishment and reduced root and shoot growth due to aluminum and copper exposure	Contaminant concentrations in surface soil (mg/kg) that measure adverse effects on growth, reproduction, or survival of terrestrial plants.
Surface Water and Sediment	bis(2-Ethylhexyl) phthalate, aluminum, and copper	Wildlife	Substantial reduction (i.e., greater than 50 percent) in small mammals and birds subpopulations from reproductive impairment due to phthalate esters, aluminum, and copper exposure	Oral contaminant doses (mg/kg BW-day) based on measured adverse effects on growth, reproduction, or survival (e.g., LD_{50} studies) of mammalian or avian laboratory test populations.
Surface Water	bis(2-Ethylhexyl) phthalate, aluminum, and copper	Aquatic organisms	Reduction of invertebrate and amphibian subpopulations due to phthalate esters, aluminum, and copper exposure.	Chemical concentrations in surface water ($\mu g/\ell$) associated with adverse effects to growth, reproduction, survival, and biodiversity of aquatic organisms.
Sediment	Phthalate esters, aluminum, and copper	Aquatic organisms	Reduction of invertebrate and amphibian subpopulations due to phthalate ester, aluminum, and copper exposure.	Chemical concentrations in sediment ($\mu g/kg$ and mg/kg) associated with adverse effects to growth, reproduction, and survival of aquatic organisms
Groundwater	Phthalate ester, aluminum. and copper	Aquatic organisms	Reduction of invertebrate and amphibian subpopulations due to phthalate ester, aluminum and copper exposure.	Chemical concentrations in surface water ($\mu g/\ell$) associated with adverse effects to growth, reproduction, and survival of aquatic organisms.

See notes at end of table

Table 7-1 (Continued)
Endpoints for Ecological Assessment, Site 14

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Medium	Primary ECPCs	Receptor	Assessment Endpoint	Measurement Endpoint
Groundwater	Phthalate esters, aluminum, and copper	Wetland plants	Reduction of aquatic plant subpopulations due to phthalate ester, aluminum, and copper exposure.	Chemical concentrations in solution ($\mu g/\ell$) that measure adverse effects on growth, reproduction, or survival of plants.

Notes: mg/kg = milligrams per kilogram.
BW = body weight
LD_{50} = lethal dose to 50 percent of a test population.
LC_{50} = lethal concentration to 50 percent of a test population.
$\mu g/\ell$ = micrograms per liter.
$\mu g/kg$ = micrograms per kilogram.

that these contaminants are not known to bioaccumulate substantially, the likely pose little risk to semiaquatic wildlife. However, aquatic organisms, could potentially be at risk. The primary adverse effects associated with invertebrate and amphibian exposure to phthalate esters, aluminum, and copper relate to reproductive effects following prolonged (i.e., chronic) exposures. Consequently, the specific assessment endpoint selected for aquatic receptors at Site 14 is a substantial reduction in subpopulations due to phthalate ester, aluminum, and copper exposure.

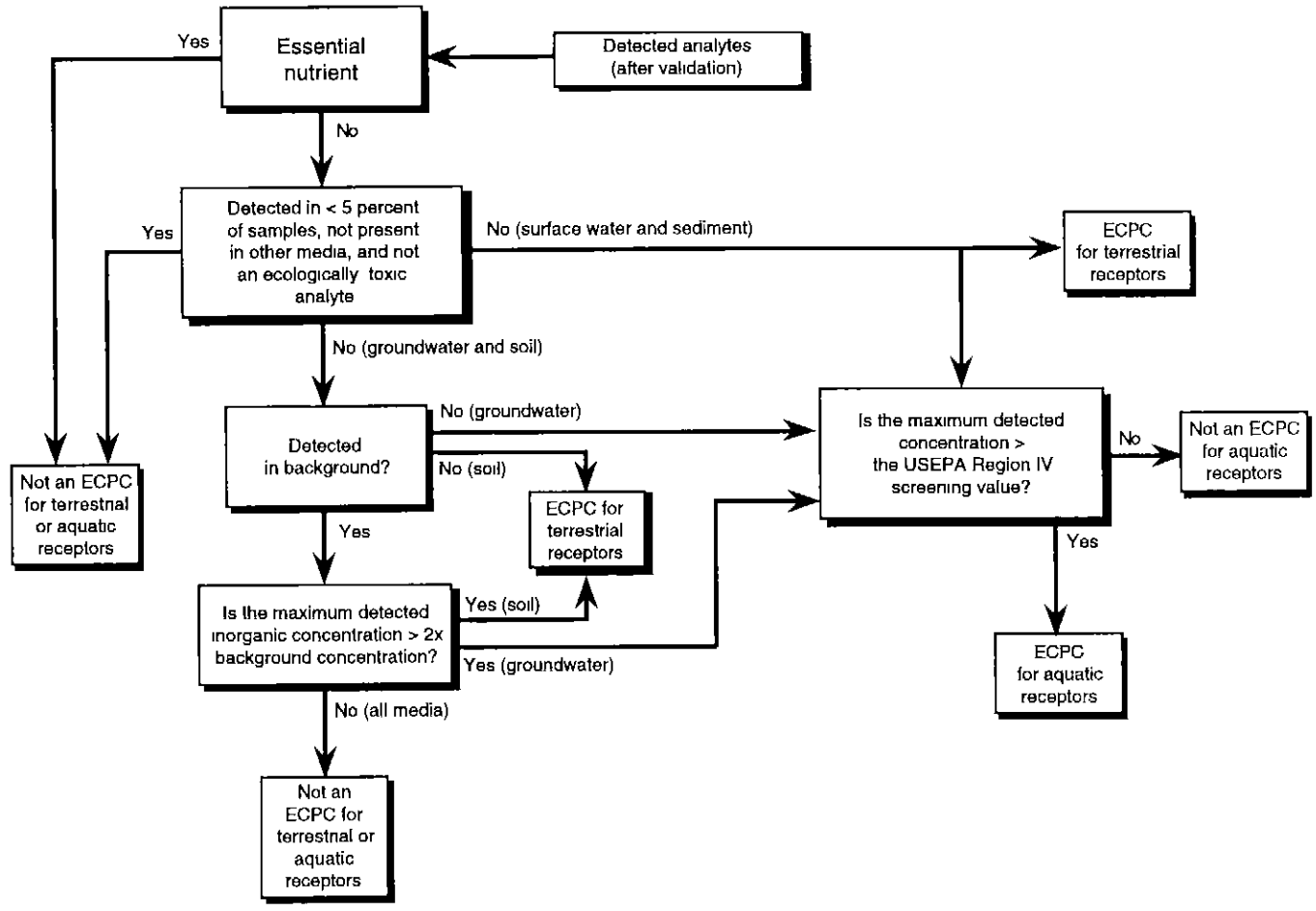
The objectives of the ERA are as defined by the specific assessment endpoints presented above. However, all potential site-related contaminants were evaluated in order to provide a more complete assessment of potential ecological risks. The measurement endpoints used to gauge the likelihood of population- and community-level effects are chemical-specific toxicity values reported in the literature that are based on laboratory-measured survival, reproductive, and growth impairment effects.

7.1.3 Hazard Assessment and Selection of ECPCs The hazard assessment includes a review of analytical data and selection of ECPCs. ECPCs are the analytes detected in environmental media (surface soil, surface water, sediment, and groundwater) that could present a potential risk for ecological receptors. The process for selecting ECPCs is depicted on Figure 7-2. Additional detail regarding the ECPC selection process is provided in Chapter 24.0 of the GIR (ABB-ES, 1996a). Analytical data for Site 14 were evaluated for use in risk assessment pursuant to national guidance, *Guidance for Data Useability in Risk Assessment (Parts A and B)* (USEPA, 1992b). More detail regarding data useability is provided in Chapter 6.0, and in the GIR (ABB-ES, 1996a).

ECPCs are not intended to include contaminants representative of background conditions (Chapter 4.0). Background analyte concentrations used in the ECPC screening process are provided in Chapter 3.0 of the RIDD. In accordance with USEPA Region IV guidance (USEPA, 1991d), an analyte was not selected as an ECPC if the maximum detected concentration of an inorganic analyte detected in surface soil or groundwater was less than 2 times the average inorganic concentration detected in the respective background samples. Analytical results from surface soil locations CFBKSS16 through CFBKSS21 and CFBKSS9 were included in the background surface soil summary for Site 14. Data collected in 1995 from the upper zone of the shallow surficial aquifer (CFBKMW1S, CFBKMW2S, CFBKMW4S, CFBKMW4SD, CFBKMW5S, CFBKMW7S, and CFBKMW8S) were used from the NAS Cecil Field background groundwater database for screening groundwater ECPCs.

No background database exists for surface water and sediment and no upgradient surface water or sediment location exists at Site 14; therefore, all analytes in these media were retained as wildlife (including terrestrial plants and invertebrates) ECPCs. USEPA Region IV surface water and sediment screening criteria (USEPA, 1995a) were used for screening surface water, groundwater, and sediment ECPCs (for aquatic organisms only). If the maximum detected concentration of an analyte was less than the USEPA Region IV screening value, then the analyte was not selected as an ECPC for aquatic receptors.

The essential nutrients (e.g., calcium, magnesium, potassium, and sodium) were excluded as aquatic and wildlife ECPCs for all media, and iron was excluded as a wildlife ECPC for all media (ABB-ES, 1996a). These analytes are considered to be toxic at only extremely elevated concentrations.



NOTES:
ECPC = ecological contaminant of potential concern
USEPA = U.S. Environmental Protection Agency
> = greater than
< = less than
x = times

FIGURE 7-2
ECOLOGICAL CONTAMINANT OF POTENTIAL CONCERN SELECTION PROCESS

REMEDIAL INVESTIGATION
OPERABLE UNIT 5

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

8500-52-TKD FIG 7-2 112296MAW

All analytes detected in surface soil, surface water, sediment, and groundwater are summarized in tables that include the following: frequency of detection, range of detection limits, range of detected concentrations, average of detected concentrations, and screening values (i.e., twice the average background concentration for inorganic analytes detected in surface soil or groundwater). Concentrations estimated below the detection limit are included and not flagged as estimated. For those analytes that were retained as ECPCs for the ERA, the following information is also provided: average of all concentrations, 95th percentile Upper Confidence Limit (UCL) (where the sample size is greater than or equal to 10), and maximum and average EPCs. A discussion of how EPCs are determined is provided in Paragraph 7.1.4.1.

7.1.3.1 **Surface Soil** All seven surface soil samples collected in June 1995 at Site 14 were evaluated in this ERA; surface soil ECPCs are presented in Table 7-2. All of the organic analytes and TRPH detected in Site 14 surface soil were retained as wildlife ECPCs. In addition, five inorganic analytes (including aluminum, chromium, copper, nickel, and vanadium) were retained as wildlife ECPCs because their maximum detected concentrations were greater than 2 times the average background soil concentration.

7.1.3.2 **Surface Water** All four surface water samples collected in June 1995 at Site 14 were evaluated in the ERA; surface water ECPCs are presented in Table 7-3.

All of the detected analytes (except for the nutrients) were retained as wildlife ECPCs since no suitable screening background criteria were identified. All of the detected analytes (except for filtered and unfiltered iron, unfiltered nickel, and filtered antimony) were retained as aquatic ECPCs because their maximum detected concentrations were greater than the USEPA Region IV surface water screening value.

Beryllium and nickel were detected in only 1 of 4 unfiltered samples and were not detected in filtered samples. Because they were not detected in the filtered samples, it is likely that beryllium and nickel are not available to biota.

It is uncertain whether antimony (reported at 1/10 the detection limit) and cyanide (reported at the detection limit) are representative of site conditions because they were not detected in unfiltered samples.

7.1.3.3 **Sediment** All four sediment samples were evaluated in the Site 14 ERA; sediment ECPCs are presented in Table 7-4.

All detected analytes (except for the nutrients) were retained as ECPCs for wildlife. All organic analytes (except acenaphthene and pyrene), aluminum, barium, iron, manganese, and vanadium were selected as aquatic ECPCs because their maximum detected concentrations were either greater than the USEPA Region IV sediment screening value or because no sediment screening value exists.

7.1.3.4 **Groundwater** Filtered and unfiltered groundwater data from three monitoring wells screened in the shallow surficial aquifer were used to evaluate and identify groundwater ECPCs potentially contributing to surface water contamination in the drainage ditches, the scrub-shrub swamp, and the wet meadow at Site 14. However, evaluation of aquatic effects associated with exposure to unfiltered groundwater data is conservative. Contaminant concentrations in

Table 7-2
Ecological Contaminants of Potential Concern in Site 14 Surface Soil[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[2]	Range of Detection Limits	Range of Detected Concentrations	Average of Detected Concentrations[3]	2 Times Average Background Concentration[4]	Contaminant of Ecological Concern?	Average of all Concentrations[5]	Exposure Point Concentrations	
								Maximum[6]	Average[7]
Semivolatile Organic Compounds (mg/kg)									
Butylbenzylphthalate	3/7	0.395 to 0.59	0 049 to 1.7	0.69	NA	Yes	0.42	1.7	0.42
Di-n-butylphthalate	7/7	0.79 to 1.8	2.9 to 9.0	6.0	0.082	Yes	6.0	9.0	6.0
bis(2-Ethylhexyl)phthalate	3/7	0 395 to 0.59	0.056 to 1.3	0.49	NA	Yes	0.33	1.3	0.33
Pesticides and PCBs (mg/kg)									
Endosulfan II	1/7	0.004 to 0.006	0.0006	0.0006	NA	Yes	0.002	0.0006	0.0006
Inorganic Analytes (mg/kg)									
Aluminum	7/7	40	[8]185 (213, 157) to 8,510	2,770	3,860	Yes	2,770	8,510	2,770
Barium	7/7	40	1 to 5.1	3	6	No[9]			
Chromium	7/7	2	[8]0.59 (0.68, 0.49) to 7.9	2.8	3.8	Yes	2.8	7 9	2.8
Copper	5/7	5	[8]0.91 (1, 0.81J) to 163	36	NA	Yes	26	163	26
Iron	7/7	20	[8]79.9 (89.2, 70.6) to 2,480	510	630	No[10]			
Lead	5/7	0.6	2 to 7.4	3.6	8.2	No[9]			

See notes at end of table.

Table 7-2 (Continued)
Ecological Contaminants of Potential Concern in Site 14 Surface Soil[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[2]	Range of Detection Limits	Range of Detected Concentrations	Average of Detected Concentrations[3]	2 Times Average Background Concentration[4]	Contaminant of Ecological Concern?	Average of all Concentrations[5]	Exposure Point Concentrations	
								Maximum[6]	Average[7]
Inorganic Analytes (mg/kg) (Continued)									
Magnesium	2/7	1,000	38 9 to 83.7	61.3	282	No[9,10]			
Manganese	4/7	3	[8]0.71 (0.68, 0.74) to 2	1	3.8	No[9]			
Nickel	1/7	8	1.3	1.3	NA	Yes	3.6	1.3	1 3
Potassium	3/7	1,000	13.5 to 41.1	23.5	NA	No[10]			
Vanadium	7/7	10	1.3 to 9.1	2.8	4 8	Yes	2.8	9 1	2.8
General Chemistry (mg/kg)									
Total Petroleum Hydrocarbons	7/7	12 to 18	26 to 93	44	36.2	Yes	44	93	44

[1] Sample locations include CF14SS1 through CF14SS7. A duplicate sample was collected at CF14SS1.
[2] Frequency of detection is equal to the number of samples in which the analyte is detected in relation to the total number of samples analyzed
[3] Arithmetic mean of all samples in which analyte was detected.
[4] Background sample locations include: CFBSS16 through CFBSS21 and CEFBKSS9 Two times the mean background concentration for inorganics was used to screen Exposure Point Concentrations (EPCs)
[5] The average of all concentrations assigns a value of 1/2 the detection limit to all nondetects.
[6] Maximum EPCs are equal to the maximum detected concentration. The 95th percent upper confidence limit was not calculated because there are fewer than 10 samples in the data set.
[7] Average EPCs are equal to the arithmetic mean of all concentrations. When the arithmetic mean is greater than the maximum exposure point concentration, the maximum EPC was used instead.
[8] This minimum or maximum detected concentration occurs in a duplicate pair.
[9] Maximum analyte concentration is less than two times the average background concentration
[10] Analyte is an essential nutrient, and is not considered toxic except at high concentrations.

Notes. mg/kg = milligrams per kilogram
NA = not available.
PCB = polychlorinated biphenyl.
J = estimated concentration

Table 7-3
Ecological Contaminants of Potential Concern in Site 14 Surface Water[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[2]	Range of Detection Limits	Range of Detected Concentrations	Average of Detected Concentrations[3]	Region IV Chronic Water Quality Screening Values[4]	Contaminant of Ecological Concern?[5]	Average of All Concentrations[6]	Exposure Point Concentrations	
								Maximum[7]	Average[8]
Volatile Organic Compounds (µg/ℓ)									
Acetone	1/4	2	5	5	NA	Yes A/W	2	5	2
Semivolatile Organic Compounds (µg/ℓ)									
bis(2-Ethylhexyl)phthalate	3/4	10	2 to 43	16	0.3	Yes A/W	13	43	13
Pesticides and PCBs (µg/ℓ)									
Endrin	1/4	0.1	0 0063	0.0063	0.002	Yes A/W	0.04	0.0063	0 0063
Unfiltered Inorganic Analytes (µg/ℓ)									
Aluminum	4/4	200	254 to 634	434	[9]87	Yes A/W	434	634	434
Barium	4/4	200	[10]6 7 (6.9, 6.4) to 12.9	9.7	NA	Yes A/W	9.7	12.9	9.7
Beryllium	1/4	5	[10]2.0 (5 UJ, 1.4 J)	2	0.53	Yes A/W	2 4	2	2
Calcium	4/4	5,000	[10]1,050 (1,120, 987) to 11,000	3,900	NA	No[11]			
Copper	3/4	25	5.7 to 10.2	7.9	[12]4	Yes A/W	9 1	10.2	9.1
Iron	4/4	100	158 to 658	432	1,000	No[13]			
Magnesium	4/4	5,000	[10]553 (586, 519) to 1,040	837	NA	No[11]			
Manganese	4/4	15	7.7 to 44.1	18 5	NA	Yes A/W	18.5	44.1	18.5

See notes at end of table

Table 7-3 (Continued)
Ecological Contaminants of Potential Concern in Site 14 Surface Water[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[2]	Range of Detection Limits	Range of Detected Concentrations	Average of Detected Concentrations[3]	Region IV Chronic Water Quality Screening Values[4]	Contaminant of Ecological Concern?[5]	Average of All Concentrations[6]	Exposure Point Concentrations	
								Maximum[7]	Average[8]
Unfiltered Inorganic Analytes (μg/ℓ) (Continued)									
Nickel	1/4	40	3 3	3 3	[12]49	Yes W[13]	16	3 3	3.3
Potassium	3/4	5,000	64.6 to 141	104	NA	No[11]			
Sodium	4/4	5,000	[10]2,290 (2,470, 2,110) to 4,080	3,160	NA	No[11]			
Vanadium	2/4	50	2.1 to 2.5	2.3	NA	Yes A/W	14	2.5	2 5
Zinc	1/4	20	90.3	90.3	[12]30	Yes A/W	30.1	90.3	30 1
Filtered Inorganic Analytes (μg/ℓ)									
Aluminum	4/4	200	211 to 585	392	[9]87	Yes A/W	392	585	392
Antimony	3/4	60	4.1 to 7 5	5.5	160	Yes W[13]	12	7.5	7.5
Barium	4/4	200	[10]7.2 (7.1, 7 2) to 12.5	9.7	NA	Yes A/W	9.7	12.5	9.7
Calcium	4/4	5,000	[10]1,190 (1,090, 1,290) to 9,720	3,570	NA	No[11]			
Copper	4/4	25	4.3 to 9.6	6.9	[12]4	Yes A/W	6.9	9.6	6 9
Cyanide	1/1	10	10	10	5.2	Yes A/W	10	10	10

See notes at end of table.

Table 7-3 (Continued)
Ecological Contaminants of Potential Concern in Site 14 Surface Water[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[2]	Range of Detection Limits	Range of Detected Concentrations	Average of Detected Concentrations[3]	Region IV Chronic Water Quality Screening Values[4]	Contaminant of Ecological Concern?[5]	Average of All Concentrations[6]	Exposure Point Concentrations	
								Maximum[7]	Average[8]
Filtered Inorganic Analytes (µg/ℓ) (Continued)									
Iron	4/4	100	116 to 566	357	1,000	No[13]			
Magnesium	4/4	5,000	[10]610 (581, 638) to 1,240	848	NA	No[11]			
Manganese	4/4	15	3.5 to 45.7	18	NA	Yes A/W	18	45.7	18
Potassium	3/4	5,000	49.7 to 141	90	NA	No[11]			
Sodium	4/4	5,000	[10]2,410 (2,420, 2,390) to 3,830	3,130	NA	No[11]			
Vanadium	1/4	50	2	2	NA	Yes A/W	20	2	2
Zinc	2/4	20	[10]30.0 (26 6, 33.4) to 99.7	64.9	[12]30	Yes A/W	37.4	99.7	37.4
General Chemistry (mg/ℓ)									
Chloride	3/3	2	[10]5 (4, 5) to 9	7	NA	NA			
Hardness	2/3	5 to 25	[10]4 (6, 5 U) to 12	8	NA	NA			
Sulfate	2/3	5	6 to [10]10 (10, 10)	8	NA	NA			
Total Dissolved Solids	3/3	10	[10]42 (40, 43) to 91	66	NA	NA			
Total Kjeldahl Nitrogen	2/3	1	1 to [10]1 (2, 1 U)	1	NA	NA			
Total Phosphorous	2/3	0.1	0.3 to [10]0.5 (0.9 J, 0.1 J)	0.4	NA	NA			

See notes on following page

Table 7-3 (Continued)
Ecological Contaminants of Potential Concern in Site 14 Surface Water[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

[1] Sample locations include: CF14SW1, CF14SW2, CF14SW3, and CF14SW4. A duplicate was collected at CF14SW3D.
[2] Frequency of detection is equal to the number of samples in which the analyte is detected in relation to the total number of samples analyzed.
[3] Arithmetic mean of all samples in which analyte was detected.
[4] U S. Department of Environmental Protection Agency (USEPA) Region IV Waste Management Division Chronic Freshwater Quality Screening Values based on the Water Quality Standards Units Screening List (USEPA, 1995a).
[5] A = Ecological Contaminant of Potential Concern (ECPC) for aquatic receptors. W = ECPC for wildlife receptors.
[6] The average of all concentrations assigns a value of 1/2 the sample quantitation limit to all nondetects.
[7] Maximum Exposure Point Concentrations (EPCs) are equal to the maximum detected concentration. The 95th percent upper confidence limit was not calculated because there are fewer than 10 samples in the data set.
[8] Average EPCs are equal to the arithmetic mean of all concentrations. If the arithmetic mean of all concentrations is greater than the maximum EPC, then the maximum EPC was used instead
[9] Based on pH of 6.5 to 9.
[10] This value was obtained after averaging a duplicate pair.
[11] Analyte is an essential nutrient, and is not considered toxic except at high concentrations.
[12] Hardness-dependent criterion based on an estimated hardness concentration of 25 mg calcium carbonate ($CaCO_3$) as recommended by USEPA (57 FR 60848, 1992) (a site-specific hardness value of 13 mg/ℓ $CaCO_3$ was calculated using mean calcium and magnesium concentrations [Greenberg et al., 1992]).
[13] Maximum analyte concentration is below the Region IV chronic surface water screening value.

Notes: μg/ℓ = micrograms per liter.
NA = not available
A/W = see footnote 5.
PCB = polychlorinated biphenyl
mg/ℓ = milligrams per liter.
J = estimated concentration.
U = Qualifier for nondetected values. Concentration value provided is the detection limit for that sample.

Table 7-4
Ecological Contaminants of Potential Concern in Site 14 Sediment[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[2]	Range of Detection Limits	Range of Detected Concentrations	Average of Detected Concentrations[3]	Region IV Chronic Sediment Screening Values[4]	Contaminant of Ecological Concern?[5]	Average of All Concentrations[6]	Exposure Point Concentrations	
								Maximum[7]	Average[8]
Volatile Organic Compounds (mg/kg)									
Acetone	4/4	0.012 to 0.013	0.005 to [9]0.008 (0 012 J, 0.003 J)	0.006	NA	Yes A/W	0.006	0.008	0.006
2-Butanone	1/4	0.012 to 0.013	[9]0.005 (0.012 U, 0.003 J)	0.005	NA	Yes A/W	0 006	0.005	0.005
Semivolatile Organic Compounds (mg/kg)									
Acenaphthene	1/4	0.40 to 0.43	0.023	0.023	0.33	Yes W[10]	0 17	0.023	0.023
Butylbenzylphthalate	2/4	0 40 to 0.43	[9]0.18 (0.13 J, 0.45 U) to 1.3	0.7	NA	Yes A/W	0.47	1.3	0 47
1,4-Dichlorobenzene	1/4	0.40 to 0.43	0.034	0.034	NA	Yes A/W	0.17	0 034	0.034
Diethylphthalate	3/4	0 40 to 0.43	0.073 to 2.4	1.6	NA	Yes A/W	1.3	2.4	1 3
Dimethylphthalate	1/4	0.40 to 0.43	[9]0.13 (0.039 J, 0.45 U)	0.13	NA	Yes A/W	0.19	0.13	0.13
Di-*n*-butylphthalate	4/4	0 80 to 0.86	1 9 to 3.5	2.8	NA	Yes A/W	2.8	3 5	2.8
bis(2-Ethylhexyl)phthalate	2/4	0.40 to 0.43	[9]0 013 (0.030 J, 0.45 U) to 2.1	1.1	0.182	Yes A/W	0 66	2.1	0.66
Phenol	1/4	0.40 to 0.43	0 054	0.054	NA	Yes A/W	0.17	0.054	0 054
Pyrene	1/4	0 40 to 0.43	0.029	0.029	0.33	Yes W[10]	0.17	0.029	0 029
1,2,4-Trichlorobenzene	1/4	0.40 to 0.43	0.030	0 030	NA	Yes A/W	0.17	0 030	0 030

See notes at end of table.

Table 7-4 (Continued)
Ecological Contaminants of Potential Concern in Site 14 Sediment[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[2]	Range of Detection Limits	Range of Detected Concentrations	Average of Detected Concentrations[3]	Region IV Chronic Sediment Screening Values[4]	Contaminant of Ecological Concern?[5]	Average of All Concentrations[6]	Exposure Point Concentrations	
								Maximum[7]	Average[8]
Inorganic Analytes (mg/kg)									
Aluminum	4/4	40	315 to 2,560	1,170	NA	Yes A/W	1,170	2,560	1,170
Barium	4/4	40	[9]0.86 (0 52, 1.2) to 3.1	1.6	NA	Yes A/W	1.6	3.1	1 6
Chromium	4/4	2	0.69 to 3.1	1.6	[11]52.3	Yes W[10]	1.6	3.1	1.6
Copper	4/4	5	0 8 to 0.94	0.9	18.7	Yes W[10]	0.88	0.94	0.88
Iron	4/4	20	85.9 to 444	214	NA	Yes A	214	444	214
Magnesium	1/4	1,000	57	57	NA	No[12]			
Manganese	4/4	3	0.48 to 2.4	1 1	NA	Yes A/W	1.1	2 4	1.1
Nickel	1/4	8	1	1	15.9	Yes W[10]	3.3	1	1
Potassium	1/4	1,000	20 3	20 3	NA	No[12]			
Vanadium	4/4	10	0.53 to 2.4	1.4	NA	Yes A/W	1.4	2.4	1.4
General Chemistry (mg/kg)									
Total Organic Carbon	3/3	130	[9]2,700 to 5.300	3,900	NA	NA	NA	NA	NA
TRPH	1/3	13	16	16	NA	Yes A/W	9.7	16	9.7

See notes on following page.

Table 7-4 (Continued)
Ecological Contaminants of Potential Concern in Site 14 Sediment[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

[1] Sample locations include. CF14SD1, CF14SD2, CF14SD3, and CF14SD4 Duplicate at CF14SD3.
[2] Frequency of detection is equal to the number of samples in which the analyte is detected in relation to the total number of samples analyzed
[3] Arithmetic mean of all samples in which analyte was detected.
[4] U.S. Environmental Protection Agency (USEPA) Region IV Waste Management Division Sediment Screening Values (USEPA, 1995a).
[5] A = Ecological Contaminant of Potential Concern (ECPC) for aquatic receptors. W = ECPC for wildlife receptors.
[6] The average of all concentrations assigns a value of 1/2 the sample quantitation limit to all nondetects.
[7] Maximum Exposure Point Concentrations (EPCs) are equal to the maximum detected concentration. The 95th percent upper confidence limit was not calculated because there are fewer than 10 samples in the data set.
[8] Average EPCs are equal to the arithmetic mean of all concentrations. If the arithmetic mean of all concentrations is greater than the maximum EPC, then the maximum EPC was used instead.
[9] This value was obtained after averaging a duplicate pair.
[10] Maximum analyte concentration is below the Region IV chronic sediment screening value
[11] Screening value for hexavalent species of chromium.
[12] Analyte is an essential nutrient, and is not considered toxic except at high concentrations.

Notes: mg/kg = milligrams per kilogram
J = estimated concentration.
NA = not available.
A/W = see footnote 5.
U = Qualifier for nondetected values. Concentration value provided is the detection limit for that sample.
TRPH = total recoverable petroleum hydrocarbons.

unfiltered groundwater tend to be higher than those for filtered groundwater because of sorption to particulate matter; therefore, the concentrations observed in unfiltered groundwater may not be representative of ecological exposures. Since the turbidity of unfiltered groundwater at CF14MW3S exceeded 5 nephelometric turbidity units (NTUs), a filtered groundwater sample was collected at CF14MW3S. Groundwater ECPCs are identified in Table 7-5.

Toluene and five unfiltered inorganic analytes were eliminated from the ERA because they were either detected at concentrations less than the USEPA Region IV surface water screening value or two times the average background screening concentration for inorganics. In addition, the essential nutrients were also eliminated from the ERA. The remaining analytes (1,3,5-TNB, aluminum, barium [filtered only], beryllium, cobalt, iron, manganese, thallium [unfiltered only], and vanadium [filtered only]) were retained as aquatic ECPCs for evaluation in the Site 14 ERA.

Of the inorganic analytes detected in unfiltered samples, chromium, nickel, thallium, and zinc were not detected in filtered groundwater from Site 14; it is possible that these analytes may not be available to biota. All the analytes detected in filtered samples were also detected in the unfiltered samples.

7.1.4 Exposure Assessment Exposure assessment is the process of estimating or measuring the amount of an ECPC to which an ecological receptor may be exposed. The following sections briefly describe how contaminant exposures were estimated or measured for wildlife, terrestrial plants, terrestrial soil invertebrates, and aquatic receptors at Site 14. The contaminant pathway model (Figure 7-1) provides a summary of the potential exposure pathways that exist at Site 14 for each group of receptors. Additional detail regarding exposure assessment is provided in Chapter 24.0 of the GIR (ABB-ES, 1996a).

7.1.4.1 **Calculation of EPCs** Maximum and average EPCs were chosen for all ECPCs in surface soil, surface water, sediment, and groundwater to evaluate exposures to receptors. Maximum EPCs represent the highest concentration of an analyte that ecological receptors could potentially encounter at the site, whereas average EPCs represent typical site concentrations. When the sample size is greater than or equal to 10, the maximum EPC is equal to the lesser of the maximum detected concentration or the 95th percent UCL calculated on the log-transformed arithmetic mean (USEPA, 1992c). When the sample size is less than 10 (which is the case for all Site 14 media), the maximum EPC is equal to the maximum detected concentration because the 95th percent UCL can not be estimated accurately. The average of all samples is used to represent the average EPC unless it exceeds the maximum EPC, in which case the maximum EPC is used for both scenarios. The average of all concentrations assigns a value of one-half of the sample quantitation limit to all samples in which the analyte is not detected. Surface water EPCs used to estimate ingestion risks to terrestrial wildlife are equal to the greater of the maximum EPC for either filtered or unfiltered inorganic analytes (i.e., the most conservative approach was used).

Maximum and average EPCs are presented in Tables 7-2 through 7-5 for surface soil, surface water, sediment, and groundwater. A tiered approach was used to efficiently evaluate exposure and risk at Site 14; if no risk was calculated from exposure to the maximum EPC, then average exposure scenarios were not evaluated.

Table 7-5
Ecological Contaminants of Potential Concern in Site 14 Groundwater[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[2]	Range of Detection Limits	Range of Detected Concentrations	Average of Detected Concentrations[3]	Region IV Chronic Water Quality Screening Values[4]	2 Times Average Background Concentration[5]	Contaminant of Ecological Concern?[6]	Average of All Concentrations[7]	Exposure Point Concentrations	
									Maximum[8]	Average[9]
Volatile Organic Compounds (μg/ℓ)										
Toluene	1/3	1 to 2	9	9	175	NA	No[11]			
Explosive Compounds (μg/ℓ)										
1,3,5-Trinitrobenzene	1/3	0.2 to 0.26	[10]1.62 (1.62, 1.61)	1.62	NA	NA	Yes	0.62	1.62	0.62
Unfiltered Inorganic Analytes (μg/ℓ)										
Aluminum	2/3	200	578 to [10]7,230 (13,100 J, 1,360 J)	3,900	[12]87	776	Yes	2,640	7,230	2,640
Barium	3/3	200	7.6 to 23 2	16.6	NA	41	No[13]			
Beryllium	2/3	5	2.1 to [10]3 4 (3.5 J, 3.2 J)	2.7	0.53	NA	Yes	2 7	3.4	2.7
Calcium	3/3	5,000	230 to 3,870	1,890	NA	380	No[14]			
Chromium	2/3	10	2.1 to [10]6.9 (11.6, 2.2)	4.5	[15]11	70	No[11,13]			
Cobalt	1/3	50	[10]14 (2.3, 50 U)	14	NA	NA	Yes	21	14	14
Iron	3/3	100	786 to 4,960	2,850	1,000	450	Yes	2,850	4,960	2,850
Magnesium	3/3	5,000	477 to 1,180	820	NA	1,288	No [13,14]			

See notes at end of table.

Table 7-5 (Continued)
Ecological Contaminants of Potential Concern in Site 14 Groundwater[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[2]	Range of Detection Limits	Range of Detected Concentrations	Average of Detected Concentrat-ions[3]	Region IV Chronic Water Quality Screening Values[4]	2 Times Average Background Concentration[5]	Contaminant of Ecological Concern?[6]	Average of All Concentrat-ions[7]	Exposure Point Concentrations	
									Maximum[8]	Average[9]
Unfiltered Inorganic Analytes (μg/ℓ) (Continued)										
Manganese	3/3	15	[10]21 (25 J, 17 J) to 84.2	51	NA	10	Yes	51.3	84 2	51.3
Nickel	1/3	40	[10]12 (3 6 J, 40 U)	12	[18]49	32	No[11,13]			
Potassium	3/3	5,000	252 to 1,510	800	NA	NA	No[14]			
Sodium	3/3	5,000	[10]6,720 (6,430 J, 7,000) to 10,500	8,500	NA	1,150	No[14]			
Thallium	1/3	10	[10]6(6 J, 10 U)	6	4	NA	Yes	5.2	5.5	5 2
Vanadium	2/3	50	2.6 to [10]9 1 (14.6, 3.6)	5.9	NA	96	No[13]			
Zinc	1/3	20	[10]35 (58.9, 20 U)	35	[16]30	48	No[13]			
Filtered Inorganic Analytes (μg/ℓ)										
Aluminum	1/1	200	[10]966 (959, 973)	966	[12]87	776	Yes	966	966	966
Barium	1/1	200	[10]13.3 (13.5, 13.1)	13.3	NA	41	No[13]			
Beryllium	1/1	5	[10]3.1 (5 U, 3.7 J)	3.1	0.53	NA	Yes	3.1	3.1	3.1
Calcium	1/1	5,000	[10]1,260 (1,180 J, 1,340 J)	1,260	NA	380	No[14]			
Cobalt	1/1	50	[10]14 (2.1 J, 50 U)	14	NA	NA	Yes	14	14	14
Iron	1/1	100	[10]1,430 (1,410 J, 1,450 J)	1,430	1,000	450	Yes	1,430	1,430	1,430
Magnesium	1/1	5,000	[10]519 (515, 523)	519	NA	1,228	No[14]			
Manganese	1/1	15	[10]15.2 (15.4, 14.9)	15.2	NA	10	Yes	15 2	15.2	15.2
Potassium	1/1	5,000	[10]591 (632, 550)	591	NA	NA	No[14]			
Sodium	1/1	5,000	[10]6,700 (6,730 J, 6,660 J)	6,700	NA	1,150	No[14]			
Vanadium	1/1	50	[10]3 (2 6, 3)	3	NA	96	No[13]	2.8	2.8	2.8

See notes at end of table.

Table 7-5 (Continued)
Ecological Contaminants of Potential Concern in Site 14 Groundwater[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[2]	Range of Detection Limits	Range of Detected Concentrations	Average of Detected Concentrations[3]	Region IV Chronic Water Quality Screening Values[4]	2 Times Average Background Concentration[5]	Contaminant of Ecological Concern?[6]	Average of All Concentrations[7]	Exposure Point Concentrations	
									Maximum[8]	Average[9]
General Chemistry (mg/ℓ)										
Total Organic Carbon	1/1	8	1	8	NA	NA	NA	NA	NA	NA

[1] Sample locations include CF14MW1S, CF14MW2S, and CF14MW3S A duplicate sample was collected at CF14MW3S A filtered sample and its duplicate were collected at CF14MW3S.
[2] Frequency of detection is equal to the number of samples in which the analyte is detected in relation to the total number of samples analyzed.
[3] Arithmetic mean of all samples in which analyte was detected.
[4] U.S. Environmental Protection Agency (USEPA) Region IV Waste Management Division Chronic Freshwater Quality Screening Values based on the Water Quality Standards Units Screening List (USEPA, 1995a).
[5] Background sample locations include. CFBKMW1S, 2S, 4S, 4SD, 5S, 7S, and 8S. Two times the arithmetic mean of inorganic background concentrations were used to screen Exposure Point Concentrations (ECPCs).
[6] Contaminant of Potential Concern for aquatic receptors.
[7] The average of all concentrations assigns a value of 1/2 the sample quantitation limit to all nondetects.
[8] Maximum Exposure Point Concentrations (EPCs) are equal to the maximum detected concentration. The 95th percent upper confidence limit was not calculated because there are fewer than 10 samples in the data set.
[9] Average EPCs are equal to the arithmetic mean of all concentrations. If the arithmetic mean of all concentrations is greater than the maximum EPC, then the maximum EPC was used instead.
[10] This value was obtained after averaging a duplicate pair.
[11] Maximum analyte concentration is below the USEPA Region IV chronic surface water screening value
[12] Criterion is based on a pH of 6.5 to 9 (USEPA, 1988a).
[13] Maximum detected concentration less than background value. Unfiltered background groundwater concentrations were used to screen ECPCs for both filtered and unfiltered metals.
[14] Analyte is an essential nutrient, and is not considered toxic except at high concentrations.
[15] Screening value for hexavalent species of chromium.
[16] Hardness-dependent criterion based on an estimated hardness concentration of 25 mg calcium carbonate ($CaCO_3$) as recommended by USEPA (57 FR 60848, 1992) (a site-specific hardness value of 8 mg/ℓ $CaCO_3$ was calculated using mean calcium and magnesium concentrations [Greenberg et al , 1992])

Notes: μg/ℓ = micrograms per liter.
NA = not available.
J = estimated value.
U = Qualifier for nondetected values. Concentration value provided is the detection limit for that sample.
mg/ℓ = milligrams per liter

7.1.4.2 **Terrestrial Wildlife** Exposure routes for wildlife receptors include direct or indirect ingestion of soil, surface water, sediment, and ingestion of contaminated food. The actual amount of an ECPC taken in by wildlife species depends on a number of factors that can be obtained from the literature to estimate a potential dietary exposure (PDE). In calculating the PDE, wildlife species considered representative of the trophic guilds at the site are identified, quantitative exposure parameters are developed, and bioaccumulation through the food chain is considered.

Representative wildlife species were selected for evaluation in food-chain models that estimate contaminant exposures to wildlife species respective to their position in the food chain. Contaminant exposures for terrestrial wildlife are related to the foraging characteristics of the species; therefore, terrestrial receptors were chosen to represent the trophic levels typically found in southeastern flatwoods and disturbed upland communities. Below is a listing of the representative wildlife species (summarized in Table 7-6) selected for evaluating surface soil and food-chain exposures at Site 14.

- **Short-tailed shrew** (*Blarina brevicauda*). The short-tailed shrew finds suitable habitat in forests, fields, marshes, and brush. It primarily feeds on earthworms, snails, centipedes, insects, small vertebrates, and slugs (DeGraaf and Rudis, 1986). Relative to other small mammals, insectivorous species may receive high doses of contamination as a result of their voracious appetite relative to their small body size and the ability of their prey items to accumulate constituents. The shrew represents small mammal omnivores found in all portions of Site 14.

- **Rufous-sided towhee** (*Pipilo erythrophthalmus*). The towhee inhabits dense brushy cover in woodland edges and is an omnivorous bird that forages in the leaf litter of the forest floor for insects, seeds, and fruits (DeGraaf and Rudis, 1986). The home range of the towhee is 1.5 acres. The towhee represents avian omnivores found in forested areas at Site 14.

- **American woodcock** (*Scolopax minor*). The woodcock is a vermivorous (i.e., feeding primarily on earthworms) bird that inhabits areas of fertile, moist soil. These areas include open pastures, cultivated fields, and stream banks (DeGraaf and Rudis, 1986). The woodcock represents avian receptors found in all areas of Site 14.

- **Red fox** (*Vulpes vulpes*). This omnivorous mammal prefers open woodlands and grassy fields, and is most active at dawn, dusk, and night. It is an opportunistic forager, feeding on small mammals, birds, amphibians, reptiles, and invertebrates, as well as berries and other fruits (Burt and Grossenheider, 1976). The home range for the red fox is approximately 1,700 acres. The red fox represents predatory mammals at Site 14.

- **Great horned owl** (*Bubo virginianus*). The great horned owl is primarily a nocturnal hunter of small mammals. Its habitat includes low, wet, deep woods and heavily wooded swamps often near open country where it may hunt for its primary prey items consisting of small mammals and birds (DeGraaf and Rudis, 1986). The home range of the owl is 15

Table 7-6
Ecological Receptors Evaluated at OU 5

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station, Cecil Field
Jacksonville, Florida

Method of Evaluation	Receptor Evaluated		Media					
	Common Name	Scientific Name	Surface Soil		Surface Water and Sediment		Groundwater	
			14	15	14	15	14	15
Food-web Modeling	Short-tailed shrew	*Blarina brevicauda*	✓	✓	✓			
	Florida water rat	*Neofiber alleni*				✓		
	Rufous-sided towhee	*Pipilo erythrophthalmus*	✓	✓	✓			
	American woodcock	*Scolopax minor*	✓	✓				
	Red fox	*Vulpes vulpes*	✓	✓	✓			
	Raccoon	*Procyon lotor*				✓		
	Great horned owl	*Bubo virginianus*	✓	✓	✓			
	Great blue heron	*Ardea herodias*				✓[1]		
Benchmark Comparison	Terrestrial plants		✓	✓			✓	
	Soil invertebrates		✓	✓				
	Aquatic plants				✓	✓	✓	✓
	Benthic invertebrates				✓	✓	✓	✓
	Amphibians				✓	✓	✓	✓
	Fish				✓	✓	✓	✓
Toxicity Testing	Earthworm	*Eisenia foetida*		✓				
	Lettuce seed	*Lactuca sativa*		✓				

[1] Although the aquatic habitat at Site 15 is not suitable for the great blue heron, this receptor was chosen to evaluate omnivorous wading bird food-chain exposures to surface water and sediment ecological contaminants of potential concern.

Note. OU = Operable Unit

acres. The owl represents predatory avian carnivores at Site 14 that may be exposed to contamination via accumulation in mammalian and avian tissue.

Wildlife receptors exposed to surface water and sediment at Site 14 were chosen to represent the trophic levels typically found in southeastern wet meadow, scrub-shrub marsh, and ditch habitats. The following representative wildlife species (summarized in Table 7-6) were selected for evaluating surface water, sediment, and food-chain exposures for the Site 14 ERA: short-tailed shrew, rufous-sided towhee, red fox, and great horned owl.

Parameters for quantitatively evaluating exposures to wildlife include body weights, food ingestion rates, and relative consumption of food items. Exposure assumptions for each of the representative wildlife species for Site 14 are provided in Table 7-7. In addition to these parameters, the species foraging habits are considered.

The Site Foraging Frequency (SFF) considers the frequency a receptor feeds within the site area by estimating the acreage of the site relative to the receptor's home range, and by considering the fraction of the year the receptor would be exposed to site-related chemicals. By definition, the SFF cannot exceed 1. The area of Site 14 (calculated to be approximately 22 acres) is larger than the home range for the short-tailed shrew, rufous-sided towhee, and the great horned owl. Since all representative wildlife species are expected to actively forage at the site year round, it is assumed that the SFF for these receptors is 1.

Wildlife species may be exposed to ECPCs in surface soil, surface water, and sediment by incidental ingestion of these media or by ingesting prey items that have bioaccumulated these ECPCs. To estimate this exposure, the PDE (or body dose) is estimated for all representative wildlife species for each ECPC in all media according to the equations in Table 24-2 (GIR) and the methodologies described in Chapter 24.0 of the GIR (ABB-ES, 1996a).

To estimate the PDE, tissue concentrations of ECPCs in prey items were estimated using bioaccumulation factors (BAFs) for surface soil and sediment, or bioconcentration factors (BCFs) for surface water. BAFs and BCFs for most receptors were extrapolated from literature values or estimated using regression equations from scientific literature. Based on the lack of scientific data for VOC bioaccumulation and evidence provided in several reference materials (Suter, 1993; Maughan, 1993), an assumption was made that VOCs do not bioaccumulate in prey tissue. The general approach used to select BAFs for plants, invertebrates, small mammals, small birds, and semiaquatic receptors is presented in Table 24-3 of the GIR (ABB-ES, 1996a).

BAFs for invertebrate and plant prey are defined as the ratio of the ECPC concentration in plant or invertebrate tissue (mg contaminant/kg tissue wet weight) to the ECPC concentration in surface soil (mg contaminant/kg dry weight soil). BAFs reported in the scientific literature for avian and mammalian receptors are defined as the reported ratios of ECPC concentrations in the tissues of these receptors (mg contaminant/kg tissue wet weight) to the concentrations of ECPCs in their food items (mg contaminant/kg tissue wet weight). BAFs for each of the ECPCs evaluated at Site 14 are included in

Table 7-7
Exposure Parameters for OU 5 Representative Wildlife Species

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Representative Wildlife Species	Body Weight (kg)	Reported Diet	Assumed Diet for Terrestrial Exposure Assessment (% of diet)	Assumed Diet for Aquatic Exposure Assessment (% of diet)	Food Ingestion Rate (kg/day)	Water Intake Rate (ℓ/day)	Home Range (acres)
Short-tailed shrew *Blarina brevicauda*)	0.017 [a]	Earthworms, slugs and snails, fungi, insects, and vegetation [b]	78% Invertebrates 12% Plants 10% Soil [b]	78% Invertebrates 12% Plants 5% Sediment [c]	0.0024 [d]	0.0039 [e]	0.96 ± 0.09 [b]
Florida water rat (*Neofiber alleni*)	0.33 [f]	Primarily aquatic plants and some crayfish [b,g]	NA	90% Aquatic plants 8% Aquatic organisms 2% Sediment[b]	0.027 [d]	0.037 [e]	0.42 [g]
Rufous-sided towhee (*Pipilo erythrophthalmus*)	0.039 [h]	30% animals (moths, ants, caterpillars, beetles, bugs, spiders, snails), 70% vegetation (seeds of weeds, grasses, and berries) [h,i]	65% Plants 30% Invertebrates 5% Soil [b]	65% Plants 30% Invertebrates 3% Sediment [c]	0.0071 [j]	0.0067 [k]	1 5 [l]
American woodcock (*Scolopax minor*)	0.197 [l]	Primarily earthworms and insects with some plants [b]	80% Invertebrates 10% Plants 10% Soil [b]	NA	0.02 [j]	0 019 [k]	80.1 ± 68.2 [b]
Red fox (*Vulpes vulpes*)	4.69 [m]	Small mammals, birds, and invertebrates, as well as berries and other fruits [b]	57% Small mammals 20% Invertebrates 10% Small birds 10% Plants 3% Soil [b]	57% Small mammals 20% Invertebrates 10% Small birds 10% Plants 2% Sediment [c]	0 24 [d]	0.40 [e]	1,727 ± 339 [b]
Raccoon (*Procyon lotor*)	3.99 [n]	Mostly fleshy fruits, nuts acorns, corn; also frogs, crayfish, and insects [b]	NA	93% Aquatic organisms 7% Sediment [c]	0.214 [d]	0.344 [e]	385 [o]
Great blue heron (*Ardea herodias*)	2.23 ± 0 76 [b]	Mostly fish; some amphibians, crustaceans, and birds [b]	NA	98% Aquatic organisms 2% Sediment [c]	0.401	0 101 [k]	1.5 [p]

See notes at end of table.

Table 7-7 (Continued)
Exposure Parameters for OU 5 Representative Wildlife Species

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Representative Wildlife Species	Body Weight (kg)	Reported Diet	Assumed Diet for Terrestrial Exposure Assessment (% of diet)	Assumed Diet for Aquatic Exposure Assessment (% of diet)	Food Ingestion Rate (kg/day)	Water Intake Rate (ℓ/day)	Home Range (acres)
Great horned owl (*Bubo virginianus*)	1.59 [b]	Mostly rabbits; also mice, rats, chipmunks, weasels, squirrels, skunks, birds, bats, snakes, frogs, crayfish, perch, grass-hoppers [q]	80% Small mammals 19% Small birds 1% Soil [c]	80% Small mammals 19% Small birds	0 079 [j]	0 080 [k]	15 [r]

References:
[a] Mean of means reported for male and female shrews in summer and fall (USEPA, 1993b).
[b] *Wildlife Exposure Factors Handbook* (USEPA, 1993b)
[c] Sediment ingestion assumed to be roughly 50% of soil ingestion, except for the raccoon.
[d] Calculated using the mammal equation based on body weight (Wt.) in kg. Food ingestion (kg/day) = $0.0687 \times Wt^{0.822}$ (kg) (USEPA, 1993b).
[e] Calculated using the mammal equation based on body weight (Wt.) in kg. Water ingestion (ℓ/day) = $0.099 \times Wt^{0.90}$ (kg) (USEPA, 1993b).
[f] Burt and Grossenheider (1980)
[g] Values for the muskrat used for the Florida water rat (USEPA, 1993b)
[h] Terres (1980).
[i] DeGraaf & Rudis (1986). Rufous-sided towhee home range taken from savanna sparrow average (similar species).
[j] Calculated using the bird equation based on body weight (Wt.) in kg. Food ingestion (kg/day) = $0.0582 \times Wt^{0.651}$ (kg) (USEPA, 1993b)
[k] Calculated using the bird equation based on body weight (Wt.) in kg. Water ingestion (ℓ/day) = $0.059 \times Wt^{0.67}$ (kg) (USEPA, 1993b).
[l] Median of mean weights reported for adult male and female american woodcocks (USEPA, 1993b).
[m] Average of adult male and female foxes in spring (USEPA, 1993b).
[n] Median of mean weights for male and female raccoons in Alabama (USEPA, 1993b).
[o] Average of adult male and female raccoons from May to December (USEPA, 1993b).
[p] Size of heron feeding territory in summer (USEPA, 1993b).
[q] Terres (1991).
[r] Great horned owl home range taken from low end of range in southeast Madison County, New York (Hager, 1957).

Notes: OU = Operable Unit.
kg = kilograms
% = percent.
kg/day = kilograms per day.
ℓ/day = liters per day.
± = plus or minus.
NA = not applicable.

Appendix A, Table A-8. Invertebrate BAFs for inorganics were calculated based on tissue concentrations of worms exposed to Site 15 surface soil (presented in Appendix A, Table A-9).

Bioaccumulation of hydrophobic organics from sediment to biota were estimated based on BAFs found in the literature, which are the reported ratio of the ECPC in an aquatic invertebrate to the concentration in sediment. Sediment BAFs have been identified for 4,4'-DDT and daughter products, and are presented in Appendix A, Table A-8. BCFs for surface water were calculated primarily using literature values derived from the USEPA Aquatic Information Retrieval (AQUIRE) System database (presented in Appendix A, Table A-10), or by using a regression provided in Barnthouse et al. (1988). Many of the ECPCs detected in surface water have BCFs less than 300 (Appendix A, Table A-8). An assumption was made that bioconcentration of these analytes from surface water to biota is generally insignificant (USEPA, 1989a).

Although indirect exposures to wildlife from groundwater ECPCs exist, this exposure pathway is not a significant route of exposure (compared to dietary exposure) and is unlikely to result in risk. Consequently, risks to wildlife from exposure to groundwater ECPCs were not evaluated at Site 14.

The PDEs calculated from exposure to Site 14 surface soil, surface water, and sediment ECPCs for each receptor and the exposure assumptions used in calculating the PDEs are presented in Appendix B, Tables B.14-22 through B.14-24.

7.1.4.3 **Terrestrial Plants and Invertebrates** Terrestrial plants and soil invertebrates may be exposed to ECPCs via direct contact with and root uptake (plants) or ingestion (invertebrates) of ECPCs measured in Site 14 surface soil. For the purposes of the OU 5 ERA, exposures to terrestrial plants and invertebrates are assumed to occur within the top 1 foot interval of surface soil. Wetland plants may also be exposed to groundwater in areas where groundwater is within 1 foot of the ground surface.

7.1.4.4 **Aquatic Receptors** Aquatic organisms may be exposed to ECPCs via direct contact with surface water, sediment, and groundwater from the shallow surficial aquifer. The aquatic organisms most likely to experience adverse effects from exposure to groundwater ECPCs are benthic species (i.e., those species in close contact with sediment as groundwater discharges to surface water). Aquatic organism exposures to the full concentrations of analytes in groundwater are considered in the Site 14 ERA; however, this exposure assumption may be overly conservative because concentrations of analytes may attenuate before the groundwater discharges to a surface water body.

<u>7.1.5 Ecological Effects Assessment</u> The assessment endpoints of the ERA are presented in Paragraph 7.1.2.4 for receptor groups most likely at risk at Site 14. The measurement endpoints used to gauge the success of the assessment endpoints, and the methods used for identifying and characterizing ecological effects for ECPCs in surface soil, surface water, sediment, and groundwater are described in the following sections, and in greater detail in Chapter 24.0 of the GIR (ABB-ES, 1996a).

7.1.5.1 **Surface Soil** Wildlife receptors, terrestrial plants, and terrestrial invertebrates are potentially exposed to ECPCs detected in surface soil at

Site 14. The measures of adverse ecological effects for these receptors are discussed separately.

Terrestrial Wildlife. Because no long-term wildlife population data are available at NAS Cecil Field, a direct measurement of the survival and maintenance of wildlife populations at Site 14 is not possible. The literature-derived results of laboratory toxicity studies that relate the dose of a contaminant in an oral exposure with an adverse response to growth, reproduction, or survival of a test population (avian or mammalian species) were used in food-web models as a measure of the assessment endpoint. Wildlife ingestion toxicity data are presented in Appendix A, Table A-11.

For each ECPC identified and each representative wildlife species selected, two reference toxicity values (RTVs) are identified. A lethal RTV represents the threshold for lethal effects and is based on the lethal oral dose to 50 percent of a population (LD_{50}) (oral dose [in mg/kg body weight-day] lethal to 50 percent of a test population). The lethal RTV is equal to one-fifth of the lowest reported LD_{50} (i.e., RTV=0.2 LD_{50}) for the most closely related test species; this is considered to be protective against lethal effects for 99.9 percent of individuals in a test population (USEPA, 1986). A sublethal RTV is selected to represent a threshold body weight-normalized dose for adverse effects related to reproduction or growth. A summary of RTVs selected from the ingestion toxicity data are provided in Appendix A, Table A-12. More detail regarding how these RTVs are derived and what they represent is provided in Chapter 24.0 of the GIR (ABB-ES, 1996a).

If neither lethal nor sublethal toxicity information were available for an ECPC for a taxonomic group, no RTVs were identified and risks associated with the predicted exposure for the respective ECPC were not quantitatively evaluated. However, the absence of specific data for a taxonomic group does not imply that there is no anticipated toxicological effect associated with contaminant exposure by these receptors; therefore, potential risks to these taxonomic groups are qualitatively discussed in Subsection 7.1.7, Uncertainty Analysis.

Terrestrial Plants and Invertebrates. Site-specific toxicity data for plants and invertebrates are not available for Site 14; therefore, the results of toxicity studies from the literature that relate the soil or groundwater concentrations of a contaminant with an adverse growth, reproduction, or survival effect on a test population are used as a measure of the assessment endpoint. These study results are summarized in Appendix A, Tables A-13 (plants) and A-14 (invertebrates).

7.1.5.2 **Surface Water and Sediment** Wildlife receptors and aquatic organisms are potentially exposed to ECPCs detected in surface water and sediment at Site 14. The measures of adverse ecological effects for these receptors are discussed separately.

Wildlife Receptors. Lethal and sublethal RTVs were identified for each ECPC for each representative wildlife species, as previously described in Paragraph 7.1.5.1.

Aquatic Receptors. Risks to aquatic receptors exposed to surface water and sediment were evaluated by comparing benchmarks to exposure concentrations. Surface water RTVs selected for comparison to surface water exposure concentra-

tions include State of Florida Surface Water Quality Standards (Florida Administrative Code 62-302; Florida Legislature, 1995), Federal Ambient Water Quality Criteria (AWQC) (USEPA, 1991e; USEPA, 1988b), and USEPA Region IV Water Quality Criteria (USEPA, 1995b). Additional aquatic toxicity information for surface water ECPCs was obtained from searches of the USEPA AQUIRE database (USEPA, 1996e). Data obtained from the AQUIRE database are included in Appendix A, Table A-15.

Sediment benchmarks selected for comparison to detected sediment concentrations included National Oceanic and Atmospheric Administration (NOAA) Effects Range-Low (ER-L) and Effects Range-Median (ER-M) sediment guidelines (Long et al., 1994), USEPA Sediment Quality Guidelines based on equilibrium partitioning (USEPA, 1988c; USEPA, 1993c), Ontario Ministry of the Environment (OME) Lowest Effect Level (LEL) provincial sediment quality guidelines (Persaud et al., 1996) and State of Florida Sediment Quality Assessment Guidelines (FDEP, 1994).

7.1.5.3 **Groundwater** Aquatic organisms and terrestrial plants are potentially exposed to groundwater as it discharges to the surface at Site 14. The measures of adverse ecological effects for aquatic organisms and terrestrial plants are discussed separately.

Terrestrial Plants. The results of toxicity studies from the literature that relate the concentrations of a contaminant in solution with adverse plant growth, reproduction, or survival effects of a test population were used as a measure of the terrestrial plant assessment endpoint. These study results are summarized in Appendix A, Table A-13.

Aquatic Receptors. The selected assessment endpoint for aquatic receptors at Site 14 is the survival and maintenance of amphibian, invertebrate, and aquatic plant populations. Adverse effects to aquatic populations from exposure to groundwater ECPCs were estimated by comparing exposure concentrations with the surface water benchmarks mentioned in Paragraph 7.1.5.2.

7.1.6 Risk Characterization Using the assessment process described in Subsection 7.1.5, risks were characterized for ecological receptors exposed to contaminated surface soil, surface water, sediment, and groundwater at Site 14.

7.1.6.1 **Surface Soil** Potential risks associated with exposures to ECPCs in surface soil at Site 14 are discussed separately for wildlife, terrestrial plants, and soil invertebrates. Risks to wildlife are characterized by comparing PDE concentrations for each surface soil ECPC with a respective RTV (estimated threshold dose for toxicity). Risks for terrestrial plants and soil invertebrates are evaluated by comparing toxicity benchmarks to exposure concentrations.

Terrestrial Wildlife. Risks for the representative wildlife species associated with ingestion and bioaccumulation of ECPCs in surface soil and prey items are quantitatively evaluated using HQs, which are calculated for each ECPC by dividing the PDE concentration by the selected lethal and sublethal RTV. HIs are determined for each receptor by summing the HQs for all ECPCs. When the estimated PDE is less than the RTV (i.e., the HQ < 1), it is assumed that chemical exposures are not associated with adverse effects to receptors and no risks to wildlife populations exist. For instance, if the maximum PDE is less than the lethal RTV, then it is assumed that adverse effects to the survival of wildlife populations are unlikely to occur. Similarly, if the maximum PDE is

less than the sublethal RTV, then it is assumed that adverse effects to wildlife populations related to growth and reproduction are unlikely to occur. When an HI is greater than 1, a discussion of the ecological significance of the HQs comprising the HI is completed and risks from exposure to average concentrations of ECPCs are evaluated.

This hazard ranking scheme evaluates potential ecological effects to individual organisms and does not evaluate potential population-wide effects. Contaminants may cause population reductions by affecting birth and mortality rates, immigration, and emigration (USEPA, 1989a). In many circumstances, lethal or sublethal effects may occur to individual organisms with little population or community level impacts; however, as the number of individual organisms experiencing toxic effects increases, the probability that population effects will occur also increases. The number of affected individuals in a population presumably increases with increasing HQ or HI values; therefore, the likelihood of population level effects occurring is generally expected to increase with higher HQ or HI values.

The lethal and sublethal HQs and HIs calculated based on maximum EPCs for each representative wildlife species are provided in Appendix B, Table B14.25; a summary of risks to representative wildlife receptors is provided in Table 7-8 for maximum and average EPCs. Lethal and sublethal summary HIs for the rufous-sided towhee, american woodcock, red fox, and the great horned owl exposed to maximum surface soil ECPCs were less than 1. The lethal and sublethal effects HIs for the short-tailed shrew were 1.4 and 1.2, respectively, based on maximum EPCs. Vanadium was a primary contributor, contributing HQs of 0.86 and 0.61 to the lethal and sublethal HIs, respectively. In addition, aluminum contributed a sublethal HQ of 0.51 under maximum EPC.

These results are based on effects to individual organisms. With respect to the assessment endpoint selected (i.e., substantial reduction in small mammal and bird subpopulations from reproductive impairment due to phthalate esters, aluminum, and copper) none of the contaminants identified were primary risk contributors because the HQs for these analytes were all below 1. Therefore, population effects appear to be negligible.

Terrestrial Plants. Risks for terrestrial plants were evaluated by comparing the selected phytotoxicity benchmarks to maximum and average exposure concentrations. The results of this evaluation for Site 14 surface soil are presented in Table 7-9. Maximum concentrations of aluminum, chromium, and vanadium exceed their respective plant RTVs (Table 7-9); in addition, the maximum concentration of copper also exceeds its phytotoxicity benchmark. Phytotoxicity benchmarks are not available for TRPH.

The phytotoxicity benchmarks used for aluminum, chromium, copper, and vanadium were obtained from Will and Suter (1994) and were derived to represent the 10th percentile of the Lowest Observed Effects Concentrations (LOECs) for growth and yield endpoints. Since the number of aluminum, chromium, copper, and vanadium studies included in the authors' review was less than 10 (n=1, n=7, n=3, and n=2, respectively), the phytotoxicity benchmarks are equal to the lowest LOEC, and a confidence level of "low" was assigned by Will and Suter to these benchmarks. Furthermore, some of the plants used in the laboratory studies for chromium are particularly sensitive species (e.g., lettuce, tomato, oats, soybean), therefore, risks to wild plants may be overestimated. Will and Suter (1994) suggest that

Table 7-8
Results of Food-Web Modeling for Site 14 Surface Soil, Sediment, and Surface Water and Terrestrial Wildlife Risk Summary[1]

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Media Evaluated / Ecological Receptor	Lethal Effects from Exposure to Maximum EPCs	Sublethal Effects from Exposure to Maximum EPCs	Lethal Effects from Exposure to Average EPCs	Sublethal Effects from Exposure to Average EPCs	Primary Risk Contributors
Surface Soil					
Short-tailed shrew	1 4	1.2	0.52	0 38	Vanadium
Rufous-sided towhee	0.14	0.23	NE	NE	NA
American woodcock	0.058	0.095	NE	NE	NA
Red fox	0 0023	0.002	NE	NE	NA
Great horned owl	0.011	0.017	NE	NE	NA
Sediment and Surface Water					
Short-tailed shrew	0.043	0.031	NE	NE	NA
Rufous-sided towhee	0.00037	0.00018	NE	NE	NA
Red fox	0 0000026	0.0000019	NE	NE	NA
Great horned owl	0.0000059	0.00000084	NE	NE	NA

[1] Summary of Tables B.14-25 through B.14-27 in Appendix B; values shown are hazard indices. An index less than 1 is interpreted to be an acceptable risk.

Notes: EPC = exposure point concentrations.
NE = not evaluated.
NA = not applicable.

Table 7-9
Site 14 Surface Soil Terrestrial Plant and Invertebrate Risk Summary

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Analyte	Exposure Point Concentrations[1]		RTV		RTV Exceeded?[3] (by Maximum/by Average)	
	Maximum	Average	Plant[2]	Invertebrate[2]	Plant	Invertebrate
Semivolatile Organic Compounds (mg/kg)						
Butylbenzylphthalate	1.7	0.42	200	478	No/No	No/No
Di-*n*-butylphthalate	9.0	6.0	200	478	No/No	No/No
bis(2-Ethylhexyl)phthalate	1.3	0.33	>1,000	478	No/No	No/No
Pesticides and PCBs (mg/kg)						
Endosulfan II	0.0006	0.0006	[4]>1,000	[4]1	No/No	No/No
Inorganic Analytes (mg/kg)						
Aluminum	8,510	2,770	50	NA	Yes/Yes	NA
Chromium	7 9	2.8	1	50	Yes/Yes	No/No
Copper	163	26	100	30	Yes/No	Yes/No
Nickel	1.3	1 3	30	400	No/No	No/No
Vanadium	9.1	2.8	2	NA	Yes/Yes	NA
General Chemistry (mg/kg)						
Total recoverable petroleum hydrocarbons	93	44	NA	NA	NA	NA

[1] Exposure Point Concentrations (EPCs) are presented in Table 7-2. The maximum EPCs are equal to the maximum detected concentration. Average EPCs are equal to the mean of concentrations. When the mean is greater than the maximum exposure point concentration, the maximum exposure concentration was used.
[2] Plant and invertebrate RTVs are presented in Appendix A, Tables A-13 and 14 (respectively). Generally, the plant RTVs are the lowest observed effect concentration from among plant growth studies on plants in solid media, and invertebrate RTVs are the lowest lethal concentration to 50 percent of test population (14-day soil test on *Eisenia foetida*) from among chemicals in the same chemical class (applies to organic compounds). A conservative factor of 0 2 was applied to invertebrate RTVs; the resultant value should be protective of 99.9 percent of the population from lethal effects (U.S. Environmental Protection Agency, 1986)
[3] Comparison shown is maximum EPC to RTV/average EPC to RTV.
[4] Values for Endosulfan I were used as surrogates.

Notes: RTV = reference toxicity value.
mg/kg = milligrams per kilogram.
> = greater than.
PCB = polychlorinated biphenyl.
NA = not applicable.
= shading indicates exceedances.

the derived benchmarks are conservative means for estimating population- or community-level impacts.

Both the maximum and background concentrations of aluminum, chromium, and vanadium in Site 14 surface soil exceed their phytotoxicity benchmarks. However, no observations of stressed vegetation were evident at Site 14 during the September, 1995 habitat characterization. It is possible that concentrations of these analytes in Site 14 surface soil are not related to waste activities at the site, and that terrestrial plants may not be at risk.

These results suggest that individual plants could potentially suffer adverse growth and reproductive effects from exposure to maximum concentrations of aluminum, chromium, copper, and vanadium in soil at Site 14. However, maximum concentrations of chromium and vanadium only slightly exceed their phytotoxicity benchmarks. In addition, the conservative nature employed in selecting phytotoxicity benchmarks combined with the relative amount of aluminum, chromium, and vanadium detected at background levels suggest that plant populations in the area of the Site 14 surface soil sampling stations are not likely to be adversely impacted from exposure to average site concentrations. Risks to individual plants may only be a concern at CF14SS3 (located within 150 feet of the bunker) where maximum concentrations of aluminum and copper were detected; however, population-level significance (i.e., assessment endpoint selected for this receptor class) of the benchmark exceedances are likely to be inconsequential.

Terrestrial Invertebrates. Risks for terrestrial invertebrates were evaluated by comparing invertebrate toxicity benchmarks to maximum and average exposure concentrations. The results of this evaluation for Site 14 surface soil are presented in Table 7-9. The maximum concentration of copper exceeded its benchmark by less than a factor of 6, suggesting that invertebrates may be at risk from exposure to copper. Invertebrate benchmark values are not available for aluminum, vanadium, or TRPH. Risks to individual invertebrates are only a concern at CF14SS3, where the maximum concentration of copper was detected and the only benchmark exceedance occurred. This would indicate that population-level significance based on the benchmark exceedance is likely to be inconsequential, due to the limited areal extent of risks.

7.1.6.2 **Surface Water and Sediment** Potential risks associated with the ECPCs in Site 14 surface water and sediment are characterized separately for wildlife and aquatic receptors.

Wildlife Receptors. Risks for the representative wildlife species associated with ingestion of surface water, potentially contaminated aquatic life, and sediment are evaluated by comparing PDE concentrations from ingestion and bioaccumulation of surface water and sediment ECPCs with RTVs (estimated threshold for toxicity). Risks are quantified using the HI/HQ approach discussed in Paragraph 7.1.6.1.

The lethal and sublethal HIs and HQs calculated for each of the representative wildlife species from exposure to surface water and sediment ECPCs at Site 14 are provided in Appendix B, Table B.14-27. HIs for lethal effects to receptors ranged from 0.0000059 for the great horned owl to 0.094 for the short-tailed shrew, and HIs for sublethal effects to receptors ranged from 0.00000084 for the great horned owl to 0.031 for the short-tailed shrew. Since no lethal or sublethal adverse effects to individual wildlife from exposure to maximum

concentrations of surface water or sediment ECPCs are anticipated, no evaluation of risk from exposure to average ECPC concentrations was performed. With no risks predicted for individual species, it is highly unlikely that significant population-level effects would occur.

Aquatic Receptors. Risks for aquatic receptors from exposure to surface water and sediment at each sampling location were characterized based on a comparison of concentrations of ECPCs in these media with RTVs (toxicity benchmarks).

Surface Water Benchmark Comparison. The comparison, provided in Table 7-10, indicates that surface water concentrations of *bis*(2-ethylhexyl)phthalate, aluminum, copper, cyanide, and zinc exceed aquatic benchmark values.

Bis(2-ethylhexyl)phthalate was detected at 3 of 4 surface water sample locations at concentrations of 2 $\mu g/\ell$ (CF14SW2 and CF14SW4) and 43 $\mu g/\ell$ (CF14SW1). The single detect at CF14SW1 exceeds the lowest adverse effect concentration in the AQUIRE database (0.89 $\mu g/\ell$ for moorfrog hatchability) by almost two orders of magnitude, and the FDEP Class III fresh water standard (3.0 $\mu g/\ell$ for phthalate esters) by one order of magnitude. The maximum concentration does not exceed the proposed Federal AWQC of 160 $\mu g/\ell$. A review of the AQUIRE database for *bis*(2-ethylhexyl)phthalate (Appendix A, Table A-15) indicates that the maximum concentration exceeds adverse effects concentrations for the water flea, rainbow trout, and a species of amphibian. Trout, which are coldwater species of fish, do not inhabit the surface waters at Site 14. It is possible that some species of freshwater invertebrates and amphibians may be at risk from exposure to *bis*(2-ethylhexyl)phthalate at CF14SW1. The origin of *bis*(2-ethylhexyl)phthalate, identified by USEPA as a common laboratory contaminant, is not obvious as it would not be expected to be a significant component of ordnance disposal by demolition, the primary activity identified at the site.

Maximum exposure concentrations of aluminum for both filtered (585 $\mu g/\ell$) and unfiltered (634 $\mu g/\ell$) surface water exceed the USEPA chronic water quality criterion (87 $\mu g/\ell$) for aluminum and the lowest adverse effect concentration in the AQUIRE database (15 $\mu g/\ell$, an LC_{50} for trout). A review of the aluminum AWQC document (USEPA, 1988b) indicates that the 87 $\mu g/\ell$ criterion is based on an endpoint for larval trout, which are among the most sensitive ecological receptors with regard to aluminum exposure. However, no salmonids occur in warm surface waters at Site 14. A review of the AQUIRE data (Appendix A, Table A-15) indicates that many other species that may also be sensitive to maximum and average exposure concentrations of aluminum are also cold-water species of fish (i.e., trout and bass); other aquatic organisms that cannot tolerate high concentrations of aluminum include some species of amphibians and minnows. Most other aquatic receptors can tolerate concentrations of aluminum ranging from 150 to 1,000,000 $\mu g/\ell$. The origin of aluminum found in surface water is not obvious. While it may be present as a component of ordnance, it is frequently found at other NAS Cecil Field sites above the chronic AWQC and may be a result of naturally occurring sources.

Copper was detected at a maximum concentration of 10.2 $\mu g/\ell$ in unfiltered surface water and 9.6 $\mu g/\ell$ in filtered surface water; these concentrations exceed the available guidelines and criteria (4 $\mu g/\ell$) by factors of approximately 2.5. In addition, the detected concentration exceeds the lowest adverse effect concentration in the AQUIRE database (1.5 $\mu g/\ell$ for water flea reproduction). A review of the AQUIRE database (Appendix A, Table A-15) reveals that the majority

Table 7-10
Site 14 Surface Water ECPC Toxicity Benchmark Comparison[1]

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Analyte	Exposure Point Concentrations		FDEP Class III Fresh Water Quality Standards[2] (µg/ℓ)	AWQC[3] (µg/ℓ)	USEPA Region IV Water Quality Criteria (µg/ℓ)[4]	AQUIRE Lowest Reported Adverse Effect Concentration[5] (µg/ℓ)/Test Species	Result
	Maximum	Average					
Volatile Organic Compounds (µg/ℓ)							
Acetone	5	2	NA	NA	NA	550,000/water flea mortality	Not Exceeded
Semivolatile Organic Compounds (µg/ℓ)							
bis(2-Ethylhexyl)phthalate	43	13	3.0	[6]160	NA	0.89/moorfrog hatchability	Exceeded
Pesticides and PCBs (µg/ℓ)							
Endrin	0.0063	0.0063	[7]0.045	[7]0 045	[7]0.045	0.007/shrimp reproduction	Not Exceeded
Unfiltered Inorganic Analytes (µg/ℓ)							
Aluminum	634	434	NA	[8]87	[8]87	15/trout LC_{50}	Exceeded
Barium	12.9	9.7	NA	NA	NA	8,900/water flea reproduction	Not Exceeded
Beryllium	2	2	[9]0.13	[10]5.3	NA	10/guppy mortality	Not Exceeded
Copper	10.2	9.1	[11]4	[11]4	[11]4	1.5/water flea reproduction	Exceeded
Manganese	44.1	18.5	NA	NA	NA	280/phytoplankton population endpoints	Not Exceeded
Vanadium	2.5	2.5	NA	NA	NA	128/guppy LC_{50}	Not Exceeded
Zinc	90.3	30.1	[11]30	[11]30	[11]30	17.1/invertebrate population endpoints	Exceeded
Filtered Inorganic Analytes (µg/ℓ)							
Aluminum	585	392	NA	[8]87	[8]87	15/trout LC_{50}	Exceeded
Barium	12.5	9.7	NA	NA	NA	8,900/water flea reproduction	Not Exceeded
Copper	9 6	6.9	[11]4	[11]4	[11]4	1 5/water flea reproduction	Exceeded
Cyanide	10	10	5.2	5 2	5.2	180/bluegill LC_{50}	Exceeded

See notes at end of table

Table 7-10 (Continued)
Site 14 Surface Water ECPC Toxicity Benchmark Comparison[1]

Remedial Investigation
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Analyte	Exposure Point Concentrations		FDEP Class III Fresh Water Quality Standards[2] (μg/ℓ)	AWQC[3] (μg/ℓ)	USEPA Region IV Water Quality Criteria (μg/ℓ)[4]	AQUIRE Lowest Reported Adverse Effect Concentration[5] (μg/ℓ)/Test Species	Result
	Maximum	Average					
Filtered Inorganic Analytes (μg/ℓ) (Continued)							
Manganese	45.7	18	NA	NA	NA	280/phytoplankton population endpoints	Not Exceeded
Vanadium	2	2	NA	NA	NA	128/guppy LC_{50}	Not exceeded
Zinc	99.7	37.4	[11]30	[11]30	[11]30	17 1/invertebrate population endpoints	Exceeded

[1] Results of analyses of surface water samples included in Chapter 1.0 of the RIDD (ABB-ES, 1997). Only those analytes selected as aquatic ECPCs in Table 7-3 are presented
[2] Florida Department of Environmental Protection (FDEP), Chapter 62-302, Surface Water Quality Standards (Florida Legislature, 1995)
[3] Chronic Federal Ambient Water Quality Criteria (USEPA, 1991e and 1988b).
[4] USEPA Region IV Water Quality Criteria (USEPA, 1995b)
[5] From Appendix A, Table A-15 Only growth, mortality, and reproductive effects to plants, invertebrates, amphibians, and fish were considered.
[6] Proposed criterion.
[7] Value presented in Florida Legislature (1995) and USEPA (1991d, 1995b) (0.0023 μg/ℓ) is the final residue value derived to be protective of wildlife; the value shown in this risk evaluation is the final chronic value derived to be protective of aquatic life.
[8] Based on a pH of 6.5 to 9.
[9] Criterion developed to be protective of human health; was not used to evaluate toxicity to aquatic life.
[10] Insufficient data to develop criterion. Information presented is the LOEL (Lowest Observed Effects Level).
[11] Hardness dependent criterion based on an estimated hardness concentration of 25 milligrams calcium carbonate ($CaCO_3$) as recommended by USEPA (57 FR 60848, 1992) (a site-specific hardness value of 13 milligrams per liter $CaCO_3$ was calculated using mean calcium and magnesium concentrations [Greenberg et al., 1992]).

Notes. ECPC = ecological contaminant of potential concern.
FDEP = Florida Department of Environmental Protection.
μg/ℓ = micrograms per liter.
AWQC = Ambient Water Quality Criteria (guidance criteria established under the Clean Water Act).
USEPA = U S Environmental Protection Agency
AQUIRE = Aquatic Information Retrieval.
NA = Not available
· = concentration exceeds the most conservative toxicity benchmark.
PCB = polychlorinated biphenyl.

of species (for which effects data exist) can tolerate higher concentrations of copper in water than were detected at Site 14. Few species (including some species of trout, minnow, algae, and water fleas) may exhibit adverse reproductive, growth, or survival effects at concentrations less than 10.2 $\mu g/\ell$. It is unlikely that concentrations of copper in Site 14 surface water would cause adverse effects to the majority of aquatic organisms at Site 14.

Cyanide was detected in one filtered sample (CF14SW3DF) at a concentration of 10 $\mu g/\ell$. Cyanide was not detected in any other medium. The single detect is less than 2 times the FDEP freshwater quality standard, the federal chronic AWQC for cyanide, and the USEPA Region IV water quality criterion (all are 5.2 $\mu g/\ell$), and is much less than the lowest adverse effects level presented in the AQUIRE database (180 $\mu g/\ell$), which represents an LC_{50} bluegill test population. A review of the cyanide AWQC document (USEPA, 1985a) indicates that the chronic criterion is based on a lowered acute value to be protective of brook trout, which are among the most sensitive ecological receptors with regard to cyanide exposure. No salmonids occur in the limited aquatic habitat provided by Site 14. Therefore, it is unlikely that cyanide in surface water is posing a risk to the site's aquatic receptors. The origin of cyanide is not clear as it is not expected to be a component of ordnance or its degradation products.

The maximum filtered and unfiltered zinc concentrations (99.7 $\mu g/\ell$ and 90.3 $\mu g/\ell$, respectively) were both detected at CF14SW2; all other detected concentrations of zinc were close in concentration to the AWQC and other standards which are based on a low water hardness of 25 mg/ℓ as calcium carbonate. The adverse effects data in AQUIRE indicate that some freshwater invertebrates (i.e., water fleas, copopods, cladocerans, and rotifers) are sensitive species to these concentrations of zinc. It is possible that zinc may cause adverse effects to freshwater invertebrates.

Based on the results of the surface water analyses, it is possible that if detected concentrations are representative, *bis*(2-ethylhexyl)phthalate at CF14SW1, aluminum, copper, and cyanide at CF14SW3, and zinc may cause adverse effects to aquatic organisms. However, as is the case with each of these analytes, the majority of the adverse effects data suggest that most aquatic organisms can tolerate higher concentrations of these contaminants. In addition, many of the analytes evaluated are not expected to be related to site disposal activities. Although some aquatic organisms (i.e., amphibians) may be at risk from exposure to these analytes in surface water, it is unlikely that the limited aquatic habitat at Site 14 would support a diverse population of aquatic receptors.

<u>Sediment Benchmark Comparison</u>. The comparison, provided in Table 7-11, indicates that *bis*(2-ethylhexyl)phthalate was the only analyte with sediment concentrations that exceed aquatic benchmark values; however, the majority of analytes detected in Site 14 sediment could not be evaluated for aquatic organism effects because few benchmarks exist. Viewing this as a potential gap in the evaluation, some other sources of sediment quality guidelines were reviewed, including the Oak Ridge National Laboratory (ORNL) benchmarks (Hull & Suter, 1994) and USEPA Region V sediment guidelines for the Great Lakes (Fitchko, 1989). This review suggests that concentrations of acetone, most phthalates, phenol, and barium are less than benchmarks (or surrogate values based on similar compounds). The maximum concentrations of diethylphthalate was approximately 4 times higher than the ORNL benchmark. No sediment toxicity data are available for 2-butanone, chlorinated

Table 7-11
Site 14 Sediment ECPC Toxicity Benchmark Comparison[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Exposure Point Concentrations		USEPA Sediment Quality Guidelines[2]	NOAA[3]		OME LEL[4]	SQAGs[5]		Result
	Maximum	Average		ER-L	ER-M		TEL	PEL	
Volatile Organic Compounds (mg/kg)									
Acetone	0.008	0.006	NA	NA	NA	NA	NA	NA	No benchmark available
2-Butanone	0.005	0.005	NA	NA	NA	NA	NA	NA	No benchmark available
Semivolatile Organic Compounds (mg/kg)									
Butylbenzylphthalate	1.3	0.47	NA	NA	NA	NA	NA	NA	No benchmark available
1,4-Dichlorobenzene	0.034	0 034	NA	NA	NA	NA	NA	NA	No benchmark available
Diethylphthalate	2.4	1.3	NA	NA	NA	NA	NA	NA	No benchmark available
Dimethylphthalate	0.13	0.13	NA	NA	NA	NA	NA	NA	No benchmark available
Di-*n*-butylphthalate	3.5	2 8	NA	NA	NA	NA	NA	NA	No benchmark available
bis(2-Ethylhexyl)phthalate	2.1	0.66	NA	NA	NA	NA	182	2,647	Exceeds
Phenol	0 054	0.054	NA	NA	NA	NA	NA	NA	No benchmark available
1,2,4-Trichlorobenzene	0 030	0.030	NA	NA	NA	NA	NA	NA	No benchmark available
Inorganic Analytes (mg/kg)							NA	NA	
Aluminum	2,560	1,170	NA	NA	NA	NA	NA	NA	No benchmark available
Barium	3.1	1.6	NA	NA	NA	NA	NA	NA	No benchmark available
Iron	444	214	NA	NA	NA	20,000	NA	NA	Not exceeded
Manganese	2.4	1.1	NA	NA	NA	460	NA	NA	Not exceeded
Vanadium	2.4	1.4	NA	NA	NA	NA	NA	NA	No benchmark available

See notes at end of table.

Table 7-11 (Continued)
Site 14 Sediment ECPC Toxicity Benchmark Comparison[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Exposure Point Concentrations		USEPA Sediment Quality Guidelines[2]	NOAA[3]		OME LEL[4]	SQAGS[5]		Result
	Maximum	Average		ER-L	ER-M		TEL	PEL	
General Chemistry (mg/kg)									
Total recoverable petroleum hydrocarbons	16	9.7	NA	NA	NA	NA	NA	NA	No benchmark available

[1] Results of analyses of sediment samples included in Chapter 1.0 of the RIDD (ABB-ES, 1997). Only those analytes selected as aquatic ECPCs in Table 7-4 are presented.
[2] USEPA, 1988c mean Sediment Quality Criteria adjusted values using 1 percent site-specific total organic carbon. All values represent Final Residue Values.
[3] NOAA Effects Range-Low (ER-L) and Effects Range-Median (ER-M) Sediment Guidelines correspond to the concentration that is protective of 90 percent of the population and 50 percent of the population, respectively (Long et al., 1994).
[4] OME LEL Provincial Sediment Quality Guidelines (Persaud et al., 1996) correspond to a concentration that can be tolerated by the majority of benthic organisms.
[5] SQAGs TEL and PEL correspond to the upper limit at the minimal effects range, and the lower limit of the probable effects range, respectively (FDEP, 1994)

Notes: ECPC = ecological contaminant of potential concern.
USEPA = U.S. Environmental Protection Agency.
NOAA = National Oceanic and Atmospheric Administration.
ER-L = effects range-low.
ER-M = effects range-median.
OME = Ontario Ministry of the Environment.
LEL = Low Effects Level.
SQAGs = State of Florida Sediment Quality Assessment Guidelines.
TEL = toxic effect level
PEL = probable effect level.
mg/kg = milligrams per kilogram.
NA = not applicable.
= concentration exceeds the most conservative toxicity benchmark.

benzenes, aluminum, vanadium, and TRPH. Most of the maximum detected concentrations of sediment ECPCs were found at CF14SD1; some of the maximum concentrations for phthalates were also found at CF14SD3. Risks to individuals are only a concern at CF14SD1, where the maximum concentration of *bis*(2-ethylhexyl)phthalate was detected and the only benchmark exceedance occurred. This would indicate that population-level significance based on a benchmark exceedance is likely to be inconsequential. It is possible that many of these analytes (i.e., acetone, 2-butanone, aluminum, barium, and vanadium) are not related to identified site activity of ordnance disposal.

7.1.6.3 **Groundwater** Potential risks associated with exposures to ECPCs in groundwater are discussed separately for terrestrial plants and aquatic receptors.

Terrestrial Plants. Risks for terrestrial plants were evaluated by comparing selected phytotoxicity benchmarks to exposure concentrations in groundwater. The results of this evaluation, (Table 7-12), indicate that concentrations of filtered and unfiltered aluminum at sample locations CF14MW2S and CF14MW3S exceed the plant RTV for aluminum. The exposure concentrations of all other analytes were less than plant RTVs, indicating that adverse effects to plants from exposure to these analytes are not likely to occur. A phytotoxicity benchmark for groundwater was not available for 1,3,5-TNB. It should be noted that no signs of stress to vegetation in the drainage ditches were observed by ABB-ES ecologists during the September 1995 habitat characterization. Furthermore, aluminum was detected in surface water at much lower concentrations, suggesting that groundwater concentrations are not adversely affecting surface water quality.

Aquatic Receptors. Risks to aquatic organisms are evaluated by comparing exposure concentrations to surface water toxicity benchmarks. The results of this evaluation (Table 7-13) indicate that filtered and unfiltered concentrations of aluminum, cobalt, and iron exceed available aquatic benchmarks. The concentrations of cobalt and iron (filtered only) only slightly exceed the most conservative benchmarks; furthermore, copper and iron were not detected in surface water at Site 14. Therefore, these analytes are not likely to be of concern for aquatic receptors.

Exposure concentrations for both filtered and unfiltered aluminum (ranging from 578 to 7,230 $\mu g/\ell$) exceed the USEPA chronic water quality criterion (87 $\mu g/\ell$) for aluminum and the lowest adverse effect concentration in the AQUIRE database (15 $\mu g/\ell$, an LC_{50} for trout). As mentioned in Paragraph 7.1.6.2, these criterion are based on an endpoint for a species of fish that do not inhabit the warmwater systems at Site 14. Although the concentrations detected in groundwater are high enough to potentially cause adverse effects to some aquatic receptors if they were exposed to the full (i.e., undiluted) concentration, these concentrations do not occur upon discharge to the surface water.

The results of the risk evaluation for aquatic organism exposures to ECPCs detected in groundwater suggest that although concentrations of several analytes exceed benchmarks, adverse effects to aquatic organisms are unlikely to occur (except possibly from exposure to aluminum). The primary factor supporting this conclusion is that the groundwater concentrations of aluminum, cobalt, and iron are not detected in surface water.

Table 7-12
Risks for Plants Exposed to Site 14 Groundwater

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Groundwater Concentrations[1]			Plant RTV[2]	Plant RTV Exceeded?[3] (by Maximum/ by Average)
	CF14MW1S	CF14MW2S	CF14MW3S/3SD		
Explosive Compounds (mg/ℓ)					
1,3,5-Trinitrobenzene	ND	ND	0.00162	NA	NA
Total Inorganic Analytes (mg/ℓ)					
Aluminum	ND	0.578	7.23	0.2	Yes/Yes
Beryllium	0.0021	ND	0.0034	0.5	No/No
Cobalt	ND	ND	0.014	0.06	No/No
Iron	0.786	4.96	2.81	10	No/No
Manganese	0.0488	0.0842	0.021	4	No/No
Thallium	ND	ND	0.0055	0.02	No/No
Filtered Inorganic Analytes (mg/ℓ)					
Aluminum	NA	NA	0.966	0.2	Yes/Yes
Beryllium	NA	NA	0.0031	0.5	No/No
Cobalt	NA	NA	0.014	0.06	No/No
Iron	NA	NA	1.43	10	No/No
Manganese	NA	NA	0.0152	4	No/No

[1] Exposure Point Concentrations (EPCs) are presented in Table 7-5. The maximum EPCs are equal to the maximum detected concentration. Average EPCs are equal to the arithmetic mean of all concentrations. When the arithmetic mean is greater than the maximum exposure point concentration, the maximum EPC was used.
[2] Plant RTVs are presented in Appendix A, Table A-13. Generally, plant RTVs are the lowest observed concentration level from plant growth studies conducted in solution.
[3] Comparison shown is maximum EPC to RTV/average EPC to RTV.

Notes. RTV = reference toxicity value.
mg/ℓ = milligrams per liter.
NA = not available or not analyzed.
ND = not detected.
= Shading indicates exceedances

Table 7-13
Site 14 Groundwater ECPC Toxicity Benchmark Comparison[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Groundwater Concentrations			FDEP Class III Fresh Water Quality Standards[2] (µg/ℓ)	AWQC[3] (µg/ℓ)	USEPA Region IV Water Quality Criteria (µg/ℓ)[4]	AQUIRE Lowest Reported Adverse Effect Concentration[5] (µg/ℓ)/ Test Species	Result
	CF14MW1S	CF14MW2S	CF14MW3S/3SD					
Explosive Compounds (µg/ℓ)								
1,3,5-Trinitrobenzene	ND	ND	1.62	NA	NA	NA	80/trout and minnow reproduction	Not Exceeded
Unfiltered Inorganic Analytes (µg/ℓ)								
Aluminum	ND	578	7,230	NA	[6]87	[6]87	15/trout LC_{50}	Exceeded
Beryllium	0.0021	ND	3.4	[7]0.13	[8]5.3	NA	10/guppy mortality	Not exceeded
Cobalt	ND	ND	14	NA	NA	NA	11/pikeperch mortality	Exceeded
Iron	0.786	4,960	2,810	1,000	1,000	1,000	460/trout hatchability	Exceeded
Manganese	0.0488	84.2	21	NA	NA	NA	280/phytoplankton population endpoints	Not exceeded
Thallium	ND	ND	5 5	[7]6.3	[8]40	NA	82/green algae growth	Not exceeded
Filtered Inorganic Analytes (µg/ℓ)								
Aluminum	NA	NA	966	NA	[6]87	[6]87	15/trout LC_{50}	Exceeded
Beryllium	NA	NA	3.1	[7]0.13	[8]5.3	NA	10/guppy mortality	Not exceeded
Cobalt	NA	NA	14	NA	NA	NA	11/pikeperch mortality	Exceeded
Iron	NA	NA	1,430	1,000	1,000	1,000	460/trout hatchability	Exceeded

See notes at end of table

Table 7-13 (Continued)
Site 14 Groundwater ECPC Toxicity Benchmark Comparison[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Groundwater Concentrations			FDEP Class III Fresh Water Quality Standards[2] (µg/ℓ)	AWQC[3] (µg/ℓ)	USEPA Region IV Water Quality Criteria (µg/ℓ)[4]	AQUIRE Lowest Reported Adverse Effect Concentration[5] (µg/ℓ)/ Test Species	Result
	CF14MW1S	CF14MW2S	CF14MW3S/3SD					
Filtered Inorganic Analytes (µg/ℓ) (continued)								
Manganese	NA	NA	15.2	NA	NA	NA	280/phytoplankton population endpoints	Not exceeded

[1] Results of analyses of groundwater samples included in Chapter 1.0 of the RIDD (ABB-ES, 1997) Exposure point concentrations are presented in Table 7-5.
[2] Chapter 62-302, Surface Water Quality Standards (Florida Legislature, 1995).
[3] Chronic Federal Ambient Water Quality Criteria (USEPA, 1991e and 1988b).
[4] USEPA Region IV Water Quality Criteria (USEPA, 1995b)
[5] From Appendix A, Table A-15 Only growth, mortality, and reproductive effects to plants, invertebrates, amphibians, and fish were considered
[6] Criterion based on pH of 6 5 to 9.
[7] Criterion developed to be protective of human health; therefore, the value was not used to evaluate toxicity to aquatic life.
[8] Insufficient data to develop criterion. Information presented is the LOEL - Lowest Observed Effect Level.

Notes: ECPC = ecological contaminant of potential concern.
FDEP = Florida Department of Environmental Protection.
µg/ℓ = micrograms per liter.
AWQC = Ambient Water Quality Criteria (guidance criteria established under the Clean Water Act).
USEPA = U.S Environmental Protection Agency.
AQUIRE = Aquatic Information Retrieval.
ND = not detected.
NA = not available or not analyzed.
= concentration exceeds the most conservative toxicity benchmark
LC_{50} = lethal concentration to 50 percent of test population

7.1.7 Uncertainty Analysis The objective of the uncertainty analysis is to discuss the assumptions of the ERA process that may influence the risk assessment results and conclusions. General uncertainties inherent in the risk assessment process and in the OU 5 ERA are included in Table 7-14.

Specific uncertainties associated with the assessment of risks associated with contamination detected at Site 14 include the information below.

- Risks to terrestrial receptors associated with exposure to TRPH in surface soil and sediment may have been underestimated. Although selected as an ECPC for these media, TRPH was not evaluated in the ERA because there are no toxicological benchmarks. However, TRPH was detected at low concentrations in surface soil (maximum is 93 mg/kg) and sediment (maximum is 16 mg/kg) and, therefore, is not likely to cause risk. Low concentrations of TRPH can be the result of naturally occurring organic materials (e.g., pine duff).

- Risks to avian species from dietary exposures may have been underestimated because bioaccumulation and toxicity data for this taxonomic group are generally lacking in the literature. Toxicological data for mammals were not used as surrogates due to concerns about extrapolations between these two taxonomic groups. As a result, potential risks associated with several ECPCs were not evaluated. If the toxicological data obtained from studies conducted on mammals were used for estimating risks to avian species, then risk estimates for birds would be higher because risks would have been quantified for more chemicals. It is possible that minimal risks to small birds from exposure to vanadium may have been predicted.

- Risks to plants and invertebrates may have been underestimated because phytotoxicity and invertebrate benchmarks for several analytes are lacking for these receptors. The lack of toxicity data for these analytes suggests that either these analytes have not been studied, or they are not toxic to plants and invertebrates.

- Risk to aquatic organisms from exposure to analytes detected in filtered groundwater samples may have been underestimated. Because no filtered background groundwater data were available, unfiltered background groundwater data were used to screen ECPCs. As a result, barium and vanadium were not retained for the risk assessment. However, the concentrations of these analytes detected in groundwater are less than available plant and aquatic organism benchmark; therefore, adverse effects from exposure to barium and vanadium in groundwater are unlikely to occur.

- There is uncertainty associated with using unfiltered surface water and groundwater data for evaluating risk to aquatic organisms from exposure to inorganic analytes. Risks to aquatic organisms may have been overestimated because unfiltered groundwater represent the total fraction of analytes that occur in the water column, including those that are sorbed to particulates and may not migrate to a potential discharge point. Furthermore, there is uncertainty associated with the detected concentrations of filtered antimony and cyanide in surface water since these analytes were not detected in unfiltered samples.

Table 7-14
Potential Sources of Uncertainty in Ecological Risk Assessment

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Potential Source	Direction of Effect	Justification
Uncertainties Associated with ECPC Selection Process		
Degradation of chemicals not considered	Overestimate	Risk estimates are based on recent chemical concentrations. Concentrations will tend to decrease over time from degradation and the formation of daughter products.
No evaluation of Tentatively Identified Compound (TIC) data	Underestimate	Risk was not calculated for potential exposure to TICs.
Use of estimated data	Unknown	Using estimated data in the risk assessment may over- or underestimate the actual concentration of an analyte in site media; therefore, risks may also be over- or underestimated.
Uncertainties Associated with Exposure Assessment		
Food chain assumed to occur at site	Unknown	Occurrence of the food chain used in the models at the sites is unknown.
Food chain model exposure parameter assumptions	Unknown	Some exposure parameters are from the literature and some are estimated. Efforts were made to select exposure parameters representative of a variety of species or feeding guilds, so that exposure estimates would be representative of more than a single species.
Uncertain occurrence of receptors at sites	Unknown	Actual occurrence at the sites by receptors considered in the food chain models is uncertain.
Assumption that receptor species will spend equal time at all habitats within home range	Unknown	Organisms will spend varying amounts of time in different habitats, thus affecting their overall exposures.
Extrapolation of literature values from test species to representative wildlife species	Unknown	Species differ with respect to absorption, metabolism, distribution, and excretion of chemicals. The magnitude and direction of the difference will vary with each chemical.
Consumption of contaminated prey	Unknown	Toxicity to receptors may result in sickness or mortality, thus making fewer prey items available to predators. Predators may stop foraging in areas with reduced prey populations, or discriminate against, or, conversely, select contaminated prey.
Limited evaluation of dermal or inhalation exposure pathways	Underestimate	The dermal and inhalation exposure pathways are generally considered insignificant due to protective fur, feathers, chitinous exoskeletons, and the low concentration of contaminants under natural atmospheric conditions. However, under certain conditions, these exposure pathways may occur.
Maximum exposure scenarios	Overestimate	It is unlikely any receptor would be exposed concurrently to maximum concentrations of all ECPCs.

See notes at end of table

Table 7-14 (Continued)
Potential Sources of Uncertainty in Ecological Risk Assessment

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Potential Source	Direction of Effect	Justification
Missing BAF values	Underestimate	BAFs were not available in the literature for many compounds and receptor classes (i.e., birds); therefore, these gaps result in an underestimate of the total exposure to these receptors.
BAF estimation	Unknown	As many literature values were not available for some species and analytes, alternate BAFs were derived using other assumptions or regressions (Table 7-7 lists the rationale for the generation of alternate BAFs)
Continuous uptake and bioaccumulation of ECPCs by soil biota	Unknown	Tissue and organ responses to ECPC uptake were represented by a linear function, that is an oversimplification of a more complex system (i.e., trophic states and lipid concentrations may affect bioaccumulation, or contaminants may only be seasonally available).
Bioaccumulation of ECPCs in leafy portions of plants	Overestimate	Ryan and others (1988) states that compounds with log K_{ow}s > 5 are unavailable to plants due to soil sorption. Compounds with log K_{ow}s > 5 will be taken into the roots of plants, but are not easily transported into the leafy parts of plants (Briggs et al., 1982; 1983). The surface soil ingestion exposure model overestimates ECPC exposure via plant ingestion to those receptors that only eat the leafy portions of plants.
Relative uptake of inorganics by different plant species	Unknown	Estimated plant BAFs for certain inorganics were based on BAF data for leafy produce grown in sewage sludge. Variability in type of plant and substrate may make the chosen BAF values an overestimate or underestimate of actual uptake.
Uncertainties Associated with Effects		
Lack of ingestion toxicity information for reptile species	Unknown	Information is not available on the toxicity of contaminants to reptilian species resulting from dietary or oral exposures; as a result, dietary exposures to reptiles were not quantitatively evaluated in the OU 5 ERA. Assuming the toxicities of analytes to mammals and birds are similar for reptiles, and to the extent that the dietary exposures for reptiles are the same as for the tertiary consumers evaluated in the OU 5 ERA, an assumption can be made that dietary exposures to reptiles would result in similar risk levels that were predicted for predatory mammals and birds. Since no food-chain risks were predicted to these receptors, it is possible that there are no food-chain risks to reptiles. However, risks to reptiles remain unknown.

See notes at end of table.

Table 7-14 (Continued)
Potential Sources of Uncertainty in Ecological Risk Assessment

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Potential Source	Direction of Effect	Justification
Use of measurement endpoints	Overestimate	Although an attempt was made to have measurement endpoints reflect assessment endpoints, limited available ecotoxicological literature resulted in the selection of certain measurement endpoints that may overestimate assessment endpoints.
Missing RTV values	Underestimate	Reference toxicity values for certain compounds and receptor groups were not available, thereby underestimating the risk predicted by the summary HI.
Uncertainties Associated with Risk Characterization		
Risk evaluated for individual terrestrial receptors only	Overestimate	Effects on individual terrestrial organisms may occur with little population or community level effects. However, as the number of affected individuals increases, the likelihood of population-level effects increases.
Effect of decreased prey item populations on predatory receptors	Unknown	Adverse population effects to prey items may reduce the foraging population for predatory receptors, but may not necessarily adversely impact the population of predatory species.
Multiple conservative assumptions	Overestimate	Cumulative impact of multiple conservative assumptions yields high risk to ecological receptors, and may result in risk at background concentrations or the prediction of risks when there is no potential for adverse effects.
Summation of effects (HIs)	Unknown	The assumption that effects are additive ignores potential synergistic or antagonistic effects. It assumes similarity in mechanism of action, which is not the case for many substances. Compounds may induce toxic effects in different organs or systems.

Notes: ECPC = ecological contaminant of potential concern.
BAF = bioaccumulation factor.
K_{ows} = octanol-water partition coefficients.
> = greater than.
OU = Operable Unit.
ERA = ecological risk assessment.
RTVs = reference toxicity values.
HIs = hazard indices.

- No sediment benchmarks exist for chlorinated benzenes; therefore, risks to aquatic organisms from exposure to these analytes are unknown.

- Terrestrial invertebrate exposures to groundwater that is at or near the ground surface (i.e., within 1 foot during high groundwater periods) were not evaluated; therefore, risks to terrestrial invertebrates may have been underestimated. However, terrestrial invertebrates are most likely repelled by saturated conditions, and probably do not inhabit these areas.

- The bioaccumulation factors for terrestrial invertebrates are based onsite-specific information from Site 15, which may not be representative of the surface soil conditions at Site 14.

- The origin of the identified risks to ecological receptors is unclear as most of the ECPCs are not expected components of the only known activity at Site 14: ordnance disposal by explosion.

- There is uncertainty associated with utilizing average EPCs, as an average concentration based on fewer than 10 samples may not be representative of typical site conditions. At Site 14, the average concentration is calculated based on fewer than 10 samples for all of the media evaluated at this site (surface soil, surface water, sediment, and groundwater).

- Two additional surface water samples were collected in July 1997 from the ditch surrounding Site 14, in order to further evaluate the site. Sample CF14SW3 was analyzed for beryllium, and sample CF14SW1 was analyzed for *bis*(2-ethylhexyl)phthalate. Both of the samples were non-detects; therefore, no further evaluation is warranted.

- The analytical results for aluminum and copper detected in Site 14 surface soil samples were statistically compared to concentrations detected in background samples, using the Mann-Whitney *U*-test. It was determined that aluminum concentrations detected in background samples and Site 14 samples are statistically similar (i.e., from the same population). Therefore, risks based on aluminum in surface soil may be overestimated, as the aluminum concentrations detected in surface soil samples from the site are consistent with background concentrations. The statistical analysis of copper detected in site and background samples indicated that they were not from the same population. Copper was not detected in any of the background samples, and the detection limit was less than the lowest detected concentration of copper in the site samples.

<u>7.1.8 Summary of Ecological Assessment for Site 14</u> Potential risks for ecological receptors were evaluated for ECPCs in surface soil, surface water, sediment, and groundwater at Site 14. A summary of the risk findings are provided in Table 7-15.

In general, the potential for ecological risk is minimal to nonexistent. Localized potential risks were identified for terrestrial plants and soil invertebrates at CF14SS3 as a result of detected concentrations of aluminum and copper. However, these risks may be overestimated by an overly conservative

Table 7-15
Site 14 Ecological Risk Assessment Summary

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Receptor	Medium			
	Surface Soil	Surface Water	Sediment	Groundwater
Wildlife Receptors	Negligible	None	None	NA
Terrestrial Plants	[1]Aluminum and copper at CF14SS3	NA	NA	[1]Aluminum
Soil Invertebrates	[2]Copper at CF14SS3	NA	NA	NA
Aquatic Organisms	NA	None	None	[3]Aluminum

[1] No stressed vegetation observed at Site 14.
[2] Less than twice the benchmark value.
[3] Not observed in excess of benchmark value in surface water

Notes: NA = not applicable.
None = no risk.

benchmark, as the detected concentrations of aluminum are statistically comparable to background concentrations. Risks may be overestimated for copper, as the maximum detected concentration in surface soil is less than two times the plant RTV. In addition, negligible sublethal risks may occur for small mammals exposed to surface soil.

No risks are anticipated for surface water or sediment. Since no risks were identified for these media, the potential risk identified for aquatic organisms as a result of groundwater discharge is not expected to be realized.

While risks to terrestrial plants were estimated as a result of aluminum in groundwater and aluminum and copper in surface soil, field observations did not identify any stressed vegetation.

7.2 SITE 15. The Site 15 ERA was performed in a manner similar to Site 14.

7.2.1 Site Characterization Site 15, the Blue 10 Ordnance Disposal Area (and former trap and skeet range), is located in the southwestern portion of the Yellow Water Weapons Area. The site (shown in Figure 1-4) is situated in a remote portion of NAS Cecil Field. No actively used structures exist at the site, although several building foundations, burn pads, and a burn chamber remain. Site 15 is situated approximately 1,400 feet east of Caldwell Branch, which drains into Yellow Water Creek.

In September 1995, ABB-ES ecologists visited Site 15 to characterize the habitats that exist at the site and determine appropriate receptors in support of the ERA. ABB-ES ecologists walked along transects through the site identifying characteristic flora and fauna for each habitat. Figure 2-9 of the NAS Cecil Field BEAR (ABB-ES, 1996b) provides an overview of the habitats present at Site 15.

The site characterization is divided into four Paragraphs: 7.2.1.1 discusses the vegetative cover, 7.2.1.2 characterizes the wildlife habitat, 7.2.1.3 characterizes the aquatic habitat, and 7.2.1.4 provides a summary of rare, threatened, endangered, or commercially exploited species that may potentially be found at Site 15.

7.2.1.1 **Vegetative Cover** Vegetative communities identified at Site 15 include mesic and wet slash pine flatwoods, disturbed uplands, mesic and wet mixed pine/hardwoods, pine flatwoods with attributes of a dry prairie, floodplain swamps with dome swamp characteristics, manmade drainage ditches, and tannin-stained tributaries. The site, which covers approximately 110 acres, is dominated by the planted pine habitat. Vegetative communities at Site 15 are shown on Figure 2-9 of the NAS Cecil Field BEAR (ABB-ES, 1996b). The water table ranges from 1 to 3 feet of the ground surface at Site 15 throughout the year. There are no well defined drainage pathways over the majority of Site 15 (other than manmade fire ditches that meander throughout the site); several areas were described as wet or inundated during the September 1995 site visit.

Planted pine flatwoods, the dominant habitat found at Site 15, consist of a mature canopy of slash pine with an understory varying between a thick shrub layer of hollies and unvegetated areas overlain by pine needle duff. The ground in the Site 15 flatwoods is dry for the most part; however, an inundated area of flatwoods was encountered in the east-central portion of the site. Other species

of trees infrequently encountered in the pine flatwoods include red maple (*Acer rubrum*), live oak (*Quercus virginiana*), water oak (*Q. nigra*), long-leaf pine (*Pinus australis*), laurel oak (*Q. laurifolia*), turkey oak (*Q. laevis*), scrub oak (*Q. ilicifolia*), and bay (*Magnolia* sp.). Shrubs often found in the understory of the planted pine flatwoods of Site 15 include southern bayberry, gallberry, and saw palmetto. Herbaceous plants observed in the flatwoods at Site 15 include iris (*Iris* sp.), ragweed, thistle (*Cirsium* sp.), sphagnum moss (*Sphagnum* sp.), mullein (*Verbascum thapsus*), pitcher plants, dog fennel, water pennywort (*Hydrocotyle americana*), bracken fern (*Pteridium aquilinum*), acacia, lichens, vervain (*Verbena* sp.), blue sage (*Salvia azurea*), and various graminoids. Two species of vines often encountered at the Site 15 pine flatwoods include bullbriar greenbriar (*Smilax bona-nox*), and muscadine grape.

The disturbed upland areas were found generally in the area of the asphalt circle and onsite where trees had been cleared for offroad vehicles. These areas are dominated by graminoids (i.e., grasses and sedges) and other herbaceous plants, are sparsely vegetated with shrubs, and generally have no arboreal canopy. The only shrub observed in the disturbed uplands at Site 15 was black willow (*Salix nigra*). Herbaceous species found include graminoids, ragweed, fleabane (*Erigeron* sp.), thistle, bracken fern, yellow pea (*Cassia* sp.), and morning glory (*Ipomoea cordatotriloba*). Vines observed at the Site 15 disturbed uplands include muscadine grape, bullbriar greenbriar, and blackberry (*Rubus* sp.).

Mixed pine/hardwood communities were found in two general areas: disturbed roadsides and an area in the southern portion of the site bordering a floodplain swamp. Because of its proximity to the floodplain swamp, the mixed pine/hardwoods in the southern portion of Site 15 contained isolated wet areas. Tree and shrub species observed in the mixed pine/hardwoods include slash pine, sweetgum (*Liquidambar styraciflua*), southern bayberry, red maple, saw palmetto, bay, water oak, gallberry, laurel oak, and sweetbay magnolia (*Magnolia virginiana*). Herbaceous species found in these habitats include poison ivy (*Toxicodendron radicans*), ragweed, cinnamon fern (*Osmunda cinnamomea*), sedges, sphagnum moss, royal fern (*Osmunda regalis*), water pennywort, bracken fern, acacia, beauty berry (*Callicarpa americana*), and graminoids. Several vines, including bullbriar greenbriar, muscadine grape, and Virginia creeper (*Parthenocissus quinquefolia*) were also observed in the Site 15 mixed pine/hardwoods.

A distinct habitat observed in the western portion of the site was characterized as pine flatwoods with attributes of a dry prairie. This area was remote from contaminated parts of the site. Dry prairies, in their pristine form, are nearly treeless plains with a dense groundcover of grasses, herbs, and low shrubs (often saw palmetto) (Florida Natural Areas Inventory Program, 1990). These habitats are very similar to mesic flatwoods except that there are far fewer trees in a dry prairie due of the relatively high fire frequency (sometimes every 1 to 4 years) caused either by natural forces or by man. The sparse tree and shrub species observed in this habitat include live oak, saw palmetto, gallberry, and other hollies. Herbaceous species found in this habitat include reindeer moss, bamboo, white sabatia (*Sabatia brevifolia*), yellow star grass (*Hypoxis hirsuta*), clubmoss, and meadow beauty (*Rhexia nutallii*).

Another distinct habitat encountered at Site 15 was characterized as a floodplain swamp with dome swamp characteristics. These areas were identified as floodplain swamps due to their proximity to Caldwell Branch and Yellow Water Creek (i.e., within a few hundred feet of the stream and remote from the contaminated areas).

However, because these areas did not border the creeks directly, and because they were shallow, somewhat isolated, forested swamps, they fit some of the characteristics described by the Florida Natural Areas Inventory Program (1990) as a dome swamp. Two such habitats were encountered at Site 15: one in the northwestern portion of the site and the other in the extreme southern portion of the site. Tree and shrub species observed in these habitats include baldcypress (*Taxodium distichum*), sweetgum, slash pine, red maple, gallberry, cedar (*Juniperus* sp.), and titi (*Cyrilla racemiflora*). Herbaceous species observed in the floodplain swamps with dome swamp characteristics include yellow-eyed grass, thistle, sphagnum moss, royal fern, netted chain fern, spanish moss (*Tillandsia usneoides*), and water pennywort.

The manmade drainage ditches and tannin-stained first-order tributaries are discussed in Paragraph 7.2.1.3 as part of the characterization of aquatic habitat.

7.2.1.2 **Wildlife Habitat Characterization** The wildlife habitat at Site 15 is very similar to the habitat found at Site 14; many or all of the same organisms may be expected to be found at these two sites. Few signs of animal life were observed by ABB-ES ecologists during the September 1995 site visit; however, several birds were observed including pine warbler (*Dendroica pinus*), white-eyed vireo (*Vireo griseus*), rufous-sided towhee (*Pipilo erythrophthalmus*), American crow (*Corvus brachyrhynchos*), and red-bellied woodpecker (*Melanerpes carolinus*). In addition, an eastern box turtle (*Terrapene carolina*) was found. Other terrestrial flora and fauna potentially residing at Site 15 are described in the Draft NAS Cecil Field BEAR (ABB-ES, 1996b).

7.2.1.3 **Aquatic Habitat** Several aquatic habitats were observed at Site 15, some of which provide marginal aquatic habitat whereas others provide healthy aquatic habitats that would be utilized by a diverse array of organisms. Some of the aquatic habitats at Site 15 include the wet planted pine flatwoods, wet mixed pine/hardwood community, and the floodplain swamp with dome swamp characteristics. Other aquatic habitats at Site 15 include manmade drainage ditches and first order tributaries (i.e., a tributary that has no other streams feeding into it), which drain to Yellow Water Creek.

The drainage ditches at Site 15 can be characterized as shallow, narrow (i.e., generally 2 feet wide), sandy-bottomed (with detritus), ditches containing water with minimal to non-existent flow. The primary purpose of these ditches were for fire control during prescribed burns. It is unlikely that these manmade ditches provide adequate habitat for a diverse assemblage of aquatic receptors; however, the ditches may provide suitable habitat for some species of invertebrates or amphibians. There is no obvious drainage pathway for these ditches as they traverse the entire site.

In the area close to a bike path in the southwestern portion of the site, there is a small (roughly 15 feet by 40 feet), grassy-edged pond that is 5 or 6 feet deep. This pond contains water throughout the year and has a bottom substrate composed of silty sand and organic material. The pond has no obvious inlet or outlet, but it is situated near some drainage ditches; it is unclear whether the pond is associated with the ditches or is fed by groundwater.

The tributaries to the Yellow Water Creek and Caldwell Branch are approximately 10 feet wide, have gently sloping banks, are tannin stained, and have low flow

velocity (<1 feet per second). Although these streams may not provide adequate habitat for most species of fish, it is possible that some small fish, aquatic macroinvertebrates, and amphibians may inhabit these tributaries. These tributaries were encountered at the periphery of Site 15 in the northwestern and the extreme southern portions of the site.

7.2.1.4 **Rare, Threatened, and Endangered Species** No federally listed rare, threatened, or endangered species or species of concern are known to inhabit Site 15. However, the habitats provided at Site 15 may provide suitable habitat for several federally or State-listed species. Several species listed by the FDA as commercially exploited (i.e., cinnamon fern and royal fern) have been observed at Site 15. Other species listed by the FDA as threatened (i.e., pitcher plant and netted chain fern) have also been observed at the site. More information about the rare, threatened, and endangered species observed at NAS Cecil Field is provided in the NAS Cecil Field BEAR (ABB-ES, 1996b).

7.2.2 **Problem Formulation** Problem formulation is the initial step of the ERA process whereby receptors, exposure pathways, and the assessment and measurement endpoints are selected for evaluation.

7.2.2.1 **Identification of Receptors** Terrestrial and aquatic flora and fauna potentially occurring at NAS Cecil Field are presented in the GIR (ABB-ES, 1996a). Wildlife receptors, including omnivorous small mammals and predatory mammals and omnivorous and predatory birds, are expected to be found in the terrestrial habitats present at Site 15. Additional terrestrial receptors present at Site 15 would include plants and terrestrial invertebrates. Aquatic receptors present at the site and adjacent wetlands would include invertebrates, amphibians, and plants. The flora and fauna observed at Site 15 are discussed in the site characterization (Subsection 7.1.1).

Site 15 is located in a remote portion of NAS Cecil. The site is dominated by planted pine flatwoods. The surrounding area is also dominated by mature planted slash pine forests and patches of wetland habitats, which comprise a total relatively undisturbed area of over 750 acres. The site, as described in Subsection 7.2.1, is approximately 122 acres. Habitat conditions vary from wet to mesic depending on local topography. The majority of the site is dominated by mature canopy of slash pine with a mixed understory of hollies and unvegetated areas overlain by pine needle duff.

The diversity and density of avian and mammalian species is dependent on the plant communities' species composition, successional stage, and abundance (Allen et al. 1996). The planted pine forest would provide habitat for a number of insectivorous and granivorous bird species, such as the rufous-sided towhee and American woodcock, due to the presence of a well-developed understory. This habitat would also attract predatory birds, such as the great horned owl, that would feed on small birds and small mammals present at the site. Small mammals would likely be less abundant than small birds at Site 15, as most small mammals prefer dense herbaceous ground cover, which is absent from the majority of the site. The lower density of small mammals may limit the number and frequency of predatory mammals that utilize the site to forage for food.

7.2.2.2 **Identification of Exposure Pathways** Exposure pathways are identified for four groups of ecological receptors (terrestrial wildlife, terrestrial plants, terrestrial invertebrates, and aquatic receptors). The exposure pathway

includes a source of contamination, potentially contaminated media, and an exposure route. The exposure pathways from the Site 15 waste source to ecological receptors are depicted in the contaminant pathway model on Figure 7-1. The model depicts all potential exposure pathways, however (as discussed in Paragraph 7.1.2.2), shading indicates those pathways that are evaluated in the ERA for Site 15.

Terrestrial Wildlife. The wildlife exposure routes that are believed to contribute the highest potential contaminant exposures include ingestion of soil and food items that are contaminated as a result of accumulation of constituents from site media. Additional potential contaminant exposures to wildlife receptors may occur from ingestion of chemicals in surface water and sediment. As discussed in Paragraph 7.1.2.2, dermal and inhalation exposure pathways are not evaluated as part of the Site 15 ERA. Also, potential contaminant exposures for reptiles are not evaluated due to a lack of data relating contaminant exposures to adverse responses for this group.

Terrestrial Plants and Invertebrates. Terrestrial plants and soil invertebrates may be exposed to contamination in surface soil by direct contact with and root uptake (plants) or ingestion (invertebrates) of soil.

Aquatic Receptors. Exposure pathways for aquatic receptors at Site 15 include direct contact with and ingestion of surface water and sediment at Site 15, and direct contact with groundwater as it discharges to surface water.

7.2.2.3 **Evaluation of Potential Ecological Effects** A preliminary review of the analytes detected in surface soil, surface water, sediment, and groundwater was conducted to focus the ERA for Site 15. The following paragraphs identify the types of contaminants that are likely to generate adverse ecological effects.

The analytes detected in surface soil, surface water, sediment, and groundwater are presented in Chapter 4.0 of this report. All of the analytes detected in the different media were reviewed and screened against toxicological benchmarks, known toxicological properties, background concentrations, and bioaccumulation potential. The frequency of detection and types of media in which an analyte was detected were also used as screening criteria. This review and screening process identified a subset of probable risk drivers, which are presented in the following subsections.

Surface Soil. The VOCs acetone and xylene were detected at low concentrations in only one or two samples and are unlikely to pose substantial ecological risks. In most samples, PAHs and phthalate ester compounds were detected at concentrations that exceeded one part per million. PAHs and phthalate ester compounds do not readily bioaccumulate in ecological food chains; therefore, risks to higher trophic-level receptors are unlikely. The primary effects associated with exposure to PAHs are chronic reproductive and immunological effects in small mammals. The primary effects associated with exposure to phthalate esters are chronic reproductive effects to small mammals. Plants and invertebrates exposed to PAHs in surface soil may experience growth stunting and acute survival effects, respectively. Three explosive compounds were detected in surface soil; however, they were detected in only one or two samples at relatively low concentrations and are linked primarily to ecological risk drivers. The pesticides 4,4-DDD; dieldrin; endosulfan II; endrin aldehyde; and methoxychlor were detected at low frequencies in Site 15 surface soil. Although these

compounds are known to bioaccumulate in terrestrial food chains, the detected concentrations are low, and substantial biological uptake is unlikely. Inorganic analytes that would most likely affect wildlife populations include aluminum, antimony, arsenic, and lead. Literature sources describing sublethal toxicological effects to wildlife from exposure to antimony were not available. The primary effects associated with lead exposure are reproductive and developmental effects in small mammals and small birds. These analytes may also cause phytotoxicological effects such as reduced seedling establishment, reduced growth, and acute toxicity to invertebrates.

Surface Water. The explosive compounds 3-nitrotoluene, 4-nitrotoluene, tetryl, and 1,3,5-TNB were detected in surface water, and other sampled environmental media at Site 15. These explosive compounds are not known to bioaccumulate; therefore, higher trophic-level exposures are not anticipated to result in adverse ecological effects. Avian species appear to be more acutely sensitive than small mammals. Chronic reproductive (typically in males), neurological, and hematological (anemia) effects have been reported in small mammals. The inorganic analytes aluminum and lead were detected in most surface water samples at concentrations that exceed screening benchmark values; these appear to pose the greatest threat to aquatic receptors. Salmonid fish, such as trout, are believed to be particularly sensitive to aluminum and lead exposures, with adverse reproductive effects reported at concentrations similar to those detected in surface water. However, the aquatic habitat at the site does not support these species of fish, and the aquatic receptors that may occur are considerably less sensitive than trout.

Sediment. Only one VOC, 2-butanone, was detected in sediment, at a low concentration, and is therefore unlikely to pose a threat to aquatic receptors. PAHs and phthalate esters were detected frequently at elevated concentrations and may pose a risk to aquatic receptors, based on toxic effects to cold water benthic organisms. 4-nitrotoluene was the only explosive compound detected in sediment; however, it was detected infrequently at concentrations unlikely to pose a threat to ecological receptors. Pesticides and PCBs were detected in sediment at relatively low concentrations; however, they may pose a risk to aquatic receptors, based on the sensitivities of cold water benthic organisms. Inorganic analytes detected in sediment frequently at elevated concentrations include aluminum and lead, both of which can result in lethal toxicity.

Groundwater. *Bis*(2-ethylhexyl)phthalate was detected frequently at elevated concentrations and could pose a threat to aquatic receptors following discharge. The primary toxic effect of *bis*(2-ethylhexyl)phthalate is reproductive impairment in amphibians. Naphthalene was detected in site groundwater; however, it was detected in one out of eight samples and is not anticipated to result in adverse ecological effects. None of the three explosive compounds detected in groundwater (i.e., nitrobenzene, RDX, and 3-nitrobenzene) were detected at concentrations sufficient to warrant ecological concerns for discharge to surface water. PCBs were detected in one out of eight samples and at low concentrations in groundwater. Although these compounds are known to bioaccumulate in aquatic foodchains, the detected concentrations and detection frequency are low, and substantial uptake is unlikely. No inorganic analytes detected in groundwater were identified as posing a substantial threat to aquatic receptors following groundwater discharge.

7.2.2.4 **Identification of Endpoints** The assessment and measurement endpoints, and COPCs selected for the Site 14 ERA are listed in Table 7-16. Assessment endpoints represent the ecological component to be protected, whereas the measurement endpoints approximate or provide a measure of the achievement of the assessment endpoint. The general assessment and measurement endpoints selected for the Site 15 ERA are listed in Table 24-1 of the GIR (ABB-ES, 1996a). The specific assessment endpoints for the receptor groups most likely at risk at Site 15 are presented below.

Wildlife Receptors. Terrestrial wildlife receptors could be exposed to contamination in surface soil via both direct (e.g., direct contact and incidental ingestion) and indirect (e.g., consumption of contaminated prey) exposure pathways. As discussed in Paragraph 7.2.2.3, the contaminants of greatest ecological concern in this medium are PAHs, phthalate esters, aluminum, antimony, arsenic, and lead. Due to the fact that these contaminants are not known to bioaccumulate substantially, small mammals and ground foraging birds are anticipated to be at the greatest potential risk. Large predatory mammals and birds such as the fox and great horned owl would only forage at the site a certain percentage of the time and, without a bioaccumulation hazard, are expected to receive much lower exposure doses than smaller organisms with greater site fidelity. The primary adverse effects associated with terrestrial wildlife exposure to PAHs are reproductive and immunological effects following prolonged (i.e., chronic) exposures. Chronic reproductive effects are also associated with terrestrial wildlife exposure to phthalate esters, aluminum, antimony, arsenic, and lead. Developmental effects in terrestrial wildlife are also associated with prolonged exposures to lead. Consequently, the specific assessment endpoints selected for terrestrial wildlife at Site 15 is a substantial reduction (i.e., greater than 50 percent) in small mammal (e.g., shrew) and bird (e.g., woodcock) subpopulations from reproductive impairment due to PAHs, phthalate esters, aluminum, antimony, arsenic, and lead exposures, and immunological effects and developmental impairment from PAHs and lead exposure, respectively.

Semiaquatic wildlife receptors could be exposed to contamination in sediment and surface water via both direct (e.g., direct contact and incidental ingestion) and indirect (e.g., consumption of contaminated prey) exposure pathways. As discussed in Paragraph 7.2.2.3, the contaminants of greatest ecological concern in these media include PAHs, phthalate esters, aluminum, and lead. Due to the fact that these contaminants are not known to bioaccumulate substantially, small mammals are anticipated to be at the greatest potential risk. Exposure to large birds and omnivorous mammals, such as the great blue heron and raccoon, are anticipated to be considerably less than to wildlife species with restricted foraging ranges. The primary adverse effects associated with semiaquatic wildlife exposure to PAHs, phthalate esters, aluminum, and lead are similar to terrestrial wildlife exposures. The specific assessment endpoints selected for semiaquatic wildlife at Site 15 is a substantial reduction (i.e., greater than 50 percent) in small mammal (e.g., water rat) subpopulations from reproductive impairment due to PAHs, phthalate esters, aluminum, and lead exposure.

Terrestrial Plants and Soil Invertebrates. Terrestrial plants and soil invertebrates could be exposed to contaminated surface soil via direct contact, root uptake (plants), and incidental ingestion (invertebrates) exposure pathways. As discussed in Paragraph 7.2.2.3, the contaminants of greatest ecological concern in this medium are PAHs, aluminum, antimony, arsenic, and lead. The primary adverse effects associated with plant and invertebrate exposure to these contaminants are reduced growth, reduced seedling establishment (plants), and

Table 7-16
Endpoints for Ecological Assessment, Site 15

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Medium	Primary ECPCs	Receptor	Assessment Endpoint	Measurement Endpoint
Surface Soil	PAHs, phthalate esters, aluminum, antimony, arsenic, and lead.	Wildlife	Substantial reduction (i.e., greater than 50 percent) in small mammal and bird subpopulations attributable to reproductive impairment from PAHs, phthalate esters, aluminum, antimony, arsenic, and lead exposure, and immunological effects and developmental impairment from PAHs and lead exposure.	Oral contaminant doses (mg/kg BW-day) based on measured adverse effects on growth, reproduction, or survival (e.g., LD_{50} studies) of mammalian or avian laboratory test populations.
	PAHs, aluminum, antimony, arsenic, and lead.	Terrestrial invertebrates	Substantial reduction of invertebrate subpopulations form acute toxicity due to PAHs, aluminum, antimony, arsenic, and lead.	Survival and growth of the earthworm (*Eisenia foetida*) exposed to surface soil samples in laboratory toxicity tests.
	PAHs, aluminum, antimony, arsenic, and lead	Terrestrial plants	Substantial reduction of plant subpopulations from reduced growth and seedling establishment due to PAHs, aluminum, antimony, arsenic, and lead.	Germination of lettuce seeds (*Lactuca sativa*) exposed to surface soil samples in laboratory toxicity tests.
Surface Water and Sediment	Explosive compounds, aluminum, and lead.	Wildlife	Substantial reduction (i.e., greater than 50 percent) in small mammal subpopulations attributable to reproductive impairment and immunological effects from phthalate ester, aluminum, and lead exposure.	Oral contaminant doses (mg/kg BW-day) based on measured adverse effects on growth, reproduction, or survival (e.g., LD_{50} studies) of mammalian or avian laboratory test populations.
Surface Water	Explosive compounds, aluminum, and lead	Aquatic organisms	Reduction of invertebrate and amphibian subpopulations due to explosive compound, aluminum, and lead exposure.	Chemical concentrations in surface water ($\mu g/\ell$) associated with adverse effects to growth, reproduction, survival, and biodiversity of aquatic organisms.
Sediment	PAHs, phthalate esters, aluminum, and lead	Aquatic organisms	Reduction of invertebrate and amphibian subpopulations due to PAH, phthalate ester, aluminum, and lead exposures	Chemical concentrations in sediment ($\mu g/kg$ and mg/kg) associated with adverse effects to growth, reproduction, and survival of aquatic organisms

See notes at end of table

Table 7-16 (Continued)
Endpoints for Ecological Assessment, Site 15

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Medium	Primary ECPCs	Receptor	Assessment Endpoint	Measurement Endpoint
Groundwater	*bis*(2-Ethylhexyl)phthalate	Aquatic organisms	Reduction of invertebrate and amphibian subpopulations due to phthalate ester exposure.	Reduction of invertebrate and amphibian subpopulations due to phthalate ester exposure.

Notes: mg/kg = milligrams per kilogram.
μg/kg = micrograms per kilogram.
μg/ℓ = micrograms per liter.
BW = body weight.
LD_{50} = lethal dose to 50 percent of a test population
LC_{50} = lethal concentration to 50 percent of a test population.

acute toxicity (invertebrates). These contaminants do not bioaccumulate and are regulated by most organisms; therefore, chronic effects from exposure to PAHs, aluminum, antimony, arsenic, and lead are unlikely. Consequently, the specific assessment endpoints selected for plants and invertebrates at Site 14 are the protection of plant and invertebrate subpopulations from reduced growth, reduced seedling establishment, and acute toxicity due to PAHs, aluminum, antimony, arsenic, and lead.

Aquatic Organisms. Aquatic organisms could be exposed to contamination in surface water, sediment, and groundwater via incidental ingestion and direct contact exposure pathways. As discussed in Paragraph 7.2.2.3, the organic contaminants of greatest concern are phthalate esters (sediment and groundwater) and explosive compounds (surface water). The inorganic contaminants of greatest concern are aluminum and lead (surface water and sediment). Invertebrates and amphibians are expected to be at the greatest potential risks. The primary toxicological concern associated with invertebrate and amphibian exposure to explosive compounds, aluminum, lead, PAHs, and phthalate esters are chronic reproductive effects. Consequently, the specific assessment endpoints selected for aquatic organisms at Site 15 is a substantial reduction in invertebrate and amphibian subpopulations due to explosive compound, aluminum, lead, PAHs, and phthalate ester exposure.

The objectives of the ERA are as defined by the specific assessment endpoints presented above. However, all potentially site-related contaminants were evaluated in order to provide a more complete assessment of potential ecological risks. The measurement endpoints used to gauge the likelihood of population- and community-level effects are chemical-specific toxicological benchmark values reported in the literature that are based on laboratory-measured survival and reproductive effects. Earthworm toxicity tests (soil invertebrate) and lettuce seed germination toxicity tests (terrestrial plants) were conducted using Site 15 surface soil to provide relevant site-related measurement endpoints.

7.2.3 Hazard Assessment and Selection of ECPCs The hazard assessment includes a review of analytical data and selection of ECPCs; the process for selecting ECPCs is depicted on Figure 7-2. Detail regarding the ECPC selection process is provided in Subsection 7.1.3 of this report and in Chapter 24.0 of the GIR (ABB-ES, 1996a). Analytical data for Site 15 were evaluated to determine their validity for use in risk assessment pursuant to national guidance, *Guidance for Data Useability in Risk Assessment (Parts A and B)* (USEPA, 1992b).

The background investigation is discussed in Chapter 2.0, and is summarized for OU 5 in Subsection 7.1.3. Background analyte concentrations used in the screening process are provided in Chapter 3.0 of the RIDD. The following soil sample locations were chosen from the NAS Cecil Field background surface soil database for screening surface soil ECPCs based on the soil types found at Site 15: CEFBSS6 through CEFBSS8, CEFBSS15, and CFBSS22 through CFBSS27. The background groundwater samples used for screening groundwater ECPCs at Site 14 (listed in Subsection 7.1.3) were also used for screening groundwater ECPCs at Site 15. As described in Subsection 7.1.3, the USEPA Region IV surface water and sediment screening criteria (USEPA, 1995a) were used for screening surface water, groundwater, and sediment ECPCs (for aquatic organisms only).

As discussed in the GIR (ABB-ES, 1996a) and Subsection 7.1.3, the essential nutrients (e.g., calcium, magnesium, potassium, and sodium) were excluded as

aquatic and wildlife ECPCs for all media, and iron was excluded as a wildlife ECPC for all media. These analytes are considered to be toxic at only extremely elevated concentrations.

7.2.3.1 **Surface Soil** Forty-seven surface soil samples were collected in July 1995 at Site 15. An additional 25 surface soil samples were collected in May 1997 at Site 15. There are differences in the frequencies of detected concentrations (presented in Table 7-17) because 6 samples were only analyzed for PAHs, 1 sample was analyzed for TCL SVOCs only, 1 sample was analyzed for nitroaromatics only, 20 samples were analyzed for TAL lead only, and 9 samples were analyzed for antimony and arsenic only. The remaining 35 samples were analyzed for full TCL and TAL compounds, plus TRPH, TOC, and explosives. Data available from analysis of the 72 samples were evaluated in the Site 15 ERA. The selection of surface soil ECPCs is presented in Table 7-17.

Six analytes were not retained in the ERA because they were detected in fewer than 5 percent of the samples (i.e., in only one sample), and the detected concentrations are not anticipated to cause adverse effects to receptors exposed to surface soil. All other organic analytes and TRPH were retained as ECPCs. Fourteen inorganic analytes were also retained as ECPCs because their maximum detected concentrations were greater than two times the average of detected background concentrations.

7.2.3.2 **Surface Water** Three surface water samples (CF15SW1 through CF15SW3) were collected in July 1995 at Site 15. Four additional surface water samples were collected in May 1997 and analyzed for lead only. All seven samples, including one filtered sample, were evaluated in the Site 15 ERA. The selection of surface water ECPCs is presented in Table 7-18.

All the explosives and TRPH detected were retained for consideration in the ERA. In addition, 7 of the unfiltered inorganic analytes and 5 of the filtered inorganic analytes were retained as ECPCs because no upgradient concentrations were available for screening ECPCs. Only those analytes which had maximum detected concentrations greater than the USEPA Region IV surface water screening values were retained as wildlife ECPCs (all other were retained as both wildlife and aquatic receptors).

All of the unfiltered inorganic ECPCs except copper and vanadium were detected in filtered surface water from Site 15; this suggests that copper and vanadium may not be available to biota. All analytes detected in filtered surface water were also detected in unfiltered surface water.

7.2.3.3 **Sediment** Three sediment samples (CF15SD1 through CF15SD3) were collected in July 1995 at Site 15. All samples were analyzed for full TCL and TAL analytes plus TRPH, TOC, and explosives. Four additional sediment samples were collected in May 1997 and analyzed for PAHs and lead only. All seven samples were evaluated in the Site 15 ERA. The selection of sediment ECPCs is presented in Table 7-19.

All organic analytes and TRPH were retained as ECPCs for the Site 15 ERA. In addition, 6 inorganic analytes were retained as ECPCs because no upgradient sediment value was available for screening ECPCs. Only those analytes which had

Table 7-17
Ecological Contaminants of Potential Concern in Site 15 Surface Soil[1]

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Analyte	Frequency of Detection	Range of Detection Limits	Range of Detected Concen-trations	Average of Detected Concen-trations[3]	Two Times Average Background Concen-tration[4]	Contaminant of Ecological Concern?	95th % UCL[5]	Average of All Concen-trations[6]	Exposure Point Concentrations	
									Maximum[7]	Average[8]
Volatile Organic Compounds (mg/kg)										
Acetone	1/35	0.011 to 0 018	0.006	0.006	NA	No[9]				
Xylenes (total)	1/35	0.005 to 0 012	0 002	0.002	NA	No[9]				
Semivolatile Organic Compounds (mg/kg)										
Acenaphthene	15/41	0 37 to 3.7	0.031 to 17	4	NA	Yes	3	2	3	2
Anthracene	17/41	0 37 to 3.7	0.02 to 54	13	NA	Yes	11	6	11	6
Benzo(a)anthracene	26/41	0 37 to 3 7	0.052 to 340	54	NA	Yes	340	34	340	34
Benzo(a)pyrene	29/41	0.37 to 3.7	0.053 to 340	47	NA	Yes	400	33	340	33
Benzo(b)fluoranthene	31/41	0 37 to 3.7	0.041 to 510	64	NA	Yes	900	48	510	48
Benzo(g,h,i)perylene	23/41	0.37 to 3.7	0.028 to 180	26	NA	Yes	54	14	54	14
Benzo(k)fluoranthene	26/41	0 37 to 3.7	0.031 to 160	27	NA	Yes	130	17	130	17
Butylbenzylphthalate	6/32	0.37 to 20	0.16 to 0 44	0.29	171	Yes	0.93	0 87	0.44	0.44
Carbazole	14/36	0.37 to 0.59	0.021 to 43	9	NA	Yes	7	4	7	4
Chrysene	28/41	0.37 to 3.7	0.054 to 400	58	NA	Yes	460	40	400	40

See notes at end of table.

Table 7-17 (Continued)
Ecological Contaminants of Potential Concern in Site 15 Surface Soil[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection	Range of Detection Limits	Range of Detected Concen-trations	Average of Detected Concen-trations[3]	Two Times Average Background Concen-tration[4]	Contaminant of Ecological Concern?	95th % UCL[5]	Average of All Concen-trations[6]	Exposure Point Concentrations	
									Maximum[7]	Average[8]
Semivolatile Organic Compounds (mg/kg) (continued)										
Dibenz(a,h)anthracene	18/41	0 37 to 3.7	0.022 to 54	12	NA	Yes	13	6	13	6
Dibenzofuran	9/36	0 37 to 72	0.035 to 8	3	NA	Yes	1	1	1	1
Di-*n*-butylphthalate	26/32	0.37 to 20	0.065 to 6 6	2.2	2.45	Yes	5.5	2.3	5 5	2.3
bis(2-Ethylhexyl)phthalate	9/32	0.37 to 20	0.021 to 0.52	0.22	0.050	Yes	1 2	0.86	0.52	0.52
Fluoranthene	31/41	0.37 to 3 7	0.039 to 660	81	NA	Yes	1.200	62	660	62
Fluorene	12/41	0.37 to 3.7	0.043 to 9	3	NA	Yes	1	1	1	1
Indeno(1,2,3-*cd*)pyrene	26/41	0.37 to 3.7	0.025 to 160	25	NA	Yes	102	16	102	16
2-Methylnaphthalene	3/41	0 37 to 3.7	0.022 to 3.7	1 3	NA	Yes	0.9	0.6	0 9	0 6
Naphthalene	15/41	0.37 to 3.7	0.024 to 17	4	NA	Yes	2	2	2	2
Phenanthrene	28/41	0.37 to 3 7	0.029 to 270	39	NA	Yes	260	27	260	27
Pyrene	30/41	0.37 to 3.7	0.038 to 500	64	NA	Yes	690	47	500	47
Explosive Compounds (mg/kg)										
HMX	1/37	0.5 to 5	3 0	3.00	NA	Yes	1.1	0.81	1.1	0.81
3-Nitrotoluene	1/37	0.5 to 5	5.1	5.1	NA	Yes	1 2	0.87	1.2	0.87
4-Nitrotoluene	2/37	0.5 to 5	1.17 to 4.34	2.80	NA	Yes	1 4	0.93	1 4	0.93

See notes at end of table

Table 7-17 (Continued)
Ecological Contaminants of Potential Concern in Site 15 Surface Soil[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection	Range of Detection Limits	Range of Detected Concentrations	Average of Detected Concentrations[3]	Two Times Average Background Concentration[4]	Contaminant of Ecological Concern?	95th % UCL[5]	Average of All Concentrations[6]	Exposure Point Concentrations	
									Maximum[7]	Average[8]
Pesticides and PCBs (mg/kg)										
4,4'-DDE	3/27	0.0037 to 0.37	0.00016 to 0.0013	0.0007	NA	Yes	0.01	0.010	0.0013	0.0013
4,4'-DDT	3/26	0.0037 to 0.37	0.00069 to 0.021	0 009	NA	Yes	0.011	0.011	0.011	0.011
Dieldrin	1/27	0.0037 to 0.37	0.00037	0.00037	NA	Yes	0.0093	0.01	0.00037	0.00037
Endosulfan II	3/25	0.0037 to 0.37	0.00074 to [10]0 0021 (0 0019 J, 0 0045 U)	0.0012	0.00033	Yes	0.010	0.011	0.0021	0.0021
Endrin aldehyde	1/27	0.0037 to 0.37	0 0027	0.0027	NA	No[9]				
Methoxychlor	1/27	0.0046 to 1.8	0 049	0.049	NA	No[9]				
Inorganic Analytes (mg/kg)										
Aluminum	34/35	40	88 to 7,140	1,120	4,040	Yes	1,880	1,090	1,880	1,090
Antimony	23/44	12	0 46 to 2,440	160	NA	Yes	15	84	15	15
Arsenic	26/44	2	0.95 to 451	32	NA	Yes	22	19	22	19
Barium	34/35	40	0 88 to 107	15	9	Yes	29	15	29	15
Cadmium	6/35	1	0.3 to 0.92	0.63	NA	Yes	0.55	0.52	0.55	0.52
Calcium	26/35	1,000	38.3 to 102,000	5,000	NA	No[11]				
Chromium	8/35	2	1.6 to 26.9	5.4	NA	Yes	2.0	2.0	2.0	2.0
Cobalt	6/35	10	0 27 to [10]2.7 (0.33J, 10U)	0.7	NA	Yes	8.5	4 2	2.7	2.7

See notes at end of table.

Table 7-17 (Continued)
Ecological Contaminants of Potential Concern in Site 15 Surface Soil[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection	Range of Detection Limits	Range of Detected Concentrations	Average of Detected Concentrations[3]	Two Times Average Background Concentration[4]	Contaminant of Ecological Concern?	95th % UCL[5]	Average of All Concentrations[6]	Exposure Point Concentrations	
									Maximum[7]	Average[8]
Inorganic Analytes (mg/kg) (Continued)										
Copper	9/35	5	1.1 to 21.2	4.3	NA	Yes	3 2	3	3.2	3
Cyanide	3/35	0.5	[10]0.24 (0.27, 0.2) to 0.27	0.25	NA	Yes	NC	0.25	0.27	0.25
Iron	33/35	20	74.5 to 1,340	320	1,390	No[11,12]				
Lead	55/55	0 6	0.97 to 7,510	730	5	Yes	4,190	730	4,190	730
Magnesium	9/35	1,000	60.6 to 631	213	146	No[11]				
Manganese	23/35	3	0.45 to 32.2	6.5	14	Yes	6 4	4.8	6.4	4.8
Mercury	3/35	0 1	0 2 to [10]0.5 (0 8 J, 0.2 J)	0.3	1 1	No[12]				
Nickel	11/35	8	0 69 to 2.2	1.2	NA	Yes	4 1	3.1	2.2	2.2
Potassium	12/35	1,000	21.7 to 40.2	31	NA	No[11]				
Selenium	1/35	1	1.7	1.7	2.2	No[9,12]				
Silver	1/35	2	0.62	0 62	NA	No[9]				
Sodium	13/35	1,000	[10]133 (148 J, 118J) to 502	265	NA	No[11]				
Vanadium	31/35	10	0.28 to 5.2	1 5	4.8	Yes	2.5	1.9	2.5	1.9
Zinc	1/35	4	32 6	32.6	NA	Yes	2.9	2.9	2.9	2.9

See notes at end of table.

Table 7-17 (Continued)
Ecological Contaminants of Potential Concern in Site 15 Surface Soil[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection	Range of Detection Limits	Range of Detected Concentrations	Average of Detected Concentrations[3]	Two Times Average Background Concentration[4]	Contaminant of Ecological Concern?	95th % UCL[5]	Average of All Concentrations[6]	Exposure Point Concentrations	
									Maximum[7]	Average[8]
General Chemistry (mg/kg)										
Total Organic Carbon	12/12	110 to 2200	2,700 to 46,000	16,000	NA	NA				
Total Petroleum Hydrocarbons	29/35	11 to 54	[10]11 (16, 13U) to 450	86	30.3	Yes	130	73	130	73

[1] Sample locations include: CF15SS1 through CF15SS43, and CF15SS45 through CF15SS73 Duplicate samples were collected at CF15SS2, CF15SS3, CF15SS10, CF15SS20, and CF15SS26.
[2] Frequency of detection is equal to the number of samples in which the analyte is detected in relation to the total number of samples analyzed.
[3] Arithmetic mean of all samples in which analyte was detected
[4] Background sample locations include: CEFBSS6 through CEFBSS8, CEFBSS15 and CFBSS22 through CFBSS27. Two times the mean background concentration for inorganics was used to screen ECPCs
[5] The 95th percent UCL is calculated on the log-transformed average of all concentrations using the formula provided in the U.S. Environmental Protection Agency Region IV Supplemental Guidance (1991c).
[6] The average of all concentrations assigns a value of 1/2 the detection limit to all nondetects.
[7] Maximum Exposure Point Concentrations (EPCs) are equal to the lesser of the maximum detected concentration or the 95th percent UCL.
[8] Average EPCs are equal to the arithmetic mean of all concentrations. When the arithmetic mean is greater than the maximum EPC, the maximum EPC was used instead.
[9] Analyte was detected in less than 5 percent of the samples, was not detected in any other medium, and is not considered an ecologically toxic compound at these concentrations.
[10] This minimum or maximum detected concentration occurs in a duplicate pair.
[11] Analyte is an essential nutrient, and not considered toxic except at high concentrations
[12] Maximum analyte concentration is less than two times the average background concentration.

Notes. % = percent.
UCL = upper confidence limit.
mg/kg = milligrams per kilogram
NA = not available.
HMX = cyclotetramethylenetetranitramine.
PCB = polychlorinated biphenyl.
DDE = dichlorodiphenyldichloroethene.
DDT = dichlorodiphenyltrichloroethane.
J = estimated concentration.
U = Qualifier for nondetected values. Concentration value provided is the detection limit for the sample.

Table 7-18
Ecological Contaminants of Potential Concern in Site 15 Surface Water[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[2]	Range of Detection Limits	Range of Detected Concentrations	Average of Detected Concentrations[3]	Region IV Chronic Water Quality Screening Values[4]	Contaminant of Ecological Concern?[5]	Average of All Concentrations[6]	Exposure Point Concentrations	
								Maximum[7]	Average[8]
Explosive Compounds (µg/ℓ)									
3-Nitrotoluene	1/3	0.8 to 1.29	4.95	4.95	NA	Yes A/W	1.9	4.95	1 9
4-Nitrotoluene	3/3	0 8 to 1.29	[9]0.79 (1.18, 0 8 U) to 46.1	16	NA	Yes A/W	16	46 1	16
Tetryl	2/3	0.645 to 0.8	18.4 to [9]18.4 (18.7, 18.1)	18.4	NA	Yes A/W	12.4	18.4	12.4
1,3,5-Trinitrobenzene	1/3	0.4 to 0.65	6.73	6.73	NA	Yes A/W	2.4	6.73	2.4
Unfiltered Inorganic Analytes (µg/ℓ)									
Aluminum	3/3	200	[9]444 (441, 447) to 649	560	[10]87	Yes A/W	560	649	560
Arsenic	3/3	10	[9]4.4 (4, 4.8 J) to 12	7	[11]190	Yes W[12]	7	12	7
Barium	3/3	200	[9]10.1 (10.9, 9.3) to 17.1	13	NA	Yes A/W	13	17.1	13
Calcium	3/3	5,000	620 to [9]4,510 (4,940, 4,080)	2,410	NA	No[13]			
Copper	1/3	25	[9]11 (9, 25 U)	11	[14]4	Yes A/W	12	11	11
Iron	3/3	100	[9]613 (620, 605) to 1,980	1,320	1,000	Yes A	1,320	1,980	1,320
Lead	7/7	3	91 to 398	265	[14]0.5	Yes A/W	265	398	265
Magnesium	3/3	5,000	429 to 503	477	NA	No[13]			
Potassium	1/3	5,000	[9]1,430 (362, 5,000 U)	1,430	NA	No[13]			

See notes at end of table.

Table 7-18 (Continued)
Ecological Contaminants of Potential Concern in Site 15 Surface Water[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[2]	Range of Detection Limits	Range of Detected Concentrations	Average of Detected Concentrations[3]	Region IV Chronic Water Quality Screening Values[4]	Contaminant of Ecological Concern?[5]	Average of All Concentrations[6]	Exposure Point Concentrations	
								Maximum[7]	Average[8]
Unfiltered Inorganic Analytes (μg/ℓ) (Continued)									
Sodium	3/3	5,000	4,000 to [9]4,440 (5,220 J, 3,650 J)	4,210	NA	No[13]			
Vanadium	1/3	50	3.3	3.3	NA	Yes A/W	18	3.3	3.3
Filtered Inorganic Analytes (μg/ℓ)									
Aluminum	3/3	200	[9]430 (450, 403) to 585	508	[10]87	Yes A/W	508	585	508
Arsenic	2/3	10	5.6 to 12.2	8 9	[11]190	Yes W[12]	7.6	12.2	7.6
Barium	3/3	200	[9]8.8 (9.3, 8.3) to 14.9	11.7	NA	Yes A/W	11.7	14.9	11.7
Calcium	3/3	5,000	538 to [9]3,770 (3,960, 3,570)	2.090	NA	No[13]			
Iron	3/3	100	[9]490 (512, 468) to 1,650	1,050	1,000	Yes A	1,050	1,650	1,050
Lead	3/3	3	79.5 to 225	167	[14]0.5	Yes A/W	167	225	167
Magnesium	3/3	5,000	396 to 458	433	NA	No[13]			
Potassium	1/3	5,000	[9]1,510 (528, 5,000 U)	1,510	NA	No[13]			
Sodium	3/3	5,000	[9]3,600 (3,800, 3,400) to 4,070	3,900	NA	No[13]			
Water Chemistry (mg/ℓ)									
Chloride	3/3	2	[9]8 (8 J, 8 J) to 10	9	NA	Yes A	9	10	9
Hardness	3/3	5	8 to [9]42 (70 J, 14 J)	19	NA	NA			

See notes at end of table.

Table 7-18 (Continued)
Ecological Contaminants of Potential Concern in Site 15 Surface Water[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[2]	Range of Detection Limits	Range of Detected Concentrations	Average of Detected Concentrations[3]	Region IV Chronic Water Quality Screening Values[4]	Contaminant of Ecological Concern?[5]	Average of All Concentrations[6]	Exposure Point Concentrations	
								Maximum[7]	Average[8]
Water Chemistry (mg/ℓ) (Continued)									
Sulfide	1/3	1	[9]0.8 (1, 1 U)	0.8	2	No[12]			
Total Dissolved Solids	3/3	10	52 to 77	65	NA	NA			
Total Recoverable Petroleum Hydrocarbons	1/3	0.5	0.6	0.6	NA	Yes A/W	0.4	0.6	0.4

[1] Sample locations include: CF15SW1 through CF15SW7 (duplicate at CF15SW3).
[2] Frequency of detection is equal to the number of samples in which the analyte is detected in relation to the total number of samples analyzed.
[3] Arithmetic mean of all samples in which analyte was detected
[4] U.S. Environmental Protection Agency (USEPA) Region IV Waste Management Division Chronic Freshwater Quality Screening Values based on the Water Quality Standards Units Screening List (USEPA, 1995a).
[5] A = Ecological Contaminant of Potential Concern (ECPC) for aquatic receptors. W = ECPC for wildlife receptors.
[6] The average of all concentrations assigns a value of 1/2 the sample quantitation limit to all nondetects.
[7] Maximum Exposure Point Concentrations (EPCs) are equal to the maximum detected concentration The 95th percent upper confidence limit was not calculated because there are fewer than 10 samples in the data set.
[8] Average EPCs are equal to the arithmetic mean of all concentrations. If the arithmetic mean of all concentrations is greater than the maximum EPC, then the maximum ECPC was used instead
[9] This value was obtained after averaging a duplicate pair.
[10] Based on pH of 6.5 to 9.
[11] Screening value for trivalent species of arsenic.
[12] Maximum analyte concentration is below the Region IV chronic surface water screening value.
[13] Analyte is an essential nutrient, and is not considered toxic except at high concentrations
[14] Hardness-dependent criterion based on an estimated hardness concentration of 25 mg calcium carbonate ($CaCO_3$) as recommended by USEPA (57 FR 60848, 1992) (site-specific hardness is 19 mg/ℓ as $CaCO_3$).

Notes: µg/ℓ = micrograms per liter
NA = not available.
A/W = see footnote 5.
U = Qualifier for nondetected values. Concentration value provided is the detection limit for that sample.
Tetryl = trinitrophenylmethylnitramine.
J = estimated concentration.
mg/ℓ = milligrams per liter.

Table 7-19
Ecological Contaminants of Potential Concern in Site 15 Sediment[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[2]	Range of CRQL/CRDLs	Range of Detected Concentrations	Average of Detected Concentrations[3]	Region IV Chronic Sediment Screening Value[4]	Contaminant of Ecological Concern?[5]	Average of All Concentrations[6]	Exposure Point Concentrations	
								Maximum[7]	Average[8]
Volatile Organic Compounds (mg/kg)									
2-Butanone	2/3	0.011 to 0 014	0.009 to 0.018	0 014	NA	Yes A/W	0.011	0.018	0.011
Semivolatile Organic Compounds (mg/kg)									
Anthracene	2/7	0 35 to 2 3	0 043 to 0.55	0.30	0.33	Yes A/W	0.26	0.55	0.26
Benzo(a)anthracene	7/7	0.35 to 2 3	0.051 to 6.1	1.1	0.33	Yes A/W	1.1	6.1	1.1
Benzo(a)pyrene	7/7	0.35 to 2.3	0.068 to 8	1	0.33	Yes A/W	1	8	1
Benzo(b)fluoranthene	7/7	0.35 to 2.3	0.08 to 10	2	NA	Yes A/W	2	10	2
Benzo(g,h,i)perylene	6/7	0.35 to 2.3	0.10 to 3.5	0.7	NA	Yes A/W	0.6	3.5	0.6
Benzo(k)fluoranthene	6/7	0.35 to 2.3	0.13 to 3.7	0.8	NA	Yes A/W	0.72	3.7	0.7
Carbazole	1/3	0.35 to 0.46	0.058	0.058	NA	Yes A/W	0 17	0.058	0.058
Chrysene	7/7	0.35 to 2.3	0.064 to 7.3	1.3	0.33	Yes A/W	1.3	7 3	1.3
Dibenz(a,h)anthracene	4/7	0.35 to 2.3	[9]0.038 (0.034 J, 0.041 J) to 1.1	0.3	0 33	Yes A/W	0.3	1.1	0.3
Di-*n*-butylphthalate	3/3	0 35 to 0 45	0 38 to [9]3 1 (2.7, 3 5)	1.9	NA	Yes A/W	1.9	3.1	1.9
Fluoranthene	7/7	0 35 to 2 3	0.079 to 10	2	0.33	Yes A/W	2	10	2
Indeno(1,2,3-*cd*)pyrene	6/7	0 35 to 2 3	[9]0.1 (0 094 J, 0.11 J) to 4.3	0.86	NA	Yes A/W	0.77	4.3	0.77
Phenanthrene	6/7	0.35 to 2 3	[9]0 086 (0 073 J, 0.098 J) to 3.1	0.6	0.33	Yes A/W	0.6	3.1	0.6
Pyrene	7/7	0.35 to 2.3	0.084 to 9.1	1.6	0.33	Yes A/W	1.6	9.1	1.6

See notes at end of table.

Table 7-19 (Continued)
Ecological Contaminants of Potential Concern in Site 15 Sediment[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[2]	Range of CRQLs/CRDLs	Range of Detected Concentrations	Average of Detected Concentrations[3]	Region IV Chronic Sediment Screening Values[4]	Contaminant of Ecological Concern?[5]	Average of All Concentrations[6]	Exposure Point Concentrations	
								Maximum[7]	Average[8]
Explosive Compounds (mg/kg)									
4-Nitrotoluene	1/3	0.5 to 5	37.5	37.5	NA	Yes A/W	12.7	37.5	12.7
Pesticides and PCBs (mg/kg)									
4,4'-DDD	2/3	0.004 to 0.0046	[9]0.0036 (0.0045 J, 0.0026J) to 0.011	0.007	0.0033	Yes A/W	0 006	0.011	0.006
4,4'-DDE	2/3	0.004 to 0.0046	[9]0.0035 (0.0037 J, 0.0032 J) to 0.0083	0.0059	0 0033	Yes A/W	0.0047	0.0083	0.0047
4,4'-DDT	2/3	0.004 to 0.0046	[9]0.0032 (0.004 J, 0 0048 U) to 0.0081	0.0057	0.0033	Yes A/W	0.0045	0.0081	0.0045
Dieldrin	1/3	0 0035 to 0.0046	[9]0 0014 (0.00046 J, 0 0048 U)	0.0014	0.0033	Yes W[10]	0 0018	0.0014	0.0014
Inorganic Analytes (mg/kg)									
Aluminum	3/3	40	543 to [9]2,630 (2,850, 2,410)	1,760	NA	Yes A/W	1,760	2,630	1,760
Barium	3/3	40	2.3 to [9]3.9 (4.1, 3.6)	3.1	NA	Yes A/W	3.1	3.9	3.1
Calcium	3/3	1,000	63 to [9]90.5 (89.6 J, 91 4 J)	77	NA	No[11]			
Chromium	1/3	2	[9]2.1 (3 1, 2 U)	2.1	[12]52.3	Yes W[10]	1.4	2.1	1.4
Iron	3/3	20	[9]88.0 (87.8, 88.2) to 207	132	NA	Yes A	132	207	132
Lead	7/7	0 6	29 to 840	250	30.2	Yes A/W	250	840	250
Magnesium	2/3	1,000	58.8 to [9]264 (29.5, 1,000 U)	161	NA	No[11]			
Sodium	3/3	1,000	145 to 221	181	NA	No[11]			
Vanadium	3/3	10	0.72 to 2.4	1.8	NA	Yes A/W	1.8	2 4	1.8

See notes at end of table.

Table 7-19 (Continued)
Ecological Contaminants of Potential Concern in Site 15 Sediment[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[2]	Range of CRQLs/CRDLs	Range of Detected Concentrations	Average of Detected Concentrations[3]	Region IV Chronic Sediment Screening Values[4]	Contaminant of Ecological Concern?[5]	Average of All Concentrations[6]	Exposure Point Concentrations	
								Maximum[7]	Average[8]
General Chemistry (mg/kg)									
Total Organic Carbon	3/3	140 to 350	5,600 to [9]13,000 (14,000, 12,000)	8,900	NA	NA			
Total Petroleum Hydrocarbons	3/3	11 to 14	15 to [9]110 (68 J, 160 J)	67	NA	Yes A/W	67	110	67

[1] Sample locations include: CF15SD1, CF15SD2, and CF15SD7. Duplicate at CF15SD2.
[2] Frequency of detection is equal to the number of samples in which the analyte is detected in relation to the total number of samples analyzed.
[3] Arithmetic mean of all samples in which analyte was detected.
[4] U.S Environmental Protection Agency (USEPA) Region IV Waste Management Division Sediment Screening Values (USEPA, 1995b).
[5] A = Ecological Contaminant of Potential Concern (ECPC) for aquatic receptors. W = ECPC for wildlife receptors.
[6] The average of all concentrations assigns a value of 1/2 the sediment quantitation limit to all nondetects.
[7] Maximum Exposure Point Concentrations (EPCs) are equal to the maximum detected concentration. The 95th percent upper confidence limit was not calculated because there are fewer than 10 samples in the data set.
[8] Average EPCs are equal to the arithmetic mean of all concentrations. If the arithmetic mean of all concentrations is greater than the maximum EPC, then the maximum EPC was used instead.
[9] This value was obtained after averaging a duplicate pair.
[10] Maximum analyte concentration is below the Region IV chronic surface water screening value.
[11] Analyte is an essential nutrient, and is not considered toxic except at high concentrations.
[12] Screening value for hexavalent species of chromium

Notes: CRQL/CRDL = contract-required quantitation limit/contract-required detection limit.
mg/kg = milligrams per kilogram.
NA = not available
A/W = see footnote 5.
J = estimated concentration.
PCB = polychlorinated biphenyl.
DDD = dichlorodiphenyldichloroethane.
DDE = dichlorodiphenyldichloroethene.
DDT = dichlorodiphenyltrichloroethane.
U = Qualifier for nondetected values. Concentration value provided is the detection limit for that sample.

maximum detected concentrations greater than the USEPA Region IV sediment screening values were retained as wildlife ECPCs (all other were retained as both wildlife and aquatic receptors).

7.2.3.4 **Groundwater** Analytes detected in filtered and unfiltered groundwater from Site 15 are summarized in Table 7-20. Data collected from 8 monitoring wells (CF15MW1S through CF15MW8S) were used to evaluate groundwater conditions potentially contributing to surface water contamination at Site 15. However, as discussed in Paragraph 7.1.3.4, evaluation of aquatic effects associated with exposure to unfiltered groundwater data is conservative and may not be representative of ecological exposures. Since the turbidity of unfiltered groundwater at CF15MW1S, CF15MW3S, and CF15MW8S exceeded 5 NTUs, filtered groundwater samples were collected and the data are also provided in Table 7-20.

Three organic analytes were eliminated from the ERA because they were detected at concentrations less than the USEPA Region IV surface water screening value. Thirteen unfiltered and five filtered inorganic analytes were eliminated as ECPCs because either their maximum detected concentrations were less than the Region IV chronic water quality screening value (USEPA, 1995a) or two times the average background screening concentration. The remaining analytes were retained as aquatic ECPCs for evaluation in the Site 15 ERA.

Of the inorganic analytes detected in unfiltered samples, beryllium, copper, and nickel were not detected in filtered groundwater from Site 15; in addition, cyanide was also detected in unfiltered groundwater but not in filtered groundwater. This indicates that these analytes may not be available to biota. Silver was the only analyte detected in one of three filtered samples (at a concentration of 11.2 $\mu g/\ell$) and was not detected in any of the unfiltered samples; therefore, the actual presence and concentration of silver in groundwater is uncertain.

7.2.4 **Exposure Assessment** Exposure assessment is the process of estimating or measuring the amount of an ECPC to which an ecological receptor may be exposed. Subsection 7.1.4 previously describes how contaminant exposures are estimated or measured for wildlife, terrestrial plants, terrestrial soil invertebrates, and aquatic organisms. Additional detail regarding exposure assessment is provided in Chapter 24.0 of the GIR (ABB-ES, 1996a). The contaminant pathway model (Figure 7-1) provides a summary of the potential exposure pathways that exist at Site 15 for each group of receptors. Maximum and average EPCs are presented in Tables 7-17 through 7-20.

7.2.4.1 **Calculation of EPCs** Maximum and average EPCs were chosen for all ECPCs in surface soil, surface water, sediment, and groundwater by the methods described in Subsection 7.1.4 to assess exposure to terrestrial and aquatic receptors. Because there were less than 10 samples in the surface water, sediment, and groundwater data sets, the maximum detected concentration was selected as the maximum EPC for each analyte. For the surface soil data set, the lesser of the maximum detected concentration or the 95th percentile UCL calculated on the log-transformed arithmetic average was selected as the maximum EPC (USEPA, 1992c).

7.2.4.2 **Terrestrial Wildlife** Exposure routes for wildlife receptors for which EPCs were selected include direct or indirect ingestion of Site 15 soil,

Table 7-20
Ecological Contaminants of Potential Concern in Site 15 Groundwater[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[2]	Range of CRQLs/CRDLs	Range of Detected Concentrations	Average of Detected Concentrations[3]	Region IV Chronic Water Quality Screening Values[4]	Background Groundwater Concentrations[5]	Contaminant of Ecological Concern?[6]	Average of All Concentrations[7]	Exposure Point Concentrations	
									Maximum[8]	Average[9]
Semivolatile Organic Compounds (μg/ℓ)										
bis(2-Ethylhexyl)-phthalate	4/8	10	1 to 220	61	0.3	2	Yes	33	220	33
Naphthalene	1/8	10	0.5	0.5	62	NA	No[10]			
Explosive Compounds (μg/ℓ)										
Nitrobenzene	1/8	0.2	0.228	0.228	270	NA	No[10]			
3-Nitrotoluene	8/8	0.4	1.87 to 3.39	2.5	NA	NA	Yes	2.5	3 39	2 5
RDX	2/8	0.4	[11]0.302 (0.404, 0.4 U) to 0.451	0.38	NA	NA	Yes	0.24	0.451	0.24
Pesticides and PCBs (μg/ℓ)										
4,4'-DDD	1/8	0 1	[11]0 04 (0 029 J, 0 1 U)	0.042	0.006	NA	Yes	0.05	0.040	0.040
4,4'-DDE	1/8	0.1	[11]0.16 (0.26, 0.1 U)	0 16	10.5	NA	No[10]			
4,4'-DDT	1/8	0.1	[11]0.042 (0.034 J, 0.1 U)	0.040	0.001	NA	Yes	0.05	0 042	0.042
Unfiltered Inorganic Analytes (μg/ℓ)										
Aluminum	8/8	200	205 to 635	427	[12]87	776	No[13]			
Antimony	2/8	60	2 to 2.2	2	160	ND	No[10]			
Barium	8/8	200	[11]14.3 (14.3, 14.3) to 28.7	20.5	NA	41.2	No[13]			

See notes at end of table.

Table 7-20 (Continued)
Ecological Contaminants of Potential Concern in Site 15 Groundwater[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[2]	Range of CRQLs/CRDLs	Range of Detected Concentrations	Average of Detected Concentrations[3]	Region IV Chronic Water Quality Screening Values[4]	Background Groundwater Concentrations[5]	Contaminant of Ecological Concern?[6]	Average of All Concentrations[7]	Exposure Point Concentrations	
									Maximum[8]	Average[9]
Unfiltered Inorganic Analytes (μg/ℓ) (continued)										
Beryllium	1/8	5	1	1	0.53	2	No[13]			
Calcium	2/8	5,000	5,620 to 6,380	6,000	NA	380	No[14]			
Cobalt	3/8	50	1.4 to [11]1.8 (1 7 J, 1.9)	1.6	NA	11.6	No[13]			
Copper	6/8	25	4.7 to 8.7	6.7	[15]4	134	No[13]			
Cyanide	3/8	10	3.1 to [11]4 2 (3 UJ, 3.3 J)	3.7	5.2	NA	No[10]			
Iron	8/8	100	633 to 3,140	1,750	1,000	450	Yes	1,750	3,140	1,750
Magnesium	8/8	5,000	598 to 1,500	1,100	NA	1,290	No[14]			
Manganese	8/8	15	[11]8.4 (8.3, 8.4) to 49 6	21.2	NA	9.8	Yes	21.2	49 6	21.2
Nickel	1/8	40	17.5	17.5	[15]49	32	No[10,13]			
Potassium	1/8	5,000	2,010	2,010	NA	1,580	No[14]			
Sodium	5/8	5,000	5,510 to 10,800	7,900	NA	1,150	No[14]			
Thallium	3/8	10	5 to 6.1	6	4	NA	Yes	5	6	5
Vanadium	1/8	50	1 8	1.8	NA	96	No[13]			
Zinc	3/8	20	92 to 246	145	[15]30	48	Yes	60	246	60

See notes at end of table.

Table 7-20 (Continued)
Ecological Contaminants of Potential Concern in Site 15 Groundwater[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Frequency of Detection[2]	Range of CRQLs/CRDLs	Range of Detected Concentrations	Average of Detected Concentrations[3]	Region IV Chronic Water Quality Screening Values[4]	Background Groundwater Concentrations[5]	Contaminant of Ecological Concern?[6]	Average of All Concentrations[7]	Exposure Point Concentrations	
									Maximum[8]	Average[9]
Filtered Inorganic Analytes (µg/ℓ)										
Aluminum	3/3	200	85.7 to 385	211	[12]87	776	No[13]			
Antimony	3/3	60	2.5 to 8.1	4.9	160	NA	No[10]			
Barium	3/3	200	15.1 to 32.2	21.4	NA	41.2	No[13]			
Calcium	1/3	5,000	6,400	6,400	NA	380	No[14]			
Cobalt	1/3	50	1.8	1.8	NA	11.6	Yes	17		
Iron	3/3	100	598 to 2,410	1,480	1,000	450	Yes	1,480	2,410	1,480
Magnesium	3/3	5,000	597 to 1,230	920	NA	1,290	No[13, 14]			
Manganese	3/3	15	12.3 to 29.1	19 6	NA	9.8	No[13]			
Potassium	1/3	5,000	2,040	2,040	NA	1,580	No[14]			
Silver	1/3	10	11.2	11.2	[16]0 012	NA	Yes	7.1	11 2	7.1
Sodium	3/3	5,000	6,820 to 9,560	7,800	NA	1,150	No[14]			
Thallium	1/3	10	5.4	5.4	4 00	NA	Yes	5.1	5.4	5.1
Vanadium	2/3	50	1 to 1.5	1	NA	96	No[13]			
Zinc	1/3	20	109	109	[15]30	48	Yes	43	109	43
General Chemistry (mg/ℓ)										
Total Organic Carbon	2/3	1	[11]1 to 4	3	NA	NA	NA			

See notes on following page.

Table 7-20 (Continued)
Ecological Contaminants of Potential Concern in Site 15 Groundwater[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

[1] Sample locations include: CF15MW1S through CF15MW8S. Duplicate at CF15MW5SD. Filtered samples were collected at CF15MW1S, CF15MW3S, and CF15MW8S.
[2] Frequency of detection is equal to the number of samples in which the analyte is detected in relation to the total number of samples analyzed.
[3] Arithmetic mean of all samples in which analyte was detected.
[4] U.S. Environmental Protection Agency (USEPA) Region IV Waste Management Division Chronic Freshwater Quality Screening Values based on the Water Quality Standards Units Screening List (USEPA, 1995a).
[5] Background sample locations include: CFBKMW1S, 2S, 4S, 4SD, 5S, 7S, and 8S Two times the arithmetic mean of inorganic background concentrations were used to screen ecological contaminant of potential concern.
[6] Contaminant of Potential Concern for aquatic receptors.
[7] The average of all concentrations assigns a value of 1/2 the sediment quantitation limit to all nondetects.
[8] Maximum Exposure Point Concentrations (EPCs) are equal to the maximum detected concentration. The 95th percent UCL was not calculated because there are fewer than 10 samples in the data set
[9] Average EPCs are equal to the arithmetic mean of all concentrations If the arithmetic mean of all concentrations is greater than the maximum EPC, then the maximum EPC was used instead.
[10] Maximum analyte concentration is below the Region IV chronic surface water screening value.
[11] This value was obtained after averaging a duplicate pair.
[12] Criterion is based on a pH of 6.5 to 9 (USEPA, 1988a).
[13] Maximum analyte concentration is less than two times the average background concentration.
[14] Analyte is an essential nutrient, and is not considered toxic except at high concentrations
[15] Hardness-dependent criterion based on an estimated hardness concentration of 25 mg calcium carbonate ($CaCO_3$) as recommended by USEPA (57 FR 60848, 1992) (a site-specific hardness value of 19 mg/ℓ $CaCO_3$ was calculated using mean calcium and magnesium concentrations [Greenberg et al., 1992]).
[16] Based on the marketability of fish; therefore, this value may not have significant ecological value

Notes: CRQL/CRDL = contract-required quantitation limit/contract-required detection limit.
μg/ℓ = micrograms per liter.
NA = not available.
RDX = cyclotrimethylenenitramine.
U = Qualifier for nondetected values. Concentration value provided is the detection limit for that sample.
PCB = polychlorinated biphenyl.
DDD = dichlorodiphenyldichloroethane.
J = estimated value
DDE = dichlorodiphenyldichloroethene.
DDT = dichlorodiphenyltrichloroethane.
ND = not detected.
mg/ℓ = milligrams per liter.

ingestion of contaminated food, and ingestion of surface water and sediment. The rationale for selecting wildlife receptors according to their respective levels within the food chain is discussed in Paragraph 7.1.4.2. Terrestrial receptors were chosen to represent the trophic levels typical of a southeastern disturbed pine flatwoods community for soil and food exposures in the Site 15 ERA. The following representative wildlife species (summarized in Table 7-6) were selected for the Site 15 ERA: short-tailed shrew, rufous-sided towhee, american woodcock, red fox, and great horned owl.

Semiaquatic receptors were chosen to represent the trophic levels typical of forested stream and swamp communities for surface water, sediment, and food exposures. The representative wildlife species listed below (summarized in Table 7-6) were selected for the Site 15 ERA.

- **Florida water rat** (*Neofiber alleni*). This small mammalian omnivore may be exposed to contamination in surface water and sediment as a result of direct ingestion and ingestion of aquatic prey. Aquatic prey (plants and invertebrates) may become contaminated as a result of accumulation of contaminants from the surface water and sediment. The Florida water rat was selected to represent mammalian omnivores that would receive higher doses as a result of their small body size.

- **Raccoon** (*Procyon lotor*). The raccoon represents an opportunistic species that may be exposed to contamination in surface water and sediments both as a result of direct ingestion and ingestion of aquatic prey. Aquatic prey (plants, invertebrates, and fish) may become contaminated as a result of accumulation of contaminants from the surface water and sediments. The raccoon represents higher trophic level omnivorous mammals found in ditch, stream, and swamp environments at Site 15.

- **Great blue heron** (*Ardea herodias*). This species represents a higher trophic level avian receptor that may be exposed to surface water and sediment contamination. Great blue herons feed primarily on aquatic prey items including fish, frogs, and invertebrates. Although the habitat provided at Site 15 is not appropriate for the great blue heron, it has been selected to represent other wading birds, which are more likely to use the site (i.e., other herons and egrets).

Exposure assumptions (body weights, food ingestion rates, relative consumption of food items, etc.) for each of the representative wildlife species for Site 15 are provided in Table 7-7.

The area of the Site 15 uplands (roughly calculated to be 110 acres) is larger than the home ranges for the short-tailed shrew, rufous-sided towhee, american woodcock, and great horned owl. In addition, the area of the aquatic habitat (roughly estimated to be 0.5 acre) is larger than the home range for the Florida water rat. Since all representative wildlife receptors are expected to actively forage at the site year round, it is assumed that the SFF (defined in Paragraph 7.1.4.2) for these receptors is 1.

A PDE (or body dose) is used to estimate contaminant intake for all representative wildlife species from exposure to each ECPC in all media according to the equations in Table 24-2 (GIR) and the methodologies described in Chapter 24.0 of

the GIR (ABB-ES, 1996a). The PDEs calculated from exposure to surface soil ECPCs for each receptor and the exposure assumptions used in calculating the PDEs are presented in Appendix B, Tables B.15-28 and B.15-29. The PDEs calculated from exposure to surface water and sediment ECPCs for each receptor and the exposure assumptions used in calculating the PDEs are presented in Appendix B, Tables B.15-30 and B.15-31.

Tissue concentrations of ECPCs in prey items were estimated using BAFs. The general approach used to select BAFs for terrestrial receptors is discussed in Paragraph 7.1.4.2 and summarized in Table 24-3 of the GIR (ABB-ES. 1996a). BAFs for each of the ECPCs evaluated at Site 15 are included in Appendix A, Table A-8. To estimate bioaccumulation potential of soil invertebrates, worms were analyzed for inorganic analytes following a 30-day toxicity test described in Paragraph 7.2.4.3. Invertebrate BAFs were calculated by dividing the results of the tissue analyses for earthworms by surface soil concentrations; invertebrate BAFs are presented in Appendix A, Table A-9. The BAFs for sediment and BCFs for surface water used in the Site 15 ERA have been discussed in Paragraph 7.2.4.2. Sediment BAFs and surface water BCFs are presented in Appendix A, Table A-8.

Although indirect exposures to wildlife from groundwater ECPCs exist, this exposure pathway is not a significant route of exposure and is unlikely to result in risk. Consequently, risks to wildlife from exposure to groundwater ECPCs were not evaluated at Site 15.

7.2.4.3 **Terrestrial Plants and Invertebrates** Terrestrial plants and soil invertebrates may be exposed to ECPCs via direct contact with and root uptake (plants) or ingestion (invertebrates) of ECPCs measured in Site 15 surface soil. For the purposes of the Site 15 ERA, exposures to terrestrial plants and invertebrates are assumed to occur within the top 1 foot interval of surface soil.

Laboratory reared earthworms (*Eisenia foetida*) and lettuce seed (*Lactuca sativa*) were exposed to eight surface soil samples collected from Site 15 and a laboratory control. In addition, serial dilution tests (at 50 percent, 25 percent, 12.5 percent, and 6.25 percent) were performed on earthworms and lettuce for two of the surface soil samples. Soil toxicity studies were conducted in accordance with the USEPA methods and protocols entitled *Protocols for Short Term Toxicity Screening of Hazardous Waste Sites* (Green et al., 1989). Earthworms were exposed to Site 15 soils in 30-day survival, growth, and bioaccumulation tests. Lettuce seeds were exposed to Site 15 soils in 120-hour static whole soil germination tests. The results of these tests were used to evaluate the bioavailability of chemicals and receptor toxicity from exposure to soil contaminants. Results of the Site 15 soil toxicity testing are presented in Appendix D.

7.2.4.4 **Aquatic Receptors** Aquatic organisms may be exposed to ECPCs via direct contact with surface water, sediment, and groundwater from the shallow surficial aquifer. The aquatic organisms most likely to experience adverse effects from exposure to groundwater ECPCs are benthic species (i.e., those species in close contact with sediment as groundwater discharges to surface water). Aquatic organism exposures to the full concentrations of analytes in groundwater are considered in the Site 15 ERA; however, this exposure assumption may be overly conservative because concentrations of analytes most likely attenuate before reaching the discharge area.

7.2.5 Ecological Effects Assessment The ecological effects assessment discusses what measurement endpoints were used to evaluate potential adverse impacts to the assessment endpoints. The methods used for identifying and characterizing ecological effects for ECPCs in surface soil, surface water, sediment, and groundwater are described in the following sections, and in greater detail in Chapter 24.0 of the GIR (ABB-ES, 1996a).

7.2.5.1 Surface Soil Wildlife receptors, terrestrial plants, and terrestrial invertebrates are potentially exposed to ECPCs detected in surface soil at Site 15. The measures of adverse ecological effects for these receptors are discussed separately.

Terrestrial Wildlife. As mentioned in Paragraph 7.1.5.1, no long-term wildlife population data are available at NAS Cecil Field; therefore, a direct measurement of this assessment endpoint is not possible. Instead, literature-derived results of laboratory toxicity studies that relate the dose of a contaminant in an oral exposure with an adverse response to growth, reproduction, or survival of a test population (avian or mammalian species) were used in food-web models as a measure of the assessment endpoint. Wildlife ingestion toxicity data are presented in Appendix A, Table A-11.

Lethal and sublethal RTVs were selected for each ECPC identified and each representative wildlife species selected, representing threshold doses for lethal effects and adverse effects related to reproduction or growth (respectively). A summary of RTVs selected from the ingestion toxicity data are provided in Appendix A, Table A-12. More detail regarding how these RTVs are derived and what they represent is provided in Paragraph 7.1.5.1 and in Chapter 24.0 in the GIR (ABB-ES, 1996a).

If neither lethal nor sublethal RTVs were available for an ECPC for a taxonomic group, risks associated with the predicted exposure for the respective ECPC were not quantitatively evaluated. However, the absence of specific data for a taxonomic group does not imply that there is no anticipated toxicological effect associated with contaminant exposure by these receptors; therefore, potential risks to these taxonomic groups are qualitatively discussed in the uncertainties section.

Terrestrial Plants and Invertebrates. Adverse effects to terrestrial plants and soil invertebrates were evaluated in two ways: by means of toxicity testing and by comparing soil concentrations at Site 15 with toxicity benchmarks for these receptor groups.

As mentioned in Paragraph 7.2.4.3, the toxicity of Site 15 surface soil to plants and soil invertebrates was measured by use of two soil laboratory toxicity tests: a sub-acute toxicity test with earthworms and a seed germination toxicity test with lettuce seed. Protocols used in the 30-day survival test with earthworms and the seed germination toxicity test are included in Appendix D. In addition, definitive serial dilutions (at 50 percent, 25 percent, 12.5 percent, and 6.25 percent) were performed for two samples (CF15SS15 and CF15SS20) and *E. foetida* survival was measured to derive 14- and 30-day LC_{50} for earthworms. The results

of earthworm and lettuce seed toxicity testing of surface soil samples are presented in Table 7-21, and are discussed in the following paragraphs.

Earthworm survival in the reference sample for Site 15 (CF15SS48) was not significantly different ($P \leq 0.05$) from the survival observed in the control soils: survival was 100 percent for all samples. Following 30-day exposures, earthworm survival in the reference sample was significantly different ($P \leq 0.05$) compared results obtained for soil samples CF15SS6, CF15SS26, CF15SS46, and CF15SS15 (100 percent and 50 percent). Although the results of the test appear to indicate that earthworm survival was adversely affected in the 12.5 percent and 6.25 percent dilutions of CF15SS15 and in the 12.5 percent dilution for CF15SS20, these results were considered anomalies by the toxicity testing laboratory since no adverse effects were observed for earthworms at higher concentrations. These results may be attributable to poor sample homogeneity. Earthworm survival at day 14 was not statistically evaluated.

The 14- and 30-day LC_{50} for *E. foetida* in soil sample CF15SS15 were determined to be 75 percent and 31 percent respectively. In other words, an estimated 74.5 percent of all analyte concentrations contributed to the death of 50 percent of the earthworms tested after exposure to Site 15 surface soils for 14 days. Similarly, 30.7 percent of all analyte concentrations contributed to the death of 50 percent of earthworms after 30-day exposures.

In calculating the LC_{50}, data from the 12.5 percent and 6.25 percent dilutions were not included because of the reduced survival (i.e., 100 percent survival was achieved by the 25 percent dilution; therefore, the reduced survival observed at the 12.5 percent and 6.25 percent dilutions were considered anomalies). These LC_{50} values may be higher than what actual LC_{50} would be if the dose-response curve included all the dilutions.

Earthworm growth was significantly less ($P \leq 0.05$) in all of the serial dilutions for CF15SS15 (50 percent, 25 percent, 12.5 percent, and 6.25 percent) than was observed in the reference sample (0.356 grams wet weight). No earthworm growth measurements were made for the 100 percent sample from CF15SS15 or for CF15SS6, CF15SS26, and CF15SS46 as there was 100 percent mortality of earthworms in these samples. No statistical differences in earthworm growth were observed between the reference sample and the earthworms reared in soils from CF15SS7, CF15SS18, or CF15SS20. It should be noted that egg and young production were observed for *E. foetida* during the 30 day study; however, the soil samples in which these observations were made were not noted and the observations were not quantified.

Lettuce seed germination in sample CF15SS20 (100 percent only) were significantly ($P \leq 0.05$) less than the germination observed in the reference sample. The remaining seven samples (including all the serial dilutions for CF15SS15 and the 50 percent, 25 percent, 12.5 percent, and 6.25 percent dilutions of CF15SS20) showed no statistical differences ($P > 0.10$) from the reference sample.

7.2.5.2 Surface Water The measure of adverse ecological effects for wildlife and aquatic receptors from exposure to chemicals in surface water are discussed separately.

Wildlife Receptors. For the purposes of food-web modeling, lethal and sublethal RTVs were identified for each surface water ECPC for each representative wildlife species, as described in Paragraph 7.2.5.1.

Table 7-21
Surface Soil Toxicity Results[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Sample Location	Earthworm (*Eisenia foetida*)			Lettuce Seed (*Lactuca sativa*) Germination (%)
	14-day Survival (%)	30-day Survival (%)	30-day Mean Growth (grams as group wet weight)	
Control	100	100	0.25	94
CF15SS6	33	[2]0	NC	95
CF15SS7	100	100	0.334	92
CF15SS18	100	100	0.270	98
CF15SS26	20	[2]0	NC	97
CF15SS46	17	[2]0	NC	93
CF15SS48 (Reference)	100	100	0.356	94
CF15SS15 (6.25%)	87	[3]30	[2]0.071	89
CF15SS15 (12.5%)	93	70	[2]-0.053	93
CF15SS15 (25%)	100	100	[2]-0.031	96
CF15SS15 (50%)	100	10	[2]-0.293	97
CF15SS15 (100%)	17	[2]0	NC	98
CF15SS20 (6.25%)	100	60	0.375	95
CF15SS20 (12.5%)	100	[3]17	0.188	98
CF15SS20 (25%)	100	97	0.167	93
CF15SS20 (50%)	100	97	0.258	88
CF15SS20 (100%)	100	97	0.133	[3]56
14-day LC_{50} = 75% [4]				
30-day LC_{50} = 31% [4]				

[1] Toxicity testing methods and results (including controls) are described in Appendix D.
[2] Statistically different from the reference.
[3] These results may be statistically significant; however, the significance of these results are questionable because no effect was detected at higher exposure concentrations.
[4] These LC_{50}s are estimated using the data from CF15SS15 only.

Notes: % = percent.
NC = not able to calculate value.
LC_{50} = lethal concentration to 50 percent of test population.

Aquatic Receptors. Potential adverse ecological effects associated with ECPCs in surface water were evaluated based on a comparison of the ECPC concentrations with available literature-derived benchmarks. The surface water RTVs selected for comparison to surface water exposure concentrations for Site 15 are the same as those used for Site 14 (discussed in Paragraph 7.1.5.2).

7.2.5.3 Sediment The measure of adverse ecological effects for wildlife and aquatic receptors from exposure to chemicals in sediment are discussed separately.

Wildlife Receptors. For the purposes of food-web modeling, lethal and sublethal RTVs were identified for each sediment ECPC for each representative wildlife species, as described in Paragraph 7.2.5.1.

Aquatic Receptors. Potential adverse ecological effects associated with ECPCs in sediment were evaluated based on a comparison of the ECPC concentrations with literature-derived benchmarks. The sediment RTVs selected for comparison to sediment exposure concentrations for Site 15 are the same as those used for Site 14 (discussed in Paragraph 7.1.5.3).

7.2.5.4 Groundwater Aquatic organisms are potentially exposed to groundwater. Adverse effects to aquatic organism populations from exposure to groundwater ECPCs were estimated by comparing exposure concentrations for Site 15 groundwater with the surface water benchmarks mentioned in Paragraph 7.1.5.2.

7.2.6 Risk Characterization This subsection presents the risk characterization for ecological receptors exposed to surface soil, surface water, sediment, and groundwater at Site 15.

7.2.6.1 Surface Soil Potential risks associated with exposures to ECPCs in surface soil at Site 15 are discussed separately for wildlife and terrestrial plants/soil invertebrates. Risks to wildlife are characterized by comparing PDE concentrations from ingestion and bioaccumulation of surface soil ECPCs with RTVs (estimated threshold dose for toxicity). Risks for terrestrial plants and soil invertebrates are evaluated based on the results of the respective soil toxicity tests and a comparison of Site 15 surface soil exposure concentrations with benchmarks for terrestrial plants and invertebrates.

Terrestrial Wildlife. Risks for the representative wildlife species associated with ingestion and bioaccumulation of ECPCs in surface soil and prey items are quantitatively evaluated using the HQ and HI approach discussed in Paragraph 7.1.6.1.

The lethal and sublethal HQs and HIs calculated based on maximum EPCs for each representative wildlife species are provided in Appendix B, Table B.15-32; a summary of risks to representative wildlife receptors is provided in Table 7-22. Lethal and sublethal summary HIs for the red fox and the great horned owl exposed to maximum surface soil ECPCs were less than 1. Lethal effects HIs ranged from 2.0 for the rufous-sided towhee to 4.3 for the short-tailed shrew; sublethal effects HIs ranged from 2.9 for the American woodcock to 88 for the short-tailed shrew. Lead was a primary risk contributor, contributing between 70 and 79 percent of lethal risks to the shrew, towhee, and woodcock, and 88 percent of the sublethal risks to the shrew. Arsenic was also a significant risk contributor, contributing to 55 and 63 percent of the sublethal risks to the woodcock and

Table 7-22
Results of Food-Web Modeling for Surface Soil, Sediment, and Surface Water, Site 15[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Media Evaluated / Ecological Receptor	Lethal Effects from Exposure to Maximum EPCs	Sublethal Effects from Exposure to Maximum EPCs	Lethal Effects from Exposure to Average EPCs	Sublethal Effects from Exposure to Average EPCs	Primary Risk Contributors
Surface Soil					
Short-tailed shrew	4.3	88	1.1	18	Lead
Rufous-sided towhee	2.0	3.0	0.76	2.1	Lead, arsenic
American woodcock	2.4	2.9	0.77	1.7	Lead, arsenic
Red fox	0.031	0.6	NE	NE	NA
Great horned owl	0.063	0.14	NE	NE	NA
Sediment and Surface Water					
Florida water rat	0.097	2.0	NE	0.61	Lead
Raccoon	0.00011	0.0018	NE	0.00057	NA
Great blue heron	0.017	0.20	NE	0.11	NA

[1] The information listed below is a summary of Tables B.15-42 through B.15-45 in Appendix B.

Notes: EPC = Exposure point concentrations.
NE = not evaluated.
NA = not applicable.

towhee, respectively. In addition, two PAHs contributed 3 percent of the overall sublethal risk to the shrew. Because risks from maximum exposure concentrations were calculated to be greater than 1, an evaluation of risks to the shrew, towhee, and woodcock from exposure to average EPCs was also completed.

The lethal and sublethal HQs and HIs calculated based on average EPCs in Site 15 surface soil are also provided in Appendix B, Table B.15-33 and summarized in Table 7-22. The lethal effects HIs ranged from 0.76 for the towhee to 1.1 for the shrew; sublethal effects HIs ranged from 1.7 for the woodcock to 18 for the shrew. As with the maximum exposure scenario, lead was the primary risk contributor to the shrew, while arsenic was the primary risk contributor to the towhee and woodcock for sublethal effects.

Evaluation of the results of the food-web modeling suggest that no risks to predatory mammals and birds from exposure to Site 15 surface soil are expected. Slight risks to small birds are estimated from exposure to maximum concentrations of lead and arsenic. However, it is unlikely that organisms would continuously be exposed to maximum concentrations; no risks to small birds from average concentrations of lead (which better represent typical exposures) are anticipated, although slight risks to small birds are estimated from exposure to average concentrations of arsenic. Small mammals are most at risk of experiencing sublethal effects (i.e., adverse effects to development and reproduction) from exposure to concentrations of lead in Site 15 surface soil.

Terrestrial Plants and Invertebrates - Toxicity Test Evaluation. Risks for terrestrial plants and invertebrates are characterized based on the results of laboratory toxicity tests and benchmark comparisons. The surface soil analytical and toxicity test samples were collected concurrently and split for the two separate analyses. The analytical results for the surface soil samples were used to help interpret the contaminant exposures and responses of the test species (earthworms and lettuce seed) in the toxicity tests.

Statistically significant differences in earthworm survival were observed between the reference sample (CF15SS48) and surface soil samples collected from CF15SS6, CF15SS15, CF15SS26, and CF15SS46 at Site 15 (Paragraph 7.2.5.1). Furthermore, statistically significant differences in earthworm growth were observed between the reference sample and surface soil location CF15SS15, located downrange of the former skeet range. Lettuce seed germination in the reference soil was significantly higher than surface soil collected from location CF15SS20, which is located approximately 880 feet south of the burn chamber and 100 feet southwest of the access road.

Correlations between soil concentration of total PAHs, aluminum, arsenic, iron, lead, manganese, TOC and biological effects (i.e., earthworm growth, earthworm survival, and lettuce seed germination) were examined to identify contaminants potentially responsible for the observed biological results (Appendix C). The remaining surface soil ECPCs were not included in the regression analyses because these analytes were detected in only a few of the surface soil samples selected for toxicity testing, or were detected at high concentration at CF15SS7, which resulted in no statistically significant effects to either earthworms or lettuce. Evaluation of the correlation (regressions) indicates that all the observed biological effects are poorly correlated with concentrations of PAHs, arsenic, iron, and manganese detected in soil.

Correlation regressions performed for lettuce seed germination suggest that none of the analyte concentrations are correlated with the observed effects. The poor correlation is at least partially attributed to the fact that adverse effects to lettuce seed germination were only observed at one sample location (CF15SS20). A review of the analyte concentrations at this location shows that all analytes (with the exception of PAHs) were detected at lower concentrations at CF15SS20 than at several other toxicity test locations where no adverse effects to lettuce seed germination were observed. The only other location in which PAHs were detected at higher concentrations was at CF15SS7; although lettuce seed germination was slightly reduced at CF15SS7, the results were not significant. It is possible that the adverse effects to lettuce seed germination observed at CF15SS20 may be caused by a combination of factors (i.e., high concentrations of PAHs and moderately high concentrations of lead and aluminum), or they may be related to other factors (i.e., such as soil pH, grain size, or laboratory procedures) unrelated to waste contamination.

The results of the regressions for aluminum show poor correlation between earthworm survival and aluminum concentrations (correlation coefficient values (correlation coefficient [r^2] value) 0.57 for 14-day survival and 0.49 for 30-day survival). Furthermore, there is a moderate correlation between aluminum concentrations and earthworm growth (r^2 value was 0.79). These results indicate that aluminum concentrations in Site 15 surface soil may contribute to the observed suppression on earthworm growth and survival.

Correlation regressions for lead show a moderate correlation between earthworm survival and lead concentrations (r^2 values were 0.71 for 14-day survival and 0.63 for 30-day survival). There was a poor correlation between lead concentrations and earthworm growth (r^2 value was 0.45). These results indicate that lead concentrations in Site 15 surface soil may be interpreted as contributing to observed suppression earthworm survival.

The results of correlation regressions for TOC show poor to moderate correlation between earthworm survival and TOC concentrations (r^2 values were 0.64 for 14-day survival and 0.55 for 30-day survival). There is also a poor to moderate correlation between TOC concentrations and earthworm growth (r^2 value was 0.50). These results suggest that the TOC content of Site 15 soil is correlated with the adverse effects on earthworm survival and growth (i.e., TOC concentrations may correlate with depositional areas where soil and certain analytes that are toxic to earthworms accumulate after high water periods such as rain events).

A multiple linear regression comparing the observed effects with lead, aluminum, and TOC concentrations indicates that earthworm survival is moderately correlated with concentrations of these three analytes (r^2 values 0.80 and 0.70). These results suggest that concentrations of lead and aluminum may contribute to decreased earthworm survival.

No adverse responses were observed to either of the test species at the soil sample location with the highest concentration of TRPH (300 mg/kg at CF15SS7). It is unlikely that TRPH is related to the adverse responses observed for the test organisms.

The observed adverse effects to earthworms and lettuce are not collocated. The reduced lettuce germination occurred at CF15SS20, which did not have high concentrations of any of the analytes evaluated in the ERA (except PAHs); nor

were there explosives detected at this location. Therefore, the reduced germination may be due to a combination of factors (e.g., additive effects of PAH and lead concentrations). All of the sample locations where reduced earthworm growth and survival were observed have the higher concentrations of aluminum (1,250 to 5,570 mg/kg) and lead (1,340 to 7,510 mg/kg). Furthermore, areas with high TOC content (13,000 to 46,000 mg/kg) seem to be correlated with the observed effects (i.e., toxic analytes contributing to decreased earthworm survival may accumulate in depositional areas). It is likely that the combination of these analytes and other physical stressors may have caused the adverse effects to earthworms.

Terrestrial Plants - Benchmark Comparison. Risks for terrestrial plants were also evaluated by comparing the selected phytotoxicity benchmarks to maximum and average exposure concentrations (Table 7-23). Maximum and average concentrations of 10 PAHs, aluminum, antimony, chromium, lead, and vanadium exceed respective plant RTVs. Phytotoxicity benchmarks are not available for carbazole, explosive compounds, cyanide, and TRPH.

The phytotoxicity benchmarks used for aluminum, antimony, chromium, and vanadium were obtained from a review by Will and Suter (1994) and were derived to represent the 10th percentile of the LOECs for growth and yield endpoints. Because the number of aluminum, antimony, chromium, and vanadium studies included in the review was less than 10 (n=1, n=1, n=7, and n=2, respectively), the phytotoxicity benchmarks are equal to the lowest LOEC, and a confidence level of "low" was assigned Will and Suter (1994) to these benchmarks. Furthermore, some of the plants used in the laboratory studies for chromium are particularly sensitive species (e.g., lettuce, tomato, oats, soybean); therefore, risks to wild plants from exposure to these analytes may be overestimated. Will and Suter (1994) suggest that the derived benchmarks are conservative means for estimating population- or community-level impacts.

Both the maximum and background concentrations of aluminum and vanadium in Site 15 surface soil exceed their phytotoxicity benchmarks. No background value was available for chromium for Site 15; however, background values of chromium generally observed at NAS Cecil Field (i.e., 3.8 for Site 14) also exceed the phytotoxicity benchmark. The average detected concentrations (which better represent typical site concentrations) of aluminum (1,880 mg/kg), chromium (2 mg/kg), and vanadium (1.9 mg/kg), are well below background concentrations observed at NAS Cecil Field (4,040 mg/kg for aluminum and 4.8 mg/kg for vanadium) or are consistent with the phytotoxicity benchmarks (i.e., chromium and vanadium) and are not likely to result in adverse effects to plants. Furthermore, no observations of stressed vegetation were evident at Site 15 during the September, 1995 habitat characterization. It is possible that concentrations of these analytes in Site 15 surface soil are not site related, and that terrestrial plants may not be at risk.

Based on this evaluation, plants could potentially be impaired from exposure to maximum concentrations of several PAHs, aluminum, arsenic, antimony, chromium, lead, and vanadium in soil at Site 15. It is likely that the concentrations of PAHs and lead may cause adverse effects to plants; furthermore, it is recognized that several of these analytes (PAH, lead, and possibly arsenic and antimony) are related to past waste activities at the site. However, site concentrations of aluminum, chromium, and vanadium may not cause adverse effects to plants (as estimated) for several reasons. The phytotoxicity benchmarks selected for these

Table 7-23
Risk Summary for Plants and Invertebrates in Site 15 Surface Soil

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Exposure Point Concentrations[1]		RTV		RTV Exceeded?[3] (by Maximum/by Average)	
	Maximum	Average	Plant[2]	Invertebrate[2]	Plant	Invertebrate
Semivolatile Organic Compounds (mg/kg)						
Acenaphthene	3	2	25	34	No/No	No/No
Anthracene	11	6	25	34	No/No	No/No
Benzo(a)anthracene	340	34	25	34	Yes/Yes	Yes/Yes
Benzo(a)pyrene	340	33	25	34	Yes/Yes	Yes/No
Benzo(b)fluoranthene	510	48	25	34	Yes/Yes	Yes/Yes
Benzo(g,h,i)perylene	54	14	25	34	Yes/No	Yes/No
Benzo(k)fluoranthene	130	17	25	34	Yes/No	Yes/No
Butylbenzylphthalate	0.44	0.44	200	478	No/No	No/No
Carbazole	7	4	NA	NA	NA	NA
Chrysene	400	40	25	34	Yes/Yes	Yes/Yes
Dibenz(a,h)anthracene	13	6	25	34	No/No	No/No
Dibenzofuran	1	1	617	NA	No/No	NA
Di-*n*-butylphthalate	5.5	2.3	200	478	No/No	No/No
bis(2-Ethylhexyl)phthalate	0.52	0.52	>1,000	478	No/No	No/No
Fluoranthene	660	62	25	34	Yes/Yes	Yes/Yes
Fluorene	1	1	25	34	No/No	No/No
Indeno(1,2,3-cd)pyrene	102	16	25	34	Yes/No	Yes/No
2-Methylnaphthalene	0.9	0.6	25	34	No/No	No/No
Naphthalene	2	2	100	34	No/No	No/No
Phenanthrene	260	27	25	34	Yes/Yes	Yes/No
Pyrene	500	47	25	34	Yes/Yes	Yes/Yes
Explosive Compounds (mg/kg)						
HMX	1.1	0.81	NA	NA	NA	NA
3-Nitrotoluene	1.2	0.87	NA	NA	NA	NA
4-Nitrotoluene	1.4	0.93	NA	NA	NA	NA
Pesticides and PCBs (mg/kg)						
4,4'-DDE	0.0013	0.0013	12.5	12	No/No	No/No
4,4'-DDT	0.011	0.011	12.5	12	No/No	No/No
Dieldrin	0.00037	0.00037	12.5	30	No/No	No/No
Endosulfan II	0.0021	0.0021	[4]>1000	[4]1	No/No	No/No

See notes at end of table.

Table 7-23 (Continued)
Risk Summary for Plants and Invertebrates in Site 15 Surface Soil

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Exposure Point Concentrations[1]		RTV		RTV Exceeded?[3] (by Maximum/by Average)	
	Maximum	Average	Plant[2]	Invertebrate[2]	Plant	Invertebrate
Inorganic Analytes (mg/kg)						
Aluminum	1,880	1,090	50	NA	Yes/Yes	NA
Antimony	15.3	45.3	5	NA	Yes/Yes	NA
Arsenic	22.4	19.4	10	100	Yes/Yes	No/No
Barium	29.4	15.4	500	NA	No/No	NA
Cadmium	0.55	0.52	3	50	No/No	No/No
Chromium	2	2	1	50	Yes/Yes	No/No
Cobalt	2.7	2.7	20	NA	No/No	NA
Copper	3.2	3	100	30	No/No	No/No
Cyanide	0.27	0.25	NA	NA	NA	NA
Lead	4,190	730	50	1,190	Yes/Yes	Yes/No
Manganese	6.4	4.8	500	NA	No/No	NA
Nickel	2.2	2.2	30	400	No/No	No/No
Vanadium	2.5	1.9	2	NA	Yes/No	NA
Zinc	2.9	2.9	50	130	No/No	No/No
General Chemistry (mg/kg)						
Total Recoverable Petroleum Hydrocarbons	130	73	NA	NA	NA	NA

[1] Exposure Point Concentrations (EPCs) are presented in Table 7-17. The maximum EPCs are equal to the lesser of the maximum detected concentration or the 95th percent upper confidence limit. Average EPCs are equal to the mean of all concentrations When the mean is greater than the maximum EPC, the maximum EPC was used.
[2] Plant and invertebrate RTVs are presented in Appendix A, Tables A-13 and A-14 (respectively). Generally, the plant RTVs are the lowest observed effect concentration from among plant growth studies on plants in solid media, and invertebrate RTVs are the lowest lethal concentration to 50 percent of test population (14-day soil test on *Eisenia foetida*) from among chemicals in the same chemical class (applies to organic compounds). A conservative factor of 0.2 was applied to invertebrate RTVs; the resultant value should be protective of 99.9 percent of the population from lethal effects (U.S. Environmental Protection Agency, 1986).
[3] Comparison shown is maximum EPC to RTV/average EPC to RTV.
[4] Values for Endosulfan I were used as surrogates.

Notes: RTV = reference toxicity value.
mg/kg = milligrams per kilogram.
= shading indicates exceedances.
NA = not applicable.
> = greater than.
HMX = cyclotetramethylenetetranitramine.
PCB = polychlorinated biphenyl.
DDE = dichlorodiphenyldichloroethene.
DDT = dichlorodiphenyltrichloroethane.

analytes may be overly conservative and may overestimate risk to plants. In addition, background concentrations of aluminum, chromium, and vanadium also exceed phytotoxicity benchmarks and average concentrations of these analytes. Lastly, these analytes are not related to past waste activities at the site and no signs of stressed vegetation were observed at Site 15.

The benchmark exceedances for PAHs, lead, and possibly antimony and arsenic suggest that these analytes may be the primary cause for the adverse responses observed for lettuce seed germination at CF15SS20 (where PAHs were detected at some of their highest concentrations).

Terrestrial Invertebrates - Benchmark Comparison. Risks for terrestrial invertebrates were also evaluated by comparing invertebrate toxicity benchmarks to maximum and average exposure concentrations. The results of this evaluation for Site 15 surface soil are presented in Table 7-23. The maximum and average concentration of 10 PAHs and lead exceed their benchmarks, suggesting that terrestrial invertebrates may experience effects from exposure to these analytes. However, no adverse effects to earthworm survival or growth were observed in laboratory toxicity tests for sample locations CF15SS7 or CF15SS20, where the highest PAH concentrations were detected. Earthworm survival and growth were adversely impacted at several sample locations where lead was detected at concentrations ranging from 1,340 to 7,510 mg/kg (e.g., CF15SS6, CF15SS15, CF15SS26, and CF15SS46). These concentrations exceed the lead benchmark of 1,190 mg/kg, suggesting that lead is the primary agent contributing to adverse effects to earthworms. Invertebrate benchmark values are not available for carbazole, dibenzofuran, explosive compounds, aluminum, antimony, barium, cobalt, cyanide, manganese, vanadium, or TRPH.

7.2.6.2 **Surface Water and Sediment** Potential risks are characterized for wildlife and aquatic receptors by comparing PDE concentrations from ingestion and bioaccumulation of surface water and sediment ECPCs with RTVs (estimated threshold for toxicity) (as discussed in Paragraph 7.1.6.2). Risks for aquatic life are characterized based on a comparison of exposure concentrations of the ECPCs in surface water and sediment samples with the benchmarks.

Wildlife Receptors. Risks for the representative wildlife species associated with ingestion of surface water, potentially contaminated aquatic life, and sediment is quantitatively evaluated using the HI and HQ approach.

The lethal and sublethal HIs and HQs calculated for each of the representative wildlife species from exposure to surface water and sediment ECPCs at Site 15 are provided in Appendix B, Table B.15-34. HIs for lethal effects to receptors ranged from 0.00011 for the raccoon to 0.097 for the Florida water rat, and HIs for sublethal effects to receptors ranged from 0.00018 for the raccoon to 2.0 for the Florida water rat. The HIs for lethal effects were all below 1; however, the HI for sublethal effects from exposure to maximum surface water and sediment ECPCs exceeded 1 for the Florida water rat. This slight risk to small mammals is estimated from exposure to lead. Therefore, evaluation of risk from exposure to average ECPCs was conducted. The lack of bioaccumulation factors for PAHs and several inorganics causes uncertainty about wildlife exposures to these analytes.

The sublethal HIs and HQs calculated based on average ECPCs in Site 15 surface water and sediment are provided in Appendix B, Table B.15-35. HIs and HQs were not calculated for lethal effects from exposure to average surface water and

sediment ECPCs, as no lethal effects were predicted in the maximum exposure scenario. HIs for sublethal effects to receptors ranged from 0.00057 for the raccoon to 0.61 for the Florida water rat.

Evaluation of the results of the food-web modeling suggests slight risks to small mammals may exist from exposure to maximum concentrations of lead. However, it is unlikely that organisms would continuously be exposed to maximum concentrations; no risks to small mammals from average concentrations of lead (which better represent typical exposure) are anticipated.

Aquatic Receptors. Risks for aquatic receptors are discussed separately for surface water and sediment.

Surface Water. The potential for adverse effects to aquatic receptors was evaluated by comparing filtered and unfiltered surface water concentrations with benchmarks, (Table 7-24). This comparison indicates that filtered and unfiltered concentrations of aluminum, iron, and lead exceed aquatic benchmark values. In addition, the unfiltered concentration of copper at CF15SW2 exceeds its benchmark.

The concentrations of aluminum in filtered and unfiltered surface water at Site 15 are consistent with the concentrations detected in surface water at Site 14, ranging from 427 to 649 $\mu g/\ell$. For the same reasons discussed in Paragraph 7.1.6.2, it is possible that the concentrations of aluminum detected in Site 15 surface water would not cause risk to most aquatic receptors.

Concentrations of copper in Site 15 surface water are also consistent with concentrations detected in Site 14 surface water. Copper was detected at CF15SW2 at a concentration of 11 $\mu g/\ell$ in unfiltered surface water, which exceeds the available guidelines and criteria (4 $\mu g/\ell$) by less than a factor of 3 and the lowest adverse effect concentration in the AQUIRE database (1.5 $\mu g/\ell$ for water flea reproduction) by a factor of 7. For the same reasons presented in Paragraph 7.1.6.2, it is unlikely that concentrations of copper in Site 15 surface water would cause adverse effects to aquatic organisms.

The concentrations of iron detected in filtered and unfiltered surface water from Site 15 range from 490 to 1,980 $\mu g/\ell$. These concentrations barely exceed the USEPA AWQC, FDEP Class III standard, and the USEPA Region IV criterion. The benchmark selected from the AQUIRE database (460 $\mu g/\ell$ for trout hatchability) (Appendix A, Table A-15) is protective of a cold-water species of fish that do not inhabit the warm surface waters at Site 15. The next lowest benchmark in the AQUIRE database (3,700 $\mu g/\ell$ for duckweed growth) exceeds the maximum EPCs. This evidence suggests that concentrations of iron in Site 15 surface water are not likely to cause adverse effects to aquatic organisms.

Lead was detected in filtered and unfiltered surface water at concentrations ranging from 79.5 to 398 $\mu g/\ell$. These concentrations exceed the Federal AWQC, FDEP Class III standards, and the Region IV criterion of 0.5 $\mu g/\ell$ by several orders of magnitude; however, the AWQC document for lead (USEPA, 1985b) indicates that this criterion (recommended for use with the total recoverable method of analysis) may be overly protective. The benchmark selected from the AQUIRE database (52 $\mu g/\ell$) is protective of trout, which is a coldwater species of fish that does not inhabit the warm waters of Site 15. The other effects data

Table 7-24
Site 15 Surface Water ECPC Exposure and Toxicity Benchmark Comparison[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
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Jacksonville, Florida

Analyte	Exposure Point Concentration		FDEP Class III Fresh Water Quality Standards[2] (μg/ℓ)	AWQC[3] (μg/ℓ)	USEPA Region IV Water Quality Criteria (μg/ℓ)[4]	AQUIRE Lowest Reported Adverse Effect Concentration[5] (μg/ℓ)/Test Species	Result
	Maximum	Average					
Explosive Compounds (μg/ℓ)							
3-Nitrotoluene	4.95	1.9	NA	NA	NA	NA	No data[6]
4-Nitrotoluene	46.1	16	NA	NA	NA	NA	No data[6]
Tetryl	18.4	12.4	NA	NA	NA	[7]80/trout and minnow reproduction	Not Exceeded
1,3,5-Trinitrobenzene	6.73	2.4	NA	NA	NA	80/trout and minnow reproduction	Not Exceeded
Unfiltered Inorganic Analytes (μg/ℓ)							
Aluminum	649	560	NA	[8]87	[8]87	15/trout LC_{50}	Exceeded
Barium	17.1	13	NA	NA	NA	8,900/water flea reproduction	Not exceeded
Copper	11	11	[9]4	[9]4	[9]4	1.5/water flea reproduction	Exceeded
Iron	1,980	1,320	1,000	1,000	1,000	460/trout hatchability	Exceeded
Lead	398	265	[9]0.5	[9]0.5	[9]0.5	52/trout mortality	Exceeded
Vanadium	3 3	3.3	NA	NA	NA	128/guppy LC_{50}	Not exceeded
Filtered Inorganic Analytes (μg/ℓ)							
Aluminum	585	508	NA	[8]87	[8]87	15/trout LC_{50}	Exceeded
Barium	14 9	11 7	NA	NA	NA	8,900/water flea reproduction	Not exceeded
Iron	1,650	1,050	1,000	1,000	1,000	460/trout hatchability	Exceeded
Lead	225	167	[9]0.5	[9]0.5	[9]0 5	52/trout mortality	Exceeded

See notes at end of table

Table 7-24 (Continued)
Site 15 Surface Water ECPC Exposure and Toxicity Benchmark Comparison[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Exposure Point Concentration		FDEP Class III Fresh Water Quality Standards[2] (µg/ℓ)	AWQC[3] (µg/ℓ)	USEPA Region IV Water Quality Criteria (µg/ℓ)[4]	AQUIRE Lowest Reported Adverse Effect Concentration[5] (µg/ℓ)/Test Species	Result
	Maximum	Average					
Water Chemistry (µg/ℓ)							
Chloride	10,000	9,000	NA	230,000	230,000	NA	Not exceeded
Total Petroleum Hydrocarbons	600	400	NA	NA	NA	NA	No benchmark available

[1] Results of analyses of surface water samples included in Chapter 1.0 of the RIDD. Only those analytes selected as aquatic ECPCs in Table 7-18 are presented
[2] FDEP, Chapter 62-302, Surface Water Quality Standards (Florida Legislature, 1995)
[3] Chronic Federal Ambient Water Quality Criteria (USEPA, 1991e and 1988b).
[4] USEPA Region IV Water Quality Criteria (USEPA, 1995b)
[5] From Appendix A, Table A-15. Only growth, mortality, and reproductive effects to plants, invertebrates, amphibians, and fish were considered.
[6] No criteria, guidelines, or information in the AQUIRE database exists for this compound However, the concentrations of this analyte detected in Site 15 groundwater are less than a No Observed Effect Concentration of 3,200 µg/ℓ for developmental effects to the frog *Xenopus laevis* found in the literature (Devillers & Exbrayat, 1992)
[7] Value for 1,3,5-trinitrobenzene used as a surrogate because of structural similarities.
[8] Based on a pH of 6.5 to 9.
[9] Hardness-dependent criterion based on an estimated hardness concentration of 25 mg calcium carbonate ($CaCO_3$) as recommended by USEPA (57 FR 60848, 1992) (site-specific hardness is 19 mg/ℓ as $CaCO_3$).

Notes. ECPC = ecological contaminant of potential concern.
FDEP = Florida Department of Environmental Protection.
µg/ℓ = micrograms per liter.
AWQC = Ambient Water Quality Criteria (guidance criteria established under the Clean Water Act).
USEPA = U.S. Environmental Protection Agency.
AQUIRE = Aquatic Information Retrieval.
NA = not available.
Tetryl = trinitrophenylmethylnitramine.
= concentration exceeds the most conservative toxicity benchmark.
LC_{50} = lethal concentration to 50 percent of test population

presented in AQUIRE (Appendix A, Table A-1) suggest that other aquatic organisms may tolerate the concentrations of lead detected in Site 15 surface water.

Based on the results of the surface water analyses, it is possible that aquatic organisms may suffer adverse effects from exposure to aluminum, copper, iron, and lead in surface water. However, based on the conservative nature of the benchmarks used and the consistent nature in which some analytes (e.g., aluminum) are detected in surface water and groundwater, it is possible that risks were overestimated. Aluminum, copper, and iron may not be associated with site-related activities; therefore, detected concentrations of these analytes may be consistent with background and may not cause adverse effects to aquatic organisms from exposure to Site 15 surface water. Lead is associated with past site activities, and was detected at high concentrations in surface soil at Site 15. Although the lead benchmarks used for evaluating adverse effects to aquatic organisms are conservative and drainage pathways from surface soil to surface water are not clear, it is possible that site-related activities may have contributed lead contamination to surface water that could cause adverse effects to aquatic organisms. Due to a lack of TRPH toxicity data, there is uncertainty associated with aquatic organism exposures to TRPH in Site 15 surface water at CF15SW1, which is discussed in Subsection 7.2.7.

Sediment. The potential for adverse effects to aquatic receptors from exposure to Site 15 sediment was evaluated by comparing sediment concentrations with benchmarks, as provided in Table 7-25. This comparison indicates that concentrations of all 12 PAHs (primarily at sample location CF15SD3), 4,4'-DDT and its daughter products (detected at CF15SD2 and CF15SD3), and lead (at CF15SD2, CF15SD3, CF15SD4, CF15SD5, and CF15SD7) exceed aquatic benchmark values; in addition, the concentrations of benzo(b)fluoranthene at CF15SD1 and CF15SD2 also exceed its benchmark. No benchmarks are available for 2-butanone, carbazole, di-*n*-butylphthalate, 4-nitrotoluene, aluminum, barium, vanadium, or TRPH.

Nearly all of the concentrations of PAHs detected at CF15SD3 exceed the NOAA ER-Ls for marine and estuarine environments and OME LELs for cold water environments; none of the concentrations exceed USEPA sediment guidelines or NOAA ER-Ms. The NOAA ER-Ls and OME LELs were developed to be protective of 90 percent of aquatic organism populations and the majority of aquatic organisms, respectively. All exceedances are approximately two times the benchmarks or less; these slight exceedances suggest that although aquatic organisms may be at risk from exposure to PAHs, the potential adverse effects may be slight.

The concentrations of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT (collectively known as DDT_R), and lead at CF15SD2 barely exceeded sediment benchmarks; therefore, it is likely that adverse effects to aquatic organisms (based on the OME LEL and the NOAA ER-L) at this sediment location are unlikely to occur.

Concentrations of DDT_R at CF15SD3 slightly exceed USEPA sediment guidelines and OME LELs; in addition, concentrations of DDT_R exceed NOAA ER-Ls, potentially resulting in adverse effects to aquatic organisms. The magnitude of these exceedances suggests that any adverse effects would be minimal. In addition, DDT_R is not related to ordnance disposal activities and, therefore, may not be site related.

Table 7-25
Site 15 Sediment ECPC Exposure and Toxicity Benchmark Comparison[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Exposure Point Concentration		USEPA Sediment Quality Guidelines[2]	NOAA[3]		OME LEL[4]	SQAGs[5]		Result
	Maximum	Average		ER-L	ER-M		TEL	PEL	
Volatile Organic Compounds (mg/kg)									
2-Butanone	0.018	0.011	NA	NA	NA	NA	NA	NA	No benchmark available
Semivolatile Organic Compounds (mg/kg)									
Anthracene	0.55	0.26	NA	0.0853	1.1	0.22	0.047	0.245	Exceeds
Benzo(a)anthracene	6 1	1 1	NA	0.261	1.6	0.32	0 748	0.693	Exceeds
Benzo(a)pyrene	8	1	NA	0.43	1.6	0.37	0 0888	0.763	Exceeds
Benzo(b)fluoranthene	10	2	NA	NA	NA	[6]0 24	NA	NA	Exceeds
Benzo(g,h,i)perylene	3.5	0.6	NA	NA	NA	0.17	NA	NA	Exceeds
Benzo(k)fluoranthene	3.7	0.7	NA	NA	NA	0 24	NA	NA	Exceeds
Carbazole	0.058	0.058	NA	NA	NA	NA	NA	NA	No benchmark available
Chrysene	7.3	1.3	NA	0 384	2.8	0.34	0.108	0.846	Exceeds
Dibenz(a,h)anthracene	1.1	0.3	NA	0 0634	0 26	0.06	0.0062	0.135	Exceeds
Di-*n*-butylphthalate	3.1	1 9	NA	NA	NA	NA	NA	NA	No benchmark available
Fluoranthene	10	2	6.2	0.6	5 1	0.75	NA	NA	Exceeds
Indeno(1,2,3-*cd*)pyrene	4.3	0.77	NA	NA	NA	0 2	NA	NA	Exceeds
Phenanthrene	3 1	0 6	1.6	0.24	1.5	0 56	NA	NA	Exceeds
Pyrene	9 1	1 6	NA	0.665	2.6	0 49	0.153	1.398	Exceeds
Explosive Compounds (mg/kg)									
4-Nitrotoluene	37 5	12 7	NA	NA	NA	NA	NA	NA	No benchmark available
Pesticides and PCBs (mg/kg)									
4,4'-DDD	0.011	0.006	[7]0.00828	[7]0.00158	[7]0.0461	0 008	0.00122	0.00781	Exceeds
4,4'-DDE	0.0083	0.0047	[7]0.00828	0 0022	0 027	0.005	0.00207	0 374	Exceeds
4,4'-DDT	0.0081	0.0045	0.00828	0.00158	0 0461	0.008	0.00119	0.00477	Exceeds

See notes at end of table

Table 7-25 (Continued)
Site 15 Sediment ECPC Exposure and Toxicity Benchmark Comparison[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Exposure Point Concentration		USEPA Sediment Quality Guidelines[2]	NOAA[3]		OME LEL[4]	SQAGs[5]		Result
	Maximum	Average		ER-L	ER-M		TEL	PEL	
Inorganic Analytes (mg/kg)									
Aluminum	2,630	1,760	NA	NA	NA	NA	NA	NA	No benchmark available
Barium	3.9	3.1	NA	NA	NA	NA	NA	NA	No benchmark available
Iron	207	132	NA	NA	NA	20	NA	NA	Not exceeded
Lead	840	250	NA	46.7	218	31	30.2	112	Exceeds
Vanadium	2.4	1.8	NA	NA	NA	NA	NA	NA	No benchmark available
General Chemistry (mg/kg)									
Total Petroleum Hydrocarbons	0.11	0.067	NA	NA	NA	NA	NA	NA	No benchmark available

[1] Results of analyses of sediment samples included in Chapter 1.0 of the RIDD. Only those analytes selected as aquatic ECPCs in Table 7-19 are presented.
[2] U.S. Environmental Protection Agency (USEPA, 1988c; USEPA, 1993c) mean Sediment Quality Criteria adjusted values using 1 percent site-specific total organic carbon. All values represent Final Residue Values.
[3] NOAA ER-L and ER-M Sediment Guidelines correspond to the concentration that is protective of 90 percent of the population and 50 percent of the population, respectively (Long et al., 1994).
[4] OME LEL Provincial Sediment Quality Guidelines (Persaud et al , 1996) correspond to a concentration that can be tolerated by the majority of cold water benthic organisms
[5] SQAGs TEL and PEL correspond to the upper limit at the minimal effects range, and the lower limit of the probable effects range, respectively (FDEP, 1994).
[6] Value for benzo(k)fluoranthene used as a surrogate.
[7] Value for 4,4'-DDT used as a surrogate

Notes: ECPC = ecological contaminant of potential concern.
USEPA = U.S. Environmental Protection Agency.
NOAA = National Oceanic and Atmospheric Administration.
ER-L = effects range-low
ER-M = effects range-median.
OME = Ontario Ministry of the Environment
LEL = Low Effects Level
SQAGs = State of Florida Sediment Quality Assessment Guidelines.
TEL = toxic effect level.
PEL = probable effect level.
mg/kg = milligrams per kilogram
NA = not available.
= concentration exceeds the most conservative toxicity benchmark.
PCB = polychlorinated biphenyl.
DDD = dichlorodiphenyldichloroethane.
DDE = dichlorodiphenyldichloroethene.

The maximum lead concentration detected at CF15SD7 (840 mg/kg) exceeds the NOAA ER-L and OME LEL by factors of approximately 18 and 27, respectively; this concentration also exceeded the NOAA ER-M. Although drainage pathways from surface soil to sediment are not clear, it is possible that activities at Site 15 may have contributed to lead contamination that could result in adverse effects to aquatic organisms.

Based on the results of the sediment analyses, it is possible that aquatic organisms may suffer marginal adverse effects from exposure to PAHs, DDT_R, and lead in sediment. However, based on the evidence provided above, it is likely that only lead and PAHs are site related. Adverse effects to aquatic organisms caused by the presence of TRPH in sediment cannot be assessed as no TRPH benchmarks exist for sediment.

7.2.6.3 Groundwater Risks to aquatic organisms from exposure to Site 15 groundwater are evaluated by comparing exposure concentrations to the surface water toxicity benchmarks, which are presented in Table 7-26. Maximum concentrations of *bis*(2-ethylhexyl)phthalate, 4,4'-DDT, iron, silver (filtered only), and zinc exceed available aquatic benchmarks.

Bis(2-ethylhexyl)phthalate was detected in four monitoring wells at concentrations ranging from 1 to 220 $\mu g/\ell$. The maximum exposure concentration exceeded available surface water benchmarks, including the FDEP standard (3.0 $\mu g/\ell$), the proposed Federal AWQC (160 $\mu g/\ell$), and the lowest adverse effect concentration in the AQUIRE database (0.89 $\mu g/\ell$ for moorfrog hatchability). Although *bis*(2-ethylhexyl)phthalate was detected in groundwater that may result in adverse effects to aquatic organisms, this analyte was not detected in surface water. Because it was not found in surface water, it is overly conservative to assume that organisms would be exposed to undiluted groundwater concentrations.

Maximum concentrations of 4,4'-DDT (0.042 $\mu g/\ell$) exceed the Federal AWQC, FDEP standard, and USEPA Region IV criterion (0.001 $\mu g/\ell$). However, the endpoints for these benchmarks are based on residues in fish for the protection of wildlife; no benchmark has been derived for the protection of aquatic life. The only chronic value in the AWQC (USEPA, 1980) that is protective of aquatic life is 0.74 ($\mu g/\ell$), which is greater than the maximum exposure concentration. Nearly all of the over 1,000 effects concentrations listed in the AQUIRE database for 4,4'-DDT (Appendix A, Table A-15) are greater than 0.042 $\mu g/\ell$, with the exception of a few studies based primarily on physiological, oxygen consumption, hematological, and locomotive effects. None of these endpoints are considered appropriate assessment endpoints for evaluating the decline of aquatic organism populations. The selected endpoint (0.04 $\mu g/\ell$ for water flea mortality) is the only study in the AQUIRE database with an appropriate endpoint (i.e., a measure of the survival and maintenance of aquatic organisms); the maximum concentration of 4,4'-DDT only slightly exceeds this effects concentration. This suggests that the levels of 4,4'-DDT detected in Site 15 groundwater are not likely to cause adverse effects to aquatic organisms.

Iron was detected in all monitoring wells at concentrations ranging from 633 to 3,140 $\mu g/\ell$ in unfiltered samples, and from 598 to 2,410 $\mu g/\ell$ in filtered samples. The maximum exposure concentration exceeds several guidelines and criteria (1,000 $\mu g/\ell$) by a factor of three, and the lowest adverse effect concentration in the AQUIRE database (460 $\mu g/\ell$ for trout hatchability). As previously mentioned, no salmonids (cold water species) occur at Site 15. The maximum

Table 7-26
Site 15 Groundwater Exposure Concentration and Toxicity Benchmark Comparison[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	Exposure Point Concentrations		FDEP Class III Fresh Water Quality Standards[2] (µg/ℓ)	AWQC[3] (µg/ℓ)	USEPA Region IV Water Quality Criteria (µg/ℓ)[4]	AQUIRE Lowest Reported Adverse Effect Concentration[5] (µg/ℓ)/ Test Species	Result
	Maximum	Average					
Semivolatile Organic Compounds (µg/ℓ)							
bis(2-Ethylhexyl)phthalate	220	33	3.0	[6]160	NA	0.89/moorfrog hatchability	Exceeded
Explosive Compounds (µg/ℓ)							
3-Nitrotoluene	3.39	2.5	NA	NA	NA	NA	No data[7]
RDX	0.451	0.24	NA	NA	NA	710/catfish mortality	Not Exceeded
Pesticides and PCBs (µg/ℓ)							
4,4'-DDD	0.040	0.040	[8]0.001	[8]0.001	[8]0.001	0.04/water flea mortality	Not Exceeded
4,4'-DDT	0.042	0.042	[9]0.001	[9]0.001	[9]0.001	0.04/water flea mortality	Exceeded
Unfiltered Inorganic Analytes (µg/ℓ)							
Iron	3,140	1,750	1,000	1,000	1,000	460/trout hatchability	Exceeded
Manganese	49.6	21.2	NA	NA	NA	280/phytoplankton population endpoints	Not Exceeded
Thallium	6	5	[10]6.3	[11]40	NA	82/green algae growth	Not Exceeded
Zinc	246	60.5	[12]30	[12]30	[12]30	17.1/invertebrate population endpoints	Exceeded
Filtered Inorganic Analytes (µg/ℓ)							
Iron	2,410	1,480	1,000	1,000	1,000	460/trout hatchability	Exceeded
Silver	11.2	7.1	0.07	0 12	NA	11/water flea LC_{50}	Exceeded
Thallium	5.4	5.1	[10]6.3	[11]40	NA	82/green algae growth	Not Exceeded
Zinc	109	43	[12]30	[12]30	[12]30	17.1/invertebrate population endpoints	Exceeded

See notes on following page.

Table 7-26 (Continued)
Site 15 Groundwater Exposure Concentration and Toxicity Benchmark Comparison[1]

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

[1] Results of analyses of groundwater samples included in Chapter 1.0 of the RIDD (ABB-ES, 1997). Exposure point concentrations presented in Table 7-20.
[2] Florida Administrative Code, Chapter 62-302, Surface Water Quality Standards (Florida Legislature, 1995).
[3] Chronic Federal Ambient Water Quality Criteria (USEPA, 1991e and 1988b).
[4] USEPA Region IV Water Quality Criteria (USEPA, 1995b)
[5] From Appendix A, Table A-15. Only growth, mortality, and reproductive effects to plants, invertebrates, amphibians, and fish were considered.
[6] Proposed criterion
[7] No criteria, guidelines, or information in the AQUIRE database exists for this compound. However, the concentrations of this analyte detected in Site 15 groundwater are less than a No Observed Effect Concentration of 3,200 $\mu g/\ell$ for developmental effects to the frog *Xenopus laevis* found in the literature (Devillers & Exbrayat, 1992).
[8] Value for 4,4'-DDT used as a surrogate
[9] Value is derived to be protective of wildlife; no guidelines or criteria exist for the protection of aquatic life
[10] Criterion developed to be protective of human health; therefore was not used to evaluate toxicity to aquatic life.
[11] Insufficient data to develop criterion. Information presented is the LOEL - Lowest Observed Effect Level.
[12] Hardness-dependent criterion based on an estimated hardness concentration of 25 mg/ℓ of calcium carbonate ($CaCO_3$), as recommended by USEPA (57 FR 60848, 1992) (a site-specific hardness value of 19 mg/ℓ $CaCO_3$ was calculated using mean calcium and magnesium concentrations [Greenberg et al., 1992]).

Notes: FDEP = Florida Department of Environmental Protection.
$\mu g/\ell$ = micrograms per liter.
AWQC = Ambient Water Quality Criteria (guidance criteria established under the Clean Water Act)
USEPA = U.S. Environmental Protection Agency.
AQUIRE = Aquatic Information Retrieval.
= concentration exceeds the most conservative toxicity benchmark.
NA = not available
RDX = cyclotrimethylenenitramine
PCB = polychlorinated biphenyl.
DDD = dichlorodiphenyldichloroethane.
DDT = dichlorodiphenyltrichloroethane.
LC_{50} = lethal concentration to 50 percent of test population.

exposure concentration is less than the next lowest adverse effect concentration in the AQUIRE database (Appendix A, Table A-15), which is 3,700 $\mu g/\ell$ (based on an endpoint for duckweed growth). This suggests that concentrations of iron in groundwater at Site 15 may not cause adverse effects to aquatic organisms.

Silver, detected in one filtered groundwater sample at a concentration of 11.2 $\mu g/\ell$, was not detected in unfiltered groundwater samples or in any other media collected at Site 15. The groundwater concentration is over 100 times higher than the FDEP Standard and 93 times higher than the Federal AWQC for silver. A review of the silver AWQC document (USEPA, 1980) indicates that larval trout are among the most sensitive ecological receptors with regard to silver exposure. In addition, there is uncertainty associated with the detection of silver in filtered groundwater at only one location at such a high concentration, especially since silver was not detected in unfiltered groundwater or in any other Site 15 media. Given this evidence, it is likely that silver in groundwater is not posing a risk to aquatic receptors at Site 15.

Zinc was detected in 3 out of 8 monitoring wells at concentrations ranging from 92 to 246 $\mu g/\ell$ in unfiltered samples, and 109 $\mu g/\ell$ in filtered samples. The maximum exposure concentration exceeds several guidelines and criteria (30 $\mu g/\ell$) and the lowest adverse effect concentration in the AQUIRE database (17.1 $\mu g/\ell$ for invertebrate population endpoints). Although these concentrations may cause adverse effects to aquatic organisms, zinc was not detected in surface water samples at Site 15.

The results of the risk evaluation for aquatic organism exposures to ECPCs detected in groundwater suggest that although concentrations of several analytes exceed benchmarks, adverse effects to aquatic organisms may be minimal or are unlikely to occur. Factors supporting this conclusion include 1) concentrations of these analytes detected in groundwater are less than those detected in surface water (or were not detected in surface water at all), 2) these analytes are detected at concentrations less than relevant benchmarks, and 3) the presence of some of the analytes detected in groundwater is questionable.

7.2.7 Uncertainty Analysis The objective of the uncertainty analysis is to discuss the assumptions of the ERA process that may influence the risk assessment results and conclusions. General uncertainties inherent in the risk assessment process and in the Site 15 ERA are included in Table 7-14.

Specific uncertainties associated with the assessment of risks associated with contamination at Site 15 are included below.

- Risk to aquatic organisms from exposure to analytes detected in filtered groundwater samples may have been underestimated. Because no filtered background groundwater data were available, unfiltered background groundwater data were used to screen ECPCs. As a result, filtered aluminum, barium, cobalt, manganese, and vanadium were not retained for the risk assessment. However, the concentrations of these analytes (with the exception of aluminum) detected in groundwater are less than available plant and aquatic organism benchmarks; therefore, adverse effects from exposure to these analytes in groundwater are unlikely to occur. In the case of aluminum, concentrations in groundwater are less than in surface water; therefore, it is unlikely

that concentrations of aluminum in groundwater would contribute to adverse effects for aquatic organisms.

- There is uncertainty associated with using unfiltered surface water and groundwater data for evaluating risk to aquatic organisms from exposure to inorganic analytes. Risks to aquatic organisms may have been overestimated because unfiltered groundwater represents the total fraction of analytes that occur in the water column, including those that are sorbed to particulates and are unlikely to be biologically available or to migrate to a potential discharge point. Furthermore, there is uncertainty associated with the detected concentrations of filtered silver in groundwater since this analyte was not detected in the unfiltered sample or in any other site media.

- Risks to terrestrial receptors associated with exposure to TRPH in surface soil, surface water, and sediment may have been underestimated. Although selected as an ECPC for these media, TRPH was not evaluated in the ERA for exposures to wildlife or aquatic organisms because there are no toxicological benchmarks. However, exposures to PAHs (which may comprise the majority of TRPH detected at Site 15) were evaluated as part of the Site 15 ERA.

- There is uncertainty associated with the lack of sediment BAFs for PAHs; this may result in an underestimate of risk for terrestrial wildlife that ingest aquatic organisms that may bioaccumulate these compounds.

- Risks to avian species may have been underestimated because bioaccumulation and toxicity data for this taxonomic group are generally lacking in the literature, and mammalian data were not used as surrogates due to concerns about extrapolations between these two groups. As a result, potential risks associated with several ECPCs were not evaluated. If the data obtained from studies conducted on mammals were used for estimating risks to avian species, then risk estimates for birds would be higher because risks would have been quantified for more chemicals.

- There is uncertainty associated with the results of the serial dilutions performed in the laboratory toxicity tests. In both the dilutions performed for CF15SS15 and CF15SS20, conditions generally improved in the 50 percent and 25 percent dilutions, but declined again in the 12.5 percent and 6.25 percent dilutions. The toxicity test laboratory attributed these occurrences to poor sample homogeneity.

- The cotton mouse (*Peromyscus gossypinus*) was selected as an alternate wildlife receptor to better evaluate ecological effects for the small mammals in the terrestrial habitats at Site 15 when developing lead preliminary remedial goals. The cotton mouse was selected because its habitat covers much more of the Site 15 terrestrial conditions than does that of the shrew. Risks to the cotton mouse were calculated in the same manner as for the shrew. The lethal and sublethal risks predicted for small mammals (i.e., based on the shrew) are significantly reduced when risks for small mammals are modeled for the cotton mouse. The HQs calculated based on lethal effects were less than 1 for

average and maximum exposure point concentrations and well below the HQs calculated for the shrew. The HQs for sublethal effects were slightly above 1 for average and maximum exposure point concentrations. However, the HQs were calculated based on conservative assumptions, and thus would likely be overestimating risks at the site.

- There is uncertainty associated with utilizing average groundwater concentrations. The average concentrations of *bis*(2-ethylhexyl)-phthalate, 4,4'-DDT, iron, silver, and zinc detected in groundwater exceed surface water benchmark values; however, the average concentration is based on fewer than 10 samples and may not be representative of typical site conditions. Therefore, risks based on these exceedances may also not be representative of the site.

- There is uncertainty associated with risks predicted for terrestrial invertebrates from exposure to aluminum detected in surface soil. The analytical results for aluminum detected in Site 15 surface soil samples were statistically compared to concentrations detected in background samples, using the Mann-Whitney *U*-test. It was determined that aluminum concentrations detected in Site 15 samples and background samples are statistically similar (i.e., from the same population). Therefore, risks based on aluminum in surface soil may be overestimated, as the aluminum concentrations detected in site samples are consistent with background concentrations.

7.2.8 Summary of Ecological Assessment for Site 15 Potential risks for wildlife, terrestrial plants, soil invertebrates, and aquatic organisms were evaluated for ECPCs in surface soil, surface water, sediment, and groundwater at Site 15. Conclusions for the ERA are summarized in Table 7-27 and in the paragraphs that follow.

Surface Soil. Risk conclusions for wildlife, terrestrial plants and soil invertebrates exposed to surface soil are included below.

- Based on the results of food-web modeling, lethal risks may occur based on the shrew; but not the cotton mouse, and sublethal risks are likely to occur to small mammals and small birds from exposure to lead and arsenic.

- Observed reduced lettuce seed germination may be attributed to concentrations of PAHs. It is also possible that other factors (e.g., physical limitations) or a combination of analytes caused the observed effect.

- The benchmark comparison suggests that risks to plants may be a concern due to exposure to concentrations of PAHs, lead, and possibly antimony and arsenic.

- Reduced earthworm survival suggests that terrestrial invertebrate populations are at risk and were moderately correlated to soil concentrations of aluminum and lead. In addition, TOC concentrations may correspond to depositional areas where these inorganics may accumulate and where decreased earthworm survival was observed.

Table 7-27
Site 15 Ecological Risk Assessment Summary

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Receptor	Medium			
	Surface Soil	Surface Water	Sediment	Groundwater Discharge
Wildlife Receptors	Lead and arsenic (for small mammals and possibly small birds)	None	Lead	NA
Terrestrial Plants	Reduced germination (not correlated with any one analyte but may be associated with concentrations of PAHs); PAH and lead and possibly antimony and arsenic concentrations exceeded benchmarks; no visible adverse effects	NA	NA	NA
Soil Invertebrates	Reduced survival and growth possibly correlated with concentrations of lead and aluminum; PAH and lead concentrations exceeded benchmarks	NA	NA	NA
Benthic Macroinvertebrates	NA	Lead,RTV Exceeded	DDT_R, PAHs, and lead RTVs Exceeded	No substantial risks are expected

Notes: None = no effect.
NA = not applicable.
PAH = polynuclear aromatic hydrocarbon.

- Exposure concentrations of PAHs and lead exceeded invertebrate benchmarks; however, there was no correlation between concentrations of PAHs and the site-specific earthworm toxicity results.

Surface Water. Risk conclusions for each receptor group exposed to surface water are listed below.

- No lethal or sublethal risks to wildlife receptors from exposure to Site 15 surface water ECPCs are expected to occur.

Benchmark exceedances for aluminum, copper, and iron most likely overestimate risk, but risks to aquatic organisms from exposure to lead may occur.

Sediment. Risk conclusions for wildlife and aquatic organisms exposed to sediment are listed below.

- Based on the results of the food-web modeling, lethal effects to the shrew may occur due to exposure to lead EPCs; however, no sublethal risks to wildlife receptors are expected to occur.

- The lack of BAFs for PAHs is an uncertainty.

- Benchmark exceedances for DDT_R most likely overestimate risk; however, risks to aquatic organisms may occur from exposure to PAHs and lead.

- In order to better quantify exposure to lead and PAHs in sediment, toxicity testing using freshwater invertebrates is recommended for sample location CF15SD4, CF15SD5, and CF15SD7.

Groundwater. The risk conclusion for aquatic organisms exposed to groundwater as it discharges to the surface is provided below.

- While benchmarks for *bis*(2-ethylhexyl)phthalate, 4,4'-DDT, aluminum, iron, silver, and zinc were exceeded, aquatic organisms are not likely at risk since the selected benchmarks may overestimate risk at Site 15.

In summary, the results of the Site 15 ERA suggest that terrestrial plants, invertebrates, and small mammals may be at risk from exposure to some analytes detected in Site 15 surface soil (including lead and PAHs). Aquatic receptors may be at risk from exposure to lead in surface water, and from lead and PAHs in sediment. No substantial risks to aquatic receptors from exposure to groundwater are expected.

CHAPTER 8.0

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 CONCLUSIONS. Ordnance detonation and disposal activities were conducted at OU 5, Sites 14 and 15. At Site 14, ordnance was detonated in an open field adjacent to and west of a bunker used by ordnance personnel for protection. At Site 15, small arms ordnance was incinerated in a disposal chamber, and rocket propellent, flares, and cartridge-activated devices were ignited either on the ground or on a static firing pad. Prior to ordnance disposal, Site 15 functioned as a skeet range. Conclusions pertaining to OU 5 are described below.

- Soil at both sites is relatively permeable, fine-grained sand, with minor to moderate amounts of humic material. These sandy materials were encountered from land surface to approximately 15 feet bls, the maximum depth of investigation.

- The water table occurs very near the surface. At Site 14, it was encountered within 1 foot of land surface. At Site 15, it was encountered within 3 feet or less of land surface.

Conclusions pertaining to Site 14 are described below.

- Groundwater flow at Site 14 appears not to have a prevalent horizontal direction. The groundwater flow direction is radial with preferential direction dependent on water balance conditions and a strong downward component.

- Site 14 surface water drainage is closed and restricted to the site. Water in ditches created onsite are interpreted to be expressions of the shallow watertable.

- Aluminum, iron, manganese, and thallium were detected in groundwater at concentrations greater than USEPA or FDEP drinking water criteria. Aluminum concentrations were, however, within the range of background concentrations.

- Wildlife exposures to contaminants at Site 14 are not expected to adversely impact the ecological receptors.

- Surface water concentrations of *bis*(2-ethylhexyl)phthalate, aluminum, copper, and zinc exceed certain toxicological benchmarks established for aquatic receptors. However, the aquatic organisms that occur at Site 14 are limited by poor habitat conditions and are likely tolerant of the concentrations detected in surface water. In addition, *bis*(2-ethylhexyl)phthalate was not detected when the surface water was resampled.

- Based on comparison to benchmarks, ecological risks to terrestrial plants may be posed by aluminum and copper concentrations from one surface soil sample (CF14SS3) and to terrestrial invertebrates from the copper concentration in sample CF14SS3. Benchmarks for terrestrial plants are conservative and, as a result, risk to plants may be overestimated at this location. The maximum copper concentration exceeded the benchmark for invertebrates by less than a factor of 2,

suggesting that risk to invertebrates exposed to copper at the CF14SS3 location is slight.

- Aluminum concentrations in groundwater were assessed as posing a potential risk to terrestrial plants. Aluminum was detected in surface water, however, at much lower concentrations than groundwater. Additionally, stressed vegetation has not been noted at Site 14. These data suggest that groundwater concentrations are not adversely affecting surface water quality and, therefore, may not present a risk to terrestrial plants. Also, aluminum concentrations in groundwater are within the range of background concentrations, suggesting that aluminum concentrations are not site related.

- Human health risks are posed by the presence of beryllium and iron in surface water, and thallium, beryllium, iron, manganese, and aluminum in groundwater. Beryllium was not detected in surface water collected during a second sampling event.

- Future use of groundwater as a potable water supply is assessed to pose an HI of 5 (child) and 2 (adult) and an ELCR of 2×10^{-4} (aggregate of child and adult) compared to the baseline risk of 1 in 2 for men and 1 in 3 for women. These risks are greater than the acceptable limits of 1 and 1×10^{-6}, respectively. The dominant ELCR risk driver is beryllium (1×10^{-4} for adult). The central tendency aggregate residential cancer risk was assessed to be 4×10^{-5}. The central tendency noncarcinogenic risk was assessed to be 2 for an adult resident and 4 for a child resident. The major HI contributor is thallium, which had an HQ of 4.2. Beryllium and thallium were detected at concentrations greater than background shallow well concentrations. Other inorganics that contribute risk were above FDEP secondary drinking water guidance values, but within the range of background concentrations, indicating that these risks are not associated with site activity.

- Future recreational use of surface water poses an ELCR of 3×10^{-5} for an aggregate (combined adult and child) resident. Risks are based on ingestion of and dermal contact with surface water. Surface water concentrations of *bis*(2-ethylhexyl)phthalate, aluminum, copper, and zinc exceed certain toxicological benchmarks established for aquatic receptors. However, the aquatic organisms that occur at Site 14 are limited by poor habitat conditions and are likely tolerant of the concentrations detected in surface water.

Conclusions pertaining to Site 15 are described below.

- Groundwater at Site 15 flows to the west and southwest toward Caldwell Branch and Yellow Water Creek.

- Surface water at Site 15 drains to the north into a low-lying area that empties into Caldwell Branch and to the south into a swampy area that eventually drains into Yellow Water Creek.

- Organic and inorganic contaminants of concern were detected in Site 15 soil, groundwater, surface water, and sediment samples. PAHs and lead

were detected in surface soil over much of the area of investigation at concentrations greater than USEPA or FDEP criteria.

- Areas where contaminants of concern were detected are generally continuous and widespread. Lead was detected in surface soil over an area of approximately 34 acres at concentrations greater than the Office of Solid Waste and Emergency Response directive screening level of 400 mg/kg based on residential land use. PAH contamination in surface soil is distributed over approximately 37 acres at concentrations greater than FDEP soil cleanup criteria.

- Ecological risk to wildlife such as small mammals and small birds is assessed to be posed by exposure to maximum concentrations lead and arsenic concentrations in surface soil. Surface soil samples with lead concentrations that pose ecological risk are located downrange of the former skeet range. It is unlikely, however, that organisms would be continuously exposed to maximum concentrations. No risk to small mammals from average concentrations of lead are anticipated.

- Ecological risk to terrestrial plants and soil invertebrates is assessed to be posed by PAH and lead concentrations in surface soil. Some aluminum concentrations in surface soil may also pose a risk to soil invertebrates.

- Ecological risk to benthic macroinvertebrates is assessed to be posed by lead, PAH, and possibly 4,4'-DDD and 4,4'-DDT. Concentrations of seven PAHs were higher than their PEL values in sediment sample CF15SD7, which is located in the northern drainage structure. PEL values were not exceeded in a sample downgradient of CF15SD7. 4,4'-DDD and 4,4'-DDT concentrations were higher than their PEL values in sediment sample CF15SD3, which is located in the southern drainage structure.

- Concentrations of lead detected in Site 15 surface water may adversely affect aquatic organisms. Lead concentrations were greater than FDEP surface water criteria in all seven samples.

- Human health risks are assessed to be posed by the presence of PAHs, arsenic, and antimony in surface soil; thallium, iron, and antimony in groundwater; and TRPH in surface water.

- Human health risk from current land use (ingestion, dermal contact, and fugitive dust inhalation) of surface soil is estimated at 5×10^{-4} for an aggregate (adult and child) trespasser, which exceeds the ELCR of 1×10^{-6} and the USEPA upper acceptable threshold of 1×10^{-4}. This risk is posed by the presence of PAHs in surface soil. For future land use, the ELCR is estimated at 7×10^{-3} for an aggregate (adult and child) resident, and the HI for a child resident is 6. The ELCR for an occupational worker is estimated at 9×10^{-4}, 2×10^{-4} for a site maintenance worker, and 3×10^{-5} for an excavation worker. The central tendency aggregate cancer risks for a resident (1×10^{-4}), trespasser (6×10^{-5}), site maintenance worker (2×10^{-5}), and occupational worker (2×10^{-5}) are within the USEPA risk range. Major risk contributors are PAHs, arsenic, and antimony.

- Future aggregate (adult and child) resident ingestion of unfiltered groundwater is estimated at 8×10^{-5}, within USEPA's allowable cancer risk range, but greater than the FDEP threshold of 1×10^{-6}. The HI from ingestion of unfiltered groundwater is estimated at 2 for the adult resident and 5 for the child resident, both of which exceed the target HI of 1. The central tendency aggregate residential cancer risks was assessed to be 1×10^{-5}. The central tendency noncarcinogenic risk for an adult resident is 1; for a child resident is 4. Major contributors are thallium, iron, and antimony. Aluminum and iron concentrations were within the range of background concentrations and probably not site related.

- The HI for a resident child is estimated at 3 for recreational surface water exposure (ingestion and dermal contact) under a future use scenario. The USEPA target HI is 1. The major contributor is TRPH.

8.2 DATA LIMITATIONS. Outlined in this section are the limits within which the conclusions of the RI were made.

8.2.1 Data Limitations

- Suitable surface water and sediment background sample locations were not found. Site 14 is located on a drainage divide and has no upgradient area. Likewise, Site 15 is located at the head of a drainageway and, as a result, there was no upgradient drainage system that would provide representative samples. Therefore, surface water and sediment data could only be compared to available benchmark data.

8.2.2 Data Gaps

- The western extent of PAHs in Site 15 surface soil has not been delineated by confirmatory samples. If confirmatory and screening sample results are combined, then the northern extent beyond sample location CF15SS50 is still undefined.

- Arsenic and antimony have not been fully delineated in the areas surrounding sample locations CF15SS26, CF15SS15, and CF15SS46.

- The western extent of lead in Site 15 surface soil has not been delineated by confirmatory samples. If confirmatory and screening sample results are combined, the extent of lead is delineated, except in the southernmost area. Point kriging indicates lead concentrations in this southernmost area would fall below the USEPA screening concentration approximately 50 feet south of sample location CF15SS63. The distribution of lead in the southern part of the site can, then, be extrapolated using point kriging.

- The downgradient distance of contamination has not been delineated in the Site 15 drainageways.

8.3 RECOMMENDATIONS. Evaluation of the data gathered during the OU 5 RI indicates that ecological risks at Sites 14 and 15 are slight.

Human health risks posed by contaminants in Site 14 groundwater exist only if the water is used as potable water supply. It is recommended that a feasibility study not be conducted at Site 14.

Based on the risk posed by contaminants at Site 15, a feasibility study should be conducted to identify remedial alternatives for surface soil and sediment.

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APPENDIX A

APPENDIX A

EXPOSURE AND TOXICITY ASSUMPTIONS

Table A-1
Oral Dose-Response Data for Carcinogenic Effects

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Weight of Evidence	Oral Slope Factor (mg/kg-day)($^{-1}$)	Source	Test Species	Exposure Route	Tumor Type	Study Source
Volatile Organic Compounds							
Acetone	D	NE					
Semivolatile Organic Compounds							
Benzo(a)anthracene	B2	7.3E - 01	(1)				
Benzo(a)pyrene	B2	7.3E + 00	IRIS	Mouse	Oral-diet	Forestomach	IRIS
Benzo(b)fluoranthene	B2	7.3E - 01	(1)				
Benzo(g,h,i)perylene	D	NE					
Benzo(k)fluoranthene	B2	7.3E - 02	(1)				
bis(2-Ethylhexyl)phthalate	B2	1.4E - 02	IRIS	Rat	Oral-diet	Liver	IRIS
Carbazole	B2	2.0E - 02	HEAST	Mouse	Oral-diet	Liver	HEAST
Chrysene	B2	7.3E - 03	(1)				
Dibenzo(a,h)anthracene	B2	7.3E + 00	(1)				
Fluoranthene	D	NE					
Indeno(1,2,3-cd)pyrene	B2	7.3E - 01	(1)				
Phenanthrene	D	NE					
Pyrene	D	NE					
Pesticides and PCBs							
4,4'-DDD	B2	2.4E - 01	IRIS	Mouse	Oral-diet	Liver	IRIS
4,4'-DDE	B2	3.4E - 01	IRIS	Mouse/hamster	Oral-diet	Liver	IRIS
4,4'-DDT	B2	3.4E - 01	IRIS	Mouse/rat	Oral-diet	Liver	IRIS

See notes at end of table.

Table A-1 (Continued)
Oral Dose-Response Data for Carcinogenic Effects

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Weight of Evidence	Oral Slope Factor (mg/kg-day)(-1)	Source	Test Species	Exposure Route	Tumor Type	Study Source
Inorganic Analytes							
Aluminum	D	NE					
Antimony	D	NE					
Arsenic	A	1.5E + 00	IRIS	Human	Oral-drinking water	Skin	IRIS
Beryllium	B2	4.3E + 00	IRIS	Rat	Oral-drinking water	Total	IRIS
Iron	D	NE					
Lead	B2	NE					
Manganese	D	NE					
Thallium	D	NE					
Vanadium	D	NE					
Zinc	D	NE					
Total Recoverable Petroleum Hydrocarbons (TRPH)							
TRPH	D	NE	(2)				
Explosives							
HMX	D	ND					
RDX	D	ND					
1,3,5-Trinitrobenzene	D	ND					
3-Nitrotoluene	D	ND					
4-Nitrotoluene	D	ND					
Tetryl	D	ND					

See notes at end of table.

Table A-1 (Continued)
Oral Dose-Response Data for Carcinogenic Effects

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

(1) Relative potency factors (USEPA, 1993) have been applied to the ingestion slope factor for benzo(a)pyrene for all PAHs classified as A or B carcinogens.
(2) The value for pyrene has been used as a surrogate for total TRPH.

Notes: Weight of Evidence (route-specific):

A = Human carcinogen
B = Probable human carcinogen (B1 = limited human evidence, B2 = sufficient human evidence)
C = Possible human carcinogen
D = Not classifiable as to human carcinogenicity

Integrated Risk Information System (IRIS) online database search, current as of August 1996.
Health Effects Assessment Summary Tables (HEAST), current as of November 1995.

mg/kg-day -1 = milligrams per kilogram per day to the minus 1.
NE = not evaluated.
7.31E - 01 = 7 3x0.1 = 0.73.
IRIS = Integrated Risk Information System.
HEAST = Health Effects Assessment Summary Tables.
DDD = dichlorodiphenyldichloroethane.
DDE = dichlorodiphenyldichloroethene.
DDT = dichlorodiphenyltrichloroethane.
HMX = cyclotetramethylenetetranitramine.
RDX = cyclotrimethylenenitramine
ND = no data.

Table A-2
Inhalation Dose-Response Data for Carcinogenic Effects

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Weight of Evidence	Inhalation Slope Factor (mg/kg/day)$^{(-1)}$	Source	Inhalation Unit Risk ($\mu g/m^3$)$^{(-1)}$	Source	Test Species	Exposure Route	Tumor Type	Study Source
Volatile Organic Compounds									
Acetone	D	NE		NE					
Semivolatile Organic Compounds									
Benzo(a)anthracene	B2	NE		NE					
Benzo(a)pyrene	B2	NE		NE					
Benzo(b)fluoranthene	B2	NE		NE					
Benzo(g,h,i)perylene	D	NE		NE					
Benzo(k)fluoranthene	B2	NE		NE					
bis(2-Ethylhexyl)phthalate	D	NE		NE					
Carbazole	D	NE		NE					
Chrysene	B2	NE		NE					
Dibenzo(a,h)anthracene	B2	NE		NE					
Fluoranthene	D	NE		NE					
Indeno(1,2,3-cd)pyrene	B2	NE		NE					
Phenanthrene	D	NE		NE					
Pyrene	D	NE		NE					
Pesticides and PCBs									
4,4'-DDD	D	NE		NE					
4,4'-DDE	D	NE		NE					
4,4'-DDT	B2	3.4E-01	HEAST	9.7E-05	IRIS	Mouse/rat	Oral-diet	Liver	IRIS

See notes at end of table.

Table A-2 (Continued)
Inhalation Dose-Response Data for Carcinogenic Effects

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Weight of Evidence	Inhalation Slope Factor (mg/kg-day)($^{-1}$)	Source	Inhalation Unit Risk ($\mu g/m^3$)($^{-1}$)	Source	Test Species	Exposure Route	Tumor Type	Study Source
Inorganic Analytes									
Aluminum	D	NE		NE					
Antimony	D	NE		NE					
Arsenic	A	1.5E+01	IRIS	4.3E-03	IRIS	Human	Inhalation	Lung	IRIS
Beryllium	B2	8.4E+00	HEAST	2.4E-03	IRIS	Human	Inhalation	Lung	IRIS
Iron	D	NE		NE					
Lead	D	NE		NE					
Manganese	D	NE		NE					
Thallium	D	NE		NE					
Vanadium	D	NE		NE					
Zinc	D	NE		NE					
Total Recoverable Petroleum Hydrocarbons (TRPH)									
TRPH	D	NE	(1)	NE	(1)				
Explosives									
HMX	D	ND		ND					
RDX	D	ND		ND					
1,3,5-Trinitrobenzene	D	ND		ND					
3-Nitrotoluene	D	ND		ND					
4-Nitrotoluene	D	ND		ND					
Tetryl	D	ND		ND					

See notes at end of table

Table A-2 (Continued)
Inhalation Dose-Response Data for Carcinogenic Effects

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

(1) This value was provided by the Environmental Criteria and Assessment Office (ECAO) of the USEPA in response to a specific request.
(2) This value for pyrene has been used as a surrogate for TRPH.

Notes: Weight of Evidence (route-specific):

A = Human carcinogen
B = Probable human carcinogen (B1 = limited human evidence; B2 = sufficient human evidence)
C = Possible human carcinogen
D = Not classifiable as to human carcinogenicity

Integrated Risk Information System (IRIS) online database search, current as of August 1996.
Health Effects Assessment Summary Tables (HEAST), current as of November 1995.

3.4E - 01 = 3.4x0.1 = 0.34.
mg/kg-day - milligrams per kilogram per day.
$\mu g/m^3$ -1 = micrograms per cubic meter to the minus 1.
NE = not evaluated.
DDD = dichlorodiphenyldichloroethane.
DDE = dichlorodiphenyldichloroethene.
DDT = dichlorodiphenyltrichloroethane.
HEAST = Health Effects Assessment Summary Tables.
IRIS = Integrated Risk Information System
HMX = cyclotetramethylenetetranitramine.
RDX = cyclotrimethylenenitramine
ND = no data.

Table A-3
Oral Dose-Response Data for Noncarcinogenic Effects

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Chronic		Subchronic		Study Type	Confidence Level	Critical Effect	Test Animal	Uncertainty Factor	Study Source
	Oral RfD (mg/kg-day)	Source	Oral RfD (mg/kg- day)	Source						
Volatile Organic Compounds										
Acetone	1 0E-01	IRIS	1.0E+00	HEAST	Oral-gavage	Low	Increased liver, kidney weight	Rat	1,000 H,A,S	IRIS
Semivolatile Organic Compounds										
Benzo(a)anthracene	ND		ND							
Benzo(a)pyrene	ND		ND							
Benzo(b)fluoranthene	ND		ND							
Benzo(g,h,i)perylene	ND		ND							
Benzo(k)fluoranthene	ND		ND							
bis(2-Ethylhexyl)phthalate	2.0E - 02	IRIS	ND		Oral-diet	Medium	Increased liver weight	Guinea pig	1,000 H,A,S,L	IRIS
Carbazole	ND		ND							
Chrysene	ND		ND							
Dibenzo(a,h)anthracene	ND		ND							
Fluoranthene	4.0E - 02	IRIS	4.0E-01	HEAST	Oral-gavage	Low	Increased liver weight, clinical effects	Mouse	3,000 H,A,S,D	IRIS
Indeno(1,2,3-cd)pyrene	ND		ND							
Phenanthrene	ND		ND							
Pyrene	3.0E - 02	IRIS	3.0E-01	HEAST	Oral-gavage	Low	Renal tubular pathology	Mouse	3,000 H,A,S,D	IRIS

See notes at end of table.

Table A-3 (Continued)
Oral Dose-Response Data for Noncarcinogenic Effects

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Chronic		Subchronic		Study Type	Confidence Level	Critical Effect	Test Animal	Uncertainty Factor	Study Source
	Oral RfD (mg/kg-day)	Source	Oral RfD (mg/kg- day)	Source						
Pesticides and PCBs										
4,4'-DDD	ND		ND							
4,4'-DDE	ND		ND							
4,4'-DDT	5 0E - 04	IRIS	5.0E-04	HEAST	Oral-diet	Medium	Liver lesions	Rat	100 H,A	IRIS
Inorganic Analytes										
Aluminum	1.0E + 00	(1)	ND							
Antimony	4.0E - 04	IRIS	4.0E-04	HEAST	Oral-drinking water	Low	Reduced lifespan	Rat	1,000 H,A,L	IRIS
Arsenic	3.0E - 04	IRIS	3.0E-04	HEAST	Oral-drinking water	Medium	Hyperpig-m-entation, keratosis	Human	3 D	IRIS
Beryllium	5.0E - 03	IRIS	5 0E-03	HEAST	Oral-drinking water	Low	No effects observed	Rat	100 H,A	IRIS
Iron	3.0E - 01	(1)	ND							
Lead	ND		ND							
Manganese Food	1.4E - 01	IRIS	1.4E-01	HEAST	Oral-diet	NA	CNS effects	Human	1	IRIS
All other media	4.7E - 02	IRIS	ND		Oral-diet	NA	CNS effects	Human	3 M	IRIS
Thallium	8.0E - 05	IRIS (2)	8.0E-04	HEAST (2)	Oral-gavage	Low	No effects observed	Rat	3,000 H,A,S,D	IRIS
Vanadium	7.0E - 03	HEAST	7.0E-03	HEAST	Oral-drinking water	Low	No effects observed	Rat	100 H,A	HEAST
Zinc	3.0E - 01	IRIS	3.0E-01	HEAST	Oral-diet supplement	Medium	Decrease in ESOD activity	Human	3 S	IRIS

See notes at end of table.

Table A-3 (Continued)
Oral Dose-Response Data for Noncarcinogenic Effects

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Chronic		Subchronic		Study Type	Confidence Level	Critical Effect	Test Animal	Uncertainty Factor	Study Source
	Oral RfD (mg/kg-day)	Source	Oral RfD (mg/kg- day)	Source						
Total Recoverable Petroleum Hydrocarbons (TRPH)										
TRPH	3.0E-02	IRIS (3)	3.0E-01	HEAST (3)	Oral-gavage	Low	Renal tubular pathology	Mouse	3,000 H,A,S,D	IRIS
Explosives										
HMX	ND		ND							
RDX	ND		ND							
1,3,5 Trinitrobenzene	ND		ND							
3-Nitrotoluene	ND		ND							
4-Nitrotoluene	ND		ND							
Tetryl	1.0E-02	IRIS	1.0E-02	IRIS						

See notes on following page.

Table A-3 (Continued)
Oral Dose-Response Data for Noncarcinogenic Effects

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

(1) This value was provided by the Environmental Criteria and Assessment Office (ECAO) of the USEPA in response to a specific request.
(2) The ingestion RfD values for thallium are based on thallium sulfate
(3) This value for pyrene has been used as a surrogate for TRPH.

Notes. Uncertainty factors:

H = Variation in human sensitivity
A = Animal to human extrapolation
S = Extrapolation from subchronic to chronic NOAEL
L = Extrapolation from LOAEL to NOAEL
D = Inadequate data
M = Modifying factor

Integrated Risk Information System (IRIS) on-line database search, current as of August 1996.
Health Effects Assessment Summary Tables (HEAST), current as of November 1995.
Environmental Criteria and Assessment Office (ECAO) of the USEPA in response to a specific request

mg/kg-day = milligrams per kilogram per day.
IRIS = Integrated Risk Information System.
HEAST = Health Effects Assessment Summary Tables.
ND = no data.
DDD = dichlorodiphenyldichloroethane.
RDX = cyclotrimethylenenitramine.
DDE = dichlorodiphenyldichloroethene.
DDT = dichlorodiphenyltrichloroethane.
HMX = cyclotetramethylenetetranitramine.
RDX = cyclotrimethylenenitramine.

Table A-4
Inhalation Dose-Response Data for Noncarcinogenic Effects

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Chronic		Subchronic		Study Type	Confidence Level	Critical Effect	Test Animal	Uncertainty Factor	Study Source
	RfC ($\mu g/m^3$)	Source	RfC ($\mu g/m^3$)	Source						
Volatile Organic Compounds										
Acetone	ND		ND							
Semivolatile Organic Compounds										
Benzo(a)anthracene	ND		ND							
Benzo(a)pyrene	ND		ND							
Benzo(b)fluoranthene	ND		ND							
Benzo(g,h,i)perylene	ND		ND							
Benzo(k)fluoranthene	ND		ND							
bis(2-Ethylhexyl)phthalate	ND		ND							
Carbazole	ND		ND							
Chrysene	ND		ND							
Dibenzo(a,h)anthracene	ND		ND							
Fluoranthene	ND		ND							
Indeno(1,2,3-cd)pyrene	ND		ND							
Phenanthrene	ND		ND							
Pyrene	ND		ND							
Pesticides and PCBs										
4,4'-DDD	ND		ND							
4,4'-DDE	ND		ND							
4,4'-DDT	ND		ND							

See notes at end of table.

Table A-4 (Continued)
Inhalation Dose-Response Data for Noncarcinogenic Effects

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Chronic		Subchronic		Study Type	Confidence Level	Critical Effect	Test Animal	Uncertainty Factor	Study Source
	RfC ($\mu g/m^3$)	Source	RfC ($\mu g/m^3$)	Source						
Inorganic Analytes										
Aluminum	ND		ND							
Antimony	ND		ND							
Arsenic	ND		ND							
Beryllium	ND		ND							
Iron	ND		ND							
Lead	ND		ND							
Manganese	5.0E-02	IRIS	ND		Inhalation	Medium	Impaired neurobehavioral function	Human	1,000 H,L,D	IRIS
Thallium	ND		ND							
Vanadium	ND		ND							
Zinc	ND		ND							
Total Recoverable Petroleum Hydrocarbons (TRPH)										
TRPH	ND	(1)	ND	(1)						
Explosives										
HMX	ND		ND							
RDX	ND		ND							
1,3,5-Trinitrobenzene	ND		ND							
3-Nitrotolunene	ND		ND							
4-Nitrotoluene	ND		ND							
Tetryl	ND		ND							

See notes at end of table.

Table A-4 (Continued)
Inhalation Dose-Response Data for Noncarcinogenic Effects

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Chronic		Subchronic		Study Type	Confidence Level	Critical Effect	Test Animal	Uncertainty Factor	Study Source
	RfC ($\mu g/m^3$)	Source	RfC ($\mu g/m^3$)	Source						

(1) This value for pyrene has been used as a surrogate for TRPH.

Notes: Uncertainty factors:

A = Animal to human extrapolation
H = Variation in human sensitivity
S = Extrapolation from subchronic to chronic NOAEL
L = Extrapolation from LOAEL to NOAEL
D = Inadequate data
M = Modifying factor

Integrated Risk Information System (IRIS) on-line database search, current as of August 1996.
Health Effects Assessment Summary Tables (HEAST), current as November 1995.

RfC = reference concentration.
$\mu g/m^3$ = micrograms per cubic meter.
ND = no data.
DDD = dichlorodiphenyldichloroethane.
DDE = dichlorodiphenyldichloroethene.
DDT = dichlorodiphenyltrichloroethane.
IRIS = Integrated Risk Information System.
HMX = cyclotetramethylenetetranitramine.
RDX = cyclotrimethylenenitramine.

Table A-5
Dermal Dose-Response Data for Carcinogenic Effects

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Compound	Weight of Evidence	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Oral Absorption Efficiency	Reference	Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$
Volatile Organic Compounds					
Acetone	D	NE			NE
Semivolatile Organic Compounds					
Benzo(a)anthracene	B2	7.3E - 01	91%	(30)(1)	8 0e - 01
Benzo(a)pyrene	B2	7.3E + 00	91%	Hecht et al., 1979	8.0e + 00
Benzo(b)fluoranthene	B2	7.3E - 01	91%	(1)	8 0e - 01
Benzo(g,h,i)perylene	D	NE			NE
Benzo(k)fluoranthene	B2	7.3E - 02	91%	(1)	8.0e - 02
bis(2-Ethylhexyl)phthalate	B2	1.4E - 02	100%	Chadwick et al., 1982	1.4e - 02
Carbazole	B2	2 0E - 02	50%	(2)	4.0e - 02
Chrysene	B2	7.3E - 03	91%	(1)	8.0e - 03
Dibenzo(a,h)anthracene	B2	7.3E + 00	91%	(1)	8.0 + 00
Fluoranthene	D	NE			NE
Indeno(1,2,3-cd)pyrene	B2	7.3E - 01	91%	(1)	8.0e - 01
Phenanthrene	D	NE			NE
Pyrene	D	NE			NE
Pesticides and PCBs					
4,4'-DDD	B2	2.4E - 01	20%	(3)	1 2e + 00
4,4'-DDE	B2	3.4E - 01	20%	(3)	1 7e + 00
4,4'-DDT	B2	3.4E - 01	20%	Siebert, 1976	1 7e + 00

See notes at end of table.

Table A-5 (Continued)
Dermal Dose-Response Data for Carcinogenic Effects

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Compound	Weight of Evidence	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Oral Absorption Efficiency	Reference	Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$
Inorganic Analytes					
Aluminum	D	NE			NE
Antimony	D	NE			NE
Arsenic	A	1.5E + 00	98%	Vahter, 1983	1.5E + 00
Beryllium	B2	4.3E + 00	1%	Owen, 1990	4.3E + 02
Iron	D	NE			NE
Lead	B2	NE			NE
Manganese	D	NE			NE
Thallium	D	NE			NE
Vanadium	D	NE			NE
Zinc	D	NE			NE
Total Recoverable Petroleum Hydrocarbons (TRPH)					
TRPH	D	ND			ND
Explosives					
HMX	D	ND			ND
RDX	D	ND			ND
1,3,5-trinitrobenzene	D	ND			ND
3-nitrotoluene	D	ND			ND
4-nitrotoluene	D	ND			ND
Tetryl	D	ND			ND

See notes at end of table.

Table A-5 (Continued)
Dermal Dose-Response Data for Carcinogenic Effects

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

(1) The oral absorption efficiency of all PAHs is assumed to be identical to that of benzo(a)pyrene, based on structural analogy.
(2) SVOCs lacking specific information on absorption efficiency are assigned a default value of 50% (USEPA Region IV, 1993).
(3) The oral absorption efficiency of DDE and DDD is assumed to be identical to that of DDT, based on structural analogy.

Notes: Weight of Evidence (route-specific):

A = Human carcinogen
B = Probable human carcinogen (B1 = limited human evidence, B2 = sufficient human evidence)
C = Possible human carcinogen
D = Not classifiable as to human carcinogenicity

For documentation concerning oral slope factors, refer to Table 1.

mg/kg-day = milligrams per kilogram per day.
NE = not evaluated.
% = percent.
DDD = dichlorodiphenyldichloroethane.
DDE = dichlorodiphenyldichloroethene.
DDT = dichlorodiphenyltrichloroethane.
ND = no data.
HMX = cyclotetramethylenetetranitramine.
RDX = cyclotrimethylenenitramine.

Table A-6
Dermal Dose-Response Data for Noncarcinogenic Effects

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Chronic Oral RfD (mg/kg-day)	Subchronic Oral RfD (mg/kg-day)	Oral Absorption Efficiency	Reference	Dermal Chronic RfD (mg/kg-day)	Dermal Subchronic RfD (mg/kg-day)
Volatile Organic Compounds						
Acetone	1.0E - 01	1 0E + 00	100%	ATSDR, 1992	1.0E - 01	1.0E + 00
Semivolatile Organic Compounds						
Benzo(a)anthracene	NA	NA	91%	(1)	NA	NA
Benzo(a)pyrene	NA	NA	91%	Hecht et al., 1979	NA	NA
Benzo(b)fluoranthene	NA	NA	91%	(1)	NA	NA
Benzo(g,h,i)perylene	NA	NA			NA	NA
Benzo(k)fluoranthene	NA	NA	91%	(1)	NA	NA
bis(2-Ethylhexyl)phthalate	2.0E - 02	NA	100%	Chadwick et al., 1982	2.0E - 02	NA
Carbazole	NA	NA	50%	(2)	NA	NA
Chrysene	NA	NA	91%	(1)	NA	NA
Dibenzo(a,h)anthracene	NA	NA	91%	(1)	NA	NA
Fluoranthene	4.0E - 02	4.0E - 01	91%	(1)	3.6E - 02	3.6E - 01
Fluorene	4.0E - 02	4.0E - 01	91%	(1)	3.6E - 02	3.6E - 01
Indeno(1,2,3-cd)pyrene	NA	NA	91%	(1)	NA	NA
Phenanthrene	NA	NA	91%	(1)	NA	NA
Pyrene	3.0E - 02	3.0E - 01	91%	(1)	2.7E - 02	2.7E - 01
Pesticides and PCBs						
4,4'-DDD	NA	NA	20%	(3)	NA	NA
4,4'-DDE	NA	NA	20%	(3)	NA	NA
4,4'-DDT	5.0E - 04	5.0E - 04	20%	Siebert, 1976	1.0E - 04	1.0E - 04

See notes at end of table.

Table A-6 (Continued)
Dermal Dose-Response Data for Noncarcinogenic Effects

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Chronic Oral RfD (mg/kg-day)	Subchronic Oral RfD (mg/kg-day)	Oral Absorption Efficiency	Reference	Dermal Chronic RfD (mg/kg-day)	Dermal Subchronic RfD (mg/kg-day)
Inorganic Analytes						
Aluminum	1.0E + 00	ND	20%	(4)	2.0E - 01	ND
Antimony	4.0E - 04	4.0E - 04	1%	ATSDR, 1991a	4.0E - 06	4.0E - 06
Arsenic	3.0E - 04	3.0E - 04	98%	Vahter, 1983	2 9E - 04	2 9E - 04
Beryllium	5.0E - 03	5.0E - 03	1%	Owen, 1990	5.0E - 05	5.0E - 05
Iron	3.0E - 01	ND	2%	Goyer, 1991	6.0E - 03	ND
Lead	ND	ND			ND	ND
Manganese	4.7E - 02	ND	4%	ATSDR, 1991b	1.9E - 03	ND
Thallium	8.0E - 05	8.0E- 04	100%	Lie et al., 1960	8.0E - 05	8.0E - 04
Vanadium	7.0E - 03	7.0E- 03	3%	ATSDR, 1991d	2.1E - 04	2.1E - 04
Zinc	3.0E - 01	3.0E- 01	34%	Sandstrom et al., 1987	1.0E - 01	1.0E - 01
Total Recoverable Petroleum Hydrocarbons (TRPH)						
TRPH	ND	ND				
Explosives						
HMX	ND	ND				
RDX	ND	ND				
1,3,5-Trinitrobenzene	ND					
3-Titrotoluene	ND					
4-Titrotoluene	ND					
Tetryl	1 0E - 02	1.0E - 02				

See notes at end of table.

Table A-6 (Continued)
Dermal Dose-Response Data for Noncarcinogenic Effects

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

[1] The oral absorption efficiency of all PAHs is assumed to be identical to that of benzo(a)pyrene, based on structural analogy.
[2] SVOCs lacking specific information on absorption efficiency are assigned a default value of 50% (USEPA Region IV, 1993).
[3] The oral absorption efficiency of DDE and DDD is assumed to be identical to that of DDT, based on structural analogy.
[4] Inorganics lacking specific information on absorption efficiency are assigned a default value of 20% (USEPA Region IV, 1993).

Notes: For documentation concerning chronic and subchronic oral RfDs, refer to Table 3.

mg/kg day = milligrams per kilogram per day
% = percent.
ND = no data.
PCB = polychlorinated biphenyl.
DDD = dichlorodiphenyldichloroethane.
DDE = dichlorodiphenyldichloroethene.
DDT = dichlorodiphenyltrichloroethane.
HMX = cyclotetramethylenetetranitramine.
RDX = cyclotrimethylenenitramine.
NA = not applicable.

A-7 - HUMAN HEALTH TOXICITY PROFILES

Acetone. Acetone is found both naturally in the environment, resulting from the breakdown of fat in the body, and is also used as a solvent in manufacturing plastics, fibers, drugs, and other pharmaceuticals. Workers, occupationally exposed to acetone, complained of respiratory tract and eye irritation. At higher doses, workers reported headaches, feelings of light-headedness and confusion. The USEPA toxicity value for acetone is based on changes in liver weight and kidney toxicity observed in rats. Information on the carcinogenicity of acetone is inadequate to classify it as carcinogenic.

References:

Agency for Toxic Substances and Disease Registry (ATSDR), 1993, "Toxicological Profile for Acetone", Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, February.

Integrated Risk Information System (IRIS), 1993. United States Environmental Protection Agency.

Aluminum. Aluminum occurs naturally in the soil and makes up approximately 8 percent of the earth's crust. Higher soil concentrations are associated with industries that burn coal and aluminum mining and smelting. Human exposures to aluminum may occur through ingestion of foods grown in soil that contains aluminum and use of antacids, antiperspirants, and other drug store items. Aluminum in antiperspirants can cause skin rashes in some people. Factory workers who inhale large amounts of aluminum dust may develop lung problems. Aluminum has caused lower birth weights in some animals. Studies have shown that aluminum accumulates in the brains of people with Alzheimer's disease. However, any causal link between aluminum exposure and this disease is yet to be demonstrated. Both human epidemiological studies and animal experiments strongly suggest that aluminum is not a carcinogen.

Reference:

Agency for Toxic Substances and Disease Registry (ATSDR), 1989, "Toxicological Profile for Aluminum", Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, October.

Antimony. Antimony enters the environment during the mining and processing of its ores and other related compounds. Small amounts of antimony are also released into the environment by incinerators and coal-burning power plants. Antimony will strongly adhere to soil that contains iron, manganese, or aluminum. Antimony was used for medicinal purposes to treat people infected with parasites. However, chronic exposure can cause eye, skin, and lung irritation, as well as heart problems, vomiting and diarrhea. The oral RfD, based on an oral drinking water study in rats, showed changes in glucose and cholesterol metabolism. Antimony has not been evaluated by the USEPA for evidence of human carcinogenic potential.

References:

Agency for Toxic Substances and Disease Registry (ATSDR), 1991, "Toxicological Profile for Antimony", Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, February.

Integrated Risk Information System (IRIS), 1993, United States Environmental Protection Agency.

Arsenic. Arsenic has been used in pesticide formulations and has industrial uses in tanneries, as well as the glass and wine making industries. Toxicity depends on its chemical form. Arsenic is an irritant of the skin, mucous membranes, and gastrointestinal tract. Symptoms of acute toxicity include vomiting, diarrhea, convulsions, and a severe drop in blood pressure. Subchronic effects include hyperpigmentation, sensory-motor polyneuropathy, persistent headache, and lethargy. Chronic oral exposure has caused skin lesions, peripheral vascular disease, and peripheral neuropathy. The USEPA has classified arsenic in Group A, human carcinogen, based on increased incidence of lung cancer in occupational studies.

Reference:

Agency for Toxic Substances and Disease Registry (ATSDR), 1992, "Toxicological Profile for Arsenic", Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, February.

Benzo(a)anthracene. Benzo(a)anthracene is a member of the polycyclic aromatic hydrocarbons (PAH) class of compounds that contain two or more aromatic rings. PAHs are ubiquitous in nature and are also manmade. Benzo(a)anthracene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material. It is also a product of pyrolysis in tobacco smoke.

Benzo(a)anthracene has produced skin tumors in laboratory animals after dermal application. Benzo(a)anthracene produced mutations in bacteria and in mammalian cells, and transformed mammalian cells in culture. Although there are no human data that specifically link exposure to benzo(a)anthracene to human cancers, benzo(a)anthracene is a component of mixtures that have been associated with human cancer. As such, benzo(a)anthracene has been classified by USEPA as a B2, probable human carcinogen.

Reference:

MADEP, 1992, "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6", Policy #WSC/ORS-142-92, Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, Massachusetts, September.

Benzo(a)pyrene. Benzo(a)pyrene is a member of the polycyclic aromatic hydrocarbons (PAH) class of compounds that contain two or more aromatic rings. They are ubiquitous in nature and are also manmade. Benzo(a)pyrene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material. Human data demonstrating a causal relationship linking benzo(a)pyrene to carcinogenicity are lacking. However, multiple animal studies

in many species demonstrate benzo(a)pyrene to be carcinogenic following administration by a variety of routes. The mechanism through which benzo(a)-pyrene elicits its carcinogenic potential is well understood. Benzo(a)pyrene has produced positive results in numerous genotoxicity assays. Benzo(a)pyrene has been classified by the USEPA as a B2, probable human carcinogen.

References:

ATSDR, 1989, Toxicological Profile for Polycyclic Aromatic Hydrocarbons, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, October.

Clayton, George D. and Florence E. Clayton, editors, 1981, Patty's Industrial Hygiene and Toxicology, 3rd Revised Edition: John Wiley & Sons, New York.

Integrated Risk Information System (IRIS), 1993, United States Environmental Protection Agency.

Benzo(b)fluoranthene. Benzo(b)fluoranthene is a member of the polycyclic aromatic hydrocarbons (PAH) class of compounds that contain two or more aromatic rings. PAHs are ubiquitous in nature and are also manmade. Benzo(b)fluoranthene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material.

Although there are no human data that specifically link exposure to benzo(b)fluoranthene to human cancers, benzo(b)fluoranthene is a component of mixtures that have been associated with human cancer. These include coal tar, soots, coke oven emissions, and cigarette smoke. Benzo(b)fluoranthene produced tumors in mice after lung implantation, intraperitoneal, or subcutaneous injection, and skin painting. Benzo(b)fluoranthene has produced positive results in several genotoxicity assays. It has been classified as a B2, probable human carcinogen, by the USEPA.

Reference:

MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, Massachusetts, September.

Benzo(k)fluoranthene. Benzo(k)fluoranthene is a member of the polycyclic aromatic hydrocarbons (PAH) class of compounds that contain two or more aromatic rings. PAHs are ubiquitous in nature and are also manmade. Benzo(k)fluoranthene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material.

Although there are no human data that specifically link exposure to benzo(k)fluoranthene to human cancers, benzo(k)fluoranthene is a component of mixtures that have been associated with human cancer. These include coal tar, soots, coke oven emissions, and cigarette smoke. Benzo(k)fluoranthene produced tumors after lung implantation in mice and when administered with a promoting agent in skin-painting studies. Benzo(k)fluoranthene is mutagenic in bacteria. Benzo(k)fluoranthene has been classified by USEPA as a B2, probable human carcinogen.

Reference:

MADEP, 1992, "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6", Policy #WSC/ORS-142-92, Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, Massachusetts September.

Benzo(g,h,i)perylene. Benzo(g,h,i)perylene is a member of the polycyclic aromatic hydrocarbons (PAH) class of compounds that contain two or more aromatic rings. PAHs are ubiquitous in nature and are also manmade. They occur naturally in coal tar, crude oil, and are formed from incomplete combustion of organic material.

There are no available data regarding human exposures. There are inadequate animal data from lung implant, skin-painting and subcutaneous injection bioassays. The USEPA has determined that benzo(g,h,i)perylene is not classifiable as to human carcinogenicity and has assigned it to class D.

Reference:

MADEP, 1992, "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6", Policy #WSC/ORS-142-92, Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, Massachusetts September.

Beryllium. Beryllium is a trace element that is obtained by extraction from mineral ores. Most beryllium is contributed to the environment by the burning of fossil fuels that contain beryllium ore. Beryllium is generally incorporated into alloy metals that are used in jet engine parts and electrical components. Pure beryllium metal is used in parts for aircraft brakes, nuclear weapons, nuclear reactors, and precision instruments.

Available data on beryllium suggest that it is most toxic to the lungs. Acute inhalation exposures to high concentrations of beryllium in the air can cause chemical pneumonitis, the symptoms of which include cough, shortness of breath, and fatigue. These symptoms can persist and even worsen after exposure to beryllium has been discontinued. Inhalation exposures to low concentrations of beryllium can produce chronic beryllium disease, which results in inhibited breathing efficiency. Inhalation of beryllium has been shown to produce lung cancer in animals, and an increased incidence of lung cancer has been demonstrated in workers who are exposed to beryllium in the air. Therefore, beryllium has been classified by the USEPA as a B2, probable human carcinogen.

Reference:

Agency for Toxic Substances and Disease Registry (ATSDR), 1991, "Toxicological Profile for Beryllium", Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, February.

***Bis*(2-ethylhexyl)phthalate (DEHP)**. DEHP is used industrially as a plasticizer for resins and is found in many plastic materials as it makes them more flexible. It is also used in manufacturing organic pump fluids in electrical capacitors. Acute exposure to DEHP has produced eye and mucous membrane irritation, nausea.

and diarrhea. Chronic exposure of laboratory animals to DEHP indicate that the target organs are the liver, causing morphological and biochemical changes, as well as the testes, producing damage to the seminiferous tubules. DEHP has produced developmental and reproductive effects in laboratory animals, including spina bifida and reduced fertility. DEHP has been shown to cause a dose-related increase in liver tumors in mice and rats. Thus, the USEPA has designated DEHP as a B2, probable human carcinogen.

Reference:

ATSDR, 1991, Toxicological Profile for Di(2-ethylhexyl)phthalate, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, October.

Carbazole. Carbazole is a dibenzopyrole compound that is formed from the incomplete combustion of nitrogen-containing organic matter, such as tobacco in cigarettes. Carbazole is also contained in crude oil and coal tars. Carbazole is used for making dyes, photographic plates, and in reagents.

Data on the adverse effects of carbazole exposure are limited. No data were available concerning human exposure. In animals, the oral LD_{50} has been reported as ranging from 500 to 5000 milligrams per kilogram (mg/kg), depending on the animal species tested. However, subcutaneous injections of 10 milligram (mg) carbazole for 1 year did not produce any adverse effects in mice. In a carcinogenicity bioassay with mice, chronic oral administration of carbazole in the diet produced both hepatocellular carcinomas and forestomach papillomas in males and females. Limited *in vitro* genotoxicity data indicate that carbazole is not mutagenic, suggesting that a reactive metabolite is responsible for the carcinogenic effects. Based on these data, carbazole has been ranked a group B2, probable human carcinogen.

Reference:

International Agency for Research on Cancer, 1983, IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans. Polynuclear Aromatic Compounds, Part 1, Chemical, Environmental and Experimental Data, Volume 32 World Health Organization, France.

Chrysene. Chrysene is one of the polycyclic aromatic hydrocarbons (PAH) compounds that are formed during the combustion of organic material. Although there are no human data that specifically link exposure to chrysene to human cancers, chrysene is a component of mixtures that have been associated with human cancer. These include coal tar, soots, coke oven emissions and cigarette smoke. Chrysene produced chromosomal abnormalities in hamsters and mouse germ cells after gavage exposure, positive responses in bacterial gene mutation assays, and transformed mammalian cells exposed in culture. Due to its similarities with benzo(a)pyrene and other carcinogenic PAHs, chrysene has been classified as a B2, probable human carcinogen.

Reference:

MADEP, 1992, "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6", Policy #WSC/ORS-142-92, Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, Massachusetts, September.

Dichlorodiphenyldichloroethane (DDD), Dichlorodiphenyldichloroethene (DDE), Dichlorodiphenyltrichloroethane (DDT). DDT was one of the most highly used insecticides and is now ubiquitous in the environment. It was used extensively in World War II to control lice (applied directly to human skin), and later used as an agricultural insecticide and as a public health tool to control insects that spread typhus and malaria. DDD and DDE were contained as impurities in DDT and are also primary metabolites of DDT and share similar toxicological properties. DDT, DDD, and DDE are highly persistent in the environment, and thus tend to bioconcentrate in the food chain. This, combined with its toxicological properties, has been attributed to the decline in population of several predatory bird species.

DDT is absorbed to a minor extent via inhalation and dermal routes, and to a large extent by the oral route. Exposure to humans is likely greatest through ingestion of mucous that was contaminated with DDT that had been inhaled. DDT is absorbed into the lymphatic system and distributed to fats throughout the body. In both humans and animals, DDT acts as a central nervous system stimulant by interfering with the movement of ions within neurons. DDT acts as an estrogenic compound in animals, and this has been attributed to numerous adverse reproductive effects observed in animals exposed to DDT. DDT also causes liver hypertrophy, hepatocyte degeneration, and induces the enzyme cytochrome P450, which can affect the metabolism of other xenobiotics. There is no conclusive evidence of DDT-induced carcinogenicity in humans. However, DDT has produced liver tumors in laboratory animals. DDD, DDE, and DDT have, therefore, been placed in U.S. Environmental Protection Agency's weight of evidence group B2, probable human carcinogen.

Reference:

Agency for Toxic Substances and Disease Registry (ATSDR), 1992, "Toxicological Profile for DDD, DDE, and DDT", Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, October.

Dibenzo(a,h)anthracene. Dibenzo(a,h)anthracene is one of the polycyclic aromatic hydrocarbons (PAH) compounds which are formed during the combustion of organic material. This compound is found in tobacco smoke, food, and industrial emissions. Although there are no human data that specifically link exposure to dibenzo(a,h)anthracene to human cancers, dibenzo(a,h)anthracene is a component of mixtures that have been associated with human cancer. These include coal tar, soots, coke oven emissions and cigarette smoke. Dibenzo(a,h)anthracene is metabolized similarly to benzo(a)pyrene, and has produced skin tumors in laboratory animals following dermal exposure. Dibenzo(a,h)anthracene has also been shown to be mutagenic, producing DNA damage in human cell cultures. Due to its similarities with benzo(a)pyrene and other carcinogenic PAHs, dibenzo(a,h)anthracene has been classified as a B2, probable human carcinogen.

Reference:

MADEP, 1992, "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6", Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, Massachusetts, September.

Fluoranthene. Fluoranthene is one of the polycyclic aromatic hydrocarbons (PAH) compounds which are formed during the combustion of organic material. Although there are no human data that specifically link exposure to chrysene to human cancers, fluoranthene is a component of mixtures that have been associated with human cancer. It is a constituent of coal tar and petroleum-derived asphalt. No data regarding human exposure are available, and animal data suggest that fluoranthene is not carcinogenic. Fluoranthene has been classified by USEPA as a D carcinogen.

Reference:

ATSDR, 1989, Toxicological Profile for Polycyclic Aromatic Hydrocarbons, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, October.

Indeno(1,2,3-cd)pyrene. Indeno(1,2,3-c,d)pyrene is one of the polycyclic aromatic hydrocarbons (PAH) compounds that are formed during the combustion of organic material and is a component of cigarette smoke and smoke stack emissions. No carcinogenicity data specifically for indeno(1,2,3-c,d)pyrene are available in humans, however, toxic effects are attributable to mixtures of PAHs. Animal studies indicate that indeno(1,2,3-c,d)pyrene can induce skin tumors in mice, and may have some immunosuppressive effects. In mammalian cell cultures, indeno(1,2-,3-c,d)pyrene was found to be genotoxic. It has been classified by the USEPA as a B2 carcinogen.

Reference:

MADEP, 1992, "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92, Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, Massachusetts, September.

Iron. Iron is a metal that is required for a variety of physiological functions such as heme biosynthesis, oxidative phosphorylation and mixed-function oxidase-mediated metabolic reactions. Only divalent forms of iron are absorbed. As absorption occurs, divalent iron is biochemically converted to trivalent iron, the biologically active form. Under normal conditions, absorbed dietary iron is complexed to hemoglobin and transported to the liver for storage until needed for physiological reactions. The balance of iron is regulated only by the amount of dietary intake and the degree of intestinal absorption. Intestinal absorption tends to be low (2 - 15 percent) except during periods of increased iron need when absorption efficiency increases dramatically.

Acute iron toxicity has been well characterized following the accidental ingestion of iron-containing preparations by children. Shortly after ingestion, the corrosive effects of iron cause vomiting and diarrhea, often bloody. Later

signs include shock, metabolic acidosis, seizures, liver and/or kidney failure, coma, and death. Chronic iron overload manifests as disturbances in liver function, diabetes mellitus, and endocrine and cardiovascular effects. Inhalation of iron containing dust or fumes in occupational settings may result in deposition of iron particles in the lungs leading to interstitial fibrosis. Autopsies of hematite miners noted an increase in lung cancer. However, the etiology of the lung cancer may be related to factors other than iron exposure such as cigarette, silica or PAH exposures.

References:

Aisen, P., Cohen, G. and Kang, J.O., 1990,Iron Toxicosis, Int. Rev. Exp. Pathol, 31:1-46.

Goyer, R.A., 1991. Toxic Effects of Metals. In: Casarett and Doull's Toxicology: The Basic Science of Poisons, 3rd edition, Eds. C.D. Klaassen, M.O. Amdur and J. Doull. Macmillan Publishing Co. New York, New York.

Lead. Lead is used as a component in storage batteries and was widely used in gasoline and paints. It is the most ubiquitous toxic metal in the environment. The most serious effects of chronic exposure are encephalopathy, renal damage, and changes in the hematopoietic system, which is the most sensitive indicator of lead exposure. Peripheral nerve dysfunction is observed in adults at blood lead levels of 30 to 50 micrograms per liter ($\mu g/\ell$)-blood. The nervous systems of children are reported to be affected at levels of 15 micrograms per liter ($\mu g/\ell$)-blood (Benignus and others, 1981). Chronic lead exposure by workers through inhalation has resulted in statistically significant increases in tumors. Oral exposures of lead salts in animals has been shown to increase tumor formation.

References:

Amdur, Mary O., John Doull, Curtis D. Klaassen, 1991, Toxicology: The Basic Science of Poisons, 4th edition: Pergamon Press, Inc., New York, New York.

Benignus, V.A., Otto, D.A., Muller, K.E., Seiple, K.J., 1981, "Effects of Age and Body Lead Burden on CNS Function in Young Children, II:EEG Spectra." Electroencephalograph. Clin. Neurophysiol, 52:240-248.

Manganese. Manganese is a naturally occurring substance found in many types of rock. It does not generally occur in the environment as the pure metal, rather, it is found combined with other chemicals such as sulfur, oxygen, and chlorine. Manganese is mixed with iron to make various types of steel. Manganese is a component of some ceramics, pesticides, fertilizers, and in nutritional supplements. In small doses manganese is beneficial to human health. Manganese miners and steel workers exposed to elevated concentrations of manganese have evidenced mental and emotional disturbances, and slow and clumsy body movements. Target organs of manganese are the lung and central nervous system. When inhaled, manganese dust can also cause lung irritation. USEPA has classified manganese as a Class D, not classifiable as to human carcinogenicity.

Reference:

Agency for Toxic Substances and Disease Registry (ATSDR), 1991, "Toxicological Profile for Manganese", Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, February.

Phenanthrene. Phenanthrene is a member of the polycyclic aromatic hydrocarbons (PAH) class of compounds which contain two or more aromatic rings. PAHs are ubiquitous in nature and are also manmade. Phenanthrene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material.

Phenanthrene has been shown to be a skin photosensitizer in humans. Intraperitoneally injection in rats produced liver effects. Although limited evidence exists that phenanthrene is a mutagen, the majority of tests have proved negative. Equivocal evidence exists for cancer after dermal application of phenanthrene in rats. Ingestion of 200 milligrams of phenanthrene produced no tumors in rats after 2 months.

Reference:

MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92, Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, Massachusetts, September.

Pyrene. Pyrene is a member of the polycyclic aromatic hydrocarbons (PAH) class of compounds which contain two or more aromatic rings. They are ubiquitous in nature and are also manmade. It occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material. Pyrene is reported to be a skin irritant to humans. Rats administered pyrene exhibited blood chemistry changes, as well as liver and kidney damage. Pyrene was shown to be inactive as an initiating agent and thus has been classified as a D carcinogen.

Reference:

ATSDR, 1989, Toxicological Profile for Polycyclic Aromatic Hydrocarbons Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, October.

Thallium. Thallium is a naturally occurring soft metal that is a minor constituent in a variety of ores and is obtained as a by-product of the refining of iron, cadmium, and zinc. It is used as a catalyst, in certain alloys, jewelry, thermometers, semiconductors, dyes and pigments, and optical lenses. It has been used medically as a depilatory agent. Additionally, it is used as a rodenticide and insecticide. Thallium is efficiently absorbed from the gastrointestinal tract. Excretion occurs primarily through urine and feces. Following absorption, distribution occurs to kidney tissue to a large extent, with lesser distribution to thyroid, intestines, testes, pancreas, skin, bone, and spleen.

Thallium is one of the more toxic metals. Acute toxicity results in gastrointestinal irritation, shock, ascending paralysis, seizures, and psychic disturbances.

Signs of subacute or chronic thallium poisoning include hair loss, nail dystrophy, cataracts, peripheral muscular weakness and atrophy, chorea, peripheral neuropathy, and kidney damage. Loss of vision have been related to industrial thallium exposures. No information is available which addresses the carcinogenic potential of thallium.

References:

Goyer, R.A., 1991, Toxic Effects of Metals. In: Casarett and Doull's Toxicology: The Basic Science of Poisons, 3rd edition, Eds. C.D. Klaassen, M.O. Amdur and J. Doull: Macmillan Publishing Co. New York, New York.

Tweig, M., 1990, Thallium, In: Poisoning and Drug Overdose, Ed. K.R. Olson. Appleton & Lange, CT. pps. 276-7.

Tetryl. Tetryl is a commercial name for tinitrophenylmethylnitramine (CAS number 479458). This chemical is also known as n-methyl-n2,4,6-te tranitroaniline. It is an explosive that is used as a detonating agent for less sensitive high explosives. There is no carcinogenicity data available for tetryl. Animal studies with rabbits indicate that tetryl can cause histopathological effects in the liver, kidney, and spleen.

Vanadium. Vanadium is widely, but sparsely, distributed in the earth's crust and in the environment. It is invaluable as an alloying agent with steel; ferrovanadium alloys are used in high-stress applications such as bearings, jet engines, and cutting tools. Human and animal studies indicate that vanadium is readily absorbed from the lungs and poorly absorbed from the gastrointestinal tract. It distributes primarily to the bone and kidney. Vanadium is a respiratory irritant. Inhalation of vanadium dusts in both animals and occupationally-exposed workers induces mild to moderate respiratory irritation. The effects are reversible and subside when exposure is discontinued. No studies were located regarding cancer in humans or animals following inhalation, oral, or dermal exposures. However, vanadium has been found to induce DNA damage in human cell cultures, suggesting that vanadium may have the potential to be genotoxic to humans.

Reference:

ATSDR, 1990, Toxicological Profile for Vanadium, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, October.

Zinc. The most common use of zinc is as a protective coating for other metals. Zinc is emitted into the air during mining, refining, manufacturing, and combustion of zinc-containing materials. Zinc is an essential trace element and is found in many foods. Zinc compounds are of relatively low toxicity via ingestion, however, ingestion may result in gastrointestinal distress and diarrhea. Metal fume fever results from occupational inhalation of fumes of zinc oxide whose symptoms include chills, fever, and profuse sweating. There is no evidence that zinc is a carcinogen.

Reference:

Amdur, Mary O., John Doull, Curtis D. Klaassen, 1991, Toxicology: The Basic Science of Poisons, 4th edition: Pergamon Press, Inc., New York, New York.

Table A-8
Summary of Bioaccumulation and Bioconcentration Data

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	log K_{ow}	[b]	Bioaccumulation Factor [a]						Bioconcentration Factor [a]
			Terrestrial Invertebrate [c]	Terrestrial Plant [d]	Mammal [e]	Bird [f]	Aquatic [g] Invertebrate	Aquatic Plant	Fish
VOLATILES									
Acetone	-0.24		[h]	[h]	NA	NA	NA	NA	NA
2-Butanone	0.29		[h]	[h]	NA	NA	NA	NA	[h]
SEMIVOLATILES									
Acenaphthene	3.9	5.3	5.0E-02	6.7E-03	3.0E-01	NA	NA	NA	[h]
Anthracene	4.5	5.3	5.0E-02	6.7E-03	3.0E-01	NA	NA	NA	[h]
Benzo(a)anthracene	5.7	5.3	5.0E-02	6.7E-03	3.0E-01	NA	NA	NA	[h]
Benzo(a)pyrene	6	5.3	5.0E-02	6.7E-03	3.0E-01	NA	NA	NA	[h]
Benzo(b)fluoranthene	6.1	5.3	5.0E-02	6.7E-03	3.0E-01	NA	NA	NA	[h]
Benzo(g,h,i)perylene	6.6	5.3	5.0E-02	6.7E-03	3.0E-01	NA	NA	NA	[h]
Benzo(k)fluoranthene	6.1	5.3	5.0E-02	6.7E-03	3.0E-01	NA	NA	NA	[h]
Butylbenzylphthalate	4.9	4.1	5.0E-02	3.3E-02	1.5E-01	NA	NA	NA	[h]
Carbazole	3.76 [i]	3.8	5.0E-02	5.2E-02	1.5E-01	NA	NA	NA	[h]
Chrysene	5.7	5.3	5.0E-02	6.7E-03	3.0E-01	NA	NA	NA	[h]
Dibenz(a,h)anthracene	6.5	5.3	5.0E-02	6.7E-03	3.0E-01	NA	NA	NA	[h]
Dibenzofuran	4.1	4.1	5.0E-02	3.3E-02	1.5E-01	NA	[h]	[h]	[h]
1,4-Dichlorobenzene	3.5	3.9	[h]	[h]	1.5E-01	NA	NA	NA	[h]
Diethylphthalate	3.2	4.1	[h]	[h]	1.5E-01	NA	NA	NA	[h]
Dimethylphthalate	2.1	4.1	[h]	[h]	1.5E-01	NA	NA	NA	[h]
Di-n-butylphthalate	5.2	4.1	5.0E-02	3.3E-02	1.5E-01	NA	NA	NA	[h]
bis(2-Ethylhexyl)phthalate	5.1	4.1	5.0E-02	3.3E-02	1.5E-01	NA	NA	NA	3.1E+02 [j]
Fluoranthene	4.95 [k]	5.3	5.0E-02	6.7E-03	3.0E-01	NA	NA	NA	[h]
Fluorene	4.2	5.3	5.0E-02	6.7E-03	3.0E-01	NA	[h]	[h]	[h]
Indeno(1,2,3-cd)pyrene	6.6	5.3	5.0E-02	6.7E-03	3.0E-01	NA	NA	NA	[h]
-Methylnaphthalene	3.86 [l]	5.3	5.0E-02	6.7E-03	3.0E-01	NA	[h]	[h]	[h]
aphthalene	3.6	5.3	5.0E-02	6.7E-03	3.0E-01	NA	[h]	[h]	[h]
Phenanthrene	4.5	5.3	5.0E-02	6.7E-03	3.0E-01	NA	NA	NA	[h]
Phenol	1.5	1.5	[h]	[h]	1.5E-01	NA	NA	NA	[h]
Pyrene	5.3	5.3	5.0E-02	6.7E-03	3.0E-01	NA	NA	NA	[h]
1,2,4-Trichlorobenzene	4.3	3.9	[h]	[h]	1.5E-01	NA	NA	NA	[h]
EXPLOSIVES									
HMX	0.26 [m]		5.0E-02	5.5E+00	1.5E-01	NA	[h]	[h]	[h]
3-Nitrotoluene	2.4		5.0E-02	3.2E-01	1.5E-01	NA	[h]	[h]	5.5E+01 [j]
4-Nitrotoluene	2.4		5.0E-02	3.2E-01	1.5E-01	NA	NA	NA	5.5E+01 [j]
TETRYL	2.4 [n]		[h]	[h]	1.5E-01	NA	[h]	[h]	5.5E+01 [j]
1,3,5-Trinitrobenzene	1.2		[h]	[h]	1.5E-01	NA	[h]	[h]	3.9E+00 [j]
PESTICIDES/PCBs									
4,4'-DDD	6		[h]	[h]	1.2E+00 [o]	2.9E+00 [p]	2.1E+01 [q]	NA	3.4E+03 [ai]
4,4'-DDE	5.7		1.7E+00 [r]	1.0E-02 [s]	1.2E+00 [o]	2.9E+00 [p]	2.1E+01 [q]	NA	3.4E+03 [ai]
4,4'-DDT	6.4		5.7E-01 [r]	1.0E-02 [s]	1.2E+00 [o]	2.9E+00 [p]	2.1E+01 [q]	NA	3.4E+03 [ai]
Dieldrin	4.6		5.5E+00 [t]	1.7E-02	1.5E+00 [u]	4.4E-01 [v]	2.1E+01 [w]	NA	[h]
Endosulfan II	3.6		5.5E+00 [x]	6.4E-02	1.1E-02 [y]	NA	[h]	[h]	[h]
Endrin	5.6		[h]	[h]	1.8E-02 [y]	5.9E-01 [y]	[h]	[h]	2.6E+02 [y]
INORGANICS									
Aluminum	NA		1.0E-01	8.0E-04 [z]	7.5E-02 [aa]	NA	NA	6.0E-03 [ab]	9.5E+01 [ai]
Antimony	NA		2.2E+00	4.0E-02 [z]	5.0E-02 [aa]	NA	[h]	[h]	1.0E+00 [j]
Arsenic	NA		7.3E-01	3.0E-01 [ac]	1.0E-01 [aa]	NA	[h]	[h]	2.8E+02 [j]
Barium	NA		5.5E+00	3.0E-02 [z]	7.5E-03 [aa]	NA	NA	2.5E-02 [ab]	4.0E+00 [j]
Beryllium	NA		[h]	[h]	5.0E-02 [ad]	NA	[h]	[h]	2.0E+00 [j]
Cadmium	NA		3.1E+00	3.3E+01 [ae]	2.1E+00 [aa]	3.8E-01 [af]	[h]	[h]	2.5E+01 [ai]
Chromium	NA		1.6E-01 [ag]	1.5E-03 [z]	2.8E-01 [aa]	NA	NA	6.3E-03 [ab]	[h]
Cobalt	NA		5.5E-01	4.0E-03 [z]	1.0E+00 [aa]	NA	[h]	[h]	[h]
Copper	NA		1.6E-01 [ag]	7.8E-01 [ah]	6.0E-01 [ae]	NA	NA	6.0E-02 [ab]	1.0E+01 [ai]
Cyanide	NA		0.0E+00 [aj]	1.0E+00 [ak]	0.0E+00 [aj]	NA	[h]	[h]	0.0E+00 [aj]
Lead	NA		2.9E-01	0.0E+00 [ae]	1.5E-02 [aa]	NA	NA	5.6E-02 [al]	4.0E+00 [ai]
Manganese	NA		1.6E+00	5.0E-02 [z]	2.0E-02 [aa]	NA	NA	1.3E-01 [ab]	1.5E+03 [ai]
Nickel	NA		3.7E+00	1.2E-02 [z]	3.0E-01 [aa]	NA	NA	1.4E-02 [al]	1.0E+02 [j]
Vanadium	NA		5.0E+00	1.1E-03 [z]	1.2E-01 [aa]	NA	NA	NA	1.0E-02 [j]
Zinc	NA		9.2E-01	6.1E-01 [ah]	2.1E+00 [aa]	NA	[h]	[h]	1.6E+02 [ai]

Table A–8
Summary of Bioaccumulation and Bioconcentration Data

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	log K_{ow} [b]	Bioaccumulation Factor [a]						Bioconcentration Factor [a]
		Terrestrial Invertebrate [c]	Terrestrial Plant [d]	Mammal [e]	Bird [f]	Aquatic [g] Invertebrate	Aquatic Plant	Fish

NOTES

[a] Units for bioaccumulation factors (BAFs) are mg/kg fresh wt tissue over mg/kg dry wt soil for terrestrial invertebrates and plants, mg/kg fresh wt tissue over mg/kg fresh wt food for small mammals and small birds, and mg/kg fresh wt tissue over mg/kg fresh wt. sediment for aquatic plants and organisms No BAFs were calculated for VOAs since available evidence suggests that these analytes do not bioaccumulate. Units for bioconcentration factors (BCFs) are μg/kg fresh wt. tissue over μg/L water. BCFs are presented for only those analytes that are selected as surface water ECPCs.

[b] From Superfund Chemical Data Matrix (USEPA, 1993) unless otherwise noted. Log K_{ow}s for classes of semivolatile compounds were averaged to provide an average BAF value. Compounds were grouped accordingly: PAHs (5.3), phthalates (4 1), carbazole (3.8), dibenzofuran (4 1), chlorinated benzenes (3.9), and phenol (1.5).

[c] Average of earthworm BAFs for SVOCs (Beyer, 1990) converted from dry weight to wet weight assuming earthworm is 80% water, unless otherwise noted. For inorganic analytes, site–specific BAFs (calculated in Table A–9) are presented unless otherwise noted.

[d] Plant BAF calclulated using the following equation presented by Travis and Arms (1988) unless otherwise noted: log (Plant Uptake Factor) = 1 588 – 0 578 (log Kow) Converted from dry weight to wet weight plant concentration assuming 80% water content.

[e] Calculated using the following equation in Travis and Arms (1988) for semivolatile organic analytes with log K_{ow}s > 5: log BTF (biotransfer factor) = log K_{ow} – 7.6; result multiplied by average ingestion rates for non–lactating and lactating test animals to convert from BTFs to BAFs, and divided by a factor of 0 2 to convert from dry feed to fresh feed. There is an uncertainty involved in using this equation for PAHs because this study did not use any PAHs in the regression analysis. When no literature values were available, BAFs were calculated for pesticides and PCBs, regardless of the log K_{ow}, due to the tendancy of these lipophylic compounds to bioaccumulate. With the exception of pesticides and PCBs, BAFs for analytes with log K_{ow}s < 5 are assumed to be 0.15 because they are unlikely to bioaccumulate in animal tissue (Maughan, 1993).

[f] Bioaccumulation data are generally lacking for avians. Therefore, there is uncertainty associated with estimating body–doses for birds without considering what chemicals may have bioaccumulated in prey–item tissue

[g] Used to represent bioaccumulation from sediment to fish and aquatic invertebrates. Sediment BAFs are presented for only those analytes that were selected as sediment ECPCs.

[h] This receptor group is not likely to be exposed to this ECPC Receptor exposures to analytes detected in surface soil include terrestrial invertebrates, terrestrial plants, mammals, and birds Receptor exposures to analytes detected in surface water and sediment include aquatic organisms, aquatic plants, fish, mammals, and birds.

[i] Hansch and Leo (1979)

[j] Calculated using a regression equation provided in Barnthouse *et al* (1988) unless otherwise noted.

[k] USEPA (1992), Dermal Exposure Guidance

[l] ATSDR, 1993a (Toxicological Profile for Naphthalene).

[m] Log K_{ow} for HMX from ATSDR (1994).

[n] Calculated log K_{ow} as presented in ATSDR (1993d)

[o] BAF for shrews and voles calculated using measured concentrations of DDT_R in stomach content and in whole body (Forsyth & Petrie, 1984)

[p] Whole–body pheasant BAF for 4,4'–DDT presented in USEPA (1985b); derived from Kenaga (1973).

[q] Amphipod to sediment mean biomagnification factor for total DDT in Lake Michigan and Lake Ontario (Evans *et al*, 1991).

[r] Geometric means of 4,4'–DDT [Davis (1968), Davis & Harrison (1966), Wheatley & Hardman (1968), Bailey et al. (1970), Cramp & Olney (1967), and Beyer & Gish (1980)], 4,4'–DDE [Davis (1968), Davis & Harrison (1966), Cramp & Olney (1967), Collett & Harrison (1968), Hunt & Sacho (1969), and Gish (1970)], and 4,4–DDD [Barker (1958), Davis (1968), Davis & Harrison (1966), Cramp & Olney (1967), Collett & Harrison (1968), Wheatley & Hardman (1968), Hunt & Sacho (1969), Bailey et al. (1970), Dimond et al. (1970), Gish (1970), and Beyer & Gish (1980)] reported for earthworms. Dry soil concentrations calculated assuming 10% moisture content in sandy–loam soils (Donahue et al., 1977).

[s] Geometric mean of 4,4'–DDT, 4,4'–DDD, and 4,4'–DDE BAFs (fresh wt/dry wt) reported for roots (carrot, potato, sugar beet), grains (corn, oats), and legumes (alfalfa) derived from USEPA (1985b) converted from dry weight to wet–weight per values provided by Suter (1993)

[t] Geometric mean of reported BAFs for earthworms (Edwards & Thompson, 1973). Values provided by Gish (1970) were converted from dry weight to wet weight by multiplying by a conversion factor of 0.2 assuming 80% water composition of earthworms

[u] BAF calculated from data presented by Potter et al (1974). Based on an average dieldrin concentration in cow muscle and fat of 0.17 mg/kg (dry weight) and a dieldrin concentration of 0.11 mg/kg in the diet (dry weight).

[v] Jeffries and Davis (1968).

[w] Value for 4 4'–DDT used as a surrogate.

[x] Value for dieldrin used as a surrogate

[y] BAFs from Garten & Trabalka (1983) were converted from (mg/kg fat)/(mg/kg diet) to (mg/kg fresh wt.)/(mg/kg diet) by multiplying the value by an assumed fat content of 10%.

[z] Value from Baes et al. (1984) for leafy portions of plants multiplied by 0.2 to represent 80% water composition of plants.

[aa] Value derived from biotransfer factors (BTFs), presented in Baes et al. (1984) for uptake into cattle BTF converted to BAF by multiplying by food ingestion rate of 50 kg/day wet weight

[ab] Aquatic plant BAFs derived from an uptake study (Cherry & Guthrie, 1979) with two sedge species, *Andropogon virginicus* and *Cyperus retrofractus*, that were exposed to contaminated sediment. Values were converted from dry weight plant tissue to wet weight by applying a factor of 0.2 (assuming plants are 80% water).

[ac] Average of BAF values reported from Wang et al (1984), Sheppard et al (1985), and Merry et al. (1986).

[ad] Mean of values reported for *Sorex araneus* in MacFadyen (1980).

[ae] Mammal value for copper and plant value for cadmium from Levine et al., 1989. Lead does not accumulate in plant tissue, therefore, a BAF of zero was assigned.

Table A–8
Summary of Bioaccumulation and Bioconcentration Data

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Analyte	log K_{ow} [b]	Bioaccumulation Factor [a]						Bioconcentration Factor [a]
		Terrestrial Invertebrate [c]	Terrestrial Plant [d]	Mammal [e]	Bird [f]	Aquatic [g] Invertebrate	Aquatic Plant	Fish

[af] Based on accumulation of cadmium in kidneys of European quail in Pimentel et al. (1984).
[ag] BAF for earthworms from Dierckxsens et al.(1985).
[ah] Median of values reported from Levine et al (1989)
[ai] Geometric mean of BCFs obtained from AQUIRE (1994) and AWQC documents (calculated in Appendix A, Table A–10).
[aj] Cyanide has not been shown to bioaccumulate in any organism
[ak] Cyanide is naturally occurring in some plants, the extent to which it is taken up from soil is unknown and therefore a BAF of 1 is conservatively assumed
[al] Aquatic plant BAFs for lead and nickel from Mudroch & Capobianco (1979) represent BAFs for ECPCs from sediment in several lakes, rivers, and bays into water lilies. Values converted from dry weight plant tissue to wet weight by applying a factor of 0.2 (assuming plants are 80% water).

NA = Not available

Table A–9
Calculation and Summary of Earthworm Bioaccumulation Factors

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

		Soil Data (mg/kg dry weight)		Barthworm Data (mg/kg wet weight)		Bioaccumulation Factor [2]
SITE ID	ANALYTE	RESULT	RDL [1]	RESULT	RDL [1]	([Earthworm]/[Soil])
CF15SS7	Aluminum	415		51.4		1 24E−01
	Antimony	1 4		6	12	4.29E+00
	Arsenic	2.6		2 5		9.62E−01
	Barium	42		9.8		2.33E−01
	Cadmium	0 78		2 4		3.08E+00
	Chromium	ND	2	0.49		NC
	Cobalt	0.27		5	10	1 85E+01
	Copper	ND	5	4.2		NC
	Cyanide	ND	0.5	ND	0.5	NA
	Lead	205		83.3		4 06E−01
	Manganese	30 9		3 9		1 26E−01
	Nickel	1.3		4	8	3.08E+00
	Selenium	ND		1.2		NC
	Thallium	ND	2	0.45		NC
	Vanadium	0.97		5	10	5.15E+00
	Zinc	32.6		29.9		9.17E−01
CF15SS18	Aluminum	316		64		2.03E−01
	Antimony	ND	12	ND	12	NC
	Arsenic	1 1		1	2	9.09E−01
	Barium	2.4		1		4.17E−01
	Cadmium	ND	1	ND	1	NA
	Chromium	ND	2	ND	2	NA
	Cobalt	ND	10	ND	10	NA
	Copper	ND	5	2		NC
	Cyanide	ND	0 5	ND	0.5	NA
	Lead	14.1		5.2		3.69E−01
	Manganese	5.6		3.7		6.61E−01
	Nickel	0.9		4	8	4.44E+00
	Selenium	ND	1	0.88		NC
	Vanadium	0.78		5	10	6 41E+00
	Zinc	ND	4	20.3		NC
CF15SS20 [3]	Aluminum	820		62.1		7.57E−02
	Antimony	ND	12	ND	12	NA
	Arsenic	1.3		1.2		9.23E−01
	Barium	7.1		1 3		1.83E−01
	Cadmium	ND	1	ND	1	NA
	Chromium	ND	2	0.45		NC
	Cobalt	ND	10	ND	10	NA
	Copper	ND	5	3.2		NC
	Cyanide	ND	0.5	ND	0.5	NA
	Lead	287		41.6		1 45E−01
	Manganese	3.8		4.5		1.18E+00
	Mercury	0.5		0.09		1.80E−01
	Nickel	ND	8	ND	8	NA
	Selenium	ND	1	1.3		NC
	Vanadium	1 4		5	10	3.57E+00
	Zinc	ND	4	24.2		NC
CF15SS48	Aluminum	333		14 4		4 32E−02
	Antimony	ND	12	ND	12	NA
	Arsenic	ND	2	ND	2	NA
	Barium	1.1		20	40	1.82E+01
	Cadmium	ND	1	ND	1	NA
	Chromium	ND	2	ND	2	NA
	Cobalt	ND	10	1 5		NC
	Copper	ND	5	2 3		NC
	Cyanide	ND	0.5	ND	0.5	NA
	Lead	0.97		0.3	0.6	3.09E−01
	Manganese	0.86		2 2		2 56E+00
	Nickel	ND	8	ND	8	NA
	Selenium	ND	1	1.3		NC

Table A–9
Calculation and Summary of Earthworm Bioaccumulation Factors

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

		Soil Data (mg/kg dry weight)		Earthworm Data (mg/kg wet weight)		Bioaccumulation Factor [2]
SITE ID	ANALYTE	RESULT	RDL [1]	RESULT	RDL [1]	([Earthworm]/[Soil])
CF15SS48	Vanadium	0.66		5	10	7.58E+00
(cont)	Zinc	ND	4	21		NC
CF15SS15 [4]	Aluminum	2,790		168		6.02E–02
	Antimony	151		6	12	3.97E–02
	Arsenic	48 3		5.8		1.20E–01
	Barium	2.4		20	40	8.33E+00
	Cadmium	ND	1	ND	1	NA
	Chromium	ND	2	ND	2	NA
	Cobalt	ND	10	ND	10	NA
	Copper	ND	5	ND	5	NA
	Cyanide	ND	0.5	ND	0 5	NA
	Lead	3,760		746		1.98E–01
	Manganese	1		3.2		3.20E+00
	Nickel	1.1		4	8	3.64E+00
	Silver	ND	2	5.3		NC
	Vanadium	2.1		5	10	2.38E+00
	Zinc	ND	4	57.5		NC

Compound	Sample Location BAFs					OU 5
	CF15SS7 BAF	CF15SS18 BAF	CF15SS20 BAF	CF15SS48 BAF	CF15SS15 BAF	BAF [5]
Aluminum	1.24E–01	2.03E–01	7.57E–02	4.32E–02	6 02E–02	1 01E–01
Antimony	4.29E+00	NC	NA	NA	3.97E–02	2 16E+00
Arsenic	9.62E–01	9.09E–01	9 23E–01	NA	1 20E–01	7 28E–01
Barium	2.33E–01	4 17E–01	1 83E–01	1.82E+01	8 33E+00	5.47E+00
Cadmium	3.08E+00	NA	NA	NA	NA	3.08E+00
Chromium	NC	NA	NC	NA	NA	NA [6]
Cobalt	1 85E+01	NA	NA	NC	NA	[7] 1.85E+01
Copper	NC	NC	NC	NC	NA	NA [6]
Cyanide	NA	NA	NA	NA	NA	NA
Lead	4 06E–01	3.69E–01	1 45E–01	3.09E–01	1 98E–01	2.86E–01
Manganese	1.26E–01	6.61E–01	1.18E+00	2 56E+00	3.20E+00	1.55E+00
Nickel	3.08E+00	4.44E+00	NA	NA	3 64E+00	3.72E+00
Vanadium	5.15E+00	6.41E+00	3.57E+00	7.58E+00	2 38E+00	5.02E+00
Zinc	9.17E–01	NC	NC	NC	NC	9.17E–01

NOTES·

[1] Reported detection limits (RDLs) are presented when an analyte was detected in only one of the two media evaluated. The value presented and used for calculation of the bioaccumulation factor corresponds to 1/2 the RDL.

[2] Units for BAFs are equal to mg/kg wet weight tissue over mg/kg dry weight soil.

[3] The soil data result listed is the arithmetic average of the detected concentrations in soil for CF15SS20 and its duplicate.

[4] The earthworm data listed is the 50 percent value from a dilution series Paired soil data results represent half the actual concentration detected in soil

[5] BAFs are presented for only the analytes selected as ECPCs in OU 5 surface soils. Analytes detected in earthworms that were not detected in OU 5 surface soils are assumed to be not site related. BAFs are equal to the arithmetic average of sample location–specific BAFs.

[6] No site specific BAF was calculated for this analyte as this analyte was not detected in surface soil at locations where earthworm toxicity data exists. Therefore, a literature value of 1.6E–01 was used for the BAF (Dierckxsens, et al., 1985)

[7] The site specific BAF calculated for this analyte at NAS Cecil Field is artificially elevated because one–half of the earthworm RDL was used when calculating the BAF Therefore, a site–specific BAF of 5.5E–01 (calculated for Site 5) will be used as a surrogate.

NA = Not Analyzed
NC = Not Calculated
ND = Not Detected

Table A–10
Bioconcentration Data

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Concentration (µg/L)	BCF	ln (BCF)	Reference	Year of Publication
Pesticides								
4,4'–DDT	Pimephales promelas; Fathead minnow	ADULT	32 days	6 5	29,400	10 2887499	AQUIRE, 1994 210616	79
	Ulva rigida; Green algae	NR	7 days	1,000	152	5 02388052	AQUIRE, 1994 217588	74
	Ulva rigida; Green algae	NR	7 days	1,000	159	5.06890420	AQUIRE, 1994 217588	74
	Ulva rigida; Green algae	NR	7 days	1,000	1,983	7 59236612	AQUIRE, 1994 217588	74
	Ulva rigida, Green algae	NR	7 days	1,000	319	5.76519110	AQUIRE, 1994 217588	74
	Ulva rigida; Green algae	NR	7 days	1,000	1,062	6.96790920	AQUIRE, 1994 217588	74
	Ephemera danica; Mayfly	1.5 YR, 21–23 MM, NYMPH	24 hours	0.761	440	6 08677472	AQUIRE, 1994 212045	73
	Ephemera danica; Mayfly	1 5 YR, 21–23 MM, NYMPH	48 hours	0 761	610	6.41345895	AQUIRE, 1994 212045	73
	Ephemera danica, Mayfly	1.5 YR, 21–23 MM, NYMPH	72 hours	0.761	2,230	7 70975686	AQUIRE, 1994 212045	73
	Ephemera danica, Mayfly	1.5 YR, 21–23 MM, NYMPH	96 hours	0 761	1,980	7 59085212	AQUIRE, 1994 212045	73
	Ephemera danica; Mayfly	1.5 YR, 21–23 MM, NYMPH	5 days	0 761	3,060	8 02617019	AQUIRE, 1994 212045	73
	Ephemera danica; Mayfly	1.5 YR, 21–23 MM, NYMPH	7 days	0 761	2,900	7.97246601	AQUIRE, 1994 212045	73
	Ephemera danica, Mayfly	1.5 YR, 21–23 MM, NYMPH	8 days	0.761	8,250	9.01796847	AQUIRE, 1994 212045	73
	Ephemera danica; Mayfly	1 5 YR, 21–23 MM, NYMPH	9 days	0.761	2,860	7.95857690	AQUIRE, 1994 212045	73
	Calanus sp; Calanoid copepod	STAGES IV AND V	24 hours	0.212	20,000	9.90348755	AQUIRE, 1994 210427	75
	Calanus sp; Calanoid copepod	STAGES IV AND V	24 hours	0.15	30,000	10.3089526	AQUIRE, 1994 210427	75
	Calanus sp; Calanoid copepod	STAGES IV AND V	7 days	0 195	129,000	11.7675676	AQUIRE, 1994 210427	75
	Calanus sp; Calanoid copepod	STAGES IV AND V	7 days	0.213	115,000	11.6526874	AQUIRE, 1994 210427	75
	Calanus sp; Calanoid copepod	STAGES IV AND V	10 days	0 199	259,000	12 4645833	AQUIRE, 1994 210427	75
	Calanus sp; Calanoid copepod	STAGES IV AND V	14 days	0.21	182,000	12 1117619	AQUIRE, 1994 210427	75
	Calanus sp. Calanoid copepod	STAGES IV AND V	14 days	0.178	304,000	12.6247829	AQUIRE, 1994 210427	75
	Calanus sp; Calanoid copepod	STAGES IV AND V	14 days	0 247	194,000	12 1756134	AQUIRE, 1994 210427	75
	Calanus sp: Calanoid copepod	STAGES IV AND V	21 days	0 277	228,000	12 3371009	AQUIRE, 1994 210427	75
	Calanus sp; Calanoid copepod	STAGES IV AND V	21 days	0.223	230,000	12 3458345	AQUIRE, 1994 210427	75
	Calanus sp; Calanoid copepod	STAGES IV AND V	21 days	0 239	267,000	12.4950039	AQUIRE, 1994 210427	75
	Calanus sp; Calanoid copepod	STAGES IV AND V	28 days	0 267	397,000	12.8916915	AQUIRE, 1994 210427	75
	Calanus sp; Calanoid copepod	STAGES IV AND V	28 days	0.271	255,000	12.4490188	AQUIRE, 1994 210427	75
	Calanus sp; Calanoid copepod	STAGES IV AND V	28 days	0 346	134,000	11 8055950	AQUIRE, 1994 210427	75
	Calanus sp; Calanoid copepod	STAGES IV AND V	35 days	0.131	73,600	11 2064003	AQUIRE, 1994 210427	75
	Calanus sp; Calanoid copepod	STAGES IV AND V	35 days	0 211	402,000	12.9042073	AQUIRE, 1994 210427	75
	Calanus sp, Calanoid copepod	STAGES IV AND V	35 days	0.34	154,000	11 9447078	AQUIRE, 1994 210427	75
	Calanus sp; Calanoid copepod	STAGES IV AND V	42 days	0.211	475,000	13 0710700	AQUIRE, 1994 210427	75
	Calanus sp, Calanoid copepod	STAGES IV AND V	42 days	0.385	178,000	12.0895388	AQUIRE, 1994 210427	75
	Calanus sp; Calanoid copepod	STAGES IV AND V	49 days	0 449	161,000	11.9891596	AQUIRE, 1994 210427	75
	Calanus sp; Calanoid copepod	STAGES IV AND V	49 days	0 43	114,000	11 6439537	AQUIRE, 1994 210427	75
	Calanus sp; Calanoid copepod	STAGES IV AND V	56 days	0 382	196,000	12 1858699	AQUIRE, 1994 210427	75
	Calanus sp: Calanoid copepod	STAGES IV AND V	56 days	0 392	220,000	12 3013828	AQUIRE, 1994 210427	75
	Calanus sp; Calanoid copepod	STAGES IV AND V	56 days	0 458	60,900	11 0169884	AQUIRE, 1994 210427	75
	Calanus sp; Calanoid copepod	NR	72 hours	2	110	4.70048036	AQUIRE, 1994 210740	73
	Culex pipiens quinquefasciata, Mosquito	NR	24 hours	2	300	5 70378247	AQUIRE, 1994 210740	73
	Gambusia affinis; Mosquitofish	NR	48 hours	2	300	5.70378247	AQUIRE, 1994 210740	73
	Gambusia affinis; Mosquitofish	NR	72 hours	2	344	5 84064165	AQUIRE, 1994 210740	73
	Gambusia affinis; Mosquitofish	NR	24 hours	2	1,170	7 06475902	AQUIRE, 1994 210740	73
	Daphnia magna; Water flea							

Table A–10
Bioconcentration Data

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Concentration (µg/L)	BCF	ln (BCF)	Reference	Year of Publication
4,4'–DDT (cont.)	Daphnia magna; Water flea	NR	48 hours	2	1,570	7 35883089	AQUIRE, 1994 210740	73
	Daphnia magna; Water flea	NR	72 hours	2	1,330	7.19293422	AQUIRE, 1994 210740	73
	Culex pipiens quinquefasciata, Mosquito	NR	24 hours	2	515	6.24416690	AQUIRE, 1994 210740	73
	Culex pipiens quinquefasciata, Mosquito	NR	48 hours	2	165	5.10594547	AQUIRE, 1994 210740	73
	Lepomis macrochirus; Bluegill	0 49 G, 3 0–5.1 CM, JUVENILE	5 days	0 249	23,000	10.0432494	AQUIRE, 1994 216498	80
	Lepomis macrochirus; Bluegill	0.49 G, 3.0–5 1 CM, JUVENILE	5 days	0 028	25,000	10.1266311	AQUIRE, 1994 216498	80
	Lepomis macrochirus; Bluegill	0 49 G, 3.0–5 1 CM, JUVENILE	28 days	0.249	24,000	10 0858091	AQUIRE, 1994 216498	80
	Lepomis macrochirus, Bluegill	0.49 G, 3.0–5 1 CM, JUVENILE	28 days	0.028	25,000	10 1266311	AQUIRE, 1994 216498	80
	Salvelinus namaycush; Lake trout, siscowet	YEARLING, 29 5 G	90 days	0.006 to 0 009	52,750	10 8733190	AQUIRE, 1994 212049	74
	Salvelinus namaycush; Lake trout, siscowet	YEARLING, 29.5 G	120 days	0.006 to 0.009	44,286	10 6984238	AQUIRE, 1994 212049	74
	Salvelinus namaycush; Lake trout, siscowet	YEARLING, 29.5 G	152 days	0.006 to 0.009	45,250	10.7199579	AQUIRE, 1994 212049	74
	Pimephales promelas; Fathead minnow	45 D	266 days	1.48	1.2	0 18232155	AQUIRE, 1994 210534	77
	Pimephales promelas; Fathead minnow	45 D	266 days	1.53	99,000	11 5028751	AQUIRE, 1994 210534	77
	Crassostrea gigas; Pacific oyster	JUVENILE	7 days	10	15,100	9 62245002	AQUIRE, 1994 210646	64
	Crassostrea gigas; Pacific oyster	JUVENILE	40 days	1	30,000	10 3089526	AQUIRE, 1994 210646	64
	Crassostrea gigas; Pacific oyster	JUVENILE	40 days	0.1	70,000	11.1562505	AQUIRE, 1994 210646	64
	Astacus leptodactylus; Crayfish	6.8 G	NR	50	242	5.48893772	AQUIRE, 1994 218908	73
	Styela plicata; Sea squirt	NR	10 days	100	200	5 29831736	AQUIRE, 1994 210646	64
	Styela plicata; Sea squirt	NR	10 days	10	1,000	6 90775527	AQUIRE, 1994 210646	64
	Lanice conchilega, Polychaete	NR	67 hours	0 06	208	5 33897934	AQUIRE, 1994 219232	72
	Lanice conchilega; Polychaete	NR	67 hours	0.11	273	5.60837228	AQUIRE, 1994 219232	72
	Lanice conchilega; Polychaete	NR	48 hours	1 12	75	4 31748811	AQUIRE, 1994 219232	72
	Lanice conchilega; Polychaete	NR	48 hours	2 24	83 5	4 42484663	AQUIRE, 1994 219232	72
	Lanice conchilega; Polychaete	NR	48 hours	11 2	70 4	4 25419326	AQUIRE, 1994 219232	72
	Lanice conchilega, Polychaete	NR	31 days	2 24	2,286	7 73455884	AQUIRE, 1994 219232	72
	Lanice conchilega; Polychaete	NR	31 days	2.24	4,643	8 44311598	AQUIRE, 1994 219232	72
	Nereis diversicolor; Polychaete	NR	7 hours	30	283	5.64544689	AQUIRE, 1994 219232	72
	Nereis diversicolor; Polychaete	NR	24 hours	30	490	6 19440539	AQUIRE, 1994 219232	72
	Nereis diversicolor; Polychaete	NR	5 days	0.3	2,033	7.61726781	AQUIRE, 1994 219232	72
	Nereis diversicolor, Polychaete	NR	5 days	0.75	1,653	7.41034709	AQUIRE, 1994 219232	72
	Nereis diversicolor; Polychaete	NR	5 days	3	1,400	7 24422751	AQUIRE, 1994 219232	72
	Siphlonurus sp; Mayfly	NYMPH	24 hours	0.047	10,200	9 23014299	AQUIRE, 1994 219364	71
	Siphlonurus sp; Mayfly	NYMPH	48 hours	0 047	20,000	9.90348755	AQUIRE, 1994 219364	71
	Siphlonurus sp; Mayfly	NYMPH	72 hours	0 047	22,900	10 0388921	AQUIRE, 1994 219364	71
	Ischnura verticalis, Damselfly	NAIAD	48 hours	0.1013	3,500	8.16051824	AQUIRE, 1994 219364	71
	Libellula sp; Dragonfly	NAIAD	48 hours	0 0793	910	6.81344459	AQUIRE, 1994 219364	71
	Palaemonetes kadiakensis, Grass shrimp	MATURE ADULT	48 hours	0.1	3,700	8 21608809	AQUIRE, 1994 219364	71
	Palaemonetes kadiakensis; Grass shrimp	MATURE ADULT	72 hours	0 1	5,000	8 51719319	AQUIRE, 1994 219364	71
	Hexagenia bilineata; Mayfly	Hexagenia bilineata; Mayfly	24 hours	0 0521	9,400	9 14846496	AQUIRE, 1994 219364	71
	Hexagenia bilineata; Mayfly	Hexagenia bilineata; Mayfly	48 hours	0 0521	16,700	9 72316399	AQUIRE, 1994 219364	71
	Hexagenia bilineata, Mayfly	Hexagenia bilineata; Mayfly	72 hours	0 0521	32,600	10 3920675	AQUIRE, 1994 219364	71
	Gammarus fasciatus, Scud	MATURE ADULT	72 hours	0 0813	20,600	9 93304635	AQUIRE, 1994 219364	71
	Orconectes nais; Crayfish	MATURE ADULT	24 hours	0.0803	880	6 77992190	AQUIRE, 1994 219364	71
	Orconectes nais; Crayfish	MATURE ADULT	48 hours	0 0803	2,100	7 64969262	AQUIRE, 1994 219364	71

Table A–10
Bioconcentration Data

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Concentration (µg/L)	BCF	ln (BCF)	Reference	Year of Publication
4,4'–DDT (cont.)	Orconectes nais; Crayfish	MATURE ADULT	72 hours	0 0803	2,900	7.97246601	AQUIRE, 1994 219364	71
	Palaemonetes kadiakensis; Grass shrimp	MATURE ADULT	24 hours	0.1	1,500	7 31322038	AQUIRE, 1994 219364	71
	Daphnia magna, Water flea	MATURE ADULT	24 hours	0 0803	25,400	10 1425044	AQUIRE, 1994 219364	71
	Daphnia magna; Water flea	MATURE ADULT	48 hours	0 0803	69,100	11 1433100	AQUIRE, 1994 219364	71
	Daphnia magna; Water flea	MATURE ADULT	72 hours	0.0803	114,100	11 6448305	AQUIRE, 1994 219364	71
	Gammarus fasciatus; Scud	MATURE ADULT	24 hours	0.0813	4,600	8.43381158	AQUIRE, 1994 219364	71
	Gammarus fasciatus, Scud	MATURE ADULT	48 hours	0.0813	12,100	9 40096073	AQUIRE, 1994 219364	71
	Chironomus sp, Midge	LARVAE	24 hours	0 0463	7,800	8.96187901	AQUIRE, 1994 219364	71
	Chironomus sp, Midge	LARVAE	48 hours	0.0463	24,500	10 1064283	AQUIRE, 1994 219364	71
	Chironomus sp; Midge	LARVAE	72 hours	0.0463	47,800	10.7747809	AQUIRE, 1994 219364	71
	Culex pipiens, Mosquito	LARVAE	48 hours	0.1046	133,600	11 8026055	AQUIRE, 1994 219364	71
	Penaeus duorarum; Pink shrimp (america)	ADULT, 6.4 CM, 3.6 G	24 hours	0.14	71.4	4 26829786	AQUIRE, 1994 219655	70
	Penaeus duorarum; Pink shrimp (america)	ADULT, 6.4 CM, 3 6 G	96 hours	0.14	143	4 96284463	AQUIRE, 1994 219655	70
	Penaeus duorarum; Pink shrimp (america)	ADULT, 6.4 CM, 3 6 G	7 days	0.14	429	6.06145691	AQUIRE, 1994 219655	70
	Penaeus duorarum; Pink shrimp (america)	ADULT, 6.4 CM, 3 6 G	10 days	0.14	1,214	7.10167597	AQUIRE, 1994 219655	70
	Penaeus duorarum, Pink shrimp (america)	ADULT, 6.4 CM, 3 6 G	13 days	0.14	1,500	7.31322038	AQUIRE, 1994 219655	70
	Penaeus duorarum; Pink shrimp (america)	ADULT, 6 4 CM, 3 6 G	16 days	0.14	1,143	7.04141166	AQUIRE, 1994 219655	70
	Penaeus duorarum, Pink shrimp (america)	ADULT, 6 4 CM, 3 6 G	19 days	0 14	1,000	6.90775527	AQUIRE, 1994 219655	70
	Penaeus duorarum; Pink shrimp (america)	ADULT, 6 4 CM, 3.6 G	22 days	0 14	857	6.75343791	AQUIRE, 1994 219655	70
	Penaeus duorarum; Pink shrimp (america)	7 6 CM, 3.8 G	56 days	0 05	8,600	9.05951748	AQUIRE, 1994 219655	70
	Penaeus duorarum; Pink shrimp (america)	7.6 CM, 3.8 G	56 days	0.05	6,800	8 82467789	AQUIRE, 1994 219655	70
	Penaeus duorarum; Pink shrimp (america)	ADULT, 6.4 CM, 3.6 G	56 days	0.05	2,600	7.86326672	AQUIRE, 1994 219655	70
	Penaeus duorarum; Pink shrimp (america)	ADULT, 6 4 CM, 3 6 G	56 days	0.05	1,200	7.09007683	AQUIRE, 1994 219655	70
	Penaeus duorarum, Pink shrimp (america)	ADULT, 6.4 CM, 3.6 G	56 days	0 05	1,000	6 90775527	AQUIRE, 1994 219655	70
	Penaeus duorarum; Pink shrimp (america)	ADULT, 6.4 CM, 3.6 G	56 days	0.05	400	5 99146454	AQUIRE, 1994 219655	70
	Penaeus duorarum, Pink shrimp (america)	ADULT, 6.4 CM, 3.6 G	56 days	0 05	200	5 29831736	AQUIRE, 1994 219655	70
	Penaeus duorarum; Pink shrimp (america)	ADULT, 6.4 CM, 3 6 G	56 days	0 05	800	6.68461172	AQUIRE, 1994 219655	70
	Penaeus duorarum; Pink shrimp (america)	ADULT, 13.3 CM, 21.1 G	28 days	0 12	336,667	12 7268495	AQUIRE, 1994 219655	70
	Penaeus duorarum; Pink shrimp (america)	ADULT, 13.3 CM, 21.1 G	28 days	0 12	18,333	9.81645799	AQUIRE, 1994 219655	70
	Penaeus duorarum; Pink shrimp (america)	ADULT, 13.3 CM, 21 1 G	28 days	0.12	16,417	9 70607266	AQUIRE, 1994 219655	70
	Penaeus duorarum, Pink shrimp (america)	ADULT, 13 3 CM, 21.1 G	28 days	0 12	15,500	9.64859530	AQUIRE, 1994 219655	70
	Penaeus duorarum; Pink shrimp (america)	ADULT, 6 4 CM, 3.6 G	28 days	0 12	14,083	9 55272367	AQUIRE, 1994 219655	70
	Penaeus duorarum; Pink shrimp (america)	ADULT, 6 4 CM, 3 6 G	28 days	0.12	5,500	8 61250337	AQUIRE, 1994 219655	70
	Penaeus duorarum; Pink shrimp (america)	ADULT, 6.4 CM, 3.6 G	28 days	0.12	1,583	7.36707705	AQUIRE, 1994 219655	70
	Penaeus setiferus; White shrimp (america)	ADULT, 16.2 CM, 28 0 G	18 days	0.2	55,000	10 9150884	AQUIRE, 1994 219655	70
	Penaeus setiferus; White shrimp (america)	ADULT, 16 2 CM, 28.0 G	18 days	0.2	1,800	7.49554194	AQUIRE, 1994 219655	70
	Penaeus setiferus, White shrimp (america)	ADULT, 16.2 CM, 28 0 G	18 days	0 2	200	5 29831736	AQUIRE, 1994 219655	70
	Penaeus setiferus; White shrimp (america)	ADULT, 16 2 CM, 28.0 G	18 days	0.2	2,750	7.91935619	AQUIRE, 1994 219655	70
	Penaeus setiferus, White shrimp (america)	ADULT, 16 2 CM, 28 0 G	18 days	0.2	2,300	7.74066440	AQUIRE, 1994 219655	70
	Penaeus setiferus; White shrimp (america)	ADULT, 16.2 CM, 28.0 G	18 days	0 2	4,300	8 36637030	AQUIRE, 1994 219655	70
	Penaeus setiferus; White shrimp (america)	ADULT, 16.2 CM, 28.0 G	18 days	0.2	100	4.60517018	AQUIRE, 1994 219655	70
	Indonaia caerulea; Unionid clam	30–40 MM	24 hours	5	273	5.60947179	AQUIRE, 1994 219493	80
	Indonaia caerulea, Unionid clam	30–40 MM	24 hours	10	236	5 46383180	AQUIRE, 1994 219493	80
	Indonaia caerulea; Unionid clam	30–40 MM	24 hours	50	40	3.68887945	AQUIRE, 1994 219493	80

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Chemical Name	Species	Age	Exposure	Concentration (µg/L)	BCF	ln (BCF)	Reference	Year of Publication
4,4'–DDT (cont.)	Indonaia caerulea, Unionid clam	30–40 MM	19 days	5	684	6 52795791	AQUIRE, 1994 219493	80
	Indonaia caerulea, Unionid clam	30–40 MM	19 days	10	329	5.79605775	AQUIRE, 1994 219493	80
	Indonaia caerulea; Unionid clam	30–40 MM	7 days	50	195	5.27299955	AQUIRE, 1994 219493	80
	Indonaia caerulea; Unionid clam	30–40 MM	7 days	10	329	5.79605775	AQUIRE, 1994 219493	80
	Indonaia caerulea; Unionid clam	30–40 MM	7 days	5	495	6.20455776	AQUIRE, 1994 219493	80
	Daphnia magna; Water flea	1ST INSTAR, 9 UG	24 hours *	8	16,000	9 68034400	AQUIRE, 1994 219303	71
	Daphnia magna; Water flea	1ST INSTAR, 9 UG	24 hours *	50	23,000	10.0432494	AQUIRE, 1994 219303	71
	Pollachius virens; Coalfish or saithe	YEARLING, 11 5 CM, 14 G	12 hours	2	87	4 46590811	AQUIRE, 1994 219737	80
	Pollachius virens; Coalfish or saithe	YEARLING, 11.5 CM, 14 G	24 hours	1.5	730	6.59304453	AQUIRE, 1994 219737	80
	Pollachius virens, Coalfish or saithe	YEARLING, 11.5 CM, 14 G	72 hours	1.4	2,100	7 64969262	AQUIRE, 1994 219737	80
	Pollachius virens; Coalfish or saithe	YEARLING, 11.5 CM, 14 G	7 days	1 2	730	6 59304453	AQUIRE, 1994 219737	80
	Pollachius virens, Coalfish or saithe	YEARLING, 11 5 CM, 14 G	14 days	1 2	1,900	7 54960916	AQUIRE, 1994 219737	80
	Pollachius virens; Coalfish or saithe	YEARLING, 11 5 CM, 14 G	12 hours	2	110	4.70048036	AQUIRE, 1994 219737	80
	Pollachius virens; Coalfish or saithe	YEARLING, 11.5 CM, 14 G	24 hours	1.5	37	3.61091791	AQUIRE, 1994 219737	80
	Pollachius virens; Coalfish or saithe	YEARLING, 11.5 CM, 14 G	72 hours	1.4	38	3 63758615	AQUIRE, 1994 219737	80
	Pollachius virens; Coalfish or saithe	YEARLING, 11.5 CM, 14 G	7 days	1 2	23	3 13549421	AQUIRE, 1994 219737	80
	Pollachius virens, Coalfish or saithe	YEARLING, 11.5 CM, 14 G	12 hours	2	3	1.09861228	AQUIRE, 1994 219737	80
	Pollachius virens; Coalfish or saithe	YEARLING, 11.5 CM, 14 G	24 hours	1.5	4	1.38629436	AQUIRE, 1994 219737	80
	Pollachius virens; Coalfish or saithe	YEARLING, 11.5 CM, 14 G	72 hours	1.4	21	3.04452243	AQUIRE, 1994 219737	80
	Pollachius virens, Coalfish or saithe	YEARLING, 11.5 CM, 14 G	7 days	1.2	7	1.94591014	AQUIRE, 1994 219737	80
	Pollachius virens; Coalfish or saithe	YEARLING, 11.5 CM, 14 G	14 days	1.2	26	3 25809653	AQUIRE, 1994 219737	80
	Gambusia affinis; Mosquitofish	NR	24 hours	0.16 to 4	10	2.30258509	AQUIRE, 1994 216978	77
	Gambusia affinis; Mosquitofish	NR	to 16 days	0.064	25,293	10.1382829	AQUIRE, 1994 216978	77
	Simocephalus sp; Water flea	NR	3 hours	0.1	61,545	11.0275238	AQUIRE, 1994 219859	80
	Simocephalus sp; Water flea	NR	3 hours	0.5	19,847	9.89580814	AQUIRE, 1994 219859	80
	Simocephalus sp, Water flea	NR	3 hours	1	8,813	9 08398318	AQUIRE, 1994 219859	80
	Simocephalus sp; Water flea	NR	12 hours	0.1	63,194	11.0539646	AQUIRE, 1994 219859	80
	Simocephalus sp, Water flea	NR	48 hours	0 1	148,842	11 9106406	AQUIRE, 1994 219859	80
	Simocephalus sp, Water flea	NR	5 days	0.1	138,311	11.8372600	AQUIRE, 1994 219859	80
	Simocephalus sp; Water flea	NR	12 hours	0.5	24,998	10.1265511	AQUIRE, 1994 219859	80
	Simocephalus sp; Water flea	NR	72 hours	0 5	15,890	9 67344525	AQUIRE, 1994 219859	80
	Simocephalus sp; Water flea	NR	48 hours	1	10,107	9 22098353	AQUIRE, 1994 219859	80
	Simocephalus sp; Water flea	NR	7 days	1	13,407	9.50353223	AQUIRE, 1994 219859	80
	Rana temporaria; Frog	TADPOLE	24 hours	36 2	1,522	7.32778053	AQUIRE, 1994 218802	73
	Rana temporaria; Frog	TADPOLE	24 hours	36 2	221	5 39816270	AQUIRE, 1994 218802	73
	Rana temporaria; Frog	TADPOLE	24 hours	10.5	371	5 91620206	AQUIRE, 1994 218802	73
	Rana temporaria; Frog	TADPOLE	24 hours	10.5	552	6.31354804	AQUIRE, 1994 218802	73
	Rana temporaria; Frog	TADPOLE	24 hours	2.7	2,593	7 86057078	AQUIRE, 1994 218802	73
	Rana temporaria; Frog	TADPOLE	24 hours	2 7	1,852	7 52402141	AQUIRE, 1994 218802	73
	Rana temporaria; Frog	TADPOLE	24 hours	17.5	3,149	8 05484022	AQUIRE, 1994 218802	73
	Rana temporaria; Frog	TADPOLE	24 hours	17 5	457	6 12468339	AQUIRE, 1994 218802	73
	Rana temporaria; Frog	TADPOLE	24 hours	4.9	796	6 67959918	AQUIRE, 1994 218802	73
	Rana temporaria; Frog	TADPOLE	24 hours	4.9	1,184	7 07665381	AQUIRE, 1994 218802	73
	Rana temporaria, Frog	TADPOLE	24 hours	1.9	3,684	8 21175439	AQUIRE, 1994 218802	73

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4,4'–DDT (cont.)	Rana temporaria; Frog	TADPOLE	24 hours	1 9	2,632	7.87549929	AQUIRE, 1994 218802	73
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	FRY, 0.1–0.3 G	5 days	0.106	92,790	11.4380941	AQUIRE, 1994 219383	85
	Nereis arenaceodentata; Polychaete	NR	96 hours	1,000	1.5	0.40546510	AQUIRE, 1994 213785	91
	Neanthes grubei; Polychaete	NR	96 hours	1,000	9	2.19722457	AQUIRE, 1994 213785	91
	Blepharisma intermedium; Ciliate	NR	1 hours	1,000	861.6	6 75879112	AQUIRE, 1994 311618	82
	Blepharisma intermedium; Ciliate	NR	6 hours	1,000	15,080	9 62112464	AQUIRE, 1994 311618	82
	Blepharisma intermedium; Ciliate	NR	12 hours	1,000	29,857	10.3041846	AQUIRE, 1994 311618	82
	Blepharisma intermedium; Ciliate	NR	24 hours	1,000	28,501	10 2576944	AQUIRE, 1994 311618	82
	Blepharisma intermedium; Ciliate	NR	48 hours	1,000	29,042	10.2764983	AQUIRE, 1994 311618	82
	Blepharisma intermedium; Ciliate	NR	72 hours	1,000	36,210	10.4970906	AQUIRE, 1994 311618	82
	Blepharisma intermedium; Ciliate	NR	120 hours	1,000	33,607	10.4224985	AQUIRE, 1994 311618	82
	Blepharisma intermedium; Ciliate	NR	240 hours	1,000	59,999	11 0020831	AQUIRE, 1994 311618	82
	Anodonta grandis; Floater, mussel	NR	3 weeks	0 14 to 0.62	2,400	7.78322401	AQUIRE, 1994 212073	73
	Mussel				2,400	7.78322401	USEPA, 1980c	
	Clams				12,500	9.43348392	USEPA, 1980c	
	Cladoceran				9,923	9.20261057	USEPA, 1980c	
	Freshwater prawn				7,000	8.85366542	USEPA, 1980c	
	Crayfish				5,060	8.52912176	USEPA, 1980c	
	Crayfish				1,947	7 57404500	USEPA, 1980c	
	Mayfly				4,075	8 31262602	USEPA, 1980c	
	Dragonfly				2,700	7.90100705	USEPA, 1980c	
	Bloodworm				4,750	8.46589989	USEPA, 1980c	
	Red leech				7,520	8.92532141	USEPA, 1980c	
							3,406 = Geometric Mean BCF for 4,4'–DDT	
Inorganics								
Aluminum	Salvelinus fontinalis; Brook trout	0.2 grams, 30 days	56 days	268	36	3.58351893	AQUIRE, 1994 213592	91
Aluminum chloride	Unio pictorum; Mussel;	9 4 (7.7–10.18) cm	3 weeks	166.8 to 414 3	250	5.52146091	AQUIRE, 1994 210076	90
							95 = Geometric Mean BCF for Aluminum	
Cadmium	Spirulina platensis, Blue–green algae	NR	12 hours	100	14 61	2.68170622	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	24 hours	100	18.3	2.90690105	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	36 hours	100	18	2.89037175	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	48 hours	100	16 1	2.77881927	AQUIRE, 1994 312317	86
	Spirulina platensis, Blue–green algae	NR	12 hours	500	7.81	2 05540496	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	24 hours	500	8 77	2 17133680	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	36 hours	500	8 56	2.14710019	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	48 hours	500	7.42	2.00417905	AQUIRE, 1994 312317	86
	Spirulina platensis, Blue–green algae	NR	12 hours	1000	6 22	1.82776990	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	24 hours	1000	7 04	1 95160817	AQUIRE, 1994 312317	86
	Spirulina platensis: Blue–green algae	NR	36 hours	1000	7.14	1 96571277	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	48 hours	1000	6 77	1 91250108	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	12 hours	5000	3.06	1.11841491	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	24 hours	5000	2 79	1.02604159	AQUIRE, 1994 312317	86

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Chemical Name	Species	Age	Exposure	Concentration (µg/L)	BCF	ln (BCF)	Reference	Year of Publication
Cadmium (cont.)	Spirulina platensis; Blue–green algae	NR	36 hours	5000	2 63	0.96698384	AQUIRE, 1994 312317	86
	Spirulina platensis, Blue–green algae	NR	48 hours	5000	2.1	0 74193734	AQUIRE, 1994 312317	86
	Spirulina platensis, Blue–green algae	NR	12 hours	10000	2.42	0.88376754	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	24 hours	10000	1 85	0.61518563	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	36 hours	10000	1 69	0 52472852	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	48 hours	10000	1.55	0 43825493	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	12 hours	100	16.76	2 81899509	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	24 hours	100	14.02	2.64048488	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	36 hours	100	13.04	2.56802155	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	48 hours	100	13 41	2.59600069	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	12 hours	500	8 56	2 14710019	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	24 hours	500	7.64	2 03339760	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	36 hours	500	7 36	1 99605993	AQUIRE, 1994 312317	86
	Spirulina platensis, Blue–green algae	NR	48 hours	500	6.5	1 87180217	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	12 hours	1000	6.13	1 81319474	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	24 hours	1000	6	1.79175946	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	36 hours	1000	6.16	1 81807677	AQUIRE, 1994 312317	86
	Spirulina platensis, Blue–green algae	NR	48 hours	1000	4.13	1.41827740	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	12 hours	5000	3 38	1.21787570	AQUIRE, 1994 312317	86
	Spirulina platensis, Blue–green algae	NR	24 hours	5000	3 08	1.12492959	AQUIRE, 1994 312317	86
	Spirulina platensis, Blue–green algae	NR	36 hours	5000	3.03	1.10856261	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	48 hours	5000	2 63	0.96698384	AQUIRE, 1994 312317	86
	Spirulina platensis, Blue–green algae	NR	12 hours	10000	2.63	0.96698384	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	24 hours	10000	2.31	0 83724752	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	36 hours	10000	2 21	0.79299251	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae	NR	48 hours	10000	2.2	0 78845736	AQUIRE, 1994 312317	86
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	46.21 grams	72 days	0.00127	55	4 00733318	AQUIRE, 1994 210688	89
	Coregonus clupeaformis; Lake whitefish	26 63 grams	72 days	0.00125	42 1	3.74004774	AQUIRE, 1994 210688	89
	Cladoceran				320	5.76832099	USEPA, 1980d	
	Crayfish				184	5 21493575	USEPA, 1980d	
	Stonefly				373	5 92157841	USEPA, 1980d	
	Mayfly				1,630	7.39633529	USEPA, 1980d	
	Mayfly				3,520	8 16621626	USEPA, 1980d	
	Dragonfly				736	6 60123011	USEPA, 1980d	
	Dragonfly				680	6 52209279	USEPA, 1980d	
	Dragonfly				1,300	7.17011954	USEPA, 1980d	
	Dragonfly				928	6 83303173	USEPA, 1980d	
	Caddisfly				4,190	8 34045601	USEPA, 1980d	
	Beetle				164	5.09986642	USEPA, 1980d	
	Beetle				260	5 56068163	USEPA, 1980d	
	Midge				2,220	7.70526247	USEPA, 1980d	
	Midge				1,830	7 51207124	USEPA, 1980d	
	Biting midge				936	6 84161547	USEPA, 1980d	
	Biting midge				662	6.49526555	USEPA, 1980d	

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Chemical Name	Species	Age	Exposure	Concentration (µg/L)	BCF	ln (BCF)	Reference	Year of Publication
Cadmium (cont.)	Snail				1,750	7.46737106	USEPA, 1980d	
							25 = Geometric Mean BCF for Cadmium	
Copper	Spirulina platensis; Blue–green algae;	NR	12 hours	100	36.65	3.60141342	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	24 hours	100	39.51	3.67655380	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	36 hours	100	31.2	3.44041809	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	48 hours	100	25.38	3.23396146	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	12 hours	500	12.5	2.52572864	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	24 hours	500	17	2.83321334	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	36 hours	500	12.7	2.54160199	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	48 hours	500	11.4	2.43361335	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	12 hours	1000	8.13	2.09556092	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	24 hours	1000	12.2	2.50143595	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	36 hours	1000	9.53	2.25444471	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	48 hours	1000	8.13	2.09556092	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	12 hours	5000	2.6	0.95551144	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	24 hours	5000	4.99	1.60743590	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	36 hours	5000	4.27	1.45161382	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	48 hours	5000	3.68	1.30291275	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	12 hours	10000	.1.46	0.37843643	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	24 hours	10000	3.4	1.22377543	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	36 hours	10000	3.07	1.12167756	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	48 hours	10000	2.68	0.98581679	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	12 hours	100	28.31	3.34321509	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	24 hours	100	36.01	3.58379667	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	36 hours	100	35.39	3.56642929	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	48 hours	100	31.18	3.43977686	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	12 hours	500	9.37	2.23751309	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	24 hours	500	11.02	2.39971180	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	36 hours	500	12	2.48490664	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	48 hours	500	11.47	2.43973493	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	12 hours	1000	5.76	1.75093747	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	24 hours	1000	6.22	1.82776990	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	36 hours	1000	7.81	2.05540496	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	48 hours	1000	8.58	2.14943391	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	12 hours	5000	1.93	0.65752000	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	24 hours	5000	2.12	0.75141608	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	36 hours	5000	2.45	0.89608802	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	48 hours	5000	2.41	0.87962674	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	12 hours	10000	1.2	0.18232155	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	24 hours	10000	1.35	0.30010459	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	36 hours	10000	1.49	0.39877612	AQUIRE, 1994 312317	86
	Spirulina platensis; Blue–green algae;	NR	48 hours	10000	1.38	0.32208349	AQUIRE, 1994 312317	86
	Asiatic clam				19,800	9.89343721	USEPA, 1985e	

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Chemical Name	Species	Age	Exposure	Concentration (µg/L)	BCF	ln (BCF)	Reference	Year of Publication
Copper (cont.)	Cladoceran				471	6 15485809	USEPA, 1985e	
	Stonefly				203	5.31320597	USEPA, 1985e	
							10 = Geometric Mean BCF for Copper	
Iron	Oyster				2,740	7.91571319	Vasquez et al., 1994	
							2,740 = BCF for Iron	
Lead	Salvelinus fontinalis; Brook trout	FINGERLING, 7 3–10 cm	3 weeks	4.1 to 88	1,400	7 24422751	AQUIRE, 1994 315675	75
	Salvelinus fontinalis; Brook trout	FINGERLING, 7.3–10 cm	3 weeks	135	41.9	3.73528582	AQUIRE, 1994 315675	75
	Salvelinus fontinalis; Brook trout	FINGERLING, 7.3–10 cm	3 weeks	135	7.78	2.05155633	AQUIRE, 1994 315675	75
	Salvelinus fontinalis, Brook trout	FINGERLING, 7–10 cm	3 weeks	4 3	160	5 07517381	AQUIRE, 1994 315675	75
	Salvelinus fontinalis; Brook trout	FINGERLING, 7–10 cm	3 weeks	5.7	140	4 94164242	AQUIRE, 1994 315675	75
	Salvelinus fontinalis; Brook trout	FINGERLING, 7–10 cm	3 weeks	12.5	73	4 29045944	AQUIRE, 1994 315675	75
	Salvelinus fontinalis; Brook trout	FINGERLING, 7–10 cm	3 weeks	12 5	32	3.46573590	AQUIRE, 1994 315675	75
	Salvelinus fontinalis; Brook trout	FINGERLING, 7–10 cm	3 weeks	12 5	24	3 17805383	AQUIRE, 1994 315675	75
	Salvelinus fontinalis; Brook trout	FINGERLING, 7–10 cm	3 weeks	12.5	48	3.87120101	AQUIRE, 1994 315675	75
	Salvelinus fontinalis; Brook trout	FINGERLING, 7–10 cm	3 weeks	12 5	160	5 07517381	AQUIRE, 1994 315675	75
	Salvelinus fontinalis, Brook trout	FINGERLING, 7–10 cm	3 weeks	12.5	16	2.77258872	AQUIRE, 1994 315675	75
	Colisa fasciata; Giant gourami	NR	8 hours	902	2.9	1.06471073	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	8 hours	902	0 8	−0.2231435	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	16 hours	0.860	3 4	1.22377543	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	16 hours	0.860	0.4	−0.9162907	AQUIRE, 1994 213784	91
	Colisa fasciata, Giant gourami	NR	16 hours	0 860	1	0	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	24 hours	801	3 4	1.22377543	AQUIRE, 1994 213784	91
	Colisa fasciata, Giant gourami	NR	24 hours	801	0.3	−1.2039728	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	24 hours	801	1.1	0.09531017	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	5 days	1000	5	1.60943791	AQUIRE, 1994 213784	91
	Colisa fasciata, Giant gourami	NR	5 days	1000	0.5	−0 6931471	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	5 days	1000	3 9	1.36097655	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	10 days	701	6.9	1.93152141	AQUIRE, 1994 213784	91
	Colisa fasciata, Giant gourami	NR	10 days	701	0.7	−0.3566749	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	10 days	701	6.1	1 80828877	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	15 days	586	5 3	1.66770682	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	15 days	586	0 8	−0 2231435	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	15 days	586	5.7	1 74046617	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	20 days	621	7 2	1.97408102	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	20 days	621	0 7	−0.3566749	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	20 days	621	6 5	1.87180217	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	25 days	601	8	2 07944154	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	25 days	601	0.9	−0.1053605	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	25 days	601	7 1	1.96009478	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	8 hours	1799	0.9	−0 1053605	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	8 hours	1799	0 6	−0 5108256	AQUIRE, 1994 213784	91
	Colisa fasciata, Giant gourami	NR	8 hours	1799	0.8	−0 2231435	AQUIRE, 1994 213784	91

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Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Concentration (µg/L)	BCF	ln (BCF)	Reference	Year of Publication
Lead (cont)	Colisa fasciata; Giant gourami	NR	16 hours	1602	1 8	0 58778666	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	16 hours	1602	0 8	−0.2231435	AQUIRE, 1994 213784	91
	Colisa fasciata, Giant gourami	NR	16 hours	1602	1.8	0 58778666	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	24 hours	1523	1.7	0 53062825	AQUIRE, 1994 213784	91
	Colisa fasciata, Giant gourami	NR	24 hours	1523	0.8	−0 2231435	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	24 hours	1523	2.1	0 74193734	AQUIRE, 1994 213784	91
	Colisa fasciata, Giant gourami	NR	5 days	1544	3 1	1.13140211	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	5 days	1544	1 2	0 18232155	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	5 days	1544	3 2	1.16315080	AQUIRE, 1994 213784	91
	Colisa fasciata, Giant gourami	NR	10 days	1368	2 8	1.02961941	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	10 days	1368	2 1	0.74193734	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	10 days	1368	4 2	1.43508452	AQUIRE, 1994 213784	91
	Colisa fasciata, Giant gourami	NR	15 days	1402	4.5	1.50407739	AQUIRE, 1994 213784	91
	Colisa fasciata, Giant gourami	NR	15 days	1402	1.5	0 40546510	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	15 days	1402	3.7	1 30833281	AQUIRE, 1994 213784	91
	Colisa fasciata, Giant gourami	NR	20 days	1301	6 8	1.91692261	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	20 days	1301	1 9	0 64185388	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	20 days	1301	4.9	1.58923520	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	25 days	1300	4 9	1.58923520	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	25 days	1300	1 8	0.58778666	AQUIRE, 1994 213784	91
	Colisa fasciata, Giant gourami	NR	25 days	1300	5	1.60943791	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	8 hours	4324	0.8	−0.2231435	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	8 hours	4324	0 4	−0 9162907	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	8 hours	4324	1	0	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	16 hours	4300	1.7	0.53062825	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	16 hours	4300	0.6	−0.5108256	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	16 hours	4300	1	0	AQUIRE, 1994 213784	91
	Colisa fasciata, Giant gourami	NR	24 hours	4285	1 4	0.33647223	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	24 hours	4285	0 5	−0 6931471	AQUIRE, 1994 213784	91
	Colisa fasciata, Giant gourami	NR	24 hours	4285	1 6	0.47000362	AQUIRE, 1994 213784	91
	Colisa fasciata, Giant gourami	NR	5 days	4188	4.2	1 43508452	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	5 days	4188	0.9	−0.1053605	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	5 days	4188	2 2	0.78845736	AQUIRE, 1994 213784	91
	Colisa fasciata, Giant gourami	NR	10 days	4180	4 2	1.43508452	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	10 days	4180	1	0	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	10 days	4180	3 8	1 33500106	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	15 days	4060	4 5	1.50407739	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	15 days	4060	1.1	0 09531017	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	15 days	4060	3 9	1 36097655	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	20 days	4000	4 9	1.58923520	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	20 days	4000	1.4	0 33647223	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	20 days	4000	4 4	1.48160454	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	25 days	4000	4 5	1.50407739	AQUIRE, 1994 213784	91
	Colisa fasciata; Giant gourami	NR	25 days	4000	1 4	0.33647223	AQUIRE, 1994 213784	91

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Chemical Name	Species	Age	Exposure	Concentration (µg/L)	BCF	ln (BCF)	Reference	Year of Publication
Lead (cont.)	Colisa fasciata; Giant gourami	NR	25 days	4000	4.3	1.45861502	AQUIRE, 1994 213784	91
	Snail				1,700	7.43838353	USEPA, 1985f	
	Snail				738	6.60394382	USEPA, 1985f	
	Stonefly				1,120	7.02108396	USEPA, 1985f	
	Caddisfly				499	6.21260609	USEPA, 1985f	
							4 = Geometric Mean BCF for Lead	
Manganese	Physa sp; Pouch snail;	NR	NR	165.1	1,300	7.17011954	AQUIRE, 1994 212745	77
	Physa sp; Pouch snail;	NR	NR	142.9	800	6.68461172	AQUIRE, 1994 212745	77
	Corbicula fluminea; Asiatic clam	NR	NR	60	470	6.15273269	AQUIRE, 1994 218433	80
	Corbicula fluminea, Asiatic clam	NR	NR	60	1,800	7.49554194	AQUIRE, 1994 218433	80
	Corbicula fluminea; Asiatic clam	NR	NR	70	470	6.15273269	AQUIRE, 1994 218433	80
	Corbicula fluminea; Asiatic clam	NR	NR	70	2,100	7.64969262	AQUIRE, 1994 218433	80
	Plankton; Plankton;	NR	NR	32	690	6.53669159	AQUIRE, 1994 212830	78
	Oligochaeta; Annelid worm class	NR	NR	32	88	4.47733681	AQUIRE, 1994 212830	78
	Insecta; Insect class;	NR	NR	32	28	3.33220451	AQUIRE, 1994 212830	78
	Osteichthyes; Class – bony fishes	661–824 grams	NR	32	84	4.43081679	AQUIRE, 1994 212830	78
	Lemna minor; Duckweed,	NR	NR	148.5	10,900	9.29651806	AQUIRE, 1994 218581	75
	Chironomidae; Midge family;	LARVAE	NR	< 30	3,900	8.26873183	AQUIRE, 1994 315437	82
	Crustacea, Crustacean class,	NR	NR	< 30	1,100	7.00306545	AQUIRE, 1994 315437	82
	Unio pictorum; Mussel;	12.5 grams	NR	< 30	160,000	11.9829290	AQUIRE, 1994 315437	82
	Anodonta cygnea; Swan mussel,	28.5 grams	NR	< 30	350,000	12.7656884	AQUIRE, 1994 315437	82
	Abramis brama; Bream;	350 grams	NR	< 30	600	6.39692965	AQUIRE, 1994 315437	82
	Abramis brama; Bream,	350 grams	NR	< 30	240	5.48063892	AQUIRE, 1994 315437	82
	Abramis brama; Bream,	350 grams	NR	< 30	170	5.13579843	AQUIRE, 1994 315437	82
	Stizostedion lucioperca; Pikeperch	500 grams	NR	< 30	260	5.56068163	AQUIRE, 1994 315437	82
	Stizostedion lucioperca; Pikeperch	500 grams	NR	< 30	210	5.34710753	AQUIRE, 1994 315437	82
	Stizostedion lucioperca; Pikeperch	500 grams	NR	< 30	70	4.24849524	AQUIRE, 1994 315437	82
	Melosira varians; Diatom;	NR	NR	16.66 to 23.23	59,052	10.9861736	AQUIRE, 1994 215512	80
	Elodea sp; Waterweed;	NR	NR	16.66 to 23.23	12,465	9.43067999	AQUIRE, 1994 215512	80
	Lemna sp; Duckweed,	NR	NR	16.66 to 23.23	46,647	10.7503638	AQUIRE, 1994 215512	80
	Planaria sp; Planarian, flatworm	NR	NR	16.66 to 23.23	2,255	7.72090525	AQUIRE, 1994 215512	80
	Tubifex sp; Tubificid worm,	NR	NR	16.66 to 23.23	14,583	9.58761174	AQUIRE, 1994 215512	80
							1,494 = Geometric Mean BCF for Manganese	
Zinc	Asiatic clam				126.2	4.83786795	USEPA, 1987	
	Asiatic clam				71.6	4.27109507	USEPA, 1987	
	Asiatic clam				102.2	4.62693167	USEPA, 1987	
	Mayfly				1,130	7.02997291	USEPA, 1987	
	Stonefly				106	4.66343909	USEPA, 1987	
							162 = Geometric Mean BCF for Zinc	

NOTES.

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Remedial Investigation
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Chemical Name	Species	Age	Exposure	Concentration (µg/L)	BCF	ln (BCF)	Reference	Year of Publication

NR = Not Reported
cm = centimeters

Table A–11
Ingestion Toxicity Information for Wildlife

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Test Species	Test Type	Duration	Effect	Lethal RTV mg/kgBW–day Oral LD50	Lethal RTV mg/kgBW–day LOAEL	Sublethal RTV mg/kgBW–day LOAEL	Sublethal RTV mg/kgBW–day NOAEL	Reference
VOLATILE ORGANIC COMPOUNDS									
Acetone	Rat	Oral	NR	Reproductive effects			273,000		RTECS, 1993
	Rat	Oral LD_{50}	NR	Mortality	5,800				RTECS, 1993
	Rat	Oral LD_{50}		Mortality	9,750				Sax, 1984
	Mouse	Oral LD_{50}	NR	Mortality	3,000				RTECS, 1993
	Rabbit	Oral LD_{50}	NR	Mortality	5,340				RTECS, 1993
2–Butanone	Rat	Oral LD_{50}	NR	Mortality	2,737				RTECS, 1994
	Mouse	Oral LD_{50}	NR	Mortality	4,050				RTECS, 1994
	Rat	Oral (subchronic)	13 weeks	NOAEL for neurological effects				173	ATSDR, 1991a
SEMIVOLATILE ORGANIC COMPOUNDS									
Acenaphthene	Mouse	Oral (chronic)	90 days	Liver weight increase				175	IRIS, 1990
	Rat	Oral (chronic)	32 days	Physiological changes			2,000		USEPA, 1984a
Anthracene	Mouse	Oral LD_{50}	NR	Mortality	17,000				RTECS, 1993
	Rodents	Oral (chronic)	NS	Carcinogenicity			3,300		Eisler, 1987a
	Mouse	Oral (chronic)	90 days	Clinical and pathological effects				1,000	IRIS, 1990
Benzo(a)anthracene	Rodents	Oral (chronic)	NS	Carcinogenicity			2		Eisler, 1987a
Benzo(a)pyrene (surrogate for Dibenz(a,h)anthracene)	Rat	Oral (chronic)	Pregnancy	Sterility in offspring			40		USEPA, 1984b
	Rat	Oral (chronic)	3.5 months	Reproductive			50		USEPA, 1984b
	Mouse	Oral	Multi–generational	Decreased fertility of F1 progeny; decreased F2 litter size.			10 [a]		MacKenzie and Angevine, 1981
	Mouse	Oral (subchronic)	6 months	Mortality		120			ATSDR, 1993b
Benzo(b)fluoranthene and Benzo(k)fluoranthene	Rodents	Oral (chronic)	NS	Carcinogenicity			40		Eisler, 1987a
	Rodents	Oral (chronic)	NS	Carcinogenicity			99		Eisler, 1987a
Benzo(g,h,i)perylene	Rat	Oral LD_{50}	NR	Mortality	2,330				RTECS, 1994
Butylbenzylphthalate	Rat	Oral	NR	Reproductive effects			21,000		RTECS, 1994
	Rat	Oral	NR	Reproductive effects			16,400		RTECS, 1994
	Rat	Oral	NR	Reproductive effects			16,400		RTECS, 1994
	Rat	Oral	NR	Reproductive effects			4,900		RTECS, 1994
	Mouse	Oral LD_{50}	NR	Mortality	4,170				RTECS, 1994
	Guinea Pig	Oral LD_{50}	NR	Mortality	13,750				RTECS, 1994
Carbazole	Rat	Oral LD_{50}		Mortality	500				USEPA, 1986a
Chrysene	Rodents	Oral (chronic)	NS	Carcinogenicity			99		Eisler, 1987a
Dibenzofuran	Rodents	Single oral dose		LC 20		500			ATSDR, 1991b
	Rodents	Oral (chronic)	13 weeks	LC 10		125			ATSDR, 1991b
	Mouse	Oral (chronic)	103 weeks	Multinuclear hepatocytes				60	ATSDR, 1991b
1,4–Dichlorobenzene	Rat	LD_{50}, gavage oil	14 days	Mortality	3,800				ATSDR, 1992
	Mouse	Oral		Systemic, hepatocellular degeneration			300		ATSDR, 1992
Diethylphthalate (surrogate for dimethylphthalate)	Mouse	Oral (subchronic)	Multi–generational	Decrease in F1 litter size			3,250		ATSDR, 1993c
	Rat	Oral LD_{50}		Mortality	8,600				NIOSH, 1985
Di–n–butylphthalate	Rat	Oral (subchronic)	48 days	Reproductive effects			125		USEPA, 1989a
	Rat	Oral (chronic)	1 year	Mortality		600			IRIS, 1991
	Mouse	Oral LD_{50}		Mortality	5.28				Sax, 1984
	Rat	Oral LD_{50}		Mortality	12,000				Sax, 1984
bis(2–Ethylhexyl)phthalate	Rat	Oral LD_{50}	NR	Mortality	30,600				RTECS, 1993
	Rat	Oral	NR	Reproductive effects			7,140		RTECS, 1993
	Rat	Oral	NR	Reproductive effects			35		RTECS, 1993
	Rat	Oral	NR	Reproductive effects			6,000		RTECS, 1993
	Rat	Oral	NR	Reproductive effects			17,200		RTECS, 1993
	Rat	Oral	NR	Reproductive effects			10,000		RTECS, 1993
	Rat	Oral	NR	Reproductive effects			9,766		RTECS, 1993
	Mouse	Oral LD_{50}	NR	Mortality	30,000				RTECS, 1993
	Mouse	Oral	NR	Reproductive effects			78,880		RTECS, 1993
	Mouse	Oral	NR	Reproductive effects			4,200		RTECS, 1993
	Mouse	Oral	NR	Reproductive effects			50		RTECS, 1993
	Mouse	Oral	NR	Reproductive effects			1,000		RTECS, 1993
	Mouse	Oral	NR	Reproductive effects			2,040		RTECS, 1993
	Rabbit	Oral LD_{50}	NR	Mortality	34,000				RTECS, 1993
	Guinea pig	Oral LD_{50}	NR	Mortality	26,000				RTECS, 1993
	Guinea pig	Oral	NR	Reproductive effects			20,000		RTECS, 1993

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Remedial Investigation
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Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Test Species	Test Type	Duration	Effect	Lethal RIV mg/kgBW–day Oral LD50	Lethal RIV mg/kgBW–day LOAEL	Sublethal RIV mg/kgBW–day LOAEL	Sublethal RIV mg/kgBW–day NOAEL	Reference
bis(2–Ethylhexyl)phthalate (cont.)	Mammal	Oral	NR	Reproductive effects			20,000		RTECS, 1993
	Mammal	Oral	NR	Reproductive effects			509,000		RTECS, 1993
	Mouse	Oral LD_{50}		Mortality	800				RTECS, 1993
	Mouse	Oral (subchronic)	13 weeks	Renal effects			125		RTECS, 1993
Fluoranthene	Rat	Oral LD_{50}	NR	Mortality	2,000				RTECS, 1994
	Mouse	Oral (subchronic)	90 days	Nephropathy; clinical and pathological effects			250	125	IRIS, 1990
Fluorene	Mouse	Oral (chronic)	13 weeks	Hematological changes			250	125	IRIS, 1990
Indeno(1,2,3–cd)pyrene	Rodents	Oral (chronic)	NS	Carcinogenicity			72		Eisler, 1987a
2–Methylnaphthalene	Rat	Oral LD_{50}		Mortality	1,630				NIOSH, 1985
Naphthalene	Rat	Oral (chronic)	100 weeks	Ocular lesions			41		USEPA, 1990b
	Rat	Oral (subchronic)	13 weeks	Decreased body weight gain			35.7		USEPA, 1990b
	Mouse	Oral LD_{50}		Mortality	533				ATSDR, 1990a
Phenanthrene	Mouse	Oral LD_{50}	NR	Mortality	700				RTECS, 1994
	Mouse	Oral (subchronic)	6 months	Increased liver weight			120		ATSDR, 1989c
Phenol	Rat	Oral LD_{50}	NR	Mortality	530				USEPA, 1980a
	Rat	Oral LD_{50}	NR	Mortality	414				TDB, 1984
	Rat	Oral LD_{50}	NR	Mortality	340				USEPA, 1980a
	Rabbit	Oral LD_{50}	NR	Mortality	600				USEPA, 1980a
	Rabbit	Oral LD_{50}	NR	Mortality	400				USEPA, 1980a
	Dog	Oral LD_{50}	NR	Mortality	500				USEPA, 1980a
	Cat	Oral LD_{50}	NR	Mortality	100				USEPA, 1980a
	Rat	Oral (subchronic)	Gestational	Reduced fetal body weights			120		IRIS, 1993
Pyrene	Rat	Oral LD_{50}	NR	Mortality	2,700				RTECS, 1993 and NIOSH, 1985
	Mouse	Oral LD_{50}	NR	Mortality	800				RTECS, 1993 and NIOSH, 1985
	Mouse	Oral (chronic)	13 weeks	Renal effects			125	75	IRIS, 1990
1,2,4–Trichlorobenzene	Rat	Oral LD_{50}	NR	Moratlity	756				Sax, 1984
	Mouse	Oral LD_{50}	NR	Moratlity	766				Sax, 1984
	Rat	Oral (acute)	NR	Moratlity		1,000			Verschueren, 1983
EXPLOSIVE COMPOUNDS									
HMX	Rat	LD_{50}, gavage	Single dose	Mortality	5,500				ATSDR, 1994
	Mouse	LD_{50}, gavage	Sigle dose	Mortality	1,700				ATSDR, 1994
	Mouse	Oral	13 weeks	Reproductive				90	ATSDR, 1994
	Mouse	Oral (acute)	14 days	Mortality of 5/6 males		300			ATSDR, 1994
1,3–Dinitrobenzene (surrogate 1,3,5–Trinitrobenzene and TETRYL)	Rat	Oral gavage	12 weeks	Reproductive, decreased spermatogenesis			1.5		ATSDR, 1993
2,4–Dinitrotoluene (surrogate for 3– and 4–Nitrotoluene)	Mouse	Oral LD_{50}	NR	Mortality	1,250				Sax, 1984
	Guinea pig	Oral LD_{50}	NR	Mortality	1,300				Sax, 1984
	Rat	Oral LD_{50}	NR	Mortality	268				Sax, 1984
	Mouse	Oral LD_{50}	NR	Mortality	1,340				Sax, 1984
	Rat	LD_{50}, gavage	Single dose	Mortality	270				ATSDR, 1989c
	Rat	Oral (chronic)	24 month	Reproductive, testicular atrophy			34	3.9	ATSDR, 1989c
	Mouse	Oral (chronic)	24 month	Reproductive, testicular atrophy			97	13.5	ATSDR, 1989c
2,6–Dinitrotoluene (surrogate for 3– and 4–Nitrotoluene)	Rat	LD_{50}, gavage	NR	Mortality	665				ATSDR, 1989c
	Mouse	LD_{50}, gavage	NR	Mortality	714				ATSDR, 1989c
	Rat	Oral (chronic)	13 week	Reproductive, testicular atrophy			35	7	ATSDR, 1989c
	Dog	Oral (chronic)	13 week	Reproductive, testicular atrophy			20	4	ATSDR, 1989c
TETRYL	Rat	Oral LD_{50}	NR	Mortality	177				Sax, 1984
	Mouse	Oral LD_{50}	NR	Mortality	621				Sax, 1984
	Rabbit	Oral gavage	1–3 doses	Mortality		1,000			ATSDR, 1993d
	Dog	Subcutaneous LDL_0	NR	Mortality		5,000			Sax, 1984
1,3,5–Trinitrobenzene (surrogate for TETRYL)	Bird	Oral LD_{50}	NR	Mortality	42				Sax, 1984
	Rat	Oral LD_{50}	NR	Mortality	450				Sax, 1984
	Guinea pig	Oral LD_{50}	NR	Mortality	730				Sax, 1984
	Rat	Oral LD_{50}	NR	Mortality	505				Sax, 1984
	Mouse	Oral LD_{50}	NR	Mortality	572				Sax, 1984

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PESTICIDES/PCBs									
4,4'–DDE	Rat	Oral LD_{50}	NR	Mortality	800				RTECS, 1993
	Mouse	Oral LD_{50}	NR	Mortality	700				RTECS, 1993
	Hamster	Oral LD_{50}	NR	Mortality	>5,000				RTECS, 1993
	Mallard	Oral	NR	Eggshell thinning			2.91		USEPA, 1993c
	Mallard	Oral	2 years	Reproductive, embryo mortality, cracked eggs			0.58		USEPA, 1993c
	Kestrel	Oral	NR	Eggshell thinning			0.39		USEPA, 1993c
4,4'–DDT (surrogate for 4,4'–DDD and 4,4'–DDE)	Rat	Oral LD_{50}	NR	Mortality	87				RTECS, 1993
	Rat	Oral LD_{50}		Mortality	100				USEPA, 1985b
	Rat	Oral	NR	Reproductive			112		RTECS, 1993
	Rat	Oral	NR	Reproductive			100		RTECS, 1993
	Rat	Oral	NR	Reproductive			430		RTECS, 1993
	Rat	Oral	NR	Reproductive			1,890		RTECS, 1993
	Rat	Oral	NR	Reproductive			250		RTECS, 1993
	Rat	Oral	NR	Reproductive			50		RTECS, 1993
	Rat	Oral (chronic)	3 generations	Reproductive			0.2		IRIS, 1991
	Rat	Oral	2 years	Reproductive			2.5		USEPA, 1993c
	Mouse	Oral LD_{50}	NR	Mortality	135				RTECS, 1993
	Mouse	Oral LD_{50}		Mortality	200				USEPA, 1985b
	Mouse	Oral	NR	Reproductive			504		RTECS, 1993
	Mouse	Oral	NR	Reproductive			81		RTECS, 1993
	Mouse	Oral	NR	Reproductive			124		RTECS, 1993
	Mouse	Oral	NR	Reproductive			148		RTECS, 1993
	Rabbit	Oral LD_{50}	NR	Mortality	250				RTECS, 1993
	Rabbit	Oral	NR	Reproductive			150		RTECS, 1993
	Guinea pig	Oral LD_{50}	NR	Mortality	150				RTECS, 1993
	Hamster	Oral LD_{50}	NR	Mortality	>5,000				RTECS, 1993
	Dog	Oral LD_{50}	NR	Mortality	150				RTECS, 1993
	Dog	Oral LD_{50}		Mortality	60				USEPA, 1985b
	Dog	Oral	NR	Reproductive			3,540		RTECS, 1993
	Monkey	Oral LD_{50}	NR	Mortality	200				RTECS, 1993
	Chicken	Oral (subchronic)	10 weeks	Decreased reproductive success, toxic symptoms			91.4 [b]		USEPA, 1985b
	Rock dove	Oral LD_{50}		Mortality	4,000				USFWS, 1984
	Black duck	Oral (chronic)	2 years	Reduced eggshell thickness			0.14 [b]		Longcore and Stendell, 1977
	Mallard	Oral LD_{50}		Mortality	2,240				USFWS, 1984
	Mallard	Oral (subchronic)	96 days	Reduced eggshell thickness			2.8		Longcore and Stendell, 1977
	Mallard	Oral	NR	Eggshell thinning			1.16		USEPA, 1993c
	Mallard	Oral	NR	Eggshell thinning			2.91		USEPA, 1993c
	Mallard	Oral	2 years	Reproductive			1.45		USEPA, 1993c
	California quail	Oral LD_{50}		Mortality	595				USFWS, 1984
	Japanese quail	Oral LD_{50}		Mortality	841				USFWS, 1984
	Pheasant	Oral LD_{50}		Mortality	1,334				USFWS, 1984
	Sandhill crane	Oral LD_{50}		Mortality	1,200				USFWS, 1984
	Kestrel	Oral (chronic)	7 wk – 1 yr	Reduced eggshell thickness			0.56a		USEPA, 1985b
	Kestrel	Oral (chronic)	1 year	Reduced eggshell thickness			0.16a		Wiemeyer, et al., 1986
	Barn owl	Oral (chronic)	2 years	Reduced eggshell thickness			0.14 [b]		Longcore and Stendell, 1977
Dieldrin	Mouse	Oral LD_{50}	NR	Mortality	38				Allen et al., 1979
	Mouse	Oral (chronic)	80 weeks	Body tremors			0.33		NCI, 1978
	Mouse	Oral (chronic)	2 year	Liver enlargement w/ histopathology			0.1		IRIS, 1991
	Mouse	Oral (chronic)	2 year	Hepatic cancer			1.3		ATSDR, 1987
	Rat	Oral (chronic)	2 year	Histologic changes			2		ATSDR, 1987
	Rat	Oral (chronic)	2 year	Liver lesions			0.05	0.005	IRIS, 1991
	Dog	Oral (chronic)	2 year	Increased liver weight; liver/body weight			0.05	0.005	IRIS, 1991
	Dog	Oral (chronic)	25 months	Hepatocyte degeneration			0.5		ATSDR, 1987b
	Monkey	Oral (chronic)	120 days	Tremors and convulsions			0.1		Smith et al., 1976
	Mouse	Oral (subchronic)	4 wks	Decreased pup survival			0.65		Virgo & Bellward, 1975
	Rat	Oral (subchronic)	120 days	Operant behavior				0.025	Smith et al., 1976
	Rat	Oral LD_{50}	NR	Mortality	46				Allen et al., 1979
	Guinea pig	Oral LD_{50}	NR	Mortality	25				Allen et al., 1979

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Dieldrin (cont.)	Rabbit	Oral LD_{50}	NR	Mortality	45				Allen et al., 1979
	House sparrow	Oral LD_{50}	NR	Mortality	48				USFWS, 1984
	Chicken	Oral LD_{50}	NR	Mortality	20				Allen et al., 1979
	Rock dove	Oral LD_{50}	NR	Mortality	27				USFWS, 1984
	Gray partridge	Oral LD_{50}	NR	Mortality	9				USFWS, 1984
	Chukar	Oral LD_{50}	NR	Mortality	25				USFWS, 1984
	Japanese quail	Oral LD_{50}	5 days	Mortality	6 [b]				Hill et al., 1975
	Japanese quail	Oral LD_{50}	NR	Mortality	70				USFWS, 1984
	California quail	Oral LD_{50}	NR	Mortality	9				USFWS, 1984
	Bobwhite	Oral LD_{50}	5 days	Mortality	3 [b]				Hill et al., 1975
	Pheasant	Oral LD_{50}	NR	Mortality	79				USFWS, 1984
	Mallard	Oral LD_{50}	5 days	Mortality	12 [b]				Hill et al., 1975
	Mallard	Oral LD_{50}	5 days	Mortality	11 [b]				Hill et al., 1975
	Mallard	Oral LD_{50}	NR	Mortality	381				USFWS, 1984
	Whistling duck	Oral LD_{50}	NR	Mortality	100				USFWS, 1984
	Canada goose	Oral LD_{50}	NR	Mortality	141				USFWS, 1984
	Goat	Oral LD_{50}	NR	Mortality	100				Allen et al., 1979
	Sheep	Oral LD_{50}	NR	Mortality	50				Allen et al., 1979
	Cattle	Oral LD_{50}	NR	Mortality	60				Allen et al., 1979
	Mule deer	Oral LD_{50}	NR	Mortality	75				Allen et al., 1979
	Cat	Oral LD_{50}	NR	Mortality	300				Allen et al., 1979
	Dog	Oral LD_{50}	NR	Mortality	65				Allen et al., 1979
Endosulfan (surrogate for Endosulfan II)	Mouse	Oral (chronic)	78 weeks	Mortality			0.9		ATSDR, 1991c
	Mouse	Oral (chronic)	78 weeks	Ovarian cyst development			0.26		ATSDR, 1991c
	Rat	Single oral dose	NR	Mortality	24				ATSDR, 1991c
	Rat	Oral (chronic)	2 years	Reduced testes weight			10		USEPA, 1980b
	Mallard	Single oral dose	NR	Mortality	33				USFWS, 1984
	Mallard	Single oral dose	NR	Mortality	31.2				USFWS, 1984
	Pheasant	Single oral dose	NR	Mortality	80				USFWS, 1984
Endrin	Mouse	Oral (chronic)	80 weeks	Mortality			0.53		ATSDR, 1989b
	Dog	Oral (chronic)	19 months	Decreased weight gain			0.1		USEPA, 1985a
	Rat	Single oral dose	NR	Mortality	3				Sax, 1984
	Bird	Single oral dose	NR	Mortality	1.8				Sax, 1984
INORGANIC ANALYTES									
Aluminum	Mouse	Oral (chronic)	2–3 generns	Reduced body weight gain of newborns			425		NIOSH, 1985
	Rat	Oral (subchronic)	15 days	Reduced growth			100		Bernuzzi, et al., 1989
	Rat	Oral LD_{50}	NR	Mortality	3,700				Sax, 1984
Antimony	Rat	Oral (acute)	Single oral dose	NOAEL for Death		16,714			ATSDR, 1991d
	Rat	Oral (chronic)	NS	Longevity; blood glucose; cholesterol			0.35 (water)		IRIS, 1993
	Rat	Oral (subchronic)	24 weeks	Decreased RBC, swelling of hepatic cords			41.8		ATSDR, 1991d
Arsenic	Rat	Oral	NR	Reproductive effects			0.61		RTECS, 1993
	Rat	Oral	NR	Reproductive effects			0.58		RTECS, 1993
	Rat	Oral LD_{50}	NR	Mortality	763				RTECS, 1993
	Mouse	Oral LD_{50}	NR	Mortality	145				RTECS, 1993
	Mallard	Oral LD_{50}	NR	Mortality	323				Eisler, 1988 a
	Cowbird	Oral LD_{50}	11 days	Mortality	18.1 [b]				Eisler, 1988 a
	Young chicken	Oral	56 days	Egg production				1 [b]	Ilermeyer, 1977
Barium	Rat	Oral (chronic)	68 weeks	Renal ultrastructure changes			142		IRIS, 1993
	Rat	Oral (subchronic)	13 weeks	Renal effects			91		Dietz et al., 1992
	Rat	Oral (acute)	10 days	Decreased ovarian weight			198		ATSDR, 1990b
	Rat	Oral (subchronic)	13 weeks	20% population mortality		430			Dietz et al., 1992
Beryllium	Rat	Oral LD_{50}	NR	Mortality	10				USEPA, 1985d
	Rat	Oral (chronic)	NR	Increase in lung sarcomas			0.22		USEPA, 1985d
	Rat	Oral (chronic)	3.2 years	Respiratory, cardiopulmonary, hematological, and hepatic effects			0.85		ATSDR, 1991e
Cadmium	Rat	Oral	NR	Reproductive effects			155		RTECS, 1993
	Rat	Oral	NR	Reproductive effects			220		RTECS, 1993
	Rat	Oral	NR	Reproductive effects			21.5		RTECS, 1993
	Rat	Oral	NR	Reproductive effects			23		RTECS, 1993
	Rat	Oral LD_{50}		Mortality	250				Eisler, 1985

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Chemical	Test Species	Test Type	Duration	Effect	Lethal RTV mg/kgBW–day Oral LD50	Lethal RTV mg/kgBW–day LOAEL	Sublethal RTV mg/kgBW–day LOAEL	Sublethal RTV mg/kgBW–day NOAEL	Reference
Cadmium (cont.)	Rat	Oral LD_{50}	NR	Mortality	225				RTECS, 1993
	Mouse	Oral LD_{50}	NR	Mortality	890				RTECS, 1993
	Mouse	Oral	NR	Reproductive effects			448		RTECS, 1993
	Mouse	Oral	NR	Reproductive effects			1,700		RTECS, 1993
	Guinea pig	Oral LD_{50}	NR	Mortality	150				Eisler, 1985
	Mallard	Oral (subchronic)	90 days	Egg production suppressed			10		Eisler, 1985
Chromium	Japanese quail	Oral LD_{50}	5 days	Mortality	126				Hill and Camardese, 1986
	Rat	Oral (subchronic)	90 days	Histopathologic and reproductive effects				1,400	Ivankovic and Preussman, 1975
	Black Duck	Oral (subchronic)	5 months	Reproductive effects				200	Outridge and Scheuhammer, 1993
	Rat	Oral LD_{50}		Mortality	200				ATSDR, 1991f
Cobalt	Rat	Oral LD_{50}		Mortality	91				ATSDR, 1991g
	Rat	Single oral dose		Hepatic/renal hyperemia			4.2		ATSDR, 1991g
	Rat	Oral (subchronic)	8 weeks	Decreased body weight gain			13		ATSDR, 1991g
	Rat	Oral (chronic)	98 days	Testicular degeneration			20		ATSDR, 1991g
	Rat	Oral (chronic)	69 days	Testicular atrophy			5		ATSDR, 1991g
	Dog	Oral (subchronic)	4 weeks	Increased red blood cell count			152		NIOSH, 1985
Copper	Rat	Single oral dose		Reproductive effects					and RTECS, 1993
	Rat	Oral LD_{50}	NR	Mortality	940				Sax, 1984
	Mouse	Oral (chronic)	30 days	Decreased litter sizes with teratogenic effects			100		Lecyk, 1980
Cyanide	Rat	Oral (subchronic)	11.5 months	Increased thyroid weight, myelin degeneration			30		IRIS, 1993
	Mouse	Single oral dose	NR	Mortality	8.5				Arthur D. Little, Inc., 1981
	Young chickens	Oral	20 days	Decreased growth and food intake			11		Fletcher and Davis, 1988
	Pig	Oral	110 days	Thyroid hypofunction during pregnancy			11		Tewe and Maner, 1981
	Hamsters	Oral	12 days	Decreased fetal weight and delayed ossification		12	11.9		Frakes et al., 1986
	Mallard	Single oral dose	NR	Mortality in 6% of population		1.1			Eisler, 1991
Lead	Rat	Oral	NR	Reproductive effects			790		RTECS, 1993
	Rat	Oral	NR	Reproductive effects			1,140		RTECS, 1993
	Rat	Oral	NR	Reproductive effects			520		RTECS, 1993
	Rat	Oral	NR	Reproductive effects			1,100		RTECS, 1993
	Calf	Oral LD_{50}	NR	Mortality	220				Eisler, 1988b
	Rat	Oral (subchronic)	12–14 days	Decreased fetal body weight			2.5		McClain and Becker, 1972
	Mouse	Oral	NR	Reproductive effects			1,120		RTECS, 1993
	Mouse	Oral	NR	Reproductive effects			6,300		RTECS, 1993
	Mouse	Oral	NR	Reproductive effects			300		RTECS, 1993
	Mouse	Oral	NR	Reproductive effects			4,800		RTECS, 1993
	Domestic animal	Oral	NR	Reproductive effects			662		RTECS, 1993
	Mammal	Oral	NR	Reproductive effects			2,118		RTECS, 1993
	Kestrel	Diet	NR	Decreased egg laying fertility; decreased egg shell thickness				4.61 [b]	Eisler, 1988b
	Kestrel nestlings	Oral	10 days	Reduced growth and brain weight; abnormal development			125		Eisler, 1988b
	Japanese quail	Oral LD_{50}	5 days	Mortality	24,752				Hill and Camardese, 1986
	Rat	Oral (chronic)	2 generations	Developmental effects				7	Kimmel et al., 1980 and Grant et al., 1980
	Guinea pig	Oral LD_{50}		Mortality	300				Sax, 1984
	Rock dove	Oral (chronic)	NS	Kidney pathology, learning deficiences			6.25		Anders et al., 1982 and Dietz et al., 1979
	Rock dove	Oral LD_{50}		Mortality	375				Kendall and Scanlon, 1985
Manganese	Mouse	Oral (subchronic)	90 days	Delayed growth of testes			140		ATSDR, 1990c
	Mouse	Oral (chronic)	103 weeks	Mortality			4,050		ATSDR, 1990c
	Rat	Oral LD_{50}	NR	Mortality	410				ATSDR, 1990c
	Rat	Oral LD_{50}	20 days	Mortality	225				ATSDR, 1990c
	Rat	Oral (subchronic)	20 days	Decreased litter weight during gestation				620	ATSDR, 1990c
	Rat	Oral (chronic)	103 weeks	Mortality			930		ATSDR, 1990c
	Guinea pig	Oral LD_{50}	NR	Mortality	400				USEPA, 1984c
	Monkey	Oral (chronic)	18 months	Weakness, rigidity			25		ATSDR, 1990c
	Rodents/livestock	Oral (subchronic)	10 days – 2 months	Decreased growth rate			100		Cunningham et al., 1966
Nickel	Mouse	Oral (subchronic)	180 days	NOAEL for mortality		2,300			Giantsios and Murray, 1982
	Rat	Oral	NR	Reproductive effects			158		RTECS, 1994
	Rat	Oral LD_{50}	NR	Mortality	67				USEPA, 1987c
	Rat	Oral (chronic)	2 years	Decreased body weight gain			50		USEPA, 1987c

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Nickel (cont.)	Rat	Oral LD_{50}	NR	Mortality	350				Sax, 1984
	Japanese quail	Oral (acute)	5 days	Mortality	504				Hill and Camardese, 1986
	Dog	Oral (chronic)	2 years	Histological lesions in bone marrow			62.5		USEPA, 1987c
Vanadium	Japanese quail	Oral LD_{50}	5 days	Mortality	96				Hill and Camardese, 1986
	Mouse	Gavage LD_{50}	One time	Mortality	31				ATSDR, 1990d
	Rat	Oral (subchronic)	2 months	Hypertension			15		Susr and Kentera, 1986
	Rat	Oral (subchronic)	35 days	Development effects				8.4	Domingo, et al., 1986
	Chicken	Oral (subchronic)	6 weeks	Decrease in egg–laying			11 [c]		Berg et al., 1963
Zinc	Rat	Oral LD_{50}		Mortality	2,510				RTECS, 1993
	Rat	Oral	Gestation	Fetal resorptions in 4 to 20% of population			200		Shiaker and Cox, 1968
	Ferret	Oral	3–13 days	Mortality and gastrointestinal effects		390			Straube et al., 1980
	Rat	Oral (subchronic)	NR	Kidney toxicity			160		Llobet, et al., 1988

Notes:
LD_{50} = Dose resulting in 50% mortality in test population
LOAEL = Lowest Observed Adverse Effect Level
BW = Body weight
NR = Not reported
[a] Value for benzo(a)pyrene chosen as a surrogate for all PAHs. Chemical–specific toxicity studies for ecologically significant endpoints are lacking for other PAHs
[b] Converted to dose per kilogram body weight by multiplying by ingestion and dividing by body weight Body weights for birds obtained from Dunning, 1984.
Ingestion rates were calculated using the following regression equation (for all birds) from USEPA, 1993b: Food Ingestion (kg/day) = 0.0582 * Body Weight$^{0.651}$ (kg) Ingestion rates for the chicken from NRC, 1984 (pg. 13)
[c] Converted from 30 ppm to 11 mg/kgBW–day using standard default parameters (USEPA, 1988b)
[d] Doses converted from pg/gBW/day to mg/kgBW/day

Table A-12
RTVs Selected for Ecological Risk Assessment [a]
Units (mg/kgBW/day)

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Compound	Small Mammal [b]		Small Bird [c]		Predatory Mammal [d]		Predatory Bird [e]	
	Lethal	Sublethal	Lethal	Sublethal	Lethal	Sublethal	Lethal	Sublethal
Volatile Organic Compounds								
Acetone	600	273,000			600	273,000		
2-Butanone	547	173			547	173		
Semivolatile Organic Compounds								
Acenaphthene	120 [f]	10 [f]			120 [f]	10 [f]		
Anthracene	3,400	10 [f]			3,400	10 [f]		
Benzo(a)anthracene	120 [f]	10 [f]			120 [f]	10 [f]		
Benzo(a)pyrene	120	10			120	10		
Benzo(b)fluoranthene	120 [f]	10 [f]			120 [f]	10 [f]		
Benzo(g,h,i)perylene	120 [f]	10 [f]			120 [f]	10 [f]		
Benzo(k)fluoranthene	120 [f]	10 [f]			120 [f]	10 [f]		
Butylbenzylphthalate	466	4,900			466	4,900		
Carbazole	100				100			
Chrysene	120 [f]	10 [f]			120 [f]	10 [f]		
Dibenz(ah)anthracene	120 [f]	10 [f]			120 [f]	10 [f]		
Dibenzofuran	125				125			
1,4-Dichlorobenzene	760				760			
Diethylphthalate	1,720	3,250			1,720	3,250		
Dimethylphthalate	1,720	3,250			1,720	3,250		
Di-n-butylphthalate	1.1	125			1.1	125		
bis(2-Ethylhexyl)phthalate	160	35			160	35		
Fluoranthene	400	10 [f]			400	10 [f]		
Fluorene	120 [f]	10 [f]			120 [f]	10 [f]		
Indeno(1,2,3-cd)pyrene	120 [f]	10 [f]			120 [f]	10 [f]		
2-Methylnaphthalene	326	10 [f]			326	10 [f]		
Naphthalene	107	35 7			107	35.7		
Phenanthrene	140	10 [f]			140	10 [f]		
Phenol	68	120			20	120		
Pyrene	160	10 [f]			160	10 [f]		
1,2,4-Trichlorobenzene	151				151			
Explosive Compounds								
HMX	300	90			300	90		
3-Nitrotoluene	35	34			35	20		
4-Nitrotoluene	35	34			35	20		
TETRYL	90	1.5	8		90	1 5	8	
1,3,5-Trinitrobenzene	90	1.5	8		90	1.5	8	
Pesticides/PCBs								
4,4'-DDD	17.4	0.2	119	0.14	12	3,540	119	0.14
4,4'-DDE	140	0 2	119	0 39	140	3,540	119	0.39
4,4'-DDT	17.4	0 2	119	0.14	12	3.540	119	0.14
Dieldrin	8	0.65	0.6		13	0 05	0.6	
Endosulfan II	5	0.26	6		5	0.26	6	
Endrin	0.6	0.53	0.4		0.6	0 1	0 4	
Inorganic Compounds								
Aluminum	740	425			740	425		
Antimony	16,714				16,714			
Arsenic	29	0.58	3.6	1	29	0.58	3.6	1
Barium	430	198			430	198		
Beryllium	2				2			
Cadmium	30	21.5		10	30	21.5		10
Chromium	40	1,400	25.2	200	40	1,400	25 2	200
Cobalt	18.2	4.2			18.2	4.2		
Copper	188	100			188	100		
Cyanide	1.7	11.9	1.1	11	1 7	11.9	1.1	11
Lead	60	2.5	75	125	60	2.5	75	125
Manganese	45	100			45	100		
Nickel	13	50	100		13	50	100	
Vanadium	6	8 4	19.2	11	6	8.4	19 2	11
Zinc	390	200			390	200		

Table A-12
RTVs Selected for Ecological Risk Assessment [a]
Units (mg/kgBW/day)

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Compound	Small Mammal [b]		Small Bird [c]		Predatory Mammal [d]		Predatory Bird [e]	
	Lethal	Sublethal	Lethal	Sublethal	Lethal	Sublethal	Lethal	Sublethal

Notes:

[a] Lethal RTVs correspond to the boxed lethal RTV (one-fifth of the oral LD_{50} or the LOAEL) presented in Table A-11. When available, oral LD_{50} data were preferentially chosen. Sublethal RTVs correspond to the boxed sublethal RTV (LOAEL or NOAEL) presented in Table A-11. When available, sublethal LOAEL data were preferentially chosen.

[b] These RTVs represent chemical concentrations that are not anticipated to result in adverse effects for the Florida water rat or the short-tailed shrew.

[c] These RTVs represent chemical concentrations that are not anticipated to result in adverse effects for the American woodcock and the rufous-sided towhee.

[d] These RTVs represent chemical concentrations that are not anticipated to result in adverse effects for the red fox or the raccoon When no data were available, the small mammal values were used as a surrogate

[e] These RTVs represent chemical concentrations that are not anticipated to result in adverse effects for the great horned owl or the great blue heron When no data were available, the small bird values were used as a surrogate.

[f] The value for benzo(a)pyrene was used as a surrogate.

LD_{50} = Median lethal dose.
LOAEL = Lowest Observed Adverst Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not available

Table A–13
SUMMARY OF TOXICITY DATA FOR PLANT RECEPTORS

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Reference	RTV in soil [a] (mg/kg)	RTV in solution [a] (mg/L)
SEMI–VOLATILE ORGANIC COMPOUNDS			
Acenaphthene		25 [b]	0.1 [b]
Anthracene		25 [b]	0.1 [b]
Benzo(a)anthracene		25 [b]	0.1 [b]
Benzo(a)pyrene		25 [b]	0.1 [b]
Benzo(b)fluoranthene		25 [b]	0.1 [b]
Benzo(k)fluoranthene		25 [b]	0.1 [b]
Benzo(g,h,i)perylene		25 [b]	0.1 [b]
Butylbenzylphthalate		200 [c]	25 [d]
Carbazole		NA	NA
Chrysene		25 [b]	0.1 [b]
Dibenz(a,h)anthracene		25 [b]	0.1 [b]
Dibenzofuran	Hulzebos *et al.*, 1993 [e]	617 [f]	130 [f]
Di–n–butylphthalate	Will and Suter, 1994	200	25 [d]
bis(2–Ethylhexyl)phthalate	Hulzebos *et al.*, 1993 [e]	>1,000	$>S_w$
Fluoranthene		25 [b]	0.1 [b]
Fluorene		25 [b]	0.1 [b]
Indeno(1,2,3–cd)pyrene		25 [b]	0.1 [b]
2–Methylnaphthalene		25 [b]	0.1 [b]
Naphthalene	Hulzebos *et al.*, 1993 [e]	100	13
Phenanthrene		25 [b]	0.1 [b]
Pyrene		25 [b]	0.1 [b]
EXPLOSIVES			
HMX		NA	NA
3–Nitrotoluene		NA	NA
4–Nitrotoluene		NA	NA
1,3,5–Trinitrobenzene		NA	NA
PESTICIDES			
Dieldrin		12.5 [g]	NA
4,4'–DDD		12.5 [g]	NA
4,4'–DDE		12.5 [g]	NA
4,4'–DDT	Eno & Everett, 1958	12.5	NA
Endosulfan II	Hulzebos *et al.*, 1993 [e]	>1,000 [h]	$>S_w$
INORGANIC ANALYTES			
Aluminum	Will and Suter, 1994	50	0.2
Antimony	Will and Suter, 1994	5	NA
Arsenic	Will and Suter, 1994	10	0.001
Barium	Will and Suter, 1994	500	NA
Beryllium	Will and Suter, 1994	10	0.5
Cadmium	Will and Suter, 1994	3	0.05
Chromium (III)	Will and Suter, 1994	1	0.05
Cobalt	Will and Suter, 1994	20	0.06
Copper	Will and Suter, 1994	100	0.03
Cyanide		NA	NA
Iron	Will and Suter, 1994	NA	10
Lead	Will and Suter, 1994	50	0.02
Manganese	Will and Suter, 1994	500	4
Nickel	Will and Suter, 1994	30	0.2
Thallium	Will and Suter, 1994	1	0.02

Table A–13
SUMMARY OF TOXICITY DATA FOR PLANT RECEPTORS

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Reference	RTV in soil [a] (mg/kg)	RTV in solution [a] (mg/L)
Vanadium	Will and Suter, 1994	2	0.5
Zinc	Will and Suter, 1994	50	0.4

Notes:
[a] RTVs in soil are equal to chemical concentrations in soil that are not expected to result in adverse effects to plants. RTVs in solution are equal to chemical concentrations in groundwater that are not expected to result in adverse effects to plants.
[b] Value for acenaphthene used as a surrogate.
[c] Value for di–n–butylphthalate used as a surrogate
[d] Value for diethylphthalate used as a surrogate.
[e] Values represent 14–day growth EC_{50}s for *Lactuca sativa* in soil, or 16– to 21–day growth EC_{50} for *L. sativa* in solution.
[f] Value for furan used as a surrogate.
[g] Value for 4,4'–DDT used as a surrogate.
[h] Value for Endosulfan I used as surrogate.
NA = Not available
S_w = Water solubility

Table 14
SUMMARY OF TOXICITY DATA FOR TERRESTRIAL AND PALUSTRINE INVERTEBRATE RECEPTORS

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Test Type	Test Duration	Test Species	Chemical Concentration (mg/kg)	Effect	RTV (mg/kg)	Reference
SEMI-VOLATILE ORGANIC COMPOUNDS							
Acenaphthene	Soil Test	14 day	*E. foetida*	173	LC_{50}	34 [a]	Neuhauser *et al.*, 1985.
Anthracene	Soil Test	14 day	*E. foetida*	173	LC_{50}	34 [a]	Neuhauser *et al.*, 1985.
Benzo(a)anthracene	Soil Test	14 day	*E. foetida*	173	LC_{50}	34 [a]	Neuhauser *et al.*, 1985.
Benzo(a)pyrene	Soil Test	14 day	*E. foetida*	173	LC_{50}	34 [a]	Neuhauser *et al.*, 1985.
Benzo(b and k)fluoranthene	Soil Test	14 day	*E. foetida*	173	LC_{50}	34 [a]	Neuhauser *et al.*, 1985.
Benzo(g,h,i)perylene	Soil Test	14 day	*E. foetida*	173	LC_{50}	34 [a]	Neuhauser *et al.*, 1985.
Butylbenzylphthalate	Soil Test	14 day	4 test species	2,390	LC_{50}	478 [b]	Neuhauser *et al.*, 1986.
Carbazole	NA	NA	NA	NA	NA	NA	NA
Chrysene	Soil Test	14 day	*E. foetida*	173	LC_{50}	34 [a]	Neuhauser *et al.*, 1985
Dibenz(a,h)anthracene	Soil Test	14 day	*E. foetida*	173	LC_{50}	34 [a]	Neuhauser *et al.*, 1985.
Dibenzofuran	NA	NA	NA	NA	NA	NA	NA
Di-n-butylphthalate	Soil Test	14 day	4 test species	2,390	LC_{50}	478 [b]	Neuhauser *et al.*, 1986.
bis(2-Ethylhexyl)phthalate	Soil Test	14 day	4 test species	2,390	LC_{50}	478 [b]	Neuhauser *et al.*, 1986.
Fluoranthene	Soil Test	14 day	*E. foetida*	173	LC_{50}	34 [a]	Neuhauser *et al.*, 1985.
Fluorene	Soil Test	14 day	*E. foetida*	173	LC_{50}	34 [a]	Neuhauser *et al.*, 1985.
Fluorene	Soil Test	14 day	4 test species	187	LC_{50}		Neuhauser *et al.*, 1986.
Indeno(1,2,3-cd)pyrene	Soil Test	14 day	*E. foetida*	173	LC_{50}	34 [a]	Neuhauser *et al.*, 1985.
2-Methylnaphthalene	Soil Test	14 day	*E. foetida*	173	LC_{50}	34 [a]	Neuhauser *et al.*, 1985.
Naphthalene	Soil Test	14 day	*E. foetida*	173	LC_{50}	34 [a]	Neuhauser *et al.*, 1985.
Phenanthrene	Soil Test	14 day	*E. foetida*	173	LC_{50}	34 [a]	Neuhauser *et al.*, 1985.
Pyrene	Soil Test	14 day	*E. foetida*	173	LC_{50}	34 [a]	Neuhauser *et al.*, 1985.
EXPLOSIVE COMPOUNDS							
HMX	NA	NA	NA	NA	NA	NA	NA
3-Nitrotoluene	NA	NA	NA	NA	NA	NA	NA
4-Nitrotoluene	NA	NA	NA	NA	NA	NA	NA
PESTICIDES							
Dieldrin	Soil Test	89 day	*E. foetida*	10	6 % decrease in number of cocoons hatched		Reinecke and Venter, 1985
Dieldrin	Soil Test	89 day	*E. foetida*	30	26 % decrease in number of coc	30	Reinecke and Venter, 1985
Dieldrin	Soil Test	89 day	*E. foetida*	100	36 % decrease in number of cocoons hatched;		Reinecke and Venter, 1985
Dieldrin	Soil Test	89 day	*E. foetida*	100	50 % decrease in number of cocoons produced		Reinecke and Venter, 1985
4,4'-DDE	Soil Test	NS	NS	60	58% mortality	12 [c]	U.S. EPA, 1985b
4,4'-DDT	Soil Test	NS	NS	60	58% mortality	12 [c]	U.S. EPA, 1985b
Endosulfan II	Soil Test	24 hour	*P. posthuma*		LC_{50}	1 [c,d]	Hans *et al.*, 1990

Table A–14
SUMMARY OF TOXICITY DATA FOR TERRESTRIAL AND PALUSTRINE INVERTEBRATE RECEPTORS

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical	Test Type	Test Duration	Test Species	Chemical Concentration (mg/kg)	Effect	RTV (mg/kg)	Reference
INORGANICS							
Aluminum	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	NA
Arsenic	Soil Test	14 day	*E. foetida*	100	0 % mortality	100	Bouche *et al.*, 1987
Arsenic	Soil Test	14 day	*E. foetida*	200	100 % mortality		Bouche *et al.*, 1987
Barium	NA	NA	NA	NA	NA	NA	NA
Cadmium	Soil Test	14 day	*E. foetida*	900	0 % mortality		Bouche *et al.*, 1987
Cadmium	Soil Test	14 day	*E. foetida*	2,700	100 % mortality		Bouche *et al.*, 1987
Cadmium	Soil Test	14 day	*E. foetida*	1,000 [f]	LC_{50}		van Gestel and van Dis, 1988
Cadmium	Soil Test	20 week	*E. foetida*	50 [g]	Decrease in cocoon production	50 [c]	Malecki *et al.*, 1982
Cadmium	Soil Test	2 week	*E. foetida*	1,843	LC_{50}		Neuhauser *et al.*, 1985
Chromium (III)	Soil Test	8 week	*E. foetida*	250	Reproduction 50% inhibited	50	Molnar *et al.*, 1989
Cobalt	NA	NA	NA	NA	NA	NA	NA
Copper	Soil Test	14 day	*E. foetida*	10	0 % mortality		Bouche *et al.*, 1987
Copper	Soil Test	14 day	*E. foetida*	30	20 % mortality	30	Bouche *et al.*, 1987
Copper	Soil Test	20 week	*E. foetida*	2,000 [g]	Decrease in cocoon production		Malecki *et al.*, 1982
Copper	Soil Test	2 week	*E. foetida*	643	LC_{50}		Neuhauser *et al.*, 1985
Cyanide	NA	NA	NA	NA	NA	NA	NA
Lead	Soil Test	20 week	*E. foetida*	5,000 [g]	Decrease in cocoon production		Malecki *et al.*, 1982
Lead	Soil Test	2 week	*E. foetida*	5,941	LC_{50}	1,190 [c]	Neuhauser *et al.*, 1985
Manganese	NA	NA	NA	NA	NA	NA	NA
Nickel	Soil Test	20 week	*E. foetida*	400 [g]	Decrease in cocoon production	400	Malecki *et al.*, 1982
Nickel	Soil Test	2 week	*E. foetida*	757	LC_{50}		Neuhauser *et al.*, 1985
Vanadium	NA	NA	NA	NA	NA	NA	NA
Zinc	Soil Test	20 week	*E. foetida*	5,000 [g]	Decrease in cocoon production		Malecki *et al.*, 1982
Zinc	Soil Test	2 week	*E. foetida*	662	LC_{50}	130 [c]	Neuhauser *et al.*, 1985

NOTES:
[a] Equal to the lowest LC_{50} in each chemical class, multiplied by a safety factor of 0.2, as described in text. Value for flourene used for PAHs.
[b] Mean of LC_{50}s for four test species (*A. teberculata*, *E. foetida*, *E. eugeniae*, and *P. excavatus*) from artificial soil tests; values used for a whole chemical class are multiplied by a factor of 0.2 (Neuhauser *et al.*, 1986). Value for dimethylphthalate used for phthalates.
[c] Conservative factor of 0.2 applied to endpoint; resultant value should be protective of 99.9% of the exposed population from acute effects (USEPA, 1986b).
[d] Value for Endosulfan I used as a surrogate
NA = Not available
NS = Not stated

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
Volatile Organic Compounds (µg/L)								
Acetone	Aedes aegypti;Mosquito	3rd INST–AR	48 H	LC_{50}	15,000,000		310574	83
	Ambystoma mexicanum;Salamander	3–4 WK	48 H	LC_{50}	20,000,000		219740	80
	Asellus aquaticus;Aquatic sowbug	NR	48 H	LC_{50}	7,550,000		315788	83
	Chironomus thummi;Midge	NR	48 H	LC_{50}	13,000,000		315788	83
	Chlorella pyrenoidosa;Green algae	LOG PHASE	48 H	GRO		3,400,000	310574	83
	Cipangopaludina malleata;Mud snail	NR	48 H	LC_{50}	48,000,000		219158	72
	Cloeon dipterum;Mayfly	NR	48 H	LC_{50}	7,600,000		315788	83
	Corixa punctata,Water boatman	NR	48 H	LC_{50}	5,000,000		315788	83
	Culex pipiens;Mosquito	3rd INST–AR	48 H	LC_{50}	17,000,000		310574	83
	Culex restuans;White dotted mosquito	3rd INST–AR	18 H	LC_{50}	6,190,000		212192	81
	Daphnia magna;Water flea	≤24 H	28 D	MOR	1,100,000		310694	83
	Daphnia magna;Water flea	≤24 H	28 D	MOR	4,300,000		310694	83
	Daphnia magna;Water flea	≤24 H	7 D	MOR	2,200,000		310694	83
	Daphnia magna;Water flea	≤24 H	14 D	MOR	4,300,000		310694	83
	Daphnia magna,Water flea	≤24 H	28 D	MOR	550,000		310694	83
	Daphnia magna;Water flea	≤24 H	7 D	MOR	550,000		310694	83
	Daphnia magna;Water flea	≤24 H	14 D	MOR	550,000		310694	83
	Daphnia magna;Water flea	≤24 H	21 D	MOR	550,000		310694	83
	Daphnia magna,Water flea	8 H	0.25 H	LOC		9,280,000	212171	44
	Daphnia magna,Water flea	≤24 H	7 D	LET	8,700,000		310694	83
	Daphnia magna;Water flea	≤24 H	21 D	MOR	1,100,000		310694	83
	Daphnia magna;Water flea	≤24 H	14 D	MOR	1,100,000		310694	83
	Daphnia magna;Water flea	≤24 H	28 D	MOR	2,200,000		310694	83
	Daphnia magna;Water flea	≤24 H	7 D	MOR	1,100,000		310694	83
	Daphnia magna;Water flea	≤24 H	14 D	MOR	2,200,000		310694	83
	Daphnia magna;Water flea	≤24 H	28 D	REP		4,300,000	310694	83
	Daphnia magna,Water flea	≤24 H	21 D	MOR	4,300,000		310694	83
	Daphnia magna,Water flea	≤ 24 H	48 H	LC_{50}	31,000,000		310694	83
	Daphnia magna,Water flea	≤ 24 H	24 H	LC_{50}	35,000,000		310694	83
	Daphnia magna,Water flea	≤24 H	21 D	MOR	2,200,000		310694	83
	Daphnia magna;Water flea	<24 H	48 H	EC_{50}IM		13,500,000	212193	80
	Daphnia magna,Water flea	≤24 H	28 D	REP		1,100,000	310694	83
	Daphnia magna;Water flea	≤24 H	7 D	MOR	4,300,000		310694	83
	Daphnia pulex,Water flea	<24 H	18 H	LC_{50}	1,220,000		212192	81
	Dugesia lugubris;Turbellarian	NR	48 H	LC_{50}	7,500,000		315788	83
	Erpobdella octoculata;Leech	NR	48 H	LC_{50}	7,000,000		315788	83
	Gambusia affinis;Mosquitofish	ADULT FEMALE	96 H	LC_{50}	13,000,000		210508	57
	Gambusia affinis;Mosquitofish	ADULT FEMALE	24 H	LC_{50}	13,500,000		210508	57
	Gambusia affinis;Mosquitofish	ADULT FEMALE	48 H	LC_{50}	13,000,000		210508	57
	Gammarus pulex;Scud	NR	48 H	LC_{50}	6,000,000		315788	83
	Hydra oligactis;Hydra	NR	48 H	LC_{50}	13,500,000		315788	83
	Hydra oligactis;Hydra	BUD–LESS	48 H	LC_{50}	13,500,000		310574	83
	Indoplanorbis exustus,Snail	NR	48 H	LC_{50}	35,000,000		219158	72
	Ischnura elegans;Dragonfly	NR	48 H	LC_{50}	6,400,000		315788	83
	Lepomis macrochirus,Bluegill	5.3–7.2cm 3.5–3.9 g	96 H	LC_{50}	8,300,000		212406	68
	Lepomis macrochirus,Bluegill	NR	96 H	LC_{50}	8,300,000		210949	68
	Lymnaea stagnalis;Great pond snail	3–4 WK	48 H	LC_{50}	7,000,000		310574	83
	Lymnaea stagnalis;Great pond snail	NR	48 H	LC_{50}	7,000,000		315788	83

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration Lethal	Effect Concentration Sublethal	AQUIRE Reference Number	Year of Publication
Acetone (cont.)	Nemoura cinerea;Stonefly	NR	48 H	LC_{50}	10,300,000		315788	83
	Oncorhynchus mykiss;Rainbow trout	5–8 WK	48 H	LC_{50}	7,400,000		310574	83
	Oncorhynchus mykiss;Rainbow trout	10 0cm 10.2 g	6 H	LET	12,500,000		210991	78
	Oncorhynchus mykiss,Rainbow trout	1.0 g	96 H	LC_{50}	5,540,000		210666	80
	Oncorhynchus mykiss;Rainbow trout	9.4 cm 10 8 g	24 H	LC_{50}	6,100,000		210991	78
	Oryzias latipes,Medaka, high–eyes	4–5 WK	48 H	LC_{50}	14,300,000		310574	83
	Palaemonetes kadiakensis;Grass shrimp, freshwater prawn	JUV–ENILE	18 H	LC_{50}	2,610,000		212192	81
	Physa acuta;Bladder snail	NR	48 H	LC_{50}	35,000,000		219158	72
	Pimephales promelas,Fathead minnow	28 D	96 H	LC_{50}	7,280,000		312448	84
	Pimephales promelas;Fathead minnow	0.12 g	96 H	LC_{50}	7,310,000		310183	83
	Pimephales promelas,Fathead minnow	33 D	96 H	LC_{50}	8,120,000		312448	84
	Pimephales promelas;Fathead minnow	32 D	96 H	LC_{50}	6,210,000		312448	84
	Pimephales promelas;Fathead minnow	3–4 WK	48 H	LC_{50}	15,000,000		310574	83
	Pimephales promelas;Fathead minnow	0 12 g	96 H	LC_{50}	8,140,000		310183	83
	Rasbora heteromorpha,Harlequinfish, red rasbora	1.3–3 cm	48 H	LC_{50}	4,000,000		210542	69
	Rasbora heteromorpha;Harlequinfish, red rasbora	1 3–3 cm	24 H	LC_{50}	5,700,000		210542	69
	Scenedesmus pannonicus,Green algae	LOG PHASE	48 H	GRO		4,740,000	310574	83
	Selenastrum capricornutum;Green algae	LOG PHASE	96 H	GRO		7,000,000	310574	83
	Semisulcospira libertina;Marsh snail	NR	48 H	LC_{50}	35,000,000		219158	72
	Tubificidae,Oligochaete family	NR	48 H	LC_{50}	15,000,000		315788	83
	Xenopus laevis,Clawed toad	3–4 WK	48 H	LC_{50}	24,000,000		219740	80
2–Butanone	Carassius auratus; Goldfish;	NR	24 H	LC_{50}	2,400,000		215773	78
	Daphnia magna, Water flea;	<24 H	24 H	LC_{50}	520,000		215184	80
	Daphnia magna; Water flea;	24 H	24 H	LC_{50}	8,890,000		215718	77
	Daphnia magna, Water flea;	<24 H	48 H	MOR	70,000		215184	80
	Daphnia magna; Water flea;	<24 H	48 H	LC_{50}	520,000		215184	80
	Daphnia magna; Water flea,	1ST INSTAR, < 24 H	48 H	EC_{50}IM		5,091,000	212193	80
	Gambusia affinis; Mosquitofish;	ADULT, FEMALE	96 H	LC_{50}	5,600,000		210508	57
	Gambusia affinis, Mosquitofish;	ADULT, FEMALE	48 H	LC_{50}	5,600,000		210508	57
	Gambusia affinis; Mosquitofish,	ADULT, FEMALE	24 H	LC_{50}	5,600,000		210508	57
	Gambusia affinis; Mosquitofish;	ADULT, FEMALE	96 H	MOR	3,200,000		210508	57
	Lepomis macrochirus; Bluegill;	FINGERLING, 38–76 MM	96 H	LC_{0}	10,000,000		212458	68
	Lepomis macrochirus; Bluegill;	5 G, 7(5–11) CM	24 H	LC_{50}	5,640,000		210922	54
	Lepomis macrochirus, Bluegill,	5 G, 7(5–11) CM	48 H	LC_{50}	5,640,000		210922	54
	Leuciscus idus; Ide, silver or golden orfe,	NR	NR	LC_{50}	4,600,000		210547	78
	Leuciscus idus; Ide, silver or golden orfe;	NR	NR	LC_{50}	4,600,000		210547	78
	Pimephales promelas; Fathead minnow,	0 12 G	96 H	LC_{50}	3,200,000		310183	83
	Pimephales promelas; Fathead minnow;	31 D, 22.0 MM, 0 167 G	96 H	LC_{50}	3,220,000		312448	84
Semivolatile Organic Compounds								
bis(2–Ethylhexyl)phthalate	Anacystis aeruginosa; Blue–green algae;	LOG–PHASE 500000 CELLS/ML	96 H	EC_{50}GR		>=320	215336	81
	Anacystis aeruginosa; Blue–green algae,	LOG–PHASE 500000 CELLS/ML	96 H	PGR *		>=320	215336	81
	Brachydanio rerio; Zebra danio, zebrafish;	4–5 WK	96 H	LC_{50}	>320		215390	84
	Brachydanio rerio; Zebra danio, zebrafish;	4–5 WK	96 H	MOR *	>=320		215390	84
	Brachydanio rerio, Zebra danio, zebrafish;	<4 H, EGGS	5 WK	DVP *		>=1000	215390	84
	Brachydanio rerio; Zebra danio, zebrafish;	1–2 D	96 H	MOR *	>=320		215390	84
	Brachydanio rerio; Zebra danio, zebrafish;	<4 H, EGGS	5 WK	GRO *		>=1000	215390	84
	Brachydanio rerio; Zebra danio, zebrafish;	1–2 D	96 H	BEH *		>=320	215390	84

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
bis(2–Ethylhexyl)phthalate (cont.)	Brachydanio rerio; Zebra danio, zebrafish,	4–5 WK	96 H	BEH *		>=320	215390	84
	Brachydanio rerio; Zebra danio, zebrafish;	1–2 D	96 H	LC_{50}	>320		215390	84
	Brachydanio rerio; Zebra danio, zebrafish;	<4 H, EGGS	5 WK	MOR *	>=1000		215390	84
	Bufo woodhousei fowleri; Fowler's toad;	EMBRYO TO LARVA	to 8 D *	LC_{50}	3,880		216772	78
	Bufo woodhousei fowleri; Fowler's toad;	LARVA	96 H *	LC_{50}	3,880		216772	78
	Carassius auratus; Goldfish;	EMBRYO TO LARVA	96 H *	LC_{50}	6,180		216772	78
	Carassius auratus; Goldfish;	EGGS, 4 D POSTHATCH	96 H	LC_{50} *	> 191000		210563	79
	Carassius auratus; Goldfish;	EGGS, 4 D POSTHATCH	96 H	LC_{50} *	> 186000		210563	79
	Carassius auratus; Goldfish,	EGGS, 4 D POSTHATCH	8 D	LC_{50} *	> 191000		210563	79
	Carassius auratus, Goldfish;	EGGS, 4 D POSTHATCH	8 D	LC_{50} *	> 186000		210563	79
	Chironomus plumosus, Midge,	EGG	30 D	HAT *		560	217688	77
	Chironomus plumosus; Midge,	LARVAE	30 D	DVP *		560	217688	77
	Chlorella pyrenoidosa; Green algae;	LOG – PHASE 10000 CELLS/ML	96 H	EC_{50}GR		>320	215336	81
	Chlorella pyrenoidosa; Green algae,	LOG – PHASE 10000 CELLS/ML	96 H	PGR *		>=320	215336	81
	Daphnia magna; Water flea,	<24 H	24 H	LC_{50}	>68000		215184	80
	Daphnia magna; Water flea,	NR	21 D	REP *		10	210736	73
	Daphnia magna, Water flea;	< 24 H	21 D	MOR *	10		311061	82
	Daphnia magna, Water flea;	NR	21 D	REP *		2.5	210736	73
	Daphnia magna; Water flea,	< 24 H	21 D	MOR *	3.2		311061	82
	Daphnia magna; Water flea,	NR	21 D	REP *		3	210736	73
	Daphnia magna, Water flea;	< 24 H	48 H	LOC *		47	311061	82
	Daphnia magna; Water flea;	NR	21 D	REP *		30	210736	73
	Daphnia magna; Water flea;	<1 D	2 WK	MOR *	32		215336	81
	Daphnia magna, Water flea;	FIRST INSTAR, < 24 H	7 D	BIO *		811	312340	87
	Daphnia magna; Water flea;	FIRST INSTAR, < 24 H	7 D	MOR *	158		312340	87
	Daphnia magna, Water flea;	<1 D	3 WK	LC_{50}	>320		215336	81
	Daphnia magna; Water flea;	FIRST INSTAR, < 24 H	7 D	MOR *	811		312340	87
	Daphnia magna; Water flea;	<24 H	2 WK	REP *		320	215336	81
	Daphnia magna; Water flea;	NR	14 D	REP *		10	210736	73
	Daphnia magna; Water flea;	<24 H	48 H	LC_{50}	11,000		215184	80
	Daphnia magna; Water flea;	NR	14 D	REP *		3	210736	73
	Daphnia magna; Water flea,	FIRST INSTAR, < 24 H	21 D	MOR *	158		312340	87
	Daphnia magna, Water flea;	NR	14 D	REP *		30	210736	73
	Daphnia magna; Water flea;	FIRST INSTAR, < 24 H	7 D	BIO *		158	312340	87
	Daphnia magna; Water flea;	< 24 H	21 D	MOR *	100		311061	82
	Daphnia magna, Water flea,	<1 D	3 WK	MOR *	>=320		215336	81
	Daphnia magna, Water flea;	< 24 H	21 D	MOR *	32		311061	82
	Daphnia magna; Water flea;	<24 H	48 H	MOR *	1,100		215184	80
	Daphnia magna; Water flea;	<1 D	2 WK	LC_{50}	>320		215336	81
	Daphnia magna; Water flea;	<1 D	24 H	EC_{50}IM		>320	215336	81
	Daphnia magna, Water flea;	FIRST INSTAR, < 24 H	21 D	MOR *	811		312340	87
	Daphnia magna, Water flea;	1ST INSTAR, 24 H	21 D	REP		3	210732	73
	Daphnia magna; Water flea;	<1 D	2 WK	MOR *	>=320		215336	81
	Daphnia pulex; Water flea;	NEONATE, < 24 H	48 H	EC_{50}IM		133	312730	87
	Euglena gracilis; Flagellate euglenoid,	LOG – PHASE 10000 CELLS/ML	96 H	EC_{50}GR		>320	215336	81
	Euglena gracilis; Flagellate euglenoid;	LOG – PHASE 10000 CELLS/ML	96 H	PGR *		>=320	215336	81
	Gammarus pseudolimnaeus; Scud,	NR	96 H	LC_{50}	>32000		210732	73
	Gammarus pseudolimnaeus; Scud,	JUVENILE	96 H	LC_{50}	> 32000		210666	80
	Gammarus pulex, Scud;	>12 MM	10 D	LOC *		100	210079	91

Table A-15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration Lethal	Effect Concentration Sublethal	AQUIRE Reference Number	Year of Publication
bis(2-Ethylhexyl)phthalate (cont.)	Gammarus pulex, Scud;	>12 MM	10 D	LOC *		500	210079	91
	Gasterosteus aculeatus; Three spine stickleback;	4-5 WK	48 H	LC_{50}	> 300		210823	89
	Gasterosteus aculeatus; Three spine stickleback;	4-5 WK	96 H	LC_{50}	> 300		210823	89
	Gasterosteus aculeatus; Three spine stickleback;	4-5 WK	24 H	LC_{50}	> 300		210823	89
	Gasterosteus aculeatus; Three spine stickleback;	EGGS, < 6 H	35 D	EC_{50} *		> 320	210823	89
	Gasterosteus aculeatus; Three spine stickleback;	4-5 WK	24 H	EC_{50} *		> 300	210823	89
	Gasterosteus aculeatus; Three spine stickleback;	EGGS, < 6 H	35 D	LC_{50}	> 320		210823	89
	Gasterosteus aculeatus; Three spine stickleback;	4-5 WK	72 H	LC_{50}	> 300		210823	89
	Gasterosteus aculeatus; Three spine stickleback;	4-5 WK	48 H	EC_{50} *		> 300	210823	89
	Gasterosteus aculeatus; Three spine stickleback;	4-5 WK	72 H	EC_{50} *		> 300	210823	89
	Gasterosteus aculeatus; Three spine stickleback;	4-5 WK	96 H	EC_{50} *		> 300	210823	89
	Ictalurus punctatus; Channel catfish;	1.5 G	96 H	LC_{50}	> 100000		210666	80
	Ictalurus punctatus; Channel catfish;	EMBRYO TO LARVA	96 H *	LC_{50}	690		216772	78
	Jordanella floridae; Flagfish;	28-35 D	3 WK	MOR *	>=320		215336	81
	Jordanella floridae; Flagfish;	<36 H	4 WK	MOR *	>=320		215336	81
	Jordanella floridae; Flagfish;	<36 H	7 D	LC_{50}	>320		215336	81
	Jordanella floridae; Flagfish;	1-2 D	96 H	LC_{50}	>320		215336	81
	Jordanella floridae; Flagfish;	4-5 WK	96 H	BEH *		>=320	215336	81
	Jordanella floridae; Flagfish;	4-5 WK	96 H	LC_{50}	>320		215336	81
	Jordanella floridae; Flagfish;	1-2 D	48 H	LC_{50}	>320		215336	81
	Jordanella floridae; Flagfish;	<36 H	4 WK	GRO *		>=320	215336	81
	Jordanella floridae; Flagfish;	28-35 D	4 WK	MOR *	>=320		215336	81
	Jordanella floridae; Flagfish;	<36 H	4 WK	LC_{50}	>320		215336	81
	Jordanella floridae; Flagfish;	4-5 WK	48 H	LC_{50}	>320		215336	81
	Jordanella floridae; Flagfish;	1-2 D	96 H	BEH *		>=320	215336	81
	Jordanella floridae; Flagfish;	28-35 D	4 WK	GRO *		>=320	215336	81
	Jordanella floridae; Flagfish;	28-35 D	2 WK	MOR *	>=320		215336	81
	Jordanella floridae; Flagfish;	28-35 D	4 WK	REP *		>=320	215336	81
	Jordanella floridae; Flagfish;	28-35 D	1 WK	MOR *	>=320		215336	81
	Lepomis macrochirus; Bluegill;	0.32-1.2 G, JUVENILE	24 H	LC_{50}	>770000		215590	81
	Lepomis macrochirus; Bluegill;	0.32-1.2 G, JUVENILE	96 H	LC_{50}	>770000		215590	81
	Lepomis macrochirus; Bluegill;	0.6 G	96 H	LC_{50}	> 100000		210666	80
	Lepomis macrochirus; Bluegill;	JUVENILE, 35 - 60 MM	0.7 H	AVO *		112,400	215272	80
	Micropterus salmoides; Largemouth bass;	EGGS, 4 D POSTHATCH	84 H	LC_{50} *	32,100		210563	79
	Micropterus salmoides; Largemouth bass;	EMBRYO TO LARVA	96 H *	LC_{50}	32,900		216772	78
	Micropterus salmoides; Largemouth bass;	EMBRYO TO LARVA	96 H *	LC_{50}	42,100		216772	78
	Micropterus salmoides; Largemouth bass;	EGGS, 4 D POSTHATCH	7.5 D	LC_{50} *	45,500		210563	79
	Micropterus salmoides; Largemouth bass;	EGGS, 4 D POSTHATCH	7.5 D	LC_{50} *	55,700		210563	79
	Micropterus salmoides; Largemouth bass;	EGGS, 4 D POSTHATCH	84 H	LC_{50} *	65,500		210563	79
	Oncorhynchus kisutch; Coho salmon, silver salmon;	1.5 G	96 H	LC_{50}	> 100000		210666	80
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	EYED EGGS	12 D *	MOR *	54		217859	76
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	EYED EGGS	100 D	HAT *		54	217859	76
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	EYED EGGS	12 D *	MOR *	14		217859	76
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	EGGS, 4 D POSTHATCH	23 D	LC_{50} *	154,000		210563	79
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	EYED EGGS	12 D *	MOR *	5		217859	76
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	EGGS, 4 D POSTHATCH	27 D	LC_{50} *	149,200		210563	79
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	1.5 G	96 H	LC_{50}	> 100000		210666	80
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	EMBRYO TO LARVA	96 H *	LC_{50}	149,200		216772	78
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	EYED EGGS	24 D *	MOR *	14		217859	76

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration Lethal	Effect Concentration Sublethal	AQUIRE Reference Number	Year of Publication
bis(2–Ethylhexyl)phthalate (cont.)	Oncorhynchus mykiss, Rainbow trout, donaldson trout;	EYED EGG	90 D	VTE *		14	215109	77
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	EYED EGGS	24 D *	MOR *	5		217859	76
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	EYED EGGS	100 D	GRO *		62	217859	76
	Oncorhynchus mykiss, Rainbow trout, donaldson trout;	EYED EGGS	24 D *	MOR *	54		217859	76
	Oncorhynchus mykiss, Rainbow trout, donaldson trout;	EGGS, 4 D POSTHATCH	27 D	LC_{50} *	139,500		210563	79
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	EYED EGGS	5 D *	MOR *	14		217859	76
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	EYED EGG	90 D	GRO *		54	215109	77
	Oncorhynchus mykiss, Rainbow trout, donaldson trout;	EYED EGGS	5 D *	MOR *	5		217859	76
	Oncorhynchus mykiss, Rainbow trout, donaldson trout,	EGGS, 4 D POSTHATCH	23 D	LC_{50} *	139,100		210563	79
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	EYED EGG	90 D	VTE *		5	215109	77
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	EMBRYO TO LARVA	96 H *	LC_{50}	139,500		216772	78
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	EYED EGGS	5 D *	MOR *	54		217859	76
	Oryzias latipes; Medaka, high–eyes;	28–35 D	4 WK	GRO *		>=320	215336	81
	Oryzias latipes, Medaka, high–eyes;	28–35 D	4 WK	REP *		>=320	215336	81
	Oryzias latipes; Medaka, high–eyes;	1–2 D	96 H	BEH *		>=320	215336	81
	Oryzias latipes; Medaka, high–eyes;	4–5 WK	48 H	LC_{50}	>320		215336	81
	Oryzias latipes, Medaka, high–eyes,	28–35 D	1 WK	MOR *	>=320		215336	81
	Oryzias latipes; Medaka, high–eyes;	4–5 WK	96 H	BEH *		>=320	215336	81
	Oryzias latipes; Medaka, high–eyes;	28–35 D	3 WK	MOR *	>=320		215336	81
	Oryzias latipes; Medaka, high–eyes;	4–5 WK	96 H	LC_{50}	>320		215336	81
	Oryzias latipes; Medaka, high–eyes,	28–35 D	4 WK	LC_{50}	>320		215336	81
	Oryzias latipes; Medaka, high–eyes;	<36 H	4 WK	LC_{50}	>320		215336	81
	Oryzias latipes; Medaka, high–eyes;	1–2 D	96 H	LC_{50}	>320		215336	81
	Oryzias latipes; Medaka, high–eyes;	<36 H	4 WK	MOR *	>=320		215336	81
	Oryzias latipes; Medaka, high–eyes;	1–2 D	48 H	LC_{50}	>320		215336	81
	Oryzias latipes, Medaka, high–eyes;	28–35 D	2 WK	MOR *	>=320		215336	81
	Oryzias latipes; Medaka, high–eyes;	28–35 D	4 WK	MOR *	>=320		215336	81
	Oryzias latipes; Medaka, high–eyes;	<36 H	7 D	LC_{50}	>320		215336	81
	Pimephales promelas; Fathead minnow,	7.5 MO, 1.24 G	56 D	MOR *	62		217859	76
	Pimephales promelas; Fathead minnow;	7.5 MO, 1.24 G	56 D	GRO *		62	217859	76
	Pimephales promelas; Fathead minnow;	FRY, 10 D	127 D	GRO *		100	215109	77
	Pimephales promelas; Fathead minnow;	FRY, 10 D	127 D	VTE *		11	215109	77
	Poecilia reticulata; Guppy;	21–28 D	2 WK	LC_{50}	>320		215336	81
	Poecilia reticulata, Guppy;	21–28 D	48 H	LC_{50}	>320		215336	81
	Poecilia reticulata; Guppy,	21–28 D	4 WK	LC_{50}	>320		215336	81
	Poecilia reticulata; Guppy,	21–28 D	1 WK	LC_{50}	>320		215336	81
	Rana arvalis; Moorfrog,	EGGS	3 WK	HAT		0.89 to 187.40	215904	87
	Rana pipiens, Leopard frog;	EMBRYO TO LARVA	to 8 D *	LC_{50}	4,440		216772	78
	Rana pipiens; Leopard frog;	LARVA	96 H *	LC_{50}	4,440		216772	78
	Salvelinus fontinalis; Brook trout;	ADULT, 1.5 YR	150 D	GRO *		52	215109	77
	Salvelinus fontinalis; Brook trout;	ADULT, 1.5 YR	150 D	VTE *		3.7	215109	77
	Selenastrum capricornutum, Green algae,	LOG–PHASE 50000 CELLS/ML	96 H	EC_{50}GR		>320	215336	81
	Selenastrum capricornutum; Green algae,	LOG–PHASE 50000 CELLS/ML	96 H	PGR *		>=320	215336	81
	Stephanodiscus hantzschii; Diatom;	LOG–PHASE 10000 CELLS/ML	96 H	EC_{50}GR		>320	215336	81
	Stephanodiscus hantzschii, Diatom,	LOG–PHASE 10000 CELLS/ML	96 H	PGR *		>=320	215336	81
Explosive Compounds (ug/L)								
RDX	Asellus militaris; Aquatic sowbug	JUVENILE	48 H	IMM [Immobilization]		100,000	1048076	77
	Ceriodaphnia dubia, Water flea	NEONATE, 4–6 H	7 D	REP [Reproduction]		3,640	1111779	91

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration Lethal	Effect Concentration Sublethal	AQUIRE Reference Number	Year of Publication
RDX (cont)	Ceriodaphnia dubia; Water flea	NEONATE, 4–6 H	7 D	REP [Reproduction]		6,010	1111780	91
	Chironomus tentans; Midge	ADULT	34 D	DVP [Development] *		2,200	1048009	77
	Chironomus tentans; Midge	<= 48 H LARVAE	19 D	MOR [Mortality] *	4,000		1048013	77
	Chironomus tentans; Midge	<= 48 H LARVAE	19 D	MOR [Mortality] *	10,000		1048014	77
	Chironomus tentans; Midge	<= 48 H LARVAE	19 D	MOR [Mortality] *	21,000		1048015	77
	Chironomus tentans; Midge	ADULT	34 D	MOR [Mortality] *	1,300		1048016	77
	Chironomus tentans; Midge	ADULT	34 D	MOR [Mortality] *	4,000		1048017	77
	Chironomus tentans; Midge	<= 48 H, LARVAE	14 D	MOR [Mortality] *	10,000		1048019	77
	Chironomus tentans; Midge	<= 48 H, LARVAE	19 D	MOR [Mortality] *	1,300		1048020	77
	Chironomus tentans; Midge	<= 48 H, LARVAE	19 D	MOR [Mortality] *	2,200		1048021	77
	Chironomus tentans; Midge	LARVAE	96 H	LC_{50} *	> 15,000		1048036	77
	Chironomus tentans; Midge	2ND OR 3RD INSTAR LARVAE	48 H	IMM [Immobilization]		100,000	1048077	77
	Daphnia magna, Water flea	<= 24 H	14 D	REP [Reproduction] *		20,000	1048018	77
	Daphnia magna; Water flea	<= 24 H	14 D	REP [Reproduction] *		4,800	1048025	77
	Daphnia magna; Water flea	<= 24 H	14 D	REP [Reproduction] *		9,500	1048026	77
	Daphnia magna; Water flea	LARVAE	96 H	LC_{50} *	> 15,000		1048035	77
	Daphnia magna, Water flea	<= 24 H	48 H	IMM [Immobilization]		100,000	1048074	77
	Gammarus fasciatus; Scud	JUVENILE	48 H	IMM [Immobilization]		100,000	1048075	77
	Ictalurus punctatus; Channel catfish	23 MM	30 D	MOR [Mortality] *	710		1048024	77
	Ictalurus punctatus, Channel catfish	2.1 G, 45 MM	24 H	LC_{50}	> 10,000		1048030	77
	Ictalurus punctatus; Channel catfish	2.1 G, 45 MM	96 H	LC_{50}	13,000		1048031	77
	Ictalurus punctatus; Channel catfish	2 1 G, 45 MM	11 D	LC_{50} *	11,000		1048032	77
	Ictalurus punctatus; Channel catfish	1 2 G, 57 MM	24 H	LC_{50}	7,500		1048064	77
	Ictalurus punctatus; Channel catfish	1.2 G, 57 MM	48 H	LC_{50}	6,000		1048065	77
	Ictalurus punctatus, Channel catfish	1.2 G, 57 MM	96 H	LC_{50}	4,100		1048066	77
	Lepomis macrochirus; Bluegill	1.0 G, 35 MM	11 D	LC_{50} *	6,400		1048029	77
	Lepomis macrochirus; Bluegill	0.8 G, 32 MM	96 H	LC_{50}	4,800		1048034	77
	Lepomis macrochirus; Bluegill	2 0 G, 41 MM	24 H	LC_{50}	> 10,000		1048037	77
	Lepomis macrochirus; Bluegill	2 0 G, 41 MM	96 H	LC_{50}	7,600		1048038	77
	Lepomis macrochirus; Bluegill	0 9 G, 33 MM	96 H	LC_{50}	3,700		1048039	77
	Lepomis macrochirus; Bluegill	0.9 G, 33 MM	96 H	LC_{50}	3,900		1048040	77
	Lepomis macrochirus; Bluegill	0.8 G, 32 MM	96 H	LC_{50}	4,800		1048041	77
	Lepomis macrochirus; Bluegill	0.8 G, 32 MM	96 H	LC_{50}	5,100		1048042	77
	Lepomis macrochirus; Bluegill	0 8 G, 32 MM	96 H	LC_{50}	4,800		1048043	77
	Lepomis macrochirus; Bluegill	0.9 G, 33 MM	96 H	LC_{50}	4,100		1048044	77
	Lepomis macrochirus; Bluegill	0.9 G, 33 MM	96 H	LC_{50}	3,800		1048045	77
	Lepomis macrochirus; Bluegill	0.9 G, 33 MM	96 H	LC_{50}	5,300		1048046	77
	Lepomis macrochirus; Bluegill	0.9 G, 33 MM	96 H	LC_{50}	3,900		1048047	77
	Lepomis macrochirus; Bluegill	0 9 G, 33 MM	96 H	LC_{50}	3,600		1048048	77
	Lepomis macrochirus; Bluegill	0.9 G, 33 MM	96 H	LC_{50}	8,400		1048052	77
	Lepomis macrochirus, Bluegill	0 9 G, 33 MM	96 H	LC_{50}	5,100		1048053	77
	Lepomis macrochirus; Bluegill	1.0 G, 35 MM	48 H	LC_{50}	8,500		1048069	77
	Lepomis macrochirus; Bluegill	1.0 G, 35 MM	96 H	LC_{50}	6,000		1048070	77
	Lepomis macrochirus; Bluegill	1.0 G, 35 MM	24 H	LC_{50}	14,000		1048078	77
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	0.9 G, 43 MM	24 H	LC_{50}	9,400		1048071	77
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	0 9 G, 43 MM	48 H	LC_{50}	7,000		1048072	77
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	0.9 G, 43 MM	96 H	LC_{50}	6,400		1048073	77
	Paratanytarsus parthenogenetic; Midge	EGG, <12 H	10 D	GRO [Growth] *		20,820	1111781	91
	Paratanytarsus parthenogenetic; Midge	EGG, <12 H	7 D	DVP [Development] *		20,820	1111782	91

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration Lethal	Effect Concentration Sublethal	AQUIRE Reference Number	Year of Publication
RDX (cont.)	Pimephales promelas; Fathead minnow	22 MM	30 D	MOR [Mortality] *	6,300		1048010	77
	Pimephales promelas; Fathead minnow	33 MM	60 D	MOR [Mortality] *	6,300		1048011	77
	Pimephales promelas; Fathead minnow	EGG	240 D	REP [Reproduction] *		6,300	1048012	77
	Pimephales promelas; Fathead minnow	1.5 G, 44 MM	96 H	LC_{50}	6,600		1048027	77
	Pimephales promelas; Fathead minnow	1.5 G, 44 MM	11 D	LC_{50} *	5,200		1048028	77
	Pimephales promelas; Fathead minnow	1.5 G, 44 MM	24 H	LC_{50} *	> 10,000		1048033	77
	Pimephales promelas; Fathead minnow	60 D POST HATCH	24 H	LC_{50}	11,000		1048049	77
	Pimephales promelas; Fathead minnow	60 D POST HATCH	48 H	LC_{50}	11,000		1048050	77
	Pimephales promelas; Fathead minnow	60 D POST HATCH	96 H	LC_{50}	11,000		1048051	77
	Pimephales promelas; Fathead minnow	7 D POST HATCH	48 H	LC_{50}	18,000		1048054	77
	Pimephales promelas; Fathead minnow	7 D POST HATCH	96 H	LC_{50}	3,800		1048055	77
	Pimephales promelas; Fathead minnow	30 D POST HATCH	24 H	LC_{50}	18,000		1048056	77
	Pimephales promelas; Fathead minnow	30 D POST HATCH	48 H	LC_{50}	16,000		1048057	77
	Pimephales promelas; Fathead minnow	30 D POST HATCH	96 H	LC_{50}	16,000		1048058	77
	Pimephales promelas; Fathead minnow	1.0 G, 43 MM	96 H	LC_{50}	5,800		1048059	77
	Pimephales promelas; Fathead minnow	EGGS	6 D	LC_{50}	> 100,000		1048060	77
	Pimephales promelas; Fathead minnow	1 H POST HATCH	48 H	LC_{50}	> 100,000		1048061	77
	Pimephales promelas; Fathead minnow	1 H POST HATCH	96 H	LC_{50}	43,000		1048062	77
	Pimephales promelas; Fathead minnow	7 D POST HATCH	24 H	LC_{50}	> 32,000		1048063	77
	Pimephales promelas; Fathead minnow	1.0 G, 43 MM	24 H	LC_{50}	10,000		1048067	77
	Pimephales promelas; Fathead minnow	1.0 G, 43 MM	48 H	LC_{50}	5,800		1048068	77
1,3,5–Trinitrobenzene	Daphnia magna; Water flea	1ST INSTAR	48 H	IMM [Immobilization]		2,700	1001843	79
	Daphnia magna; Water flea	<24 H	48 H	IMM [Immobilization]		2,980	1121700	83
	Daphnia magna; Water flea	<24 H	21 D	REP [Reproduction] *		470	1121716	83
	Daphnia magna; Water flea	<24 H	21 D	REP [Reproduction] *		750	1121717	83
	Ictalurus punctatus; Channel catfish	49–64 MM, 1.48–3.59 G, 40–44 WK	96 H	LC_{50}	380		1121704	83
	Lepomis macrochirus; Bluegill	29–40 MM, 0.64–1.82 G, 20–36 WK	96 H	LC_{50}	850		1121701	83
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	35–40 MM, 0.67–0.95 G, 10–13 WK	96 H	LC_{50}	520		1121702	83
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	63–83 MM, 3.98–9.28 G, 28–38 WK	18 D	LC_{50}	430		1121705	83
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	63–83 MM, 3.98–9.28 G, 28–38 WK	10 D	LC_{50}	520		1121706	83
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	63–83 MM, 3.98–9.28 G, 28–38 WK	71 D	REP [Reproduction] *		80	1121710	83
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	63–83 MM, 3.98–9.28 G, 28–38 WK	71 D	REP [Reproduction] *		170	1121711	83
	Pimephales promelas; Fathead minnow	JUVENILE	96 H	LC_{50}	1,030		1001804	79
	Pimephales promelas; Fathead minnow	NR	96 H	LC_{50}	< 5,000		1020476	77
	Pimephales promelas; Fathead minnow	JUVENILE, 2.4 CM, 0.28 G	96 H	LC_{50}	1,100		1071227	83
	Pimephales promelas; Fathead minnow	39–43 MM, 0.91–1.51 G, 39–112 WK	96 H	LC_{50}	490		1121703	83
	Pimephales promelas; Fathead minnow	39–43 MM, 0.91–1.51 G, 39–112 WK	10 D	LC_{50}	460		1121707	83
	Pimephales promelas; Fathead minnow	39–43 MM, 0.91–1.51 G, 39–112 WK	32 D	REP [Reproduction] *		80	1121708	83
	Pimephales promelas; Fathead minnow	39–43 MM, 0.91–1.51 G, 39–112 WK	32 D	REP [Reproduction] *		120	1121709	83
	Selenastrum capricornutum; Green algae	NR	5 D	PGR [Population growth] *		960	1121712	83
	Selenastrum capricornutum; Green algae	NR	5 D	PGR [Population growth] *		1,180	1121713	83
	Selenastrum capricornutum; Green algae	NR	5 D	PGR [Population growth] *		<100	1121714	83
	Selenastrum capricornutum; Green algae	NR	5 D	PGR [Population growth] *		<100	1121715	83
Pesticides (µg/L)								
4,4'–DDT	Acartia sp; Calanoid copepod	MATURE	24 H	LC_{50}	28		212658	88
	Acroneuria pacifica; Stonefly	NAIADS	25 D	LC_{50}	76		212238	64
	Acroneuria pacifica; Stonefly	NAIAD; 2–2.5 CM	96 H	LC_{50}	320		210528	65

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
4,4'–DDT (cont)	Acroneuria pacifica; Stonefly	NAIADS	30 D	LC_{50}	72		212238	64
	Acroneuria pacifica, Stonefly	NAIADS	20 D	LC_{50}	84		212238	64
	Acroneuria pacifica; Stonefly	NAIAD, 2–2 5 CM	96 H	LC_{50}	320		212667	64
	Acroneuria pacifica; Stonefly	NAIADS	5 D	LC_{50}	2,150		212238	64
	Acroneuria pacifica; Stonefly	NAIADS	10 D	LC_{50}	440		212238	64
	Acroneuria pacifica; Stonefly	NAIAD, 2–2.5 CM	48 H	LC_{50}	2,200		212667	64
	Acroneuria pacifica; Stonefly	NAIADS	15 D	LC_{50}	240		212238	64
	Acroneuria pacifica, Stonefly	NAIAD, 2–2.5 CM	72 H	LC_{50}	320		212667	64
	Acroneuria pacifica; Stonefly	LARVAE, 2ND INSTAR	0.193 H	ET_{50} IMM		1,000	212929	54
	Aedes aegypti; Mosquito	4TH INSTAR LARVAE *	24 H	EC_{50} IMM		83	216867	93
	Aedes aegypti; Mosquito	LARVAE, 2ND INSTAR	1.93 H	ET_{50} IMM		10	212929	54
	Aedes aegypti; Mosquito	LARVAE	96 H	LC_{50}	1		216270	74
	Aedes aegypti, Mosquito	4TH INSTAR LARVAE *	24 H	EC_{50} IMM		22	216867	93
	Aedes aegypti; Mosquito	LARVAE, 2ND INSTAR	0.307 H	ET_{50} IMM		100	212929	54
	Aedes aegypti, Mosquito	LARVAE, 2ND INSTAR	0.14 H	ET_{50} IMM		10,000	212929	54
	Aedes aegypti, Mosquito	LARVAE	24 H	LC_{50}	5		215162	79
	Aedes cantans; Mosquito	LARVAE	48 H	LC_{50}	4.2		215162	79
	Aedes cantans; Mosquito	YOUNG, 4TH INSTAR	72 H	LC_{100}	20		215162	79
	Aedes cantans, Mosquito	NR	24 H	LETH	1 to 7		219269	72
	Aedes sp; Mosquito	6 CM	48 H	LD_{50}	21,500		310309	72
	Alburnus albidus, Bleak	8 CM	96 H	LC_{50}	80		215185	79
	Alburnus alburnus; Bleak	NR	28 H	PSE		5	212223	72
	Algae; Algae, phytoplankton, algal mat	NR	to 10 H	EC_{50} PSE		100	218926	73
	Algae, Algae, phytoplankton, algal mat	NR	4 H	PSE		1,000	212188	63
	Algae; Algae, phytoplankton, algal mat	NR	10 H	EC_{50} PSE		100	218926	73
	Algae; Algae, phytoplankton, algal mat	NR	28 H	EC_{50} PSE		55	218926	73
	Algae, Algae, phytoplankton, algal mat	10000 CELLS/ML	1 to 17 D	PGR		80	219047	72
	Amphidinium carterae; Dinoflagellate	NR	1 H	ENZ		50,000	219110	72
	Anguilla rostrata; American eel	NR	1 H	PHY		50,000	219110	72
	Anguilla rostrata; American eel	56 MM, 0 18 G	24 H	LC_{50}	7		210628	70
	Anguilla rostrata; American eel	56 MM, 0.18 G	96 H	LC_{50}	4		210628	70
	Anguilla rostrata; American eel	56 MM, 0 18 G	48 H	LC_{50}	6		210628	70
	Anguilla rostrata; American eel	5 G	6 H	HEM, PHY		1,000	219110	72
	Anguilla vulgaris; Eel	MATURE	96 H	HEM, PHY		1	315978	83
	Anguilla vulgaris, Eel	MATURE	96 H	GRO		1	315978	83
	Anguilla vulgaris, Eel	MATURE	96 H	HEM, PHY		0 05	315978	83
	Anguilla vulgaris; Eel	MATURE	96 H	PHY		0 1	315978	83
	Anopheles sp; Mosquito	LARVAE, MIXED MICROFAUNA SPECIE	2 D	POP		70	312237	83
	Anopheles stephensi, Mosquito	4TH INSTAR LARVAE	24 H	LC_{50}	282		312464	84
	Anopheles stephensi; Mosquito	4TH INSTAR LARVAE	24 H	LC_{50}	175		312464	84
	Aplocheilus lineatus; Killifish	25–40 MM STD LENGTH	24 H	LC_{50}	148 9		311081	82
	Aplocheilus lineatus; Killifish	25–40 MM STD LENGTH	48 H	LC_{50}	122.8		311081	82
	Aplodinotus grunniens; Freshwater drum	3 3 G	96 H	LC_{50}	10		212009	66
	Aquatic community; Aquatic community	MICROCOSM	25 D	POP		10 to 500	213972	92
	Arctopsyche grandis; Caddisfly	LARVAE	96 H	LC_{50}	175		210528	65
	Artemia salina, Brine shrimp	5TH INSTAR	5 H	EC_{50} BEH		24	218105	58
	Artemia salina; Brine shrimp	ADULT	5 H	EC_{50} BEH		142	218105	58
	Artemia salina; Brine shrimp	3RD INSTAR	5 H	EC_{50} BEH		105	218105	58
	Artemia salina; Brine shrimp	9TH INSTAR	5 H	EC_{50} BEH		12	218105	58

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
4,4'–DDT (cont.)	Artemia salina; Brine shrimp	7TH INSTAR	5 H	EC_{50} BEH		12	218105	58
	Artemia salina, Brine shrimp	DRIED EGG	48 H	HAT		10,000	216548	80
	Artemia salina; Brine shrimp	1TH INSTAR	5 H	EC_{50} BEH		28	218105	58
	Arthropoda; Arthropod phylum	NR	48 H	LETH	200		219237	72
	Asellus brevicaudus; Aquatic sowbug	MATURE	96 H	LC_{50}	4		210666	80
	Asellus brevicaudus; Aquatic sowbug	NR	96 H	LC_{50}	4		210887	72
	Asellus brevicaudus, Aquatic sowbug	NR	24 H	LC_{50}	8.7		210887	72
	Asplanchna brightwelli; Rotifer	<= 1 D	12 H	LC_{50}	2,218		312237	83
	Astacus astacus; European crayfish	MATURE, 80–90 MM, 22 G	96 H	LC_{50}	1 to 10		218297	77
	Astacus leptodactylus, Crayfish	6.8 G	NR	RSD		50	218908	73
	Balanus amphitrite, Barnacle	ADULT	1 H *	BEH		1	218645	74
	Balanus amphitrite; Barnacle	ADULT	1 H *	BEH		0 1	218645	74
	Balanus improvisus; Barnacle	CYPRIDS	24 H *	BEH		0 03	217940	74
	Balanus improvisus; Barnacle	CYPRIDS	24 H *	CLN		60,000 to 500,000	217940	74
	Balanus improvisus; Barnacle	CYPRIDS	24 H *	BEH		1000000	217940	74
	Barbus dorsalis, Two spot african barb	6–8.5 CM, 0.52–0 59 G	96 H	LC_{50}	48		216722	67
	Barbus dorsalis; Two spot african barb	6–8.5 CM, 0.52–0 59 G	24 H	LC_{50}	86		216722	67
	Barbus dorsalis; Two spot african barb	6–8 5 CM, 0.52–0.59 G	48 H	LC_{50}	86		216722	67
	Barbus sophore, Two spot barb, dotted barb	7.1–9 1 CM, 4.0–9 5 G	15 D	CEL, PHY		50	312352	85
	Barytelphusa cunicularis; Crab	NR	72 H	LC_{50}	980		312790	87
	Barytelphusa cunicularis; Crab	NR	24 H	LC_{50}	2,020		312790	87
	Barytelphusa cunicularis; Crab	NR	48 H	LC_{50}	1,540		312790	87
	Barytelphusa cunicularis; Crab	NR	96 H	LC_{50}	560		312790	87
	Biomphalaria glabrata; Snail	14–16 MM SHELL DIAMETER	24 H	PHY		41,100	218797	73
	Biomphalaria glabrata; Snail	14–16 MM SHELL DIAMETER	24 H	PHY		1,100	218797	73
	Bosmina longirostris, Water flea	NEONATE, < 24 H	48 H	EC_{50} IMM		1.72	310658	84
	Bosmina longirostris; Water flea	NEONATE, < 24 H	48 H	EC_{50} IMM		0 63	310658	84
	Branchiura sowerbyi; Oligochaete	NR	72 H	LETH	4,000		212798	73
	Branchiura sowerbyi; Oligochaete	NR	72 H	LETH	4,000		212798	73
	Branchiura sowerbyi, Oligochaete	NR	90 D	MOR	4,000		212798	73
	Branchiura sowerbyi, Oligochaete	NR	72 H	MOR	4,000		212798	73
	Bufo woodhousei fowleri, Fowler's toad	TADPOLE, 28–35 D	96 H	LC_{50}	1,000		212891	70
	Bufo woodhousei fowleri; Fowler's toad	TADPOLE, 28–35 D	48 H	LC_{50}	1,500		212891	70
	Bufo woodhousei fowleri; Fowler's toad	TADPOLE, 28–35 D	24 H	LC_{50}	2,400		212891	70
	Callinectes sapidus, Blue crab	JUVENILE	24 H	EC_{50} EQU		10	212188	63
	Callinectes sapidus; Blue crab	JUVENILE	48 H	EC_{50} EQU		10	212188	63
	Cancer magister; Dungeness or edible crab	ZOEA	96 H	EC_{50} IMM		1 1	212264	89
	Capitella capitata, Polychaete	NR	96 H	LC_{50}	>1,000		213785	91
	Carassius auratus; Goldfish	NR	48 H	LC_{50}	68		315192	67
	Carassius auratus; Goldfish	2.72 G	96 H	LC_{50}	9.8		210851	75
	Carassius auratus; Goldfish	25 G	5.9 D	HEM		17 5	218756	74
	Carassius auratus; Goldfish	2 5–6.0 CM	24 H	LC_{50}	160		313000	65
	Carassius auratus; Goldfish	6 CM	48 H	LD_{50}	27,500		310309	72
	Carassius auratus, Goldfish	0.8 G	96 H	LC_{50}	40		212009	66
	Carassius auratus, Goldfish	4.01 CM, 1.04 G	48 H	LC_{50}	68		212682	69
	Carassius auratus; Goldfish	1 9 G	96 H	LC_{50}	180		212009	66
	Carassius auratus; Goldfish	19–31 CM	96 H	BEH		10	218528	73
	Carassius auratus, Goldfish	1.0 G	96 H	LC_{50}	21		212009	66
	Carassius auratus; Goldfish	19–31 CM	96 H	LOC		10	219065	72

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
4,4'–DDT (cont.)	Carassius auratus; Goldfish	2.5–6 0 CM	96 H	LC_{50}	13		313000	65
	Carassius auratus; Goldfish	2.5–6.0 CM	72 H	LC_{50}	18		313000	65
	Carassius auratus; Goldfish	2 5–6.0 CM	48 H	LC_{50}	32		313000	65
	Carassius auratus; Goldfish	NR	48 H	LETH	2,000		212807	50
	Carassius auratus; Goldfish	19–30 CM	96 H	LOC		10	218814	73
	Carassius auratus; Goldfish	2.4 G	96 H	LC_{50}	32		212009	66
	Carassius auratus; Goldfish	NR	96 H	LC_{50}	21		210610	70
	Carassius auratus, Goldfish	2.4 G	96 H	LC_{50}	27		212009	66
	Carassius auratus; Goldfish	0.7 G	96 H	LC_{50}	35		212009	66
	Carassius auratus; Goldfish	25 G	5 9 D	HEM		17.5	218756	74
	Carassius auratus, Goldfish	2 5 G	96 H	LC_{50}	76		212009	66
	Carassius carassius; Crucian carp	25–50 G	96 H	LC_{50}	80		312999	75
	Carassius sp; Carp	FRY	96 H	LC_{50}	710		216270	74
	Catla catla; Catla	30 MM, FINGERLING	96 H	LC_{50}	6,800		212520	86
	Ceriodaphnia cornuta; Water flea	MIXED MICROFAUNA SPECIES	2 D	POP		70	312237	83
	Ceriodaphnia cornuta; Water flea	<= 1 D	24 H	LC_{50}	23		312237	83
	Ceriodaphnia reticulata; Water flea	<= 1 D	24 H	LC_{50}	44		312237	83
	Channa punctatus; Snake–head catfish	10–15 CM	48 H	LC_{50}	46		218371	72
	Channa punctatus; Snake–head catfish	10–15 CM	72 H	LC_{50}	29		218371	72
	Channa punctatus, Snake–head catfish	10–15 CM	96 H	LC_{50}	21.4		218371	72
	Channa punctatus; Snake–head catfish	10–15 CM	24 H	LC_{50}	83		218371	72
	Channa punctatus; Snake–head catfish	NR	24 H	CEL, PHY		100	219363	71
	Chaoborus sp; Phantom midge	JUVENILE	96 H	LC_{50}	7.4		210666	80
	Chasmichthys dolichognathus; Agohaze, goby	0 01–0 02 G	24 H	LC_{50}	8		216128	76
	Chasmichthys dolichognathus; Agohaze, goby	0 01–0 02 G	24 H	LC_{50}	10		216128	76
	Chasmichthys dolichognathus, Agohaze, goby	0.01–0.02 G	48 H	LC_{50}	4.8		216128	76
	Chironomidae; Midge family	LARVAE, 9–11 MM	24 H	LC_{50}	74 65		217954	75
	Chironomus riparius; Midge	4TH INSTAR	24 H	EC_{50} IMM		4.7	216830	79
	Chironomus tentans; Midge	2ND INSTAR, 10–14 D	48 H	LC_{50}	1		217884	86
	Chironomus tentans; Midge	3RD–4TH INSTAR	24 H	EC_{50} IMM		19.5	216267	74
	Chironomus yoshimatsui; Midge	LARVAE	24 H *	EC_{50} BEH		23	212687	79
	Chlorella sp; Green algae	150000 CELLS/ML INITIAL CONC	10 D	PGR		1,000	218039	62
	Chlorella sp; Green algae	150000 CELLS/ML INITIAL CONC	10 D	PGR		600	218039	62
	Chlorella vulgaris; Green algae	NR	NR	BIO, PHY		100 to 10,000	213306	87
	Chrysophyta; Diatoms, chrysophyte division	NR	48 H	ABD		200	219237	72
	Cipangopaludina malleata; Mud snail	NR	48 H	LC_{50}	13,000		219158	72
	Cirrhinus mrigala; Carp, hawk fish	FINGERLING, 7 1 CM 3.1 G	48 H	OXC		20	218402	78
	Cirrhinus mrigala; Carp, hawk fish	30 MM, FINGERLING	96 H	LC_{50}	6,400		212520	86
	Claassenia sabulosa, Stonefly	20–25 MM	24 H	LC_{50}	16		210889	68
	Claassenia sabulosa; Stonefly	20–25 MM	48 H	LC_{50}	6 4		210889	68
	Claassenia sabulosa, Stonefly	20–25 MM	96 H	LC_{50}	3.5		210889	68
	Clarias batrachus; Walking catfish	NR	72 H	LC_{50}	4 2		311522	84
	Clarias batrachus; Walking catfish	NR	24 H	LC_{50}	18		311522	84
	Clarias batrachus; Walking catfish	NR	48 H	LC_{50}	8 5		311522	84
	Clarias batrachus; Walking catfish	NR	96 H	LC_{50}	1 75		311522	84
	Colisa fasciata; Giant gourami	48–69 MM	48 H	EC_{50} IMM		132	218745	74
	Colisa fasciata; Giant gourami	FINGERLING, 4.4 CM, 1.9 G	48 H	OXC		20	218402	78
	Colisa fasciata; Giant gourami	48–69 MM	96 H	EC_{50} IMM		126	218745	74
	Colisa fasciata, Giant gourami	48–69 MM	6 H	EC_{50} IMM		162	218745	74

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
4,4'–DDT (cont.)	Colisa fasciata; Giant gourami	48–69 MM	24 H	EC_{50} IMM		150	218745	74
	Crangon septemspinosa; Sand shrimp	2.0 G	21 H	LC_{50}	0.9		215409	80
	Crangon septemspinosa; Sand shrimp	26 MM, 0.25 G	24 H	LC_{50}	3		210627	69
	Crangon septemspinosa; Sand shrimp	2.0 G	15 H	LC_{50}	1.1		215409	80
	Crangon septemspinosa; Sand shrimp	2.0 G	96 H	LC_{50}	0.4		215409	80
	Crangon septemspinosa; Sand shrimp	2.0 G	20 H	LC_{50}	1.8		215409	80
	Crangon septemspinosa; Sand shrimp	2.0 G	15 H	LC_{50}	1.9		215409	80
	Crangon septemspinosa; Sand shrimp	26 MM, 0.25 G	48 H	LC_{50}	1		210627	69
	Crangon septemspinosa, Sand shrimp	2.0 G	16 H	LC_{50}	0.9		215409	80
	Crassostrea madrasensis; Oyster	15–20 MM	72 H	LC_{50}	15.75		210276	89
	Crassostrea madrasensis; Oyster	15–20 MM	96 H	LC_{50}	9.36		210276	89
	Crassostrea madrasensis; Oyster	15–20 MM	120 H	LC_{50}	9.28		210276	89
	Crassostrea madrasensis; Oyster	15–20 MM	24 H	LC_{50}	24.82		210276	89
	Crassostrea madrasensis; Oyster	15–20 MM	48 H	LC_{50}	16.19		210276	89
	Crassostrea virgnica; American or vigmia oyster	2.5–5.1 CM	96 H	GRO		7	212188	63
	Crassostrea virginica; American or viginia oyster	2 MO	1 to 48 WK	HIS, PHY		0.6	210981	71
	Crassostrea virgnica; American or viginia oyster	2 D LARVAE	12 D	LC_{50}	34		212400	79
	Crassostrea virgnica; American or viginia oyster	2 MO	48 WK	GRO		0.6	210981	71
	Crassostrea virginica; American or viginia oyster	2.5–5.1 CM	96 H	GRO		9	212188	63
	Crithidia fasciculata, Flagellate	NR	NR	PGR		3,500	218552	74
	Culaea inconstans; Brook stickleback	1.6 G	96 H	LC_{50}	67		212009	66
	Culex fatigans, Mosquito	LARVAE, 4TH INSTAR STAGE	24 H	LC_{50}	180		312237	83
	Culex pipiens molestus; Mosquito	4TH INSTAR	72 H	LC_{100}	50		215162	79
	Culex pipiens molestus; Mosquito	NR	3 D *	MOR	250		215162	79
	Culex pipiens molestus, Mosquito	NR	3 D *	MOR	250		215162	79
	Culex pipiens molestus; Mosquito	LARVAE	48 H	LC_{50}	7.2		215162	79
	Culex pipiens molestus; Mosquito	LARVAE	24 H	LC_{50}	8.6		215162	79
	Culex pipiens molestus; Mosquito	4TH INSTAR	72 H	LC_{100}	50		215162	79
	Culex pipiens molestus; Mosquito	NR	3 D *	MOR	250		215162	79
	Culex pipiens quinquefasciata; Mosquito	3RD–4TH INSTAR LARVAE	24 H	LC_{50}	100		219297	71
	Culex pipiens quinquefasciata; Mosquito	3RD–4TH INSTAR LARVAE	24 H	LC_{50}	80		219297	71
	Culex quinquefasciatus; Mosquito	4TH INSTAR LARVAE	24 H	LC_{50}	2.1		210810	88
	Culex quinquefasciatus, Mosquito	3RD OR 4TH INSTAR LARVAE	24 H	LC_{50}	22		311201	85
	Cyclops sp; Cyclopoid copepod	4TH INSTAR STAGE	24 H	LC_{50}	515		312237	83
	Cyclops sp; Cyclopoid copepod	MIXED MICROFAUNA SPECIES	2 D	POP		70	312237	83
	Cyclotella cryptica; Diatom	INIT CONC 50000 CELLS/ML	6 D	BMS		10	310161	84
	Cyclotella cryptica, Diatom	INIT CONC 50000 CELLS/ML	6 D	BMS		20	310161	84
	Cymatogaster aggregata; Shiner perch	48–104 MM, 1.2–11.0 G	96 H	LC_{50}	0.45		210611	72
	Cymatogaster aggregata; Shiner perch	48–104 MM, 1.2–11.0 G	96 H	LC_{50}	3.7		210611	72
	Cypridopsis vidua; Ostracod	NR	24 H	MOR	250		218599	74
	Cypridopsis vidua; Ostracod	MATURE	48 H	EC_{50} IMM		15	210666	80
	Cypridopsis vidua; Ostracod	NR	48 H	MOR	125		218599	74
	Cypridopsis vidua; Ostracod	NR	48 H	MOR	63		218599	74
	Cypridopsis vidua; Ostracod	NR	24 H	MOR	1,000		218599	74
	Cypridopsis vidua; Ostracod	NR	24 H	MOR	63		218599	74
	Cypridopsis vidua, Ostracod	NR	48 H	MOR	250		218599	74
	Cyprinodon variegatus; Sheepshead minnow	NR	24 H	EC_{50} EQU		1,000	210807	65
	Cyprinodon variegatus; Sheepshead minnow	20–40 MM	0.5 H *	AVO		5	215145	69
	Cyprinodon variegatus, Sheepshead minnow	NR	48 H	LC_{50}	5		210807	65

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration Lethal	Effect Concentration Sublethal	AQUIRE Reference Number	Year of Publication
4,4'–DDT (cont.)	Cyprinodon variegatus; Sheepshead minnow	JUVENILE	48 H	LC_{50}	5		210646	64
	Cyprinodon variegatus, Sheepshead minnow	JUVENILE	24 H	IRR		100	210646	64
	Cyprinodontidae; Killifish, topminnow family	ADULT, 13–15 CM	72 H	LETH	500		212807	50
	Cyprinus carpio; Common, mirror, colored, carp	15 G	96 H	ENZ		21	219265	72
	Cyprinus carpio, Common, mirror, colored, carp	0.6 G	96 H	LC_{50}	6		212009	66
	Cyprinus carpio; Common, mirror, colored, carp	2.2 G	96 H	LC_{50}	9.2		212009	66
	Cyprinus carpio; Common, mirror, colored, carp	NR	48 H	LC_{50}	110		315192	67
	Cyprinus carpio, Common, mirror, colored, carp	NR	6 H	BIO, PHY		50	311249	84
	Cyprinus carpio; Common, mirror, colored, carp	0 8 G	96 H	LC_{50}	6.9		212009	66
	Cyprinus carpio, Common, mirror, colored, carp	15 G	96 H	ENZ		34	219265	72
	Cyprinus carpio; Common, mirror, colored, carp	2.1 G	96 H	LC_{50}	11 3		212009	66
	Cyprinus carpio; Common, mirror, colored, carp	15 G	96 H	ENZ		34	219265	72
	Cyprinus carpio; Common, mirror, colored, carp	EGGS	96 H	HAT		1,000	219629	70
	Cyprinus carpio, Common, mirror, colored, carp	4 5 CM, 1.1 G	48 H	LC_{50}	110		212682	69
	Cyprinus carpio; Common, mirror, colored, carp	NR	96 H	LC_{50}	10		210610	70
	Cyprinus carpio, Common, mirror, colored, carp	NR	6 H	BIO, PHY		50	311249	84
	Cyprinus carpio; Common, mirror, colored, carp	12–17 CM, 40–80 G	6 H	PHY		50	310912	85
	Cyprinus carpio; Common, mirror, colored, carp	EGGS	96 H	HAT		5,000	219629	70
	Cyprinus carpio, Common, mirror, colored, carp	FRY	96 H	LC_{50}	540		216270	74
	Cyprinus carpio; Common, mirror, colored, carp	EGG	96 H	LC_{50}	350		311812	86
	Cyprinus carpio, Common, mirror, colored, carp	2.0 G	96 H	LC_{50}	4		212009	66
	Cyprinus carpio; Common, mirror, colored, carp	2.5 G	96 H	LC_{50}	12		212009	66
	Cyprinus carpio; Common, mirror, colored, carp	NR	6 H	BIO, PHY		50	311249	84
	Daphnia carinata, Water flea	2–2 5 MM ADULT	48 H	EC_{50} IMM		12	215194	76
	Daphnia carinata; Water flea	2–2.5 MM ADULT	24 H	EC_{50} IMM		23	215194	76
	Daphnia magna; Water flea	NR	26 H	EC_{50} IMM		5.5	217984	66
	Daphnia magna; Water flea	JUVENILE, 6–24 H	24 H	EC_{50} IMM		510	310871	84
	Daphnia magna; Water flea	JUVENILE, 6–24 H	48 H	EC_{50} IMM		1.1	310871	84
	Daphnia magna; Water flea	< 24 H	14 D	REP		0.5	215525	75
	Daphnia magna; Water flea	JUVENILE, 6–24 H	24 H	EC_{50} IMM		71	310871	84
	Daphnia magna; Water flea	<24 H	14 D	REP		0 75	215525	75
	Daphnia magna; Water flea	1ST INSTAR, < 24 H	26 H	LC_{50} *	4 4		212820	67
	Daphnia magna; Water flea	< 24 H	48 H	MOR	0.04		218455	74
	Daphnia magna; Water flea	1ST INSTAR, 9 UG	24 H *	MOR	8		219303	71
	Daphnia magna, Water flea	1ST INSTAR	48 H	EC_{50} IMM		4 7	210666	80
	Daphnia magna, Water flea	2–26 H ADULT	24 H	EC_{50} IMM		6.5	215539	75
	Daphnia magna; Water flea	1ST INSTAR, 9 UG	24 H *	MOR	200		219303	71
	Daphnia magna; Water flea	JUVENILE, 6–24 H	24 H	EC_{50} IMM		0.5	310871	84
	Daphnia magna; Water flea	1ST INSTAR, 9 UG	24 H *	MOR	50		219303	71
	Daphnia magna; Water flea	NR	48 H	LC_{50}	2.66		313007	76
	Daphnia magna, Water flea	< 24 H	24 H	LC_{50}	9		315291	75
	Daphnia magna; Water flea	JUVENILE, 6–24 H	24 H	EC_{50} IMM		42	310871	84
	Daphnia magna; Water flea	1ST INSTAR, 9 UG	24 H *	MOR	16		219303	71
	Daphnia magna, Water flea	JUVENILE, 6–24 H	48 H	EC_{50} IMM		0 68	310871	84
	Daphnia magna; Water flea	< 24 H	48 H	EC_{50} IMM		1 7	212076	79
	Daphnia magna; Water flea	JUVENILE, 6–24 H	24 H	EC_{50} IMM		0.99	310871	84
	Daphnia magna; Water flea	JUVENILE, 1–2 MM, <24 H	48 H	EC_{50} IMM		1 08	212554	90
	Daphnia magna; Water flea	JUVENILE, 6–24 H	24 H	EC_{50} IMM		98	310871	84
	Daphnia magna; Water flea	NR	96 H	LC_{50}	3		216270	74

Table A–15
AQUIRE Freshwater Toxicity Information
Units = μg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
4,4'–DDT (cont.)	Daphnia magna, Water flea	JUVENILE, 6–24 H	24 H	EC_{50} IMM		1.3	310871	84
	Daphnia magna; Water flea	1ST INSTAR, 9 UG	24 H *	MOR	1,100		219303	71
	Daphnia magna; Water flea	JUVENILE, 1–2 MM, <24 H	48 H	EC_{50} IMM		1.23	212554	90
	Daphnia magna; Water flea	< 24 H	48 H	MOR	0.9		218455	74
	Daphnia magna, Water flea	<24 H	14 D	EC_{50} IMM		0.67	215525	75
	Daphnia magna, Water flea	12 +/– 12 H	14 D	EC_{50} IMM		0.67	215525	75
	Daphnia magna; Water flea	<24 H	48 H	LC_{50}	3		217884	86
	Daphnia magna; Water flea	<24 H	14 D	REP		0.61	215525	75
	Daphnia magna; Water flea	JUVENILE, 1–2 MM, <24 H	48 H	EC_{50} IMM		1.51	212554	90
	Daphnia magna; Water flea	1ST INSTAR, 9 UG	24 H *	MOR	100		219303	71
	Daphnia magna; Water flea	JUVENILE, 1–2 MM, <24 H	48 H	EC_{50} IMM		1.13	212554	90
	Daphnia magna, Water flea	< 24 H	48 H	EC_{50} IMM		1.1	212076	79
	Daphnia magna, Water flea	12 +/– 12 H	14 D	REP		0.5	215525	75
	Daphnia magna, Water flea	NR	26 H	EC_{50} IMM		195	217984	66
	Daphnia magna; Water flea	JUVENILE, 1–2 MM, <24 H	48 H	EC_{50} IMM		1.2	212554	90
	Daphnia magna; Water flea	NEONATE, <24 H	48 H	EC_{50} IMM		1.1	213283	88
	Daphnia pulex; Water flea	1ST INSTAR	48 H	EC_{50} IMM		0.36	210888	66
	Daphnia pulex, Water flea	FEMALE ADULT	3 H	LC_{50}	3,500		212682	69
	Daphnia pulex, Water flea	NR	48 H	EC_{50} IMM		2.67	310658	84
	Daphnia pulex, Water flea	NEONATE, < 24 H	48 H	EC_{50} IMM		1.1	312730	87
	Daphnia pulex; Water flea	NR	3 H	LC_{50}	3,500		315192	67
	Daphnia pulex; Water flea	NR	48 H	REP		100	210666	80
	Daphnia sp, Water flea	EMBRYO	72 H	EC_{50} DVP		>17.2	212264	89
	Dendraster excentricus; Sand dollar	MIXED MICROFAUNA SPECIES	2 D	POP		70	312237	83
	Diphanosoma excisum, Water flea	<= 1 D	24 H	LC_{50}	28		312237	83
	Diphanosoma excisum; Water flea	NR	3 H *	DRF		10 to 11	217387	61
	Diptera, Fly, mosquito, midge order	ADULT, 20–25 MM	72 H	FLT		1,000	218286	79
	Donax cuneatus, Marine bivalve	ADULT, 20–25 MM	72 H	PHY		1,000	218286	79
	Donax cuneatus; Marine bivalve	ADULT, 20–25 MM	9 D	LETH	1,000		218286	79
	Donax cuneatus, Marine bivalve	ADULT, 20–25 MM	8 D	OXC		1,000	218286	79
	Donax cuneatus; Marine bivalve	150000 CELLS/ML INITIAL CONC	10 D	PGR		1,000	218039	62
	Dunaliella euchlora; Green algae	150000 CELLS/ML INITIAL CONC	10 D	PGR		600	218039	62
	Dunaliella euchlora; Green algae	NR	24 H	PSE		10	219310	71
	Dunaliella tertiolecta; Green algae	10000 CELLS/ML	1 to 17 D	PGR		80	219047	72
	Emiliania huxleyi; Coccolithophorid	10000 CELLS/ML	1 to 17 D	PGR		80	219047	72
	Ephemerella grandis; Mayfly	NYMPH	96 H	LC_{50}	25		210528	65
	Ephemeroptera; Mayfly order	NR	2.5 H *	DRF		10 to 11	217387	61
	Eretes sticticus; Beetle	NR	24 H	LC_{50}	35		215182	78
	Eretes sticticus; Beetle	NR	48 H	LC_{50}	21.5		215182	78
	Esox lucius, Northern pike	0.7 G	96 H	LC_{50}	2.7		210666	80
	Esox lucius; Northern pike	0.5 G	96 H	LC_{50}	1.7		212009	66
	EuCalanus sp. Calanoid copepod	MATURE	24 H	LC_{50}	12		212658	88
	Euplotes vannus; Ciliate	NR	48 H	REP		10,000	215922	75
	Fundulus heteroclitus; Mummichog	55 MM, 20 G	96 H	LC_{50}	5		210628	70
	Fundulus heteroclitus; Mummichog	5 G	6 H	HEM		250	219110	72
	Fundulus heteroclitus; Mummichog	5 G	24 H	LETH	750		219110	72
	Fundulus heteroclitus; Mummichog	55 MM, 20 G	24 H	LC_{50}	11		210628	70
	Fundulus heteroclitus, Mummichog	5 G	96 H	MOR	250		219110	72
	Fundulus heteroclitus; Mummichog	4–5 CM	7 D	RGN		10	218232	75

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
4,4'–DDT (cont.)	Fundulus heteroclitus; Mummichog	5 G	72 H	MOR	250		219110	72
	Fundulus heteroclitus; Mummichog	ADULT	24 H	LC_{100}	1,000		218806	72
	Fundulus heteroclitus; Mummichog	5 G	48 H	MOR	250		219110	72
	Fundulus heteroclitus, Mummichog	42 (36–45) MM	10 D	LC_{50}	2.7		212814	70
	Fundulus heteroclitus; Mummichog	5–10 CM	0.25 H	BIO, PHY		18,000	219485	81
	Fundulus heteroclitus; Mummichog	5 G	24 H	HEM		75	219110	72
	Fundulus heteroclitus, Mummichog	5 G	96 H	MOR	25		219110	72
	Fundulus heteroclitus, Mummichog	5 G	24 H	MOR	250		219110	72
	Fundulus heteroclitus; Mummichog	5 G	24 H	MOR	75		219110	72
	Fundulus heteroclitus; Mummichog	4–5 CM	14 D	RGN		10	218232	75
	Fundulus heteroclitus; Mummichog	5 G	48 H	MOR	75		219110	72
	Fundulus heteroclitus, Mummichog	42 (36–45) MM	96 H	LC_{50}	3		212814	70
	Fundulus heteroclitus; Mummichog	5 G	72 H	MOR	75		219110	72
	Fundulus heteroclitus, Mummichog	55 MM, 20 G	48 H	LC_{50}	5		210628	70
	Fundulus heteroclitus; Mummichog	5 G	6 H	HEM		250	219110	72
	Fundulus heteroclitus, Mummichog	ADULT	24 H	LC_{0}	70		218806	72
	Fundulus heteroclitus; Mummichog	5 G	96 H	MOR	75		219110	72
	Fundulus majalis; Striped killifish	40 MM, 0.92 G	48 H	LC_{50}	2		210628	70
	Fundulus majalis; Striped killifish	40 MM, 0.92 G	24 H	LC_{50}	3		210628	70
	Fundulus majalis, Striped killifish	40 MM, 0.92 G	96 H	LC_{50}	1		210628	70
	Fundulus similis, Longnose killifish	JUVENILE	48 H	LC_{50}	5.5		212188	63
	Fundulus similis; Longnose killifish	NR	24 H	LC_{50}	28		210807	65
	Fundulus similis; Longnose killifish	NR	48 H	LC_{50}	18		210807	65
	Fundulus similis; Longnose killifish	JUVENILE	24 H	LC_{50}	5.5		212188	63
	Gambusia affinis, Mosquitofish	NR	48 H	LC_{50}	313		215494	73
	Gambusia affinis, Mosquitofish	NR	14.5 D	LT_{50}	4		216978	77
	Gambusia affinis; Mosquitofish	FEMALE, 3.8–5.1 CM, 0.68–0.81 G	48 H	LC_{50}	60		210568	80
	Gambusia affinis, Mosquitofish	NR	13.4 H	LT_{50}	1,500		216978	77
	Gambusia affinis, Mosquitofish	NR	24 H *	MOR	2		212128	61
	Gambusia affinis; Mosquitofish	1.8–4.8 CM	24 H	MOR	1		219096	72
	Gambusia affinis; Mosquitofish	NR	48 H *	MOR	2		212128	61
	Gambusia affinis; Mosquitofish	NR	13.4 H	LT_{50}	2,500		216978	77
	Gambusia affinis; Mosquitofish	NR	48 H	LC_{50}	528		215494	73
	Gambusia affinis; Mosquitofish	1.9 G, 4.3 CM	24 H	LC_{50}	560		216038	70
	Gambusia affinis, Mosquitofish	1.9 G, 4.3 CM	96 H	LC_{50}	20		216038	70
	Gambusia affinis; Mosquitofish	FEMALE, 3.8–5.1 CM, 0.68–0.81 G	96 H	LC_{50}	40		210568	80
	Gambusia affinis; Mosquitofish	NR	24 H *	MOR	2		212128	61
	Gambusia affinis, Mosquitofish	NR	12.5 H	LT_{50}	1,000		216978	77
	Gambusia affinis, Mosquitofish	NR	48 H *	MOR	2		212128	61

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
4,4'–DDT (cont.)	Gambusia affinis; Mosquitofish	NR	13 H	LT_{50}	500		216978	77
	Gambusia affinis; Mosquitofish	NR	24 H *	MOR	2		212128	61
	Gambusia affinis; Mosquitofish	FRY, 2.06 CM, 222 MG, BEHERA STRAIN	96 H	LC_{50}	9.87		313099	86
	Gambusia affinis, Mosquitofish	NR	96 H *	MOR	0.5		212128	61
	Gambusia affinis; Mosquitofish	NR	48 H	LC_{50}	43		215494	73
	Gambusia affinis, Mosquitofish	1.9 G, 4.3 CM	48 H	LC_{50}	46		216038	70
	Gambusia affinis; Mosquitofish	NR	0.17 H	ENZ		40,000	217212	78
	Gambusia affinis; Mosquitofish	NR	23 H	LT_{50}	100		216978	77
	Gambusia affinis; Mosquitofish	95 % MATURE FEMALES	0.67 H	ENZ		3	219148	72
	Gambusia affinis; Mosquitofish	NR	13.4 H	LT_{50}	2,000		216978	77
	Gambusia affinis, Mosquitofish	NR	24 H	MOR	2		212128	61
	Gambusia affinis, Mosquitofish	FEMALE, 3.8–5.1 CM, 0.68–0.81 G	72 H	LC_{50}	55		210568	80
	Gambusia affinis; Mosquitofish	NR	48 H	MOR	2		212128	61
	Gambusia affinis, Mosquitofish	2.0–5.8 CM	96 H	LC_{50}	0.45		216033	77
	Gambusia affinis, Mosquitofish	NR	24 H *	MOR	2		212128	61
	Gambusia affinis; Mosquitofish	FRY, 2.06 CM, 222 MG	24 H	LC_{50}	58.58		313099	86
	Gambusia affinis; Mosquitofish	NR	48 H *	MOR	2		212128	61
	Gambusia affinis, Mosquitofish	FRY, 2.06 CM, 222 MG	24 H	LC_{50}	22.74		313099	86
	Gambusia affinis; Mosquitofish	NR	24 H	MOR	0.5		212128	61
	Gambusia affinis; Mosquitofish	NR	14.2 D	LT_{50}	20		216978	77
	Gambusia affinis; Mosquitofish	NR	48 H	MOR	0.5		212128	61
	Gambusia affinis, Mosquitofish	FEMALE, 3.8–5.1 CM, 0.68–0.81 G	24 H	LC_{50}	70		210568	80
	Gambusia affinis; Mosquitofish	NR	24 H *	MOR	0.5		212128	61
	Gambusia affinis; Mosquitofish	0.5 G	96 H	LC_{50}	27		210942	72
	Gambusia affinis, Mosquitofish	NR	48 H *	MOR	0.5		212128	61
	Gambusia affinis; Mosquitofish	FRY, 2.06 CM, 222 MG, BEHERA STRAIN	96 H	LC_{50}	27.69		313099	86
	Gambusia affinis; Mosquitofish	95 % MATURE FEMALES	0.67 H	ENZ		3	219148	72
	Gambusia affinis; Mosquitofish	1.8–4.8 CM	24 H	MOR	5		219096	72
	Gambusia affinis, Mosquitofish	NR	72 H *	MOR	0.5		212128	61
	Gammarus duebeni; Scud	ADULT, 50–80 MG	72 H	PHY		3.5	218132	75
	Gammarus fasciatus; Scud	NR	48 H	LC_{50}	1		210887	72
	Gammarus fasciatus; Scud	NR	24 H	LC_{50}	15		210887	72
	Gammarus fasciatus; Scud	NR	96 H	LC_{50}	3.2		210948	72
	Gammarus fasciatus; Scud	NR	96 H	LC_{50}	3.2		210887	72
	Gammarus fasciatus; Scud	NR	24 H	LC_{50}	1.1		210887	72
	Gammarus fasciatus; Scud	NR	24 H	LC_{50}	4.2		210887	72
	Gammarus fasciatus, Scud	NR	5 D	LC_{50}	0.6		210887	72
	Gammarus fasciatus; Scud	NR	48 H	LC_{50}	3.1		210887	72
	Gammarus fasciatus; Scud	NR	5 D	LC_{50}	0.32		210887	72
	Gammarus fasciatus; Scud	NR	5 D	LC_{50}	0.6		210948	72
	Gammarus fasciatus, Scud	NR	96 H	LC_{50}	0.8		210887	72
	Gammarus fasciatus; Scud	NR	96 H	LC_{50}	1.8		210887	72
	Gammarus lacustris; Scud	2 MONTH OLD	48 H	LC_{50}	2.1		210885	69
	Gammarus lacustris, Scud	2 MO	24 H	LC_{50}	12		210885	69
	Gammarus lacustris, Scud	2 MONTH OLD	24 H	LC_{50}	4.7		210885	69
	Gammarus lacustris; Scud	2 MONTH OLD	96 H	LC_{50}	1		210885	69
	Gammarus lacustris; Scud	MATURE	96 H	LC_{50}	1		210666	80
	Gammarus lacustris, Scud	1 MONTH OLD	24 H	LC_{50}	1.4		210885	69
	Gammarus lacustris; Scud	NR	96 H	LC_{50}	9		212094	64

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
4,4'–DDT (cont.)	Gammarus lacustris; Scud	2 MONTH OLD	24 H	LC_{50}	5 6		210885	69
	Gammarus lacustris; Scud	NR	96 H	LC_{50}	9		210528	65
	Gammarus lacustris; Scud	3 MONTH OLD	24 H	LC_{50}	8		210885	69
	Gammarus lacustris; Scud	2 MONTH OLD	24 H	LC_{50}	7.6		210885	69
	Gasterosteus aculeatus; Three spine stickleback	22–44 MM, 0.38–0 77 G	24 H	LC_{50}	18		210522	61
	Gasterosteus aculeatus; Three spine stickleback	22–44 MM, 0.38–0 77 G	96 H	LC_{50}	11 5		210522	61
	Gasterosteus aculeatus; Three spine stickleback	22–44 MM, 0 38–0.77 G	96 H	LC_{50}	18		210522	61
	Gasterosteus aculeatus; Three spine stickleback	22–44 MM, 0.38–0.77 G	72 H	LC_{50}	14 5		210522	61
	Gasterosteus aculeatus; Three spine stickleback	22–44 MM, 0 38–0.77 G	72 H	LC_{50}	18.5		210522	61
	Gasterosteus aculeatus, Three spine stickleback	22–44 MM, 0.38–0.77 G	24 H	LC_{50}	22		210522	61
	Gasterosteus aculeatus; Three spine stickleback	22–44 MM, 0.38–0.77 G	48 H	LC_{50}	21		210522	61
	Gasterosteus aculeatus; Three spine stickleback	22–44 MM, 0 38–0 77 G	48 H	LC_{50}	15		210522	61
	Girella punctata; Green fish	0 15–0 24 G	24 H	LC_{50}	6.5		216128	76
	Girella punctata, Green fish	0 15–0.24 G	48 H	LC_{50}	7		216128	76
	Girella punctata, Green fish	0.15–0 24 G	24 H	LC_{50}	7 2		216128	76
	Girella punctata; Green fish	0.15–0.24 G	48 H	LC_{50}	6		216128	76
	Halodule uninervis, Macrophyte	2–3 G FRESH WT	6 H	PSE		50	310569	84
	Halophila ovalis; Macrophyte	2–3 G FRESH WT	6 H	PSE		50	310569	84
	Hemitripterus americanus; Sea raven	NR	0.5 H	ENZ		1,000	219361	71
	Hesperophylax sp; Caddisfly	LARVAE	0.25 H	LETH	15,000		315079	49
	Hesperophylax sp; Caddisfly	LARVAE	0 25 H	MOR	15,000		315079	49
	Heterocypris incongruens, Ostracod	ADULT	48 H	LETH	5,000		218599	74
	Heterocypris incongruens; Ostracod	ADULT	48 H	MOR	100		218599	74
	Heterocypris incongruens; Ostracod	ADULT	24 H	MOR	5,000		218599	74
	Heterocypris incongruens, Ostracod	ADULT	24 H	MOR	100		218599	74
	Heteropneustes fossilis, Indian catfish	19 8–22 0 CM, 40–57 G	96 H	LC_{50}	2,950		312480	84
	Heteropneustes fossilis, Indian catfish	19.8–22 0 CM, 40–57 G	11 D	HEM, PHY		500	312480	84
	Heteropneustes fossilis; Indian catfish	19 8–22.0 CM, 40–57 G	72 H	LC_{50}	3,020		312480	84
	Heteropneustes fossilis; Indian catfish	19 8–22.0 CM, 40–57 G	48 H	LC_{50}	3,550		312480	84
	Homarus americanus; American lobster	NR	0.17 H	BIO, PHY		1,100	212818	74
	Homarus americanus; American lobster	NR	0.17 H	BIO, PHY		3,500	212818	74
	Hydropsyche californica; Caddisfly	LARVAE	96 H	LC_{50}	48		210528	65
	Hydropsyche morosa; Caddisfly	LARVAE, 42 MG	6 H	EC_{50} IMM		50	212822	72
	Hydropsyche morosa, Caddisfly	LARVAE, 25 MG	6 H	EC_{50} IMM		50	212822	72
	Hydropsyche morosa; Caddisfly	LARVAE, 32.5 MG	40 H	ET_{50} IMM		20	212822	72
	Hydropsyche morosa; Caddisfly	LARVAE, 19 0 MG	6 H	ET_{50} IMM		20	212822	72
	Hydropsyche morosa; Caddisfly	LARVAE, 42 MG	3 H	EC_{50} IMM		70	212822	72
	Hydropsyche morosa, Caddisfly	LARVAE, 25 MG	6 H *	EC_{50} IMM		250	212822	72
	Hydropsyche morosa; Caddisfly	LARVAE, 42 MG	6 H *	EC_{50} IMM		50	212822	72
	Hydropsyche morosa; Caddisfly	LARVAE, 25 MG	6 H *	EC_{50} IMM		100	212822	72
	Hydropsyche morosa; Caddisfly	LARVAE, 40 MG	6 H	EC_{50} IMM		40	212822	72
	Hydropsyche morosa; Caddisfly	LARVAE, 25 MG	3 H	EC_{50} IMM		40	212822	72
	Hydropsyche morosa; Caddisfly	LARVAE, 40 MG	6 H	EC_{50} IMM		20	212822	72
	Hydropsyche morosa, Caddisfly	LARVAE, 25 MG	3 H	EC_{50} IMM		90	212822	72
	Hydropsyche morosa; Caddisfly	LARVAE, 32.5 MG	9 H	ET_{50} IMM		100	212822	72
	Hydropsyche morosa; Caddisfly	LARVAE, 40 MG	6 H	EC_{50} IMM		30	212822	72
	Hydropsyche morosa; Caddisfly	LARVAE, 40 MG	6 H	EC_{50} IMM		60	212822	72
	Hydropsyche morosa; Caddisfly	LARVAE, 25 MG	3 H	EC_{50} IMM		500	212822	72
	Hydropsyche morosa; Caddisfly	LARVAE, 25 MG	6 H	EC_{50} IMM		150	212822	72

Table A–15
AQUIRE Freshwater Toxicity Information
Units = μg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
4,4'–DDT (cont.)	Hydropsyche morosa, Caddisfly	LARVAE, 40 MG	6 H	EC_{50} IMM		20	212822	72
	Hydropsyche morosa; Caddisfly	LARVAE, 25 MG	6 H *	EC_{50} IMM		50	212822	72
	Hydropsyche morosa, Caddisfly	LARVAE, 25 MG	6 H *	EC_{50} IMM		50	212822	72
	Hydropsyche morosa; Caddisfly	LARVAE, 40 MG	6 H	EC_{50} IMM		20	212822	72
	Hydropsyche morosa; Caddisfly	LARVAE, 25 MG	6 H	EC_{50} IMM		250	212822	72
	Hydropsyche morosa; Caddisfly	LARVAE, 19.0 MG	2 H	ET_{50} IMM		100	212822	72
	Hydropsyche morosa; Caddisfly	LARVAE, 25 MG	6 H	EC_{50} IMM		50	212822	72
	Hydropsyche morosa; Caddisfly	LARVAE, 25 MG	3 H	EC_{50} IMM		90	212822	72
	Hydropsyche recurvata; Caddisfly	LARVAE, 25 MG	6 H	EC_{50} IMM		60	212822	72
	Hydropsyche recurvata, Caddisfly	LARVAE, 25 MG	24 H *	EC_{50} IMM		40	212822	72
	Hydropsyche recurvata; Caddisfly	LARVAE, 25 MG	6 H *	EC_{50} IMM		40	212822	72
	Hydropsyche recurvata; Caddisfly	LARVAE, 25 MG	6 H	EC_{50} IMM		30	212822	72
	Hydropsyche recurvata; Caddisfly	LARVAE, 25 MG	3 H	EC_{50} IMM		1,000	212822	72
	Hydropsyche recurvata; Caddisfly	LARVAE, 25 MG	3 H	EC_{50} IMM		10	212822	72
	Hydropsyche recurvata; Caddisfly	LARVAE, 25 MG	3 H	EC_{50} IMM		1,000	212822	72
	Hydropsyche recurvata; Caddisfly	LARVAE, 25 MG	3 H	EC_{50} IMM		100	212822	72
	Hydropsyche recurvata; Caddisfly	LARVAE, 25 MG	6 H *	EC_{50} IMM		20	212822	72
	Hydropsyche recurvata; Caddisfly	LARVAE, 25 MG	6 H	EC_{50} IMM		60	212822	72
	Hydropsyche recurvata, Caddisfly	LARVAE, 25 MG	24 H *	EC_{50} IMM		300	212822	72
	Hydropsyche recurvata; Caddisfly	LARVAE, 25 MG	24 H *	EC_{50} IMM		400	212822	72
	Hydropsyche recurvata, Caddisfly	LARVAE, 25 MG	6 H	EC_{50} IMM		500	212822	72
	Hydropsyche recurvata, Caddisfly	LARVAE, 25 MG	3 H	EC_{50} IMM		90	212822	72
	Hydropsyche recurvata, Caddisfly	LARVAE, 25 MG	6 H	EC_{50} IMM		150	212822	72
	Hydropsyche sp; Caddisfly	LARVAE	0.25 H	LETH	15,000		315079	49
	Hydropsyche sp, Caddisfly	LARVAE	0.25 H	MOR	15,000		315079	49
	Ictalurus melas; Black bullhead	1.2 G	96 H	LC_{50}	4.8		210666	80
	Ictalurus melas; Black bullhead	2.1 G	96 H	LC_{50}	42		212009	66
	Ictalurus melas; Black bullhead	2.4 G	96 H	LC_{50}	23.5		212009	66
	Ictalurus melas; Black bullhead	NR	96 H	LC_{50}	5		210610	70
	Ictalurus melas; Black bullhead	2.2 G	96 H	LC_{50}	20		212009	66
	Ictalurus melas, Black bullhead	2.3 G	96 H	LC_{50}	17		212009	66
	Ictalurus punctatus; Channel catfish	NR	96 H	LC_{50}	16		210610	70
	Ictalurus punctatus, Channel catfish	10.0 G	24 H	LC_{50}	34		210942	72
	Ictalurus punctatus; Channel catfish	2.0 G	96 H	LC_{50}	17.5		212009	66
	Ictalurus punctatus; Channel catfish	2.98 G	96 H	LC_{50}	13.5		210851	75
	Ictalurus punctatus; Channel catfish	1.5 G	96 H	LC_{50}	21.5		210666	80
	Ictalurus punctatus; Channel catfish	43 (39–46) MM, 0.5 (0.4–0.6) G	96 H	LC_{50}	3.3		218048	65
	Ictalurus punctatus; Channel catfish	86.5 G, 194.6 MM	96 H	BEH		10	218528	73
	Ictalurus punctatus; Channel catfish	43, (39–46) MM, 0.5 (0.4–0.6) G	48 H	LC_{50}	4.1		218048	65
	Ictalurus punctatus, Channel catfish	43 (39–46) MM, 0.5 (0.4–0.6) G	24 H	LC_{50}	4.9		218048	65
	Ictalurus punctatus; Channel catfish	1.9 G	96 H	LC_{50}	17.5		212009	66
	Ictiobus cyprinellus; Bigmouth buffalo	ADULT	45 D	MOR	1,000		212807	50
	Indonaia caerulea; Unionid clam	ADULT, 55–65 MM	72 H	LT_{50}	1,000		218286	79
	Indoplanorbis exustus; Snail	NR	48 H	LC_{50}	5,500		219158	72
	Ischnura verticalis, Damselfly	NR	96 H	LC_{50}	56		210948	72
	Isoperla sp; Stonefly	JUVENILE	96 H	LC_{50}	1.2		210666	80
	Katelysia opima; Marine bivalve	10–15 MM	24 H	LC_{50}	16.48		210276	89
	Katelysia opima; Marine bivalve	ADULT, 25–30 MM	72 H	FLT		1,000	218286	79
	Katelysia opima; Marine bivalve	10–15 MM	96 H	LC_{50}	13.19		210276	89

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
4,4'–DDT (cont)	Katelysia opima, Marine bivalve	ADULT, 25–30 MM	80 H	MOR	1,000		218286	79
	Katelysia opima; Marine bivalve	10–15 MM	72 H	LC_{50}	14.62		210276	89
	Katelysia opima; Marine bivalve	10–15 MM	120 H	LC_{50}	11 05		210276	89
	Katelysia opima; Marine bivalve	ADULT, 25–30 MM	72 H	OXC		1,000	218286	79
	Katelysia opima, Marine bivalve	ADULT, 25–30 MM	72 H	PHY		1,000	218286	79
	Katelysia opima; Marine bivalve	10–15 MM	48 H	LC_{50}	15.78		210276	89
	Kuhlia sandvicensis; Aholehole	1.49 G, 4.3 CM	48 H	LC_{50}	6 3		216038	70
	Kuhlia sandvicensis, Aholehole	1.49 G, 4 3 CM	96 H	LC_{50}	3.9		216038	70
	Kuhlia sandvicensis; Aholehole	1.49 G, 4.3 CM	24 H	LC_{50}	12		216038	70
	Labeo rohita, Rohu	30 MM, FINGERLING	96 H	LC_{50}	6,400		212520	86
	Labeo rohita; Rohu	FINGERLING, 5.9 CM, 1.9 G	48 H	OXC		20	218402	78
	Leiostomus xanthurus; Spot	JUVENILE	24 H	LC_{50}	5		210646	64
	Leiostomus xanthurus, Spot	JUVENILE	48 H	LC_{50}	2		210646	64
	Lepomis cyanellus; Green sunfish	1.1 G	96 H	LC_{50}	6.7		212009	66
	Lepomis cyanellus, Green sunfish	1.4 G	96 H	LC_{50}	3 9		212009	66
	Lepomis cyanellus; Green sunfish	0.7 G	96 H	LC_{50}	4.4		212009	66
	Lepomis cyanellus; Green sunfish	0.8 G	96 H	LC_{50}	5		212009	66
	Lepomis cyanellus; Green sunfish	1 0 G	96 H	LC_{50}	3		212009	66
	Lepomis cyanellus, Green sunfish	0.7 G	96 H	LC_{50}	2 8		212009	66
	Lepomis cyanellus; Green sunfish	0 8 G	96 H	LC_{50}	6.4		212009	66
	Lepomis cyanellus; Green sunfish	0 8 G	96 H	LC_{50}	3 6		212009	66
	Lepomis gibbosus; Pumpkinseed	1 4 G	96 H	LC_{50}	6.7		212009	66
	Lepomis gibbosus, Pumpkinseed	1.3 G	96 H	LC_{50}	3 6		212009	66
	Lepomis gibbosus; Pumpkinseed	1.3 G	96 H	LC_{50}	2.8		212009	66
	Lepomis gibbosus; Pumpkinseed	1 4 G	96 H	LC_{50}	7.5		212009	66
	Lepomis gibbosus, Pumpkinseed	1.3 G	96 H	LC_{50}	1 8		212009	66
	Lepomis macrochirus; Bluegill	1 3 G	96 H	LC_{50}	7		212009	66
	Lepomis macrochirus; Bluegill	42 MM, 0.8 G	24 H	LC_{50}	16.5		313045	71
	Lepomis macrochirus, Bluegill	2 5 CM	96 H	LC_{50}	0.2 to 1 0		218343	77
	Lepomis macrochirus; Bluegill	38 (35–42) MM, 0 6 (0 5–0 8) G	24 H	LC_{50}	8 4		218048	65
	Lepomis macrochirus; Bluegill	1.1 G	96 H	LC_{50}	3		212009	66
	Lepomis macrochirus; Bluegill	0 6 G	96 H	LC_{50}	1.7		212009	66
	Lepomis macrochirus; Bluegill	2 5 CM	8 D	LOC		0 008	218343	77
	Lepomis macrochirus, Bluegill	0.6 G	96 H	LC_{50}	4 3		212009	66
	Lepomis macrochirus; Bluegill	2.5–5.0 CM	48 H	LC_{50}	3.3		313000	65
	Lepomis macrochirus; Bluegill	42 MM, 0.8 G	48 H	LC_{50}	13 5		313045	71
	Lepomis macrochirus; Bluegill	3 8–6 4 CM, 1.0–2.0 G	96 H	LC_{50}	8.8		210936	59
	Lepomis macrochirus, Bluegill	0 26 G ; < 1 YEAR	96 H	LC_{50}	9		212076	79
	Lepomis macrochirus; Bluegill	NR	96 H	LC_{50}	8		210610	70
	Lepomis macrochirus; Bluegill	0.5 G	96 H	LC_{50}	7		210942	72
	Lepomis macrochirus; Bluegill	ADULT, 13–15 CM	7 WK	LETH	500		212807	50
	Lepomis macrochirus; Bluegill	2.5–5 0 CM	72 H	LC_{50}	3		313000	65
	Lepomis macrochirus; Bluegill	1.0 G	96 H	LC_{50}	2.8		212009	66
	Lepomis macrochirus, Bluegill	1.2 G	96 H	LC_{50}	9 4		212009	66
	Lepomis macrochirus; Bluegill	ADULTS, 13–15 CM	7 WK	MOR	200		212807	50
	Lepomis macrochirus; Bluegill	0.8 G	96 H	LC_{50}	1.2		212009	66
	Lepomis macrochirus; Bluegill	FINGERLING, 5–7.6 CM	7 WK	LETH	100		212807	50
	Lepomis macrochirus, Bluegill	0 6 G	96 H	LC_{50}	7		212009	66
	Lepomis macrochirus; Bluegill	ADULT	45 D	MOR	1,000		212807	50

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
4,4'–DDT (cont.)	Lepomis macrochirus; Bluegill	2.5–5.0 CM	96 H	LC_{50}	2.7		313000	65
	Lepomis macrochirus, Bluegill	1 5 G	96 H	LC_{50}	8.6		210666	80
	Lepomis macrochirus, Bluegill	0.26 G ; < 1 YEAR	96 H	LC_{50}	3.4		212076	79
	Lepomis macrochirus; Bluegill	38 (35–42) MM, 0.6 (0.5–0 8) G	48 H	LC_{50}	6		218048	65
	Lepomis macrochirus; Bluegill	0 5 G	96 H	LC_{50}	2.2		210851	75
	Lepomis macrochirus; Bluegill	38 (35–42) MM, 0.6 (0 5–0 8) G	96 H	LC_{50}	4 7		218048	65
	Lepomis macrochirus; Bluegill	1 1 G	96 H	LC_{50}	3 6		212009	66
	Lepomis macrochirus; Bluegill	NR	96 H	LD_{50}	21		218046	66
	Lepomis macrochirus, Bluegill	2 5–5.0 CM	24 H	LC_{50}	10		313000	65
	Lepomis macrochirus; Bluegill	0.5 G, 35–45 MM	96 H	LC_{50}	2 9		313034	72
	Lepomis macrochirus, Bluegill	0.9 G	96 H	LC_{50}	4 6		212009	66
	Lepomis macrochirus; Bluegill	3.8–6.4 CM, 1 0–2.0 G	96 H	LC_{50}	6.4		210936	59
	Lepomis macrochirus; Bluegill	42 MM, 0.8 G	96 H	LC_{50}	12 5		313045	71
	Lepomis macrochirus, Bluegill	3 8–6.4 CM, 1.0–2.0 G	96 H	LC_{50}	16		210936	59
	Lepomis megalotis; Longear sunfish	1 0 G	96 H	LC_{50}	4.9		212009	66
	Lepomis megalotis, Longear sunfish	1 0 G	96 H	LC_{50}	12 5		212009	66
	Lepomis microlophus; Redear sunfish	NR	96 H	LC_{50}	5		210610	70
	Leuresthes tenuis, California grunion	FRY	51 D *	LETH	100		219010	73
	Limanda ferruginea, Yellowtail flounder	NR	0 5 H	ENZ		50,000	219361	71
	Lucifer sp; Decapod	MATURE	24 H	LC_{50}	26		212658	88
	Lumbriculus variegatus, Oligochaete	NR	7 D *	LC_{50}	>130		216502	80
	Lumbriculus variegatus; Oligochaete	NR	6 D *	LC_{50}	>130		216502	80
	Lymnaea stagnalis; Great pond snail	28.16 (25–35) MM	45 D	EGP		0.9	215094	92
	Macrobrachium kistnensis; Shrimp	ADULT MALE, 50–66 MM, 1 2–1.5 G	24 H	LC_{50}	48		216296	83
	Macrobrachium kistnensis, Shrimp	ADULT MALE, 50–66 MM, 1.2–1.5 G	24 H	BIO, PHY		9.6	216296	83
	Macrobrachium kistnensis, Shrimp	ADULT MALE, 50–66 MM, 1.2–1 5 G	24 H	ENZ		9.6	216296	83
	Macrobrachium lamarrei; Prawn	INTERMOLT, 12–17 MM, *	72 H	LC_{50}	4.7		311973	86
	Macrobrachium lamarrei; Prawn	INTERMOLT, 12–17 MM, *	48 H	LC_{50}	6 1		311973	86
	Macrobrachium lamarrei, Prawn	INTERMOLT, 12–17 MM, *	24 H	LC_{50}	8.6		311973	86
	Macropodus cupanus, Paradise fish	20–28 MM STD LENGTH	24 H	LC_{50}	2,813		311081	82
	Macropodus cupanus, Paradise fish	20–28 MM STD LENGTH	48 H	LC_{50}	2,277		311081	82
	Menidia menidia; Atlantic silverside	59 MM, 1 2 G	96 H	LC_{50}	0.4		210628	70
	Menidia menidia; Atlantic silverside	59 MM, 1 2 G	24 H	LC_{50}	4		210628	70
	Menidia menidia; Atlantic silverside	59 MM, 1.2 G	48 H	LC_{50}	0.4		210628	70
	Mercenaria mercenaria, Northern quahog or hard clam	ADULT, 82 MM, 21 G SHELL WT	96 H	MOR	10,000		212896	70
	Meretrix casta; Bivalve	12–17 MM	24 H	LC_{50}	24.04		210276	89
	Meretrix casta; Bivalve	12–17 MM	48 H	LC_{50}	20		210276	89
	Meretrix casta; Bivalve	12–17 MM	72 H	LC_{50}	14.42		210276	89
	Meretrix casta; Bivalve	12–17 MM	96 H	LC_{50}	14.16		210276	89
	Meretrix casta; Bivalve	12–17 MM	120 H	LC_{50}	11 28		210276	89
	Metapenaeus monoceros; Sand shrimp	70.0 MM	48 H	LC_{50}	81		212505	88
	Metapenaeus monoceros; Sand shrimp	2 5 G, 77 MM	96 H	BIO, PHY		6	213081	90
	Micrometrus minimus, Dwarf perch	48–104 MM, 1 2–11 0 G	96 H	LC_{50}	5		210611	72
	Micrometrus minimus; Dwarf perch	48–104 MM, 1.2–11.0 G	96 H	LC_{50}	0 26		210611	72
	Micropterus salmoides; Largemouth bass	YEARLING, 15–20 CM	7 WK	MOR	50		212807	50
	Micropterus salmoides; Largemouth bass	0.8 G	96 H	LC_{50}	1 5		210666	80
	Micropterus salmoides, Largemouth bass	NR	96 H	LC_{50}	2		210610	70
	Micropterus salmoides, Largemouth bass	0 5 G	96 H	LC_{50}	0 8		212009	66
	Micropterus salmoides; Largemouth bass	ADULT	45 D	MOR	1,000		212807	50

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
4,4'–DDT (cont.)	Micropterus salmoides; Largemouth bass	YEARLING, 15–20 CM	7 WK	LETH	100		212807	50
	Moina brachiata; Water flea	<= 1 D	24 H	LC_{50}	49		312237	83
	Moina brachiata; Water flea	MIXED MICROFAUNA SPECIES	2 D	POP		70	312237	83
	Moina macrocopa; Water flea	NR	3 H	LC_{50}	4,800		315192	67
	Moina macrocopa, Water flea	FEMALE ADULT	3 H	LC_{50}	4,800		212682	69
	Moronoe saxatilis; Striped bass	JUVENILE 2 7 G	96 H	LC_{50}	0.53		210602	74
	Mugil cephalus; Striped mullet	46 MM, 1 0 G	24 H	LC_{50}	4		210628	70
	Mugil cephalus; Striped mullet	88 MM, 6.8 G	96 H	LC_{50}	3		210628	70
	Mugil cephalus; Striped mullet	15.3 G	12.2 H	LT_{50}	56		310891	82
	Mugil cephalus; Striped mullet	MATURE	96 H	PHY		0.1	315978	83
	Mugil cephalus, Striped mullet	15.3 G	26.6 H	LT_{50}	56		310891	82
	Mugil cephalus; Striped mullet	100–110 MM	72 H	LC_{50}	0.4		210276	89
	Mugil cephalus; Striped mullet	MATURE	96 H	GRO		1	315978	83
	Mugil cephalus; Striped mullet	100–110 MM	48 H	LC_{50}	0 72		210276	89
	Mugil cephalus, Striped mullet	15 3 G	11 6 H	LT_{50}	56		310891	82
	Mugil cephalus; Striped mullet	100–110 MM	24 H	LC_{50}	1.19		210276	89
	Mugil cephalus; Striped mullet	100–110 MM	96 H	LC_{50}	0 26		210276	89
	Mugil cephalus, Striped mullet	MATURE	96 H	HEM		1	315978	83
	Mugil cephalus; Striped mullet	100–110 MM	120 H	LC_{50}	0.2		210276	89
	Mugil cephalus; Striped mullet	46 MM, 1.0 G	96 H	LC_{50}	0.9		210628	70
	Mugil cephalus; Striped mullet	MATURE	96 H	HEM		0 05	315978	83
	Mugil cephalus; Striped mullet	88 MM, 6 8 G	24 H	LC_{50}	7		210628	70
	Mugil cephalus, Striped mullet	46 MM, 1.0 G	48 H	LC_{50}	0.9		210628	70
	Mugil cephalus; Striped mullet	15.3 G	48 H	LC_{50}	42 to 56		310891	82
	Mugil cephalus; Striped mullet	15.3 G	7.4 H	LT_{50}	56		310891	82
	Mugil cephalus; Striped mullet	88 MM, 6.8 G	48 H	LC_{50}	6		210628	70
	Mugil curema, White mullet	JUVENILE	24 H	LC_{50}	0.8		212188	63
	Mugil curema, White mullet	0.60–1.51 G, 40 0–53 2 MM, *	24 H *	BEH		9	218124	73
	Mugil curema; White mullet	JUVENILE	48 H	LC_{50}	0.4		212188	63
	Myoxocephalus octodecemspinosu; Longhorn sculpin	NR	0.5 H	ENZ		50,000	219361	71
	Nassarius obsoletus; Eastern mud snail	15 MM, 0.16 G – SHELL	96 H	MOR	10,000		212896	70
	Nassarius obsoletus; Eastern mud snail	15 MM, 0 16 G SHELL	96 H	REP		10	212896	70
	Neanthes grubei; Polychaete	NR	96 H	LC_{50}	>1,000		213785	91
	Nereis arenaceodentata; Polychaete	NR	96 H	LC_{50}	>1,000		213785	91
	Nereis virens; Polychaete	NR	12 D	MOR	10		315468	82
	Nereis virens; Polychaete	NR	12 D	MOR	30		315468	82
	Nitocra spinipes; Harpacticoid copepod	0.6–0 8 MM, ADULTS	96 H	LC_{50}	30		215185	79
	Nitzschia delicatissima; Diatom	LOG PHASE, 75000 CELLS/ML	24 H	CLR, PHY		23 5	219126	72
	Nitzschia delicatissima; Diatom	LOG PHASE, 75000 CELLS/ML	24 H	PSE		100	219126	72
	Nitzschia delicatissima; Diatom	LOG PHASE, 75000 CELLS/ML	24 H	LETH	1,000		219126	72
	Nitzschia delicatissima, Diatom	LOG PHASE, 75000 CELLS/ML	24 H	PSE		100	219126	72
	Nitzschia delicatissima; Diatom	LOG PHASE, 75000 CELLS/ML	24 H	CLR, PHY		220	219126	72
	Nitzschia delicatissima; Diatom	LOG PHASE, 75000 CELLS/ML	24 H	PSE		100	219126	72
	Nitzschia delicatissima; Diatom	LOG PHASE, 75000 CELLS/ML	24 H	PSE		100	219126	72
	Nitzschia delicatissima, Diatom	LOG PHASE, 75000 CELLS/ML	24 H	CLR, PHY		220	219126	72
	Nitzschia delicatissima, Diatom	LOG PHASE, 75000 CELLS/ML	24 H	CEL, PHY		9.4	219126	72
	Notemigonus crysoleucas; Golden shiner	1.02–1 31 G, 54.0–60.0 MM, ADULT	24 H *	BEH		15	218124	73
	Notopterus notopterus; Featherback	92–212 MM	6 H	EC_{50} IMM		92	218745	74
	Notopterus notopterus, Featherback	92–212 MM	96 H	EC_{50} IMM		43	218745	74

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
4,4'–DDT (cont.)	Notopterus notopterus, Featherback	92–212 MM	48 H	EC_{50} IMM		62	218745	74
	Notopterus notopterus; Featherback	92–212 MM	24 H	EC_{50} IMM		84	218745	74
	Oligochaeta; Annelid worm class	NR	48 H	LETH	200		219237	72
	Oncorhynchus clarki; Cutthroat trout	1.25 G	96 H	LC_{50}	1.37		210964	71
	Oncorhynchus clarki, Cutthroat trout	.33 G	96 H	LC_{50}	0.85		210964	71
	Oncorhynchus clarki; Cutthroat trout	.33 G	48 H	LC_{50}	1.63		210964	71
	Oncorhynchus kisutch, Coho salmon, silver salmon	1.65 G	96 H	LC_{50}	18.5		210964	71
	Oncorhynchus kisutch; Coho salmon, silver salmon	< 1 YR, FINGERLING, 0.63 G	22.5 D	LT_{50}	100,000		212448	69
	Oncorhynchus kisutch, Coho salmon, silver salmon	< 1 YR, FINGERLING, 0.63 G	>95 D	LT_{50}	25,000		212448	69
	Oncorhynchus kisutch; Coho salmon, silver salmon	57–76 MM, 2.7–4.1 G	48 H	LC_{50}	46		210522	61
	Oncorhynchus kisutch; Coho salmon, silver salmon	< 1 YR, FINGERLING, 0.63 G	>95 D	LT_{50}	6,250		212448	69
	Oncorhynchus kisutch, Coho salmon, silver salmon	1.0 G	96 H	LC_{50}	4		210666	80
	Oncorhynchus kisutch; Coho salmon, silver salmon	< 1 YR, FINGERLING, 3.7 G	6.5 D	LT_{50}	400,000		212448	69
	Oncorhynchus kisutch; Coho salmon, silver salmon	NR	96 H	LC_{50}	4		210610	70
	Oncorhynchus kisutch; Coho salmon, silver salmon	< 1 YR, FINGERLING, 3.7 G	60 D	LT_{50}	100,000		212448	69
	Oncorhynchus kisutch; Coho salmon, silver salmon	FRY	25 H	LT_{50}	3.2		212298	74
	Oncorhynchus kisutch, Coho salmon, silver salmon	JUVENILE	48 H	LC_{50}	24		212003	67
	Oncorhynchus kisutch; Coho salmon, silver salmon	FRY	7.3 D	LT_{50}	0.8		212298	74
	Oncorhynchus kisutch; Coho salmon, silver salmon	JUVENILE	96 H	LC_{50}	13		212003	67
	Oncorhynchus kisutch; Coho salmon, silver salmon	< 1 YR, FINGERLING, 3.7 G	>60 D	LT_{50}	100,000		212448	69
	Oncorhynchus kisutch; Coho salmon, silver salmon	JUVENILE	96 H	PHY		50	212003	67
	Oncorhynchus kisutch; Coho salmon, silver salmon	FRY	7 D	LT_{50}	> 0.7		212298	74
	Oncorhynchus kisutch; Coho salmon, silver salmon	JUVENILE, SMALLER FISH	30 H	LETH	50		212003	67
	Oncorhynchus kisutch; Coho salmon, silver salmon	1.65 G	72 H	LC_{50}	24		210964	71
	Oncorhynchus kisutch; Coho salmon, silver salmon	JUVENILE, LARGER FISH	96 H	LETH	50		212003	67
	Oncorhynchus kisutch; Coho salmon, silver salmon	< 1 YR, FINGERLING, 0.63 G	7.5 D	LT_{50}	400,000		212448	69
	Oncorhynchus kisutch; Coho salmon, silver salmon	JUVENILE, LARGER FISH	12 H	LETH	200		212003	67
	Oncorhynchus kisutch, Coho salmon, silver salmon	57–76 MM, 2.7–4.1 G	24 H	LC_{50}	66		210522	61
	Oncorhynchus kisutch; Coho salmon, silver salmon	JUVENILE, LARGER FISH	7 H	LETH	350		212003	67
	Oncorhynchus kisutch; Coho salmon, silver salmon	57–76 MM, 2.7–4.1 G	96 H	LC_{50}	44		210522	61
	Oncorhynchus kisutch, Coho salmon, silver salmon	< 1 YR, FINGERLING, 3.7 G	60 D	LT_{50}	25,000		212448	69
	Oncorhynchus kisutch; Coho salmon, silver salmon	FRY	14 D	LT_{50}	> 0.5		212298	74
	Oncorhynchus kisutch, Coho salmon, silver salmon	< 1 YR, FINGERLING, 3.7 G	>60 D	LT_{50}	6,250		212448	69
	Oncorhynchus kisutch; Coho salmon, silver salmon	.5 G	24 H	LC_{50}	25		210964	71
	Oncorhynchus kisutch, Coho salmon, silver salmon	< 1 YR, FINGERLING, 0.63 G	23.8 D	LT_{50}	100,000		212448	69
	Oncorhynchus kisutch; Coho salmon, silver salmon	57–76 MM, 2.7–4.1 G	72 H	LC_{50}	44		210522	61
	Oncorhynchus kisutch; Coho salmon, silver salmon	.5 G	96 H	LC_{50}	11.3		210964	71
	Oncorhynchus kisutch; Coho salmon, silver salmon	FRY	55 H	LT_{50}	1.4		212298	74
	Oncorhynchus kisutch; Coho salmon, silver salmon	.5 G	72 H	LC_{50}	11.7		210964	71
	Oncorhynchus kisutch; Coho salmon, silver salmon	1.65 G	48 H	LC_{50}	30		210964	71
	Oncorhynchus kisutch; Coho salmon, silver salmon	FRY	25 H	LT_{50}	3.3		212298	74
	Oncorhynchus kisutch; Coho salmon, silver salmon	FRY	55 H	LT_{50}	1.9		212298	74
	Oncorhynchus kisutch, Coho salmon, silver salmon	.5 G	48 H	LC_{50}	12.5		210964	71
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	33 (30–38) MM, 0.3 (0.2–0.4) G	24 H	LC_{50}	3		218048	65
	Oncorhynchus mykiss, Rainbow trout, donaldson trout	YOUNG, 9–11 CM	1 H	MOR	40,000		219634	70
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	3–7 CM	48 H	LC_{50}	5.6		313000	65
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	YOUNG, 9–11 CM	1 H	MOR	40,000		219634	70
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	JUVENILE, 1–1.5 YR, 120 G, 22.8 CM	5 H	RES		52.5	217846	76
	Oncorhynchus mykiss, Rainbow trout, donaldson trout	JUVENILE, 1–1.5 YR, 120 G, 22.8 CM	5 H	RES		140	217846	76

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
4,4'–DDT (cont.)	Oncorhynchus mykiss; Rainbow trout, donaldson trout	51–79 MM, 3.2 G	72 H	LC_{50}	42		210522	61
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	.41 G	96 H	LC_{50}	1.72		210964	71
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	51–79 MM, 3.2 G	48 H	LC_{50}	42		210522	61
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	.41 G	72 H	LC_{50}	2.25		210964	71
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	51–79 MM, 3.2 G	24 H	LC_{50}	42		210522	61
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	0.16 G, 28–35 MM	96 H	LC_{50}	1.9		313034	72
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	NR	10 D	LC_{50}	0.87		210948	72
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	15 G	140 D	HEM, PHY		1	315101	71
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	0.9 G	96 H	LC_{50}	4.6		212009	66
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	0.8 G	96 H	LC_{50}	18		313046	72
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	1.0 G	96 H	LC_{50}	8.7		210666	80
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	0.8 G	48 H	LC_{50}	16.7		313046	72
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	1.6 G	96 H	LC_{50}	15		212009	66
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	0.8 G	24 H	LC_{50}	17.8		313046	72
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	1.9 G	96 H	LC_{50}	17		212009	66
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	25–50 G	96 H	LC_{50}	60		312999	75
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	3.1 G	96 H	LC_{50}	12		212009	66
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	33 (30–38) MM, 0.3 (0.2–0.4) G	96 H	LC_{50}	1.5		218048	65
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	6 CM	48 H	LD_{50}	17,000		310309	72
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	YEARLING	0.25 H	ENZ, PHY		40,000	219308	71
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	JUVENILE, 1–1.5 YR, 120 G, 22.8 CM	5 H	PHY		140	217846	76
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	41 G	48 H	LC_{50}	3.05		210964	71
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	NR	15 D	LC_{50}	0.26		210948	72
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	33 (30–38) MM, 0.3 (0.2–0.4) G	48 H	LC_{50}	2		218048	65
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	NR	5 D	LC_{50}	2.26		210948	72
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	5–13 CM	0.25 H	MOR	12,000		315079	49
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	3.4 G	96 H	LC_{50}	3.8		210851	75
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	51–79 MM, 3.2 G	96 H	LC_{50}	42		210522	61
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	2.5 G	96 H	LC_{50}	13		212009	66
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	.41 G	24 H	LC_{50}	6.9		210964	71
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	JUVENILE, 1–1.5 YR, 120 G, 22.8 CM	5 H	PHY		140	217846	76
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	5–13 CM	0.25 H	MOR	35,000		315079	49
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	0.9 G	96 H	LC_{50}	14		212009	66
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	3–7 CM	24 H	LC_{50}	5.6		313000	65
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	NR	96 H	LC_{50}	7		210610	70
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	3–7 CM	96 H	LC_{50}	3.4		313000	65
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	JUVENILE, 1–1.5 YR, 120 G, 22.8 CM	5 H	PHY		350	217846	76
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	0.5 G	96 H	LC_{50}	2.4		212009	66
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	1.2 G	96 H	LC_{50}	7.2		212009	66
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	3–7 CM	72 H	LC_{50}	5.6		313000	65
	Oncorhynchus tshawytscha; Chinook salmon	< 1 YR, FINGERLING, 1.1 G	12.3 D	LT_{50}	100,000		212448	69
	Oncorhynchus tshawytscha; Chinook salmon	< 1 YR, FINGERLING, 0.61 G	26.6 D	LT_{50}	37,500		212448	69
	Oncorhynchus tshawytscha; Chinook salmon	51–114 MM, 1.45–5 G	96 H	LC_{50}	11.5		210522	61
	Oncorhynchus tshawytscha; Chinook salmon	< 1 YR, FINGERLING, 1.1 G	>60 D	LT_{50}	6,250		212448	69
	Oncorhynchus tshawytscha; Chinook salmon	51–114 MM, 1.45–5 G	72 H	LC_{50}	14		210522	61
	Oncorhynchus tshawytscha; Chinook salmon	51–114 MM, 1.45–5 G	48 H	LC_{50}	17		210522	61
	Oncorhynchus tshawytscha; Chinook salmon	< 1 YR, FINGERLING, 4.4 G	35.5 D	LT_{50}	100,000		212448	69
	Oncorhynchus tshawytscha; Chinook salmon	< 1 YR, FINGERLING, 0.61 G	4.8 D	LT_{50}	150,000		212448	69
	Oncorhynchus tshawytscha; Chinook salmon	< 1 YR, FINGERLING, 0.61 G	>40 D	LT_{50}	9,400		212448	69

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
4,4'–DDT (cont.)	Oncorhynchus tshawytscha; Chinook salmon	< 1 YR, FINGERLING, 0 61G	1 6 D	LT_{50}	600,000		212448	69
	Oncorhynchus tshawytscha; Chinook salmon	51–114 MM, 1.45–5G	24 H	LC_{50}	38		210522	61
	Oncorhynchus tshawytscha; Chinook salmon	< 1 YR, FINGERLING, 1.1 G	>60 D	LT_{50}	25,000		212448	69
	Oncorhynchus tshawytscha; Chinook salmon	< 1 YR, FINGERLING, 1.1 G	13 7 D	LT_{50}	100,000		212448	69
	Oncorhynchus tshawytscha; Chinook salmon	< 1 YR, FINGERLING, 1 1 G	4.8 D	LT_{50}	400,000		212448	69
	Ophryotrocha labronica, Polychaete	NR	96 H	LC_{50}	>1,000		213785	91
	Orconectes nais, Crayfish	35 D, 50 MG	96 H	LC_{50}	0.9		210887	72
	Orconectes nais, Crayfish	80 D, 1200 MG	96 H	LC_{50}	30		210887	72
	Orconectes nais; Crayfish	1 D, 15 MG	24 H	LC_{50}	1.4		210887	72
	Orconectes nais; Crayfish	14 D, 23 MG	96 H	LC_{50}	0.2		210887	72
	Orconectes nais; Crayfish	21–35 D	24 H	LC_{50}	1		210887	72
	Orconectes nais, Crayfish	56 D, 500 MG	24 H	LC_{50}	45		210887	72
	Orconectes nais; Crayfish	MATURE	24 H	LC_{50}	1,100		210887	72
	Orconectes nais; Crayfish	21 D, 30 MG	24 H	LC_{50}	1		210887	72
	Orconectes nais, Crayfish	80 D, 1200 MG	24 H	LC_{50}	50		210887	72
	Orconectes nais; Crayfish	21 D, 30 MG	96 H	LC_{50}	0.24		210887	72
	Orconectes nais; Crayfish	14 D, 23 MG	24 H	LC_{50}	1.2		210887	72
	Orconectes nais; Crayfish	7 D, 20 MG	24 H	LC_{50}	1		210887	72
	Orconectes nais; Crayfish	1 D, 15 MG	96 H	LC_{50}	0.3		210887	72
	Orconectes nais; Crayfish	7 D, 20 MG	96 H	LC_{50}	0.18		210887	72
	Orconectes nais; Crayfish	JUVENILE	96 H	LC_{50}	0 18		210666	80
	Orconectes nais; Crayfish	21–35 D	96 H	LC_{50}	0 24		210887	72
	Orconectes nais, Crayfish	56 D, 500 MG	96 H	LC_{50}	28		210887	72
	Orconectes nais, Crayfish	NR	96 H	LC_{50}	100		210948	72
	Orconectes nais, Crayfish	MATURE	96 H	LC_{50}	100		210887	72
	Orconectes nais; Crayfish	35 D, 50 MG	24 H	LC_{50}	3 2		210887	72
	Oryzias latipes; Medaka, high–eyes	YOLK SAC FRY STAGE	96 H	LC_{50}	14		311174	84
	Oryzias latipes; Medaka, high–eyes	NR	24 H	LC_{50}	380		312497	86
	Oryzias latipes, Medaka, high–eyes	NR	48 H	LC_{50}	450		312497	86
	Oryzias latipes, Medaka, high–eyes	2.54 CM, 0 16 G	48 H	LC_{50}	12		212682	69
	Oryzias latipes; Medaka, high–eyes	ADULT FEMALE, SEXUALLY INACTIVA	96 H	LC_{50}	48 7		311174	84
	Oryzias latipes; Medaka, high–eyes	ADULT MALE, SEXUALLY INACTIVATE	96 H	LC_{50}	35.6		311174	84
	Oryzias latipes, Medaka, high–eyes	NR	48 H	LC_{50}	540		312497	86
	Oryzias latipes; Medaka, high–eyes	POST–LARVAE, STAGE II	96 H	LC_{50}	4 9		311174	84
	Oryzias latipes; Medaka, high–eyes	NR	48 H	LC_{50}	12		315192	67
	Oryzias latipes; Medaka, high–eyes	ADULT MALE, SEXUALLY ACTIVATED	96 H	LC_{50}	31 6		311174	84
	Oryzias latipes; Medaka, high–eyes	NR	48 H	LC_{50}	290		312497	86
	Oryzias latipes, Medaka, high–eyes	NR	24 H	LC_{50}	10,000		312497	86
	Oryzias latipes; Medaka, high–eyes	ADULT FEMALE, SEXUALLY ACTIVATE	96 H	LC_{50}	43.7		311174	84
	Oryzias latipes; Medaka, high–eyes	JUVENILE, 70 D POST–HAT	96 H	LC_{50}	76 to 157		311174	84
	Oryzias latipes; Medaka, high–eyes	NR	24 H	LC_{50}	490		312497	86
	Ostracoda, Ostracod, seed shrimp subclass	MIXED MICROFAUNA SPECIES	2 D	POP		70	312237	83
	Pagurus longicarpus; Longwrist hermit crab	3.5 MM, 0 28 G	48 H	LC_{50}	6		210627	69
	Pagurus longicarpus; Longwrist hermit crab	3 5 MM, 0.28 G	24 H	LC_{50}	7		210627	69
	Palaemon squilla; Black sea shrimp	NR	3 H	LC_{100}	100		217260	72
	Palaemon squilla; Black sea shrimp	NR	24 H	LC_{100}	1		217260	72
	Palaemon squilla; Black sea shrimp	200–300 MG	15 D	OXC		0 001	217260	72
	Palaemon squilla; Black sea shrimp	NR	24 H	LC_{100}	10		217260	72
	Palaemon squilla; Black sea shrimp	NR	3 H	LC_{100}	100		217260	72

Table A–15
AQUIRE Freshwater Toxicity Information
Units = μg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
4,4'–DDT (cont.)	Palaemon squilla; Black sea shrimp	NR	6 5 D	LC_{100}	0.1		217260	72
	Palaemon squilla; Black sea shrimp	ADULTS, 750–850 MG	10 D	OXC		0.00001	217260	72
	Palaemon squilla; Black sea shrimp	ADULTS, 750–850 MG	96 H	OXC		0 01	217260	72
	Palaemonetes kadiakensis; Grass shrimp	NR	24 H *	LC_{50}	3.7		212665	70
	Palaemonetes kadiakensis; Grass shrimp	NR	5 D	LC_{50}	1		210948	72
	Palaemonetes kadiakensis; Grass shrimp	LATE INSTAR	5 D	LC_{50}	1		210887	72
	Palaemonetes kadiakensis, Grass shrimp	NR	5 D	LC_{50}	1.3		210948	72
	Palaemonetes kadiakensis; Grass shrimp	LATE INSTAR	96 H	LC_{50}	2.3		210887	72
	Palaemonetes kadiakensis; Grass shrimp	LATE INSTAR	24 H	LC_{50}	6.8		210887	72
	Palaemonetes kadiakensis; Grass shrimp	NR	24 H *	LC_{50}	5 7		212665	70
	Palaemonetes kadiakensis; Grass shrimp	LATE INSTAR	5 D	LC_{50}	1 3		210887	72
	Palaemonetes kadiakensis; Grass shrimp	NR	24 H *	LC_{50}	2.6		212665	70
	Palaemonetes kadiakensis; Grass shrimp	LATE INSTAR	96 H	LC_{50}	3.5		210887	72
	Palaemonetes kadiakensis, Grass shrimp	MATURE	96 H	LC_{50}	2.3		210666	80
	Palaemonetes kadiakensis; Grass shrimp	LATE INSTAR	24 H	LC_{50}	9.4		210887	72
	Palaemonetes kadiakensis; Grass shrimp	NR	24 H *	LC_{50}	6 8		212665	70
	Palaemonetes kadiakensis; Grass shrimp	LATE INSTAR	48 H	LC_{50}	4.7		210887	72
	Palaemonetes kadiakensis; Grass shrimp	LATE INSTAR	48 H	LC_{50}	7 7		210887	72
	Palaemonetes pugio; Daggerblade grass shrimp	10–40 MM	0.5 H *	AVO		0.1	215146	73
	Palaemonetes vulgaris, Marsh grass shrimp	31 MM, 0.47 G	24 H	LC_{50}	12		210627	69
	Palaemonetes vulgaris; Marsh grass shrimp	31 MM, 0 47 G	48 H	LC_{50}	5.1		210627	69
	Paratanytarsus parthenogenetic; Midge	LARVAE	24 H *	EC_{50} BEH		1.4	212687	79
	Paratelphusa jacuemontii; Crab	INTERMOLT, MALE AND FEMALE	96 H	LC_{50}	62 129		213938	91
	Paratelphusa jacuemontii; Crab	INTERMOLT, MALE AND FEMALE	24 H	LC_{50}	116.43		213938	91
	Paratelphusa jacuemontii, Crab	INTERMOLT, MALE AND FEMALE	48 H	LC_{50}	91 24		213938	91
	Paratelphusa jacuemontii, Crab	INTERMOLT, MALE AND FEMALE	72 H	LC_{50}	74.35		213938	91
	Pavlova lutheri; Haptophyte	150000 CELLS/ML INIT CONC	10 D	PGR		1,000	218039	62
	Pavlova lutheri; Haptophyte	150000 CELLS/ML INIT CONC	10 D	PGR		600	218039	62
	Pelecypoda; Bivalve, clam, mussel class	OYSTER, 3.8–6.4 CM	96 H	EC_{50} SHD		40	313008	65
	Peltodytes sp; Beetle	ADULT, 5 MG	48 H	LC_{50}	4		217775	76
	Peltodytes sp, Beetle	ADULT, 5 MG	96 H	LC_{50}	1		217775	76
	Peltodytes sp; Beetle	ADULT, 5 MG	72 H	LC_{50}	2		217775	76
	Peltodytes sp, Beetle	ADULT, 5 MG	24 H	LC_{50}	7		217775	76
	Penaeus aztecus; Brown shrimp	ADULT	48 H	EC_{50} EQU		1	212188	63
	Penaeus aztecus; Brown shrimp	ADULT	24 H	EC_{50} EQU		5.5	212188	63
	Penaeus indicus, Indian prawn	70.0 MM	48 H	LC_{50}	63		212505	88
	Penaeus indicus; Indian prawn	2.5 G, 70.0 MM	48 H	LC_{50}	63		210015	87
	Penaeus indicus, Indian prawn	2.5 G, 70 0 MM	96 H	LC_{50}	37		210015	87
	Penaeus indicus; Indian prawn	75 MM, 2 5 G	48 H	LC_{50}	120		213434	90
	Penaeus sp; Penaeidean shrimp	NR	30 D	GRO		0 1	219156	72
	Penaeus sp; Penaeidean shrimp	NR	30 D	PHY		0 05	219156	72
	Penaeus sp; Penaeidean shrimp	NR	30 D	PHY		0.1	219156	72
	Pentaneura sp; Midge	JUVENILE	96 H	LC_{50}	1 5		210666	80
	Perca flavescens; Yellow perch	1 1 G	96 H	LC_{50}	0.8		212009	66
	Perca flavescens; Yellow perch	0.8 G	96 H	LC_{50}	0.6		212009	66
	Perca flavescens; Yellow perch	1 2 G	96 H	LC_{50}	1 5		212009	66
	Perca flavescens; Yellow perch	1.4 G	96 H	LC_{50}	9		210666	80
	Perca flavescens; Yellow perch	NR	96 H	LC_{50}	9		210610	70
	Phaeodactylum tricornutum; Diatom	NR	24 H	PSE		1,000	219310	71

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/l.

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration Lethal	Effect Concentration Sublethal	AQUIRE Reference Number	Year of Publication
4,4'–DDT (cont.)	Phaeodactylum tricornutum; Diatom	INIT CONC 50000 CELLS/ML	6 D	BMS		20	310161	84
	Phaeodactylum tricornutum, Diatom	250000 CELLS/ML INITIAL CONC	10 D	PGR		20	218039	62
	Phaeodactylum tricornutum; Diatom	INIT CONC 50000 CELLS/ML	6 D	BMS		10	310161	84
	Phaeodactylum tricornutum; Diatom	250000 CELLS/ML INITIAL CONC	10 D	PGR		40	218039	62
	Phaeodactylum tricornutum; Diatom	250000 CELLS/ML INITIAL CONC	10 D	PGR		1,000	218039	62
	Phaeodactylum tricornutum, Diatom	NR	24 H	PSE		100	219310	71
	Phagocata gracilis, Turbellarian, flatworm	NR	10 D	LC_{50}	3,980		312705	87
	Phoxinus eos; Northern redbelly dace	1.1 G	96 H	LC_{50}	68		212009	66
	Physa acuta, Bladder snail	NR	48 H	LC_{50}	3,500		219158	72
	Phytoconis sp; Green algae	150000 CELLS/ML INITIAL CONC	10 D	PGR		600	218039	62
	Phytoconis sp, Green algae	150000 CELLS/ML INITIAL CONC	10 D	PGR		1,000	218039	62
	Phytoconis sp; Green algae	150000 CELLS/ML INITIAL CONC	10 D	PGR		40	218039	62
	Pimephales promelas; Fathead minnow	3 8–6.4 CM, 1–2 G	24 H	LC_{50}	78		210878	59
	Pimephales promelas; Fathead minnow	3 8–6.4 CM, 1–2 G	48 H	LC_{50}	68		210878	59
	Pimephales promelas, Fathead minnow	3 8–6 4 CM, 1–2 G	96 H	LC_{50}	45 ; 34		210878	59
	Pimephales promelas, Fathead minnow	RECENTLY HATCHED	1 WK	LETH	400		212807	50
	Pimephales promelas, Fathead minnow	3 8–6.4 CM, 1–2 G	24 H	LC_{50}	29		210878	59
	Pimephales promelas, Fathead minnow	3 CM	48 H	LC_{50}	> 40		219615	70
	Pimephales promelas; Fathead minnow	NR	96 H	LD_{50}	34		218046	66
	Pimephales promelas, Fathead minnow	LARVAE	5 D	LETH	1.53		210534	77
	Pimephales promelas: Fathead minnow	41 D	266 D	PHY		1.53	210534	77
	Pimephales promelas; Fathead minnow	3.8–6 4 CM, 1–2 G	48 H	LC_{50}	27		210878	59
	Pimephales promelas, Fathead minnow	LARGE	48 H	LETH	2,000		212807	50
	Pimephales promelas; Fathead minnow	PROGENY	60 D	GRO		1.53	210534	77
	Pimephales promelas; Fathead minnow	3 CM	48 H	LC_{50}	7.4		219615	70
	Pimephales promelas; Fathead minnow	NR	96 H	LC_{50}	19		210610	70
	Pimephales promelas; Fathead minnow	1.2 G	96 H	LC_{50}	12.2		210666	80
	Pimephales promelas; Fathead minnow	3 8–6.4 CM, 1–2 G	96 H	LC_{50}	26		210878	59
	Plecoglossus altivelis, Ayu	YOUNG, 8–9 CM	1 H	MOR	60,000		219634	70
	Plecoglossus altivelis; Ayu	YOUNG, 5–7 CM	1 H	MOR	60,000		219634	70
	Plecoptera; Stonefly	NR	1 H *	DRF		10 to 11	217387	61
	Poecilia reticulata, Guppy	7 WK	0 5 H	MOR	7,000		219297	71
	Poecilia reticulata; Guppy	0 17 G, 1.8 CM	48 H	LC_{50}	8		216038	70
	Poecilia reticulata; Guppy	7 WK	24 H	LC_{50}	200		219297	71
	Poecilia reticulata; Guppy	MALE, 70 MG	12 D	HIS, PHY		2 5 to 5 8	312501	86
	Poecilia reticulata; Guppy	NR	12 D	HIS, PHY		1 2 to 3.0	219916	80
	Poecilia reticulata; Guppy	MALE, 70 MG	12 D	HIS, PHY		1.3 to 3 0	312501	86
	Poecilia reticulata, Guppy	7 WK	24 H	LC_{50}	50		219297	71
	Poecilia reticulata; Guppy	MALE, 70 MG	12 D	HIS, PHY		1.3 to 3.5	312501	86
	Poecilia reticulata; Guppy	0 17 G, 1.8 CM	96 H	LC_{50}	3		216038	70
	Poecilia reticulata; Guppy	0.17 G, 1.8 CM	24 H	LC_{50}	20		216038	70
	Polycelis felina; Turbellarian	0 80 CM	96 H	LC_{50}	1,230		212015	74
	Polypedilum nubifer; Midge	LARVAE	24 H *	EC_{50} BEH		15	212687	79
	Porphyridium sp; Red algae	10000 CELLS/ML	1 to 17 D	PGR		80	219047	72
	Procambarus acutus acutus; White river crayfish	0.7 G	96 H	LC_{50}	28		210942	72
	Procambarus acutus acutus; White river crayfish	0 25–0 40 G, 11.8–14 6 MM	48 H	EC_{50} IMM		3	212029	72
	Procladius sp; Midge	LARVAE	24 H	LC_{50}	3.6		212687	79
	Procladius sp; Midge	LARVAE	24 H *	EC_{50} BEH		3 8	212687	79
	Procladius sp, Midge	LARVAE	48 H	LC_{50}	1		212687	79

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

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Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
4,4'–DDT (cont)	Psectrocladius sp; Midge	LARVAE	24 H *	EC_{50} BEH		57	212687	79
	Pseudacris triseriata triseria; Western chorus frog	TADPOLE, 7 D	48 H	LC_{50}	900		212891	70
	Pseudacris triseriata triseria, Western chorus frog	TADPOLE, 7 D	96 H	LC_{50}	800		212891	70
	Pseudacris triseriata triseria; Western chorus frog	TADPOLE, 7 D	24 H	LC_{50}	1,400		212891	70
	Pseudopleuronectes americanus; Winter flounder	NR	0.5 H	ENZ		1,000	219361	71
	Pseudopleuronectes americanus; Winter flounder	NR	0.5 H	ENZ		50,000	219361	71
	Pteronarcella badia, Stonefly	15–20 MM	48 H	LC_{50}	9		210889	68
	Pteronarcella badia; Stonefly	15–20 MM	24 H	LC_{50}	12		210889	68
	Pteronarcella badia; Stonefly	15–20 MM	96 H	LC_{50}	2		210889	68
	Pteronarcys californica; Stonefly	30–35 MM	48 H	LC_{50}	19		210889	68
	Pteronarcys californica; Stonefly	NAIAD, 4–6 CM	72 H	LC_{50}	2,450		212667	64
	Pteronarcys californica; Stonefly	NAIADS	25 D	LC_{50}	290		212238	64
	Pteronarcys californica; Stonefly	2ND YR CLASS	96 H	LC_{50}	7		210666	80
	Pteronarcys californica, Stonefly	NAIADS	4 D	LC_{50}	3,800		212238	64
	Pteronarcys californica; Stonefly	NAIAD, 4–6 CM	48 H	LC_{50}	2,450		212667	64
	Pteronarcys californica; Stonefly	NAIAD, 4–6 CM	96 H	LC_{50}	1,800		212667	64
	Pteronarcys californica; Stonefly	30–35 MM	96 H	LC_{50}	7		210889	68
	Pteronarcys californica; Stonefly	NAIADS	15 D	LC_{50}	510		212238	64
	Pteronarcys californica; Stonefly	NAIADS	10 D	LC_{50}	1,100		212238	64
	Pteronarcys californica; Stonefly	30–35 MM, NYMPHS	96 H	LC_{50}	7		218048	65
	Pteronarcys californica, Stonefly	NAIADS	30 D	LC_{50}	265		212238	64
	Pteronarcys californica; Stonefly	30–35 MM, NYMPHS	24 H	LC_{50}	41		218048	65
	Pteronarcys californica; Stonefly	NAIAD; 4–6 CM	96 H	LC_{50}	1,800		210528	65
	Pteronarcys californica; Stonefly	NAIADS	20 D	LC_{50}	365		212238	64
	Pteronarcys californica; Stonefly	NAIADS	5 D	LC_{50}	3,000		212238	64
	Pteronarcys californica; Stonefly	30–35 MM, NYMPHS	48 H	LC_{50}	19		218048	65
	Pteronarcys californica; Stonefly	30–35 MM	24 H	LC_{50}	41		210889	68
	Rana temporaria, Frog	TADPOLE, STAGE 28, 689 MG	48 H	MOR	100		315713	79
	Rana temporaria; Frog	TADPOLE, STAGE 28, 363 MG	48 H	BEH		100	315713	79
	Rana temporaria, Frog	TADPOLE, STAGE 28, 363 MG	48 H	DVP		100	315713	79
	Rana temporaria; Frog	TADPOLE, STAGE 28, 363 MG	48 H	BEH		100	315713	79
	Rasbora daniconia; Slender rasbora	ADULT, 12 CM, 40 G	8 D	LC_{50}	6,000		313217	88
	Rasbora daniconia; Slender rasbora	ADULT, 12 CM, 40 G	8 D	PHY		< 6,000	313217	88
	Rasbora heteromorpha; Harlequinfish, red rasbora	1.3–3 CM	24 H	LC_{50}	20		210542	69
	Rasbora heteromorpha; Harlequinfish, red rasbora	1.3–3 CM	24 H	LC_{50}	10		210542	69
	Rasbora heteromorpha; Harlequinfish, red rasbora	1.3–3 CM	48 H	LC_{50}	17		210542	69
	Rasbora heteromorpha, Harlequinfish, red rasbora	1.3–3 CM	24 H	LC_{50}	140		210542	69
	Rasbora heteromorpha; Harlequinfish, red rasbora	1.3–3 CM	24 H	LC_{50}	14,200		210542	69
	Rasbora heteromorpha; Harlequinfish, red rasbora	1.3–3 CM	24 H	LC_{50}	13		210542	69
	Rasbora heteromorpha; Harlequinfish, red rasbora	1.3–3 CM	48 H	LC_{50}	110		210542	69
	Rasbora heteromorpha; Harlequinfish, red rasbora	1.3–3 CM	48 H	LC_{50}	3.1		210542	69
	Rasbora heteromorpha; Harlequinfish, red rasbora	1.3–3 CM	24 H	LC_{50}	10,700		210542	69
	Rasbora heteromorpha; Harlequinfish, red rasbora	1.3–3 CM	48 H	LC_{50}	0.54		210542	69
	Rasbora heteromorpha; Harlequinfish, red rasbora	1.3–3 CM	48 H	LC_{50}	1		210542	69
	Rasbora heteromorpha; Harlequinfish, red rasbora	1.3–3 CM	48 H	LC_{50}	8,000		210542	69
	Rasbora heteromorpha, Harlequinfish, red rasbora	1.3–3 CM	24 H	LC_{50}	3.8		210542	69
	Rasbora heteromorpha; Harlequinfish, red rasbora	1.3–3 CM	48 H	LC_{50}	170		210542	69
	Rasbora heteromorpha, Harlequinfish, red rasbora	1.3–3 CM	48 H	LC_{50}	1.4		210542	69
	Rasbora heteromorpha; Harlequinfish, red rasbora	1.3–3 CM	24 H	LC_{50}	200		210542	69

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
4,4'–DDT (cont.)	Rotifera; Rotifer phylum	NR	48 H	LETH	200		219237	72
	Sagitta sp; Chaetognaths; Arrowworms	MATURE	24 H	LC_{50}	37		212658	88
	Salmo salar; Atlantic salmon	YEARLING, 10–12 CM	24 H	PRB		70	218872	72
	Salmo salar, Atlantic salmon	20.1 G	24 H	MOR	20		219591	70
	Salmo salar, Atlantic salmon	20.1 G	24 H	MOR	200		219591	70
	Salmo salar; Atlantic salmon	EGG AT GASTRULATION	1 MO	BEH		50	218533	74
	Salmo salar; Atlantic salmon	2.5–4 CM	24 H	BEH		30	218952	73
	Salmo salar; Atlantic salmon	EGG AT GASTRULATION	1 MO	BEH		10	218533	74
	Salmo salar; Atlantic salmon	20.1 G	24 H	BEH		200	219591	70
	Salmo trutta; Brown trout	ALEVIN	24 H	LC_{50}	4.2		210542	69
	Salmo trutta; Brown trout	ALEVIN	24 H	LC_{50}	16		210542	69
	Salmo trutta; Brown trout	ALEVIN	48 H	LC_{50}	2.5		210542	69
	Salmo trutta; Brown trout	NR	96 H	LC_{50}	2		210610	70
	Salmo trutta; Brown trout	4.0 G	96 H	LC_{50}	10.9		212009	66
	Salmo trutta; Brown trout	ALEVIN	48 H	LC_{50}	11		210542	69
	Salvelinus fontinalis; Brook trout	3.3 G	96 H	LC_{50}	20		212009	66
	Salvelinus fontinalis; Brook trout	FINGERLING, 1–3 G	24 H	LC_{50}	30		212825	73
	Salvelinus fontinalis, Brook trout	UNDERYEARLING, 2–3 MO	24 H	THL		10	215531	75
	Salvelinus fontinalis; Brook trout	UNDERYEARLING, 2–3 MO	24 H	LC_{50}	54		215531	75
	Salvelinus fontinalis, Brook trout	FINGERLING, 1–3 G	24 H	THL		20	212825	73
	Salvelinus fontinalis; Brook trout	105.0 G	24 H	MOR	1,000		219591	70
	Salvelinus fontinalis; Brook trout	3.3 G	96 H	LC_{50}	17		212009	66
	Salvelinus fontinalis; Brook trout	213 G	48 H	LC_{50}	12.75		210964	71
	Salvelinus fontinalis; Brook trout	1.4 G	96 H	LC_{50}	7.2		212009	66
	Salvelinus fontinalis, Brook trout	0.4 G	96 H	LC_{50}	1.8		212009	66
	Salvelinus fontinalis; Brook trout	213 G	96 H	LC_{50}	11.9		210964	71
	Salvelinus fontinalis; Brook trout	105.0 G	24 H	BEH		1,000	219591	70
	Salvelinus fontinalis; Brook trout	1.15 G	96 H	LC_{50}	7.4		210964	71
	Salvelinus fontinalis, Brook trout	213 G	72 H	LC_{50}	11.9		210964	71
	Salvelinus fontinalis, Brook trout	213 G	24 H	LC_{50}	23.1		210964	71
	Salvelinus fontinalis, Brook trout	1.15 G	48 H	LC_{50}	7.35		210964	71
	Salvelinus fontinalis, Brook trout	1.15 G	72 H	LC_{50}	7.4		210964	71
	Salvelinus namaycush; Lake trout, siscowet	2.8 G	96 H	LC_{50}	9.5		212009	66
	Salvelinus namaycush; Lake trout, siscowet	2.5 G	96 H	LC_{50}	9.1		212009	66
	Salvelinus sp; Trout, charr	FRY	96 H	LC_{50}	46		216270	74
	Scenedesmus quadricauda; Green algae	NR	6 D	PSE		1,000	212251	71
	Scenedesmus quadricauda; Green algae	NR	48 H	PSE		100	212251	71
	Scenedesmus quadricauda; Green algae	NR	96 H	PSE		100	212251	71
	Scenedesmus quadricauda; Green algae	NR	8 D	PSE		1,000	212251	71
	Scomber scombrus, Atlantic mackerel	NR	0.5 H	ENZ		50,000	219361	71
	Selenastrum capricornutum; Green algae	NR	to 3 D	PSE		36	212249	76
	Semisulcospira libertina; Marsh snail	NR	48 H	LC_{50}	3,800		219158	72
	Seriola quinqueradiata, Yellowtail	6.1–7.6 G	24 H	LC_{50}	6.5		216128	76
	Simocephalus serrulatus; Water flea	1ST INSTAR	48 H	EC_{50} IMM		2.5	210888	66
	Simocephalus serrulatus; Water flea	1ST INSTAR	48 H	EC_{50} IMM		2.8	210888	66
	Simocephalus sp; Water flea	NR	48 H	EC_{50} IMM		5.8	219859	80
	Simuliidae; Blackfly family	LARVAE	72 H	MOR	200		219237	72
	Simuliidae; Blackfly family	LARVAE, 3RD–6TH INSTAR	0.083 H	DRF		400	212837	66
	Simuliidae; Blackfly family	LARVAE, 3RD–6TH INSTAR	0.083 H	DRF		40	212837	66

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
4,4'–DDT (cont.)	Simulium ornatum; Blackfly	EGG	24 H	HAT		1,000	212805	69
	Simulium sp; Blackfly	LARVAE	0.17 H	MOR	1,000		219634	70
	Simulium sp; Blackfly	LARVAE	0.017 H	MOR	10,000		219634	70
	Simulium sp, Blackfly	LARVAE	0.17 H	MOR	100		219634	70
	Simulium sp; Blackfly	LARVAE	0 017 H	MOR	1,000		219634	70
	Skeletonema costatum; Diatom	NR	24 H	PSE		10	219310	71
	Skeletonema costatum; Diatom	10000 CELLS/ML	1 to 17 D	PGR		80	219047	72
	Sphoeroides maculatus; Northern puffer	146 MM, 63 G	48 H	LC_{50}	89		210628	70
	Sphoeroides maculatus; Northern puffer	146 MM, 63 G	96 H	LC_{50}	89		210628	70
	Sphoeroides maculatus, Northern puffer	146 MM, 63 G	24 H	LC_{50}	115		210628	70
	Spinodiaptomus chilospinus; Calanoid copepod	ADULT, 2.2–2 8 MM	48 H	LC_{50}	24		215264	76
	Spinodiaptomus chilospinus; Calanoid copepod	ADULT, 2.2–2.8 MM	24 H	LC_{50}	32		215264	76
	Stizostedion vitreum vitreum; Walleye	1 4 G	96 H	LC_{50}	2 9		210666	80
	Stolephorus purpureus; Nehu	0 39 G, 3.6 CM	12 H	LC_{50}	1		216038	70
	Strongyocentrotus droebachien; Green sea urchin	SPERM	1 3 H	REP		3	212264	89
	Strongyocentrotus droebachien, Green sea urchin	EMBRYO	120 H	EC_{50} DVP		>82	212264	89
	Strongyocentrotus purpuratus; Purple sea urchin	EMBRYO	120 H	EC_{50} DVP		>8.2	212264	89
	Strongyocentrotus purpuratus, Purple sea urchin	SPERM	1.3 H	REP		>0 5 to <1 0	212264	89
	Stylonychia notophora, Ciliate	NR	36 H	PGR		1,000	219892	80
	Stylonychia notophora; Ciliate	NR	36 H	PGR		40,000	219892	80
	Stylonychia notophora; Ciliate	NR	9 H	PGR		100,000	219892	80
	Tetrahymena pyriformis; Ciliate	LOG PHASE	96 H	PGR		100	315127	70
	Thalassiosira guillardii, Diatom	NR	24 H	PSE		100	219310	71
	Thalassiosira guillardii, Diatom	10000 CELLS/ML	1 to 17 D	PGR		80	219047	72
	Thalassiosira guillardii; Diatom	NR	96 H	PGR		100	212225	72
	Thalassiosira guillardii; Diatom	NR	24 H	PSE		10	219310	71
	Thalassiosira weissflogii, Diatom	10000 CELLS/ML	1 to 17 D	PGR		80	219047	72
	Thalassoma bifasciatum, Bluehead wrasse	80 MM, 5 4 G	96 H	LC_{50}	7		210628	70
	Thalassoma bifasciatum; Bluehead wrasse	80 MM, 5.4 G	24 H	LC_{50}	17		210628	70
	Thalassoma bifasciatum; Bluehead wrasse	80 MM, 5.4 G	48 H	LC_{50}	4		210628	70
	Therapon jarbua; Tigerfish, crescent perch	6 9–9 2 CM, 6.5–13.1 G, 6–9 MO	96 H	LC_{50}	3 6		216020	78
	Tilapia mossambica; Mozambique tilapia	1.3 G, 3 4 CM	96 H	LC_{50}	7		216038	70
	Tilapia mossambica; Mozambique tilapia	15–20 G	to 15 D	ENZ		10	312483	85
	Tilapia mossambica; Mozambique tilapia	1.3 G, 3.4 CM	48 H	LC_{50}	12		216038	70
	Tilapia mossambica; Mozambique tilapia	ADULT, 22 G, 9.2 CM	20 D	CEL, PHY		1	312488	84
	Tilapia mossambica; Mozambique tilapia	1 3 G, 3.4 CM	24 H	LC_{50}	20		216038	70
	Tilapia mossambica; Mozambique tilapia	ADULT, 9.2 CM, 22.5 G	20 D	HIS, PHY		1	311764	86
	Tilapia mossambica, Mozambique tilapia	FEMALE, 22.0 G, 9.3 CM	20 D	HIS, PHY		1	311558	85
	Tilapia mossambica; Mozambique tilapia	15–20 G	to 15 D	BIO, PHY		10	210552	88
	Tilapia mossambica; Mozambique tilapia	MATURE, 22 00 G, 9.2 CM	10 D	HIS, PHY		1	311851	86
	Tilapia nilotica; Nile tilapia	NR	NR	RSD		0 04	312855	86
	Tilapia zillii, Tilapia	FRY, 3.36 CM, 825 MG *	96 H	LC_{50}	9.5		313099	86
	Tilapia zillii; Tilapia	FRY, 3.36 CM, 825 MG *	24 H	LC_{50}	63		313099	86
	Tilapia zillii; Tilapia	FRY, 3 36 CM, 825 MG, BEHERA STRAIN	96 H	LC_{50}	15.5		313099	86
	Tilapia zillii; Tilapia	FRY, 3.36 CM, 825 MG, BEHERA STRAIN	24 H	LC_{50}	12 78		313099	86
	Tilapia zillii; Tilapia	FRY, 3.36 CM, 825 MG, BEHERA STRAIN	24 H	LC_{50}	21 81		313099	86
	Tilapia zillii; Tilapia	FRY, 3.36 CM, 825 MG *	24 H	LC_{50}	27.5		313099	86
	Tilapia zillii; Tilapia	FRY, 3 36 CM, 825 MG *	96 H	LC_{50}	42		313099	86
	Tilapia zillii, Tilapia	FRY, 3.36 CM, 825 MG, BEHERA STRAIN	96 H	LC_{50}	9.52		313099	86

Table A–15
AQUIRE Freshwater Toxicity Information
Units = μg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration Lethal	Effect Concentration Sublethal	AQUIRE Reference Number	Year of Publication
4,4'–DDT (cont)	Tinca tinca, Tench	FRY	96 H	LC_{50}	370		216270	74
	Trichoptera; Caddisfly order	NR	3 H *	DRF		10 to 11	217387	61
	Uca pugilator; Fiddler crab	FEMALE	72 H	LOC		80	218349	79
	Uca pugilator; Fiddler crab	MALE	72 H	LOC		80	218349	79
Endrin	Acris crepitans; Cricket frog	LARVA	96 H	LC_{50} *	10		1080389	81
	Acroneuria pacifica, Stonefly	2–2 5 CM, NAIADS	72 H	LC_{50}	0 69		1002177	64
	Acroneuria pacifica; Stonefly	2–2.5 CM, NAIADS	96 H	LC_{50}	0 39		1002287	64
	Acroneuria pacifica, Stonefly	NAIAD; 2–2.5 CM	96 H	LC_{50}	32		1003553	65
	Acroneuria pacifica; Stonefly	NR	10 D	LC_{50} *	0.280		1126156	66
	Acroneuria pacifica; Stonefly	NR	15 D	LC_{50} *	0.28		1126157	66
	Acroneuria pacifica; Stonefly	NR	20 D	LC_{50} *	0.25		1126158	66
	Acroneuria pacifica; Stonefly	NR	25 D	LC_{50} *	0 22		1126159	66
	Acroneuria pacifica, Stonefly	NR	30 D	LC_{50} *	0.35		1126160	66
	Acroneuria sp; Stonefly	2ND YR CLASS	96 H	LC_{50}	> 0.18		1074043	80
	Agmenellum quadruplicatum; Blue–green algae	120000 CELLS PER ML	26 to 30 H	PGR [Population growth] *		950	1058322	71
	Algae; Algae,phytoplankton,algal mat	NR	4 H	PSE [Photosynthesis] *		1,000	1021641	63
	Ambystoma maculatum; Spotted salamander	LARVA	96 H	LC_{50} *	56		1080391	81
	Ambystoma opacum; Marbled salamander	LARVA	96 H	LC_{50} *	18		1080390	81
	Anacystis nidulans; Blue–green algae	120000 CELLS PER ML	26 to 30 H	PGR [Population growth] *		950	1058321	71
	Anguilla rostrata; American eel	57 MM, 0.16 G	24 H	LC_{50}	1.1		1026027	70
	Anguilla rostrata; American eel	57 MM, 0.16 G	48 H	LC_{50}	0.6		1026028	70
	Anguilla rostrata, American eel	57 MM, 0.16 G	96 H	LC_{50}	0.6		1026029	70
	Anguilla vulgaris; Eel	MATURE	96 H	GRO [Growth] *		1.0	1085434	83
	Asellus brevicaudus; Aquatic sowbug	3–5 WK	24 H	LC_{50}	17		1026075	72
	Asellus brevicaudus, Aquatic sowbug	3–5 WK	96 H	LC_{50}	1.5		1026076	72
	Asellus brevicaudus; Aquatic sowbug	MATURE	96 H	LC_{50}	1 5		1074035	80
	Atherix variegata, Snipefly	JUVENILE	96 H	LC_{50}	4 6		1074050	80
	Baetis sp; Mayfly	JUVENILE	96 H	LC_{50}	0.90		1074045	80
	Barbus dorsalis; Two spot african barb	6–8.5 CM	24 H	LC_{50}	3 65		1026070	67
	Barbus dorsalis, Two spot african barb	6–8 5 CM	48 H	LC_{50}	1 55		1026071	67
	Barbus dorsalis, Two spot african barb	6–8 5 CM	96 H	LC_{50}	1 25		1026072	67
	Branchiura sowerbyi; Oligochaete	NR	72 H	LETH	4,000		1031927	73
	Branchiura sowerbyi; Oligochaete	NR	72 H	MOR [Mortality] *	4,000		1031928	73
	Branchiura sowerbyi; Oligochaete	NR	72 H	MOR [Mortality] *	4,000		1031929	73
	Branchiura sowerbyi; Oligochaete	NR	90 D	MOR [Mortality] *	4,000		1031931	73
	Bufo americanus; American toad	LARVA	96 H	LC_{50} *	10		1080388	81
	Bufo woodhousei fowleri; Fowler's toad	TADPOLE, 28–35 D	24 H	LC_{50}	570		1063065	70
	Bufo woodhousei fowleri; Fowler's toad	TADPOLE, 28–35 D	48 H	LC_{50}	460		1063066	70
	Bufo woodhousei fowleri, Fowler's toad	TADPOLE, 28–35 D	96 H	LC_{50}	120		1063067	70
	Carassius auratus; Goldfish	NR	96 H	LC_{50}	2 5		1070650	88
	Carassius auratus, Goldfish	FINGERLING	96 H	LC_{50}	0.44		1074054	80
	Carassius auratus; Goldfish	1 19 G	96 H	LC_{50}	0.95		1105230	85
	Channa gachua; Snake–head catfish	140 MM	24 H	LC_{50}	7.6		1011554	78
	Channa gachua; Snake–head catfish	140 MM	48 H	LC_{50}	7 3		1011555	78
	Channa gachua; Snake–head catfish	140 MM	72 H	LC_{50}	6 95		1011556	78
	Channa gachua; Snake–head catfish	140 MM	96 H	LC_{50}	6.8		1011557	78
	Channa gachua; Snake–head catfish	140 MM	48 H	LC_{50}	7.4		1011558	78
	Channa gachua; Snake–head catfish	140 MM	48 H	LC_{50}	7 25		1011559	78

Table A-15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
Endrin (cont.)	Channa gachua; Snake-head catfish	140 MM	72 H	LC_{50}	6.90		1011560	78
	Channa gachua; Snake-head catfish	140 MM	96 H	LC_{50}	6 70		1011561	78
	Channa gachua, Snake-head catfish	140 MM	24 H	LC_{50}	7 25		1011562	78
	Channa gachua; Snake-head catfish	140 MM	48 H	LC_{50}	6 70		1011563	78
	Channa gachua; Snake-head catfish	140 MM	72 H	LC_{50}	6.55		1011564	78
	Channa gachua, Snake-head catfish	140 MM	96 H	LC_{50}	6.50		1011565	78
	Channa gachua; Snake-head catfish	110 MM	24 H	LC_{50}	6 80		1011566	78
	Channa gachua; Snake-head catfish	110 MM	48 H	LC_{50}	6.60		1011567	78
	Channa gachua; Snake-head catfish	110 MM	72 H	LC_{50}	6.35		1011568	78
	Channa gachua; Snake-head catfish	110 MM	96 H	LC_{50}	6 15		1011569	78
	Channa punctatus; Snake-head catfish	10-17 CM	24 H	MOR [Mortality] *	8 5		1014446	76
	Channa punctatus; Snake-head catfish	10-17 CM	96 H	MOR [Mortality] *	1.9		1014447	76
	Channa punctatus; Snake-head catfish	10-15 CM	24 H	LC_{50}	8.5		1051537	72
	Channa punctatus; Snake-head catfish	10-15 CM	48 H	LC_{50}	4.1		1051538	72
	Channa punctatus; Snake-head catfish	10-15 CM	72 H	LC_{50}	2 7		1051539	72
	Channa punctatus; Snake-head catfish	10-15 CM	96 H	LC_{50}	1 9		1051540	72
	Chironomidae; Midge family	LARVAE, 9-11 MM	24 H	LC_{50}	12.966		1026047	75
	Claassenia sabulosa, Stonefly	20-25 MM	24 H	LC_{50}	3.2		1008100	68
	Claassenia sabulosa; Stonefly	20-25 MM	48 H	LC_{50}	0 84		1008101	68
	Claassenia sabulosa; Stonefly	20-25 MM	96 H	LC_{50}	0.76		1008102	68
	Claassenia sabulosa; Stonefly	2ND YR CLASS	96 H	LC_{50}	0.08		1074042	80
	Clarias batrachus; Walking catfish	15 CM, 65 G	48 H	LC_{50}	5 0		1051523	75
	Clarias batrachus; Walking catfish	15 CM, 65 G	48 H	MOR [Mortality] *	1 0		1051524	75
	Clarias batrachus; Walking catfish	15 CM, 65 G	48 H	MOR [Mortality] *	3 0		1051525	75
	Clarias lazera; Catfish	19-23 CM, 150-180 G	24 H	LC_{50}	4,000		1112161	91
	Clarias lazera, Catfish	19-23 CM, 150-180 G	48 H	LC_{50}	3,700		1112162	91
	Clarias lazera; Catfish	19-23 CM, 150-180 G	72 H	LC_{50}	3,100		1112163	91
	Clarias lazera; Catfish	19-23 CM, 150-180 G	96 H	LC_{50}	2,800		1112164	91
	Colisa fasciata, Giant gourami	5 5-6 0 CM, 4 1-4.4 MG	24 H	LC_{50}	800		1127114	78
	Colpidium campylum; Ciliate	> 96 H	43 H	PGR [Population growth] *		> 10,000	1026066	80
	Coregonus lavaretus; Pollan, whitefish	2 D, 11 5 MM, ELEUTER EMBRYO	12 H	LC_{50}	204 9		1085042	77
	Coregonus lavaretus; Pollan, whitefish	2 D, 11.5 MM, ELEUTER EMBRYO	24 H	LC_{50}	20.7		1085043	77
	Coregonus lavaretus; Pollan, whitefish	2 D, 11 5 MM, ELEUTER EMBRYO	48 H	LC_{50}	9 1		1085044	77
	Coregonus lavaretus; Pollan, whitefish	2 D, 11.5 MM, ELEUTER EMBRYO	72 H	LC_{50}	3.4		1085045	77
	Coregonus lavaretus; Pollan, whitefish	8 D, 13.0 MM, PROTOPTERYGIO LARVA	12 H	LC_{50}	0.5		1085046	77
	Coregonus lavaretus; Pollan, whitefish	8 D, 13.0 MM, PROTOPTERYGIO LARVA	24 H	LC_{50}	0 2		1085047	77
	Coregonus lavaretus, Pollan, whitefish	8 D, 13.0 MM, PROTOPTERYGIO LARVA	48 H	LC_{50}	0.12		1085048	77
	Coregonus lavaretus; Pollan, whitefish	8 D, 13.0 MM, PROTOPTERYGIO LARVA	72 H	LC_{50}	0.06		1085049	77
	Coregonus peled; Whitefish	1 D, 9.4 MM, ELEUTER EMBRYO	12 H	LC_{50}	4,899.4		1085050	77
	Coregonus peled; Whitefish	1 D, 9 4 MM, ELEUTER EMBRYO	24 H	LC_{50}	3,430 2		1085051	77
	Coregonus peled; Whitefish	1 D, 9.4 MM, ELEUTER EMBRYO	48 H	LC_{50}	1,978 4		1085052	77
	Coregonus peled; Whitefish	1 D, 9 4 MM, ELEUTER EMBRYO	72 H	LC_{50}	766.2		1085053	77
	Coregonus peled; Whitefish	5 D, 10.0 MM, PROTOPTERYGIO LARVA	12 H	LC_{50}	916.8		1085054	77
	Coregonus peled; Whitefish	5 D, 10.0 MM, PROTOPTERYGIO LARVA	24 H	LC_{50}	195 9		1085055	77
	Coregonus peled; Whitefish	5 D, 10.0 MM, PROTOPTERYGIO LARVA	48 H	LC_{50}	72 4		1085057	77
	Coregonus peled; Whitefish	5 D, 10 0 MM, PROTOPTERYGIO LARVA	72 H	LC_{50}	34.6		1085058	77
	Coregonus peled; Whitefish	11 D 11.8 MM, PTERYGIO LARVA	12 H	LC_{50}	7 8		1085059	77
	Coregonus peled; Whitefish	11 D, 11.8 MM, PTERYGIO LARVA	24 H	LC_{50}	2 3		1085060	77
	Coregonus peled; Whitefish	11 D, 11.8 MM, PTERYGIO LARVA	48 H	LC_{50}	1.3		1085061	77

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
Endrin (cont.)	Coregonus peled; Whitefish	11 D, 11.8 MM, PTERYGIO LARVA	72 H	LC_{50}	0.6		1085062	77
	Crangon septemspinosa; Sand shrimp	2.0 G	96 H	LC_{50}	0 6		1006736	80
	Crangon septemspinosa; Sand shrimp	2.0 G	23 H	LC_{50}	2.3		1006737	80
	Crangon septemspinosa; Sand shrimp	2.0 G	52 H	LC_{50}	0 7		1006738	80
	Crangon septemspinosa; Sand shrimp	2.0 G	20 H	LC_{50}	2 4		1006739	80
	Crangon septemspinosa; Sand shrimp	2.0 G	45 H	LC_{50}	0 9		1006740	80
	Crangon septemspinosa; Sand shrimp	26 MM, 0.25 G	24 H	LC_{50}	2.8		1026003	69
	Crangon septemspinosa, Sand shrimp	26 MM, 0.25 G	48 H	LC_{50}	1.8		1026004	69
	Crangon sp; Caridean shrimp	ADULT, 63 MM	96 H	LC_{50}	0.4		1106933	89
	Crassostrea virginica; American or virginia oyster	JUVENILE	96 H	GRO [Growth]		400	1021637	64
	Crassostrea virginica; American or virginia oyster	JUVENILE	96 H	GRO [Growth]		33	1021638	64
	Crassostrea virginica; American or virginia oyster	2 5–5.1 CM	96 H	GRO [Growth]		33	1021646	63
	Crassostrea virginica; American or virginia oyster	EGGS, 2 CELL STAGE	48 H	DVP [Development]		790	1085623	69
	Crassostrea virginica; American or virginia oyster	2 D LARVAE	12 D	MOR [Mortality] *	25		1085625	69
	Crassostrea virginica, American or virginia oyster	2 D LARVAE	12 D	MOR [Mortality] *	50		1085626	69
	Crassostrea virginica, American or virginia oyster	2 D LARVAE	12 D	MOR [Mortality] *	100		1085627	69
	Crassostrea virginica, American or virginia oyster	2 D LARVAE	12 D	MOR [Mortality] *	250		1085628	69
	Crassostrea virginica; American or virginia oyster	2 D LARVAE	12 D	MOR [Mortality] *	500		1085629	69
	Crassostrea virginica; American or virginia oyster	2 D LARVAE	12 D	MOR [Mortality] *	1,000		1085630	69
	Crassostrea virginica; American or virginia oyster	2 D LARVAE	12 D	MOR [Mortality] *	2,500		1085631	69
	Crassostrea virginica; American or virginia oyster	2 D LARVAE	12 D	MOR [Mortality] *	5,000		1085632	69
	Crassostrea virginica; American or virginia oyster	2 D LARVAE	12 D	MOR [Mortality] *	10,000		1085633	69
	Crassostrea virginica; American or virginia oyster	YEARLING, 1.5 IN	24 H	GRO [Growth]		100	1123167	60
	Cylindrospermum sp; Blue–green algae	EXPO GRO. INITIAL % TRANS = 7	18 D	PGR [Population growth] *		500,000	1024299	73
	Cymatogaster aggregata, Shiner perch	48–104 MM, 1 2–11 0 G	96 H	LC_{50}	0.8		1050961	72
	Cymatogaster aggregata; Shiner perch	48–104 MM, 1.2–11.0 G	96 H	LC_{50}	0 12		1050963	72
	Cymatogaster aggregata; Shiner perch	ADULT, 96 MM	96 H	LC_{50}	0.5		1106934	89
	Cypridopsis vidua, Ostracod	NR	48 H	MOR [Mortality] *	0 65		1024302	74
	Cypridopsis vidua; Ostracod	NR	24 H	MOR [Mortality] *	0.32		1024312	74
	Cypridopsis vidua; Ostracod	NR	24 H	MOR [Mortality] *	0.65		1024313	74
	Cypridopsis vidua; Ostracod	NR	48 H	MOR [Mortality] *	0 16		1024314	74
	Cypridopsis vidua; Ostracod	NR	48 H	MOR [Mortality] *	0.32		1024315	74
	Cyprinodon variegatus; Sheepshead minnow	15–25 MM	96 H	LC_{50}	0 38		1000699	74
	Cyprinodon variegatus; Sheepshead minnow	EGG	0.25 D	REP [Reproduction] *		1.0	1000701	74
	Cyprinodon variegatus, Sheepshead minnow	EMBRYO	5 D	MOR [Mortality] *	1 0		1000702	74
	Cyprinodon variegatus, Sheepshead minnow	EMBRYO *	25 WK	HAT [Hatchability] *		0.31	1004295	77
	Cyprinodon variegatus; Sheepshead minnow	EMBRYO *	25 WK	HAT [Hatchability] *		0 12	1004296	77
	Cyprinodon variegatus; Sheepshead minnow	JUVENILE	96 H	LC_{50}	0.34		1004297	77
	Cyprinodon variegatus, Sheepshead minnow	FRY	33 D	LC_{50}	0.158		1012203	74
	Cyprinodon variegatus; Sheepshead minnow	JUVENILE	4 D	LC_{50}	0.38		1012204	74
	Cyprinodon variegatus; Sheepshead minnow	FRY, FULL LIFE CYCLE EXP	25 WK	MOR [Mortality] *	0.31		1071038	77
	Cyprinodon variegatus; Sheepshead minnow	FRY, FULL LIFE CYCLE EXP	25 WK	MOR [Mortality] *	0 12		1071039	77
	Cyprinodon variegatus; Sheepshead minnow	FRY, FULL LIFE CYCLE EXP	25 WK	GRO [Growth] *		0 31	1071040	77
	Cyprinodon variegatus; Sheepshead minnow	FRY, FULL LIFE CYCLE EXP	25 WK	GRO [Growth] *		0 12	1071041	77
	Cyprinodon variegatus; Sheepshead minnow	FEMALE ADULT, FULL LIFE CYCLE EX	25 WK	MOR [Mortality] *	0 31		1071042	77
	Cyprinodon variegatus, Sheepshead minnow	FEMALE ADULT, FULL LIFE CYCLE EX	175 D	MOR [Mortality] *	0.12		1071043	77
	Cyprinodon variegatus, Sheepshead minnow	ADULT, FULL LIFE CYCLE EXP	175 D	REP [Reproduction] *		0.31	1071044	77
	Cyprinodon variegatus; Sheepshead minnow	ADULT, FULL LIFE CYCLE EXP	175 D	REP [Reproduction] *		0.12	1071045	77
	Cyprinodon variegatus; Sheepshead minnow	EMBRYO AND FRY *	175 D	MOR [Mortality] *	0 31		1071046	77

Table A–15
AQUIRE Freshwater Toxicity Information
Units = μg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
Endrin (cont.)	Cyprinodon variegatus, Sheepshead minnow	EMBRYO AND FRY *	175 D	MOR [Mortality] *	0.12		1071047	77
	Cyprinus carpio; Common, mirror, colored, carp	49 MM, 1.75 G	24 H	LC_{50}	1.75		1012636	76
	Cyprinus carpio; Common, mirror, colored, carp	49 MM, 1 75 G	48 H	LC_{50}	1.35		1012637	76
	Cyprinus carpio; Common, mirror, colored, carp	132 MM, 31.5 G	24 H	LC_{50}	3 00		1012638	76
	Cyprinus carpio; Common, mirror, colored, carp	132 MM, 31.5 G	48 H	LC_{50}	2.70		1012639	76
	Cyprinus carpio; Common, mirror, colored, carp	EGGS	48 H *	LETH	1,000		1034018	70
	Cyprinus carpio, Common, mirror, colored, carp	FINGERLING	96 H	LC_{50}	0 32		1074055	80
	Cyprinus carpio; Common, mirror, colored, carp	1 D, 6.5 MM, ELEUTER EMBRYO	72 H	LC_{50}	> 256		1085090	77
	Cyprinus carpio, Common, mirror, colored, carp	2 D, 6 8 MM, ELEUTER EMBRYO	12 H	LC_{50}	551.9		1085091	77
	Cyprinus carpio; Common, mirror, colored, carp	2 D, 6 8 MM, ELEUTER EMBRYO	24 H	LC_{50}	418.4		1085092	77
	Cyprinus carpio; Common, mirror, colored, carp	2 D, 6 8 MM, ELEUTER EMBRYO	48 H	LC_{50}	131 1		1085093	77
	Cyprinus carpio; Common, mirror, colored, carp	2 D, 6.8 MM, ELEUTER EMBRYO	72 H	LC_{50}	48 6		1085094	77
	Cyprinus carpio; Common, mirror, colored, carp	10 D, 12.2 MM, PROTO PTERYGIO LARV	12 H	LC_{50}	571.1		1085095	77
	Cyprinus carpio; Common, mirror, colored, carp	10 D, 12 2 MM, PROTO PTERYGIO LARV	24 H	LC_{50}	295 4		1085096	77
	Cyprinus carpio, Common, mirror, colored, carp	10 D, 12 2 MM, PROTO PTERYGIO LARV	48 H	LC_{50}	137.1		1085097	77
	Cyprinus carpio, Common, mirror, colored, carp	10 D, 12.2 MM, PROTO PTERYGIO LARV	72 H	LC_{50}	31 3		1085098	77
	Cyprinus carpio, Common, mirror, colored, carp	27 D, 20.5 MM, JUVENILE	12 H	LC_{50}	4 6		1085099	77
	Cyprinus carpio; Common, mirror, colored, carp	27 D, 20.5 MM, JUVENILE	24 H	LC_{50}	3 5		1085100	77
	Cyprinus carpio; Common, mirror, colored, carp	27 D, 20 5 MM, JUVENILE	48 H	LC_{50}	1 3		1085101	77
	Cyprinus carpio; Common, mirror, colored, carp	27 D, 20.5 MM, JUVENILE	72 H	LC_{50}	0 9		1085102	77
	Cyprinus carpio; Common, mirror, colored, carp	6.0 CM, 2 5 G	48 H	LD50 *	0.065		1124338	69
	Cyprinus carpio; Common, mirror, colored, carp	6 0 CM, 2.5 G	48 H	LD50 *	0.002		1124339	69
	Daphnia magna, Water flea	1ST INSTAR, < 24 H	26 H	LC_{50} *	900		1026044	67
	Daphnia magna; Water flea	0–24 H, NEONATE	48 H	LC_{50}	230		1105220	85
	Daphnia magna; Water flea	0–24 H, NEONATE	48 H	LC_{50}	88		1105221	85
	Dendraster excentricus, Sand dollar	SPERM	1.3 H	REP [Reproduction]		441	1106927	89
	Dendraster excentricus; Sand dollar	EMBRYO	72 H	DVP [Development]		>362	1106930	89
	Donax cuneatus, Marine bivalve	ADULT, 20–25 MM	9 D	MOR [Mortality] *	1,000		1066461	79
	Ephemerella grandis, Mayfly	NYMPH	96 H	LC_{50}	5		1003556	65
	Fundulus heteroclitus, Mummichog	42 (36–45) MM	96 H	LC_{50}	0.60		1025979	70
	Fundulus heteroclitus, Mummichog	42 (36–45) MM	10 D	LC_{50}	0.33		1025980	70
	Fundulus heteroclitus; Mummichog	51 MM, 1.8 G	24 H	LC_{50}	1.8		1026009	70
	Fundulus heteroclitus, Mummichog	51 MM, 1 8 G	48 H	LC_{50}	0 7		1026010	70
	Fundulus heteroclitus; Mummichog	51 MM, 1.8 G	96 H	LC_{50}	0.6		1026011	70
	Fundulus heteroclitus, Mummichog	55 MM, 1.4 G	24 H	LC_{50}	5 6		1026012	70
	Fundulus heteroclitus; Mummichog	55 MM, 1.4 G	48 H	LC_{50}	4.2		1026013	70
	Fundulus heteroclitus, Mummichog	55 MM, 1.4 G	96 H	LC_{50}	1 5		1026014	70
	Fundulus majalis; Striped killifish	40 MM, 0.92 G	24 H	LC_{50}	1.8		1026021	70
	Fundulus majalis; Striped killifish	40 MM, 0 92 G	48 H	LC_{50}	0.7		1026022	70
	Fundulus majalis; Striped killifish	40 MM, 0 92 G	96 H	LC_{50}	0 3		1026023	70
	Fundulus similis; Longnose killifish	JUVENILE	24 H	LC_{50}	0 3		1021649	63
	Fundulus similis; Longnose killifish	JUVENILE	48 H	LC_{50}	0 3		1021650	63
	Fundulus similis; Longnose killifish	JUVENILE	24 H	LC_{50}	0 79		1050984	65
	Gambusia affinis affinis; Mosquitofish	NR	36 H	LC_{50}	1		1075177	64
	Gambusia affinis; Mosquitofish	2.0–5.8 CM	96 H	LC_{50}	0 12		1013658	77
	Gambusia affinis, Mosquitofish	0 12–0 60 G	1 H	LETH	500		1028938	66
	Gambusia affinis; Mosquitofish	0.12–0.60 G	36 H	LC_{50}	1		1031055	66
	Gambusia affinis; Mosquitofish	NR	48 H	LC_{50}	2,010		1060032	88
	Gambusia affinis; Mosquitofish	NR	96 H	LC_{50}	1 8		1070612	88

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
Endrin (cont.)	Gambusia affinis; Mosquitofish	0.6 G	96 H	LC_{50}	1 1		1074060	80
	Gambusia affinis; Mosquitofish	0.38 G	96 H	LC_{50}	0.69		1105227	85
	Gambusia affinis; Mosquitofish	MALES AND FEMALES	48 H	LC_{50}	1 9		1108901	86
	Gambusia affinis; Mosquitofish	BEHERA STRAIN FRY, 2 06 CM, 222 MG	24 H	LC_{50}	10.91		1108962	86
	Gambusia affinis; Mosquitofish	BEHERA STRAIN FRY, 2.06 CM, 222 MG	96 H	LC_{50}	5 27		1108963	86
	Gambusia affinis; Mosquitofish	>25 MM	48 H	LC_{50} *	0.6		1124037	69
	Gambusia affinis, Mosquitofish	NR	48 H	LC_{50} *	1 80		1125284	61
	Gambusia affinis; Mosquitofish	NR	72 H	LC_{50} *	1 05		1125285	61
	Gambusia affinis; Mosquitofish	NR	96 H	LC_{50} *	0 75		1125286	61
	Gammarus fasciatus; Scud	NR	5 D	LC_{50}	0.90		1026087	72
	Gammarus fasciatus; Scud	NR	24 H	LC_{50}	10.0		1026088	72
	Gammarus fasciatus; Scud	NR	48 H	LC_{50}	7 0		1026089	72
	Gammarus fasciatus; Scud	NR	96 H	LC_{50}	5.50		1026090	72
	Gammarus fasciatus, Scud	NR	5 D	LC_{50}	5 00		1026091	72
	Gammarus fasciatus; Scud	NR	24 H	LC_{50}	18		1026092	72
	Gammarus fasciatus; Scud	NR	96 H	LC_{50}	4.3		1026093	72
	Gammarus fasciatus; Scud	NR	24 H	LC_{50}	10		1026094	72
	Gammarus fasciatus, Scud	NR	96 H	LC_{50}	1 3		1026095	72
	Gammarus fasciatus; Scud	NR	48 H	LC_{50}	5 6		1026096	72
	Gammarus fasciatus, Scud	MATURE	96 H	LC_{50}	4 3		1074037	80
	Gammarus lacustris, Scud	NR	96 H	LC_{50}	11.5		1003555	65
	Gammarus lacustris, Scud	2 MO OLD	24 H	LC_{50}	6.4		1008200	69
	Gammarus lacustris; Scud	2 MO OLD	48 H	LC_{50}	4.7		1008201	69
	Gammarus lacustris, Scud	2 MO OLD	96 H	LC_{50}	3.0		1008202	69
	Gammarus lacustris; Scud	MATURE	96 H	LC_{50}	3.0		1074036	80
	Gammarus lacustris; Scud	NR	96 H	LC_{50}	11.5		1108315	64
	Gasterosteus aculeatus, Three spine stickleback	22–44 MM, 0.38–0.77 G	48 H	LC_{50}	0 45		1025995	61
	Gasterosteus aculeatus; Three spine stickleback	22–44 MM, 0.38–0.77 G	72 H	LC_{50}	0 45		1025996	61
	Gasterosteus aculeatus; Three spine stickleback	22–44 MM, 0.38–0 77 G	96 H	LC_{50}	0.44		1025997	61
	Gasterosteus aculeatus; Three spine stickleback	22–44 MM, 0 38–0.77 G	72 H	LC_{50}	0.58		1025998	61
	Gasterosteus aculeatus; Three spine stickleback	22–44 MM, 0.38–0 77 G	96 H	LC_{50}	0.50		1025999	61
	Gasterosteus aculeatus; Three spine stickleback	0.3 G, 1–1 5 IN	48 H	LC_{50} *	1.74		1125287	61
	Gasterosteus aculeatus, Three spine stickleback	0.3 G, 1–1.5 IN	48 H	LC_{50} *	2.55		1125288	61
	Gasterosteus aculeatus, Three spine stickleback	0 3 G, 1–1.5 IN	48 H	LC_{50} *	2 40		1125289	61
	Gasterosteus aculeatus; Three spine stickleback	0.3 G, 1–1 5 IN	48 H	LC_{50} *	2.25		1125290	61
	Gasterosteus aculeatus, Three spine stickleback	0.3 G, 1–1.5 IN	48 H	LC_{50} *	2 62		1125291	61
	Gasterosteus aculeatus; Three spine stickleback	0 3 G, 1–1.5 IN	72 H	LC_{50} *	1 71		1125292	61
	Gasterosteus aculeatus; Three spine stickleback	0 3 G, 1–1 5 IN	72 H	LC_{50} *	1 87		1125293	61
	Gasterosteus aculeatus, Three spine stickleback	0.3 G, 1–1 5 IN	72 H	LC_{50} *	1 57		1125294	61
	Gasterosteus aculeatus; Three spine stickleback	0.3 G, 1–1 5 IN	72 H	LC_{50} *	1.71		1125295	61
	Gasterosteus aculeatus; Three spine stickleback	0.3 G, 1–1 5 IN	72 H	LC_{50} *	1.95		1125296	61
	Gasterosteus aculeatus; Three spine stickleback	0.3 G, 1–1 5 IN	96 H	LC_{50} *	1.65		1125297	61
	Gasterosteus aculeatus; Three spine stickleback	0.3 G, 1–1.5 IN	96 H	LC_{50} *	1 50		1125298	61
	Gasterosteus aculeatus; Three spine stickleback	0.3 G, 1–1.5 IN	96 H	LC_{50} *	1 20		1125299	61
	Gasterosteus aculeatus, Three spine stickleback	0 3 G, 1–1.5 IN	96 H	LC_{50} *	1 57		1125300	61
	Gasterosteus aculeatus; Three spine stickleback	0.3 G, 1–1.5 IN	96 H	LC_{50} *	1 57		1125301	61
	Gasterosteus aculeatus; Three spine stickleback	FERTILIZED EGGS	4 D	DVP [Development] *		0 75 to 4 2	1125318	61
	Gasterosteus aculeatus, Three spine stickleback	FERTILIZED EGGS	8 to 9 D	HAT [Hatchability] *		0 75 to 4 2	1125319	61
	Gasterosteus aculeatus; Three spine stickleback	HATCHLING	8 to 9 D	HAT [Hatchability] *		0.75 to 4.2	1125320	61

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
Endrin (cont.)	Hexagenia bilineata; Mayfly	1ST INSTAR	96 H	LC_{50}	62		1074044	80
	Ictalurus melas; Black bullhead	IMMATURE	96 H	LC_{50}	0.45		1000077	80
	Ictalurus melas; Black bullhead	IMMATURE	7 D	LC_{50}	0 34		1000085	80
	Ictalurus melas; Black bullhead	IMMATURE	14 D	LC_{50}	0 19		1000086	80
	Ictalurus melas; Black bullhead	IMMATURE	28 D	LC_{50}	0.10		1000087	80
	Ictalurus melas; Black bullhead	1.5 G	96 H	LC_{50}	1.1		1074058	80
	Ictalurus punctatus; Channel catfish	1Y14G, 12CM, FINGERLINGS	96 H	LC_{50}	0.8		1006591	77
	Ictalurus punctatus; Channel catfish	NR	96 H	LC_{50}	1.1		1070607	88
	Ictalurus punctatus; Channel catfish	1 4 G	96 H	LC_{50}	0.32		1074059	80
	Ictalurus punctatus; Channel catfish	0.73 G	96 H	LC_{50}	0.43		1105228	85
	Ictalurus punctatus; Channel catfish	0.75G	96 H	LC_{50}	0 41		1105229	85
	Indonaia caerulea; Unionid clam	ADULT, 55–65 MM	85 H	LT50	1,000		1066465	79
	Ischnura verticalis, Damselfly	JUVENILE	96 H	LC_{50}	2 4		1074046	80
	Jordanella floridae; Flagfish	FIRST GENERATION	30 D	EGP [Egg Production] *		0 051 to 0 22	1074738	78
	Jordanella floridae; Flagfish	1–2 D LARVAE, 1ST–2ND GENERATIOI	NR	NR	0 051 to 0.30		1074740	78
	Jordanella floridae; Flagfish	FIRST GENERATION	30 D	EGP [Egg Production] *		0.30	1074766	78
	Jordanella floridae; Flagfish	1–2 D LARVAE, 1ST GENERATION	NR	GRO [Growth] *		0 30	1074768	78
	Jordanella floridae; Flagfish	1–2 D LARVAE, SECOND GENERATION	30 to 60 D	GRO [Growth] *		0.051 to 0 30	1076620	78
	Jordanella floridae; Flagfish	2–3 D	30 D	NR	0.21 to 0.39		1122410	85
	Jordanella floridae, Flagfish	2–3 D	30 D	GRO [Growth] *		0 21 to 0.39	1122411	85
	Jordanella floridae; Flagfish	2–3 D	30 D	REP [Reproduction] *		0 21 to 0.39	1122412	85
	Jordanella floridae; Flagfish	37 D	96 H	LC_{50} *	0.85		1122413	85
	Jordanella floridae; Flagfish	33 D	96 H	LC_{50} *	0 85		1125322	78
	Katelysia opima; Marine bivalve	ADULT, 25–30 MM	80 H	MOR [Mortality] *	1,000		1066457	79
	Leiostomus xanthurus; Spot	JUVENILE	24 H	LC_{50}	4.4		1021639	64
	Leiostomus xanthurus; Spot	JUVENILE	48 H	LC_{50}	0 6		1021640	64
	Lepidocephalus thermalis; Loach	50 MM ADULT	24 H	LC_{50}	3.754		1008282	78
	Lepidocephalus thermalis; Loach	50 MM ADULT	48 H	LC_{50}	3.329		1008283	78
	Lepomis macrochirus; Bluegill	WT. 0 6–1.5G	24 H	LC_{50}	2 8		1005927	69
	Lepomis macrochirus, Bluegill	WT 0 6–1.5G	24 H	LC_{50}	1.5		1005928	69
	Lepomis macrochirus; Bluegill	WT. 0.6–1.5G	24 H	LC_{50}	0 8		1005929	69
	Lepomis macrochirus; Bluegill	WT 0 6–1 5G	96 H	LC_{50}	0.61		1005930	69
	Lepomis macrochirus; Bluegill	WT. 0.6–1 5G	96 H	LC_{50}	0 41		1005931	69
	Lepomis macrochirus; Bluegill	WT. 0 6–1.5G	96 H	LC_{50}	0 37		1005932	69
	Lepomis macrochirus; Bluegill	3.8–6.4 CM, 1 0–2.0 G	96 H	LC_{50}	0 60		1011503	59
	Lepomis macrochirus; Bluegill	3.8–6 4 CM, 1.0–2.0 G	96 H	LC_{50}	0 46		1011504	59
	Lepomis macrochirus; Bluegill	3.8–6.4 CM, 1.0–2.0 G	96 H	LC_{50}	0 44		1011505	59
	Lepomis macrochirus; Bluegill	NR	24 H	LC_{50}	2.0		1034657	70
	Lepomis macrochirus; Bluegill	NR	96 H	LC_{50}	0.55		1070620	88
	Lepomis macrochirus; Bluegill	1.5 G	96 H	LC_{50}	0 61		1074062	80
	Lepomis macrochirus, Bluegill	1.41 G	96 H	LC_{50}	0 23		1105225	85
	Lepomis macrochirus; Bluegill	0 25 G	96 H	LC_{50}	0 19		1105226	85
	Lepomis macrochirus, Bluegill	0.45 G, 1–1.5 IN	72 H	LC_{50} *	0.95		1125282	61
	Lepomis macrochirus; Bluegill	0 45 G, 1–1 5 IN	96 H	LC_{50} *	0 60		1125283	61
	Lepomis macrochirus; Bluegill	0.45 G, 1–1.5 IN	72 H	LC_{50} *	0 95		1125302	61
	Lepomis macrochirus; Bluegill	0.45 G, 1–1.5 IN	72 H	LC_{50} *	2 25		1125303	61
	Lepomis macrochirus; Bluegill	0 45 G, 1–1.5 IN	72 H	LC_{50} *	2 70		1125304	61
	Lepomis macrochirus; Bluegill	0.45 G, 1–1.5 IN	96 H	LC_{50} *	0.60		1125305	61
	Lepomis macrochirus; Bluegill	0 45 G, 1–1 5 IN	96 H	LC_{50} *	0 86		1125306	61

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration Lethal	Effect Concentration Sublethal	AQUIRE Reference Number	Year of Publication
Endrin (cont.)	Lepomis macrochirus; Bluegill	0 45 G, 1–1.5 IN	96 H	LC_{50} *	1.10		1125307	61
	Lepomis macrochirus, Bluegill	0 45 G, 1–1.5 IN	96 H	LC_{50} *	8 25		1125308	61
	Lepomis macrochirus; Bluegill	0 45 G, 1–1.5 IN	96 H	LC_{50} *	5.5		1125309	61
	Lepomis macrochirus; Bluegill	0 45 G, 1–1.5 IN	96 H	LC_{50} *	2.4		1125310	61
	Lepomis macrochirus; Bluegill	0.45 G, 1–1 5 IN	96 H	LC_{50} *	1.65		1125311	61
	Lepomis macrochirus; Bluegill	0.45 G, 1–1.5 IN	96 H	LC_{50} *	0.86		1125312	61
	Lepomis macrochirus, Bluegill	0.45 G, 1–1 5 IN	96 H	LC_{50} *	0 33		1125313	61
	Lepomis macrochirus; Bluegill	0 45 G, 1–1.5 IN	72 H	LC_{50} *	23.2		1125314	61
	Lepomis macrochirus; Bluegill	0.45 G, 1–1.5 IN	72 H	LC_{50} *	1 95		1125315	61
	Lepomis macrochirus, Bluegill	0.45 G, 1–1 5 IN	72 H	LC_{50} *	2.17		1125316	61
	Lepomis macrochirus; Bluegill	0 45 G, 1–1.5 IN	72 H	LC_{50} *	0.36		1125317	61
	Menidia menidia; Atlantic silverside	54 MM, 0 9 G	24 H	LC_{50}	0.5		1026015	70
	Menidia menidia, Atlantic silverside	54 MM, 0.9 G	48 H	LC_{50}	0.08		1026016	70
	Menidia menidia; Atlantic silverside	54 MM, 0 9 G	96 H	LC_{50}	0 05		1026017	70
	Mercenaria mercenaria, Northern quahog or hard clam	ADULT, 82 MM, 21 G SHELL	96 H	MOR [Mortality] *	10,000		1021170	70
	Micrometrus minimus, Dwarf perch	48–104 MM, 1.2–11.0 G	96 H	LC_{50}	13.0		1050962	72
	Micrometrus minimus; Dwarf perch	48–104 MM, 1.2–11.0 G	96 H	LC_{50}	0.13		1050964	72
	Micropterus salmoides; Largemouth bass	FINGERLING, 0 475 G, 3.4 CM	24 H	LC_{50}	0.49		1013214	76
	Micropterus salmoides; Largemouth bass	FINGERLING, 0 475 G, 3.4 CM	48 H	LC_{50}	0.27		1013215	76
	Micropterus salmoides; Largemouth bass	FINGERLING	20 D	MOR [Mortality] *	11.5		1013216	76
	Micropterus salmoides; Largemouth bass	2.5 G	96 H	LC_{50}	0.31		1074064	80
	Mugil cephalus; Striped mullet	83 MM, 6.9 G	24 H	LC_{50}	0 7		1026024	70
	Mugil cephalus; Striped mullet	83 MM, 6.9 G	48 H	LC_{50}	0 3		1026025	70
	Mugil cephalus; Striped mullet	83 MM, 6 9 G	96 H	LC_{50}	0.3		1026026	70
	Mugil cephalus; Striped mullet	MATURE	96 H	GRO [Growth] *		1 0	1085430	83
	Mugil curema; White mullet	JUVENILE	24 H	LC_{50}	2.6		1021647	63
	Mugil curema; White mullet	JUVENILE	48 H	LC_{50}	2 6		1021648	63
	Mysidopsis bahia, Opossum shrimp	JUVENILE, 1–10 D, ADULT	16 D	REP [Reproduction]		0 007 to 0.108	1129635	82
	Mysidopsis bahia; Opossum shrimp	JUVENILE, <24 H	4 D	NR	0 120		1129637	82
	Mysidopsis bahia; Opossum shrimp	JUVENILE, <24 H	16 D	NR	0.060		1129639	82
	Nassarius obsoletus, Eastern mud snail	15 MM, 0.16 G SHELL	96 H	REP [Reproduction] *		10	1115645	70
	Nassarius obsoletus; Eastern mud snail	15 MM, 0.16 G SHELL	96 H	MOR [Mortality] *	10,000		1115646	70
	Nereis virens, Polychaete	NR	12 D	MOR [Mortality] *	110		1063211	82
	Nereis virens; Polychaete	NR	12 D	MOR [Mortality] *	110		1063212	82
	Oncorhynchus clarki; Cutthroat trout	1.30 G	48 H	LC_{50}	0 235		1004372	71
	Oncorhynchus clarki, Cutthroat trout	.37 G	48 H	LC_{50}	0.297		1004373	71
	Oncorhynchus clarki; Cutthroat trout	37 G	72 H	LC_{50}	0 147		1004374	71
	Oncorhynchus clarki, Cutthroat trout	37 G	96 H	LC_{50}	0.113		1004375	71
	Oncorhynchus clarki; Cutthroat trout	1 30 G	96 H	LC_{50}	0.192		1004376	71
	Oncorhynchus kisutch, Coho salmon,silver salmon	1.50 G	24 H	LC_{50}	2.85		1004365	71
	Oncorhynchus kisutch; Coho salmon,silver salmon	1 50 G	48 H	LC_{50}	1 44		1004366	71
	Oncorhynchus kisutch; Coho salmon,silver salmon	1.50 G	72 H	LC_{50}	0 91		1004367	71
	Oncorhynchus kisutch, Coho salmon,silver salmon	1.50 G	96 H	LC_{50}	0.76		1004368	71
	Oncorhynchus kisutch; Coho salmon,silver salmon	57–76 MM, 2.7–4.1 G	24 H	LC_{50}	1 3		1025987	61
	Oncorhynchus kisutch; Coho salmon,silver salmon	57–76 MM, 2.7–4.1 G	48 H	LC_{50}	0.8		1025988	61
	Oncorhynchus kisutch, Coho salmon,silver salmon	57–76 MM, 2 7–4.1 G	72 H	LC_{50}	0.52		1025989	61
	Oncorhynchus kisutch; Coho salmon,silver salmon	57–76 MM, 2.7–4.1 G	96 H	LC_{50}	0 79		1025990	61
	Oncorhynchus kisutch, Coho salmon,silver salmon	SMOLTS, 127 MM	96 H	LC_{50}	1 2		1106932	89
	Oncorhynchus kisutch, Coho salmon,silver salmon	1 9 G, 2 5 IN	24 H	LC_{50} *	12.0		1125273	61

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/l.

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
Endrin (cont.)	Oncorhynchus kisutch; Coho salmon,silver salmon	1.9 G, 2.5 IN	48 H	LC_{50} *	0.56		1125274	61
	Oncorhynchus kisutch; Coho salmon,silver salmon	1.9 G, 2.5 IN	72 H	LC_{50} *	0.30		1125275	61
	Oncorhynchus kisutch, Coho salmon,silver salmon	1.9 G, 2.5 IN	96 H	LC_{50} *	0.27		1125276	61
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	1.24 G	48 H	LC_{50}	0.695		1004369	71
	Oncorhynchus mykiss, Rainbow trout,donaldson trout	1.24 G	72 H	LC_{50}	0.53		1004370	71
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	1.24 G	96 H	LC_{50}	0.405		1004371	71
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	0.6–1.5 G	24 H	LC_{50}	15		1005861	69
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	0.6–1.5 G	24 H	LC_{50}	5.3		1005862	69
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	0.6–1.5 G	24 H	LC_{50}	2.8		1005863	69
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	0.6–1.5 G	96 H	LC_{50}	2.5		1005864	69
	Oncorhynchus mykiss, Rainbow trout,donaldson trout	0.6–1.5 G	96 H	LC_{50}	1.4		1005865	69
	Oncorhynchus mykiss, Rainbow trout,donaldson trout	0.6–1.5 G	96 H	LC_{50}	1.1		1005866	69
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	51–79 MM, 3.2 G	24 H	LC_{50}	0.79		1025991	61
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	51–79 MM, 3.2 G	48 H	LC_{50}	0.58		1025992	61
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	51–79 MM, 3.2 G	72 H	LC_{50}	0.58		1025993	61
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	51–79 MM, 3.2 G	96 H	LC_{50}	0.58		1025994	61
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	NR	96 H	LC_{50}	0.78		1030340	88
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	1.0 G	96 H	LC_{50}	0.75		1074052	80
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	1 D, 25.3 MM, ELEUTER EMBRYO	24 H	LC_{50}	57.9		1085063	77
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	1 D, 25.3 MM, ELEUTER EMBRYO	48 H	LC_{50}	24.4		1085064	77
	Oncorhynchus mykiss, Rainbow trout,donaldson trout	1 D, 25.3 MM, ELEUTER EMBRYO	72 H	LC_{50}	11.2		1085065	77
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	2 D, 25.5 MM, ELEUTER EMBRYO	12 H	LC_{50}	343.4		1085066	77
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	2 D, 25.5 MM, ELEUTER EMBRYO	24 H	LC_{50}	71.2		1085067	77
	Oncorhynchus mykiss, Rainbow trout,donaldson trout	2 D, 25.5 MM, ELEUTER EMBRYO	48 H	LC_{50}	21.4		1085068	77
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	2 D, 25.5 MM, ELEUTER EMBRYO	72 H	LC_{50}	7.8		1085069	77
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	8 D, 29.2 MM, ELEUTER EMBRYO	12 H	LC_{50}	9.1		1085070	77
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	8 D, 29.2 MM, ELEUTER EMBRYO	24 H	LC_{50}	3.9		1085071	77
	Oncorhynchus mykiss, Rainbow trout,donaldson trout	8 D, 29.2 MM, ELEUTER EMBRYO	48 H	LC_{50}	2.0		1085072	77
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	8 D, 29.2 MM, ELEUTER EMBRYO	72 H	LC_{50}	0.6		1085073	77
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	15 D, 31.0 MM, PROTOPTERYGIO LARV	12 H	LC_{50}	2.1		1085074	77
	Oncorhynchus mykiss, Rainbow trout,donaldson trout	15 D, 31.0 MM, PROTOPTERYGIO LARV	24 H	LC_{50}	0.98		1085075	77
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	15 D, 31.0 MM, PROTOPTERYGIO LARV	48 H	LC_{50}	< 0.25		1085076	77
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	15 D, 31.0 MM, PROTOPTERYGIO LARV	72 H	LC_{50}	< 0.25		1085077	77
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	22 D, 32.3 MM, PTERYGIO LARVA	12 H	LC_{50}	1.5		1085078	77
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	22 D, 32.3 MM, PTERYGIO LARVA	24 H	LC_{50}	0.7		1085079	77
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	22 D, 32.3 MM, PTERYGIO LARVA	48 H	LC_{50}	0.17		1085080	77
	Oncorhynchus mykiss, Rainbow trout,donaldson trout	22 D, 32.3 MM, PTERYGIO LARVA	72 H	LC_{50}	0.07		1085081	77
	Oncorhynchus mykiss, Rainbow trout,donaldson trout	29 D, 34.1 MM, PTERYGIO LARVA	12 H	LC_{50}	3.2		1085082	77
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	29 D, 34.1 MM, PTERYGIO LARVA	24 H	LC_{50}	0.63		1085083	77
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	29 D, 34.1 MM, PTERYGIO LARVA	48 H	LC_{50}	0.06		1085084	77
	Oncorhynchus mykiss, Rainbow trout,donaldson trout	29 D, 34.1 MM, PTERYGIO LARVA	72 H	LC_{50}	< 0.06		1085085	77
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	71 D, 46.2 MM, JUVENILE	12 H	LC_{50}	2.8		1085086	77
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	71 D, 46.2 MM, JUVENILE	24 H	LC_{50}	1.1		1085087	77
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	71 D, 46.2 MM, JUVENILE	48 H	LC_{50}	0.17		1085088	77
	Oncorhynchus mykiss, Rainbow trout,donaldson trout	71 D, 46.2 MM, JUVENILE	72 H	LC_{50}	0.12 to 0.25		1085089	77
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	1.44 G	96 H	LC_{50}	0.33		1105224	85
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	1 G, 1.625–2.25 IN	24 H	LC_{50} *	2.17		1125269	61
	Oncorhynchus mykiss, Rainbow trout,donaldson trout	1 G, 1.625–2.25 IN	48 H	LC_{50} *	1.45		1125270	61
	Oncorhynchus mykiss; Rainbow trout,donaldson trout	1 G, 1.625–2.25 IN	72 H	LC_{50} *	1.12		1125271	61

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
Endrin (cont.)	Oncorhynchus mykiss, Rainbow trout,donaldson trout	1 G, 1 625–2.25 IN	96 H	LC_{50} *	0 90		1125272	61
	Oncorhynchus tshawytscha, Chinook salmon	51–114 MM, 1.45–5 G	24 H	LC_{50}	2.0		1025983	61
	Oncorhynchus tshawytscha; Chinook salmon	51–114 MM, 1 45–5 G	48 H	LC_{50}	1.2		1025984	61
	Oncorhynchus tshawytscha; Chinook salmon	51–114 MM, 1 45–5 G	72 H	LC_{50}	1.2		1025985	61
	Oncorhynchus tshawytscha; Chinook salmon	51–114 MM, 1 45–5 G	96 H	LC_{50}	1.2		1025986	61
	Oncorhynchus tshawytscha; Chinook salmon	6–8 G	48 H	LC_{50} *	1.50		1125277	61
	Oncorhynchus tshawytscha; Chinook salmon	6–8 G	72 H	LC_{50} *	1.01		1125278	61
	Oncorhynchus tshawytscha; Chinook salmon	6–8 G	96 H	LC_{50} *	0 92		1125279	61
	Orconectes immunis; Crayfish	NR	96 H	LC_{50}	>230		1063616	88
	Orconectes immunis; Crayfish	1 85 G	96 H	LC_{50}	> 89		1105223	85
	Orconectes nais, Crayfish	3–5 WK	24 H	LC_{50}	20		1026073	72
	Orconectes nais; Crayfish	3–5 WK	96 H	LC_{50}	3 2		1026074	72
	Orconectes nais; Crayfish	MATURE	24 H	LC_{50}	400		1026080	72
	Orconectes nais; Crayfish	MATURE	96 H	LC_{50}	320		1026081	72
	Orconectes nais; Crayfish	EARLY INSTAR	96 H	LC_{50}	3.2		1074038	80
	Pagurus longicarpus; Longwrist hermit crab	3.5 MM, 0.28 G	24 H	LC_{50}	27		1026000	69
	Pagurus longicarpus, Longwrist hermit crab	3 5 MM, 0.28 G	48 H	LC_{50}	18		1026001	69
	Palaemonetes kadiakensis; Grass shrimp,freshwater prawn	NR	24 H *	LC_{50}	0.9		1002139	70
	Palaemonetes kadiakensis; Grass shrimp,freshwater prawn	NR	24 H *	LC_{50}	13.7		1002142	70
	Palaemonetes kadiakensis; Grass shrimp,freshwater prawn	NR	24 H *	LC_{50}	4.7		1002144	70
	Palaemonetes kadiakensis; Grass shrimp,freshwater prawn	NR	24 H *	LC_{50}	2.8		1002459	70
	Palaemonetes kadiakensis; Grass shrimp,freshwater prawn	LATE INSTAR	48 H	LC_{50}	5.0		1026077	72
	Palaemonetes kadiakensis; Grass shrimp,freshwater prawn	LATE INSTAR	96 H	LC_{50}	0.5		1026078	72
	Palaemonetes kadiakensis; Grass shrimp,freshwater prawn	LATE INSTAR	5 D	LC_{50}	0 4		1026079	72
	Palaemonetes kadiakensis; Grass shrimp,freshwater prawn	LATE INSTAR	24 H	LC_{50}	14		1026082	72
	Palaemonetes kadiakensis; Grass shrimp,freshwater prawn	LATE INSTAR	96 H	LC_{50}	3.20		1026083	72
	Palaemonetes kadiakensis, Grass shrimp,freshwater prawn	LATE INSTAR	48 H	LC_{50}	8 1		1026084	72
	Palaemonetes kadiakensis: Grass shrimp,freshwater prawn	LATE INSTAR	5 D	LC_{50}	2 4		1026085	72
	Palaemonetes kadiakensis, Grass shrimp,freshwater prawn	LATE INSTAR	24 H	LC_{50}	13		1026086	72
	Palaemonetes kadiakensis, Grass shrimp,freshwater prawn	MATURE	96 H	LC_{50}	3.2		1074039	80
	Palaemonetes pugio; Daggerblade grass shrimp	19–36 MM	96 H	LC_{50}	0.63		1000698	74
	Palaemonetes pugio; Daggerblade grass shrimp	LARVAE, 1 D	96 H	LC_{50}	1.2		1066440	79
	Palaemonetes pugio; Daggerblade grass shrimp	JUVENILE	96 H	LC_{50}	0.35		1066441	79
	Palaemonetes pugio; Daggerblade grass shrimp	ADULT	96 H	LC_{50}	0.63		1066442	79
	Palaemonetes pugio; Daggerblade grass shrimp	JUVENILE, 12–19 MM	145 D	REP [Reproduction] *		0.03	1066443	79
	Palaemonetes pugio, Daggerblade grass shrimp	EGG *	35 D *	GRO [Growth] *		0.05	1066445	79
	Palaemonetes pugio; Daggerblade grass shrimp	EGG *	35 D *	GRO [Growth] *		0.03	1066446	79
	Palaemonetes vulgaris; Marsh grass shrimp	31 MM, 0 47 G	24 H	LC_{50}	10.3		1026063	69
	Palaemonetes vulgaris; Marsh grass shrimp	31 MM, 0.47 G	48 H	LC_{50}	4 3		1026064	69
	Penaeus duorarum; Pink shrimp (america)	39–70 MM	96 H	LC_{50}	0 037		1000697	74
	Perca flavescens; Yellow perch	FINGERLING	96 H	LC_{50}	0 15		1074066	80
	Pimephales promelas, Fathead minnow	3 CM	48 H	LC_{50}	0 57		1034019	70
	Pimephales promelas, Fathead minnow	3 CM	48 H	LC_{50}	0 77		1034020	70
	Pimephales promelas; Fathead minnow	EGG	30 D	MOR [Mortality] *	0.14		1042712	78
	Pimephales promelas. Fathead minnow	EGG	30 D	HAT [Hatchability] *		0 25	1042713	78
	Pimephales promelas, Fathead minnow	EGG	30 D	MOR [Mortality] *	0.14		1042714	78
	Pimephales promelas; Fathead minnow	EGG	30 D	MOR [Mortality] *	630		1042715	78
	Pimephales promelas, Fathead minnow	NR	96 H	LC_{50}	1.7		1070645	88
	Pimephales promelas; Fathead minnow	1.2 G	96 H	LC_{50}	1.8		1074057	80

Table A–15
AQUIRE Freshwater Toxicity Information
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Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
Endrin (cont.)	Pimephales promelas; Fathead minnow	3.8–6.4 CM, 1–2 G	24 H	LC_{50}	1.6		1075033	59
	Pimephales promelas; Fathead minnow	3.8–6.4 CM, 1–2 G	48 H	LC_{50}	1.5		1075034	59
	Pimephales promelas; Fathead minnow	3.8–6.4 CM, 1–2 G	96 H	LC_{50}	1.4 ; 1.3		1075035	59
	Pimephales promelas; Fathead minnow	3.8–6.4 CM, 1–2 G	24 H	LC_{50}	6.8		1075048	59
	Pimephales promelas; Fathead minnow	3.8–6.4 CM, 1–2 G	48 H	LC_{50}	4.7		1075049	59
	Pimephales promelas; Fathead minnow	3.8–6.4 CM, 1–2 G	96 H	LC_{50}	3.8		1075050	59
	Pimephales promelas; Fathead minnow	3.8–6.4 CM, 1–2 G	24 H	LC_{50}	4.1		1075057	59
	Pimephales promelas; Fathead minnow	3.8–6.4 CM, 1–2 G	48 H	LC_{50}	3.5		1075058	59
	Pimephales promelas; Fathead minnow	3.8–6.4 CM, 1–2 G	96 H	LC_{50}	3.2		1075059	59
	Pimephales promelas; Fathead minnow	< 24 H LARVAE	96 H	LC_{50}	0.7		1103187	88
	Pimephales promelas; Fathead minnow	< 24 H LARVAE	30 D	GRO [Growth] *		0.20	1103189	88
	Pimephales promelas; Fathead minnow	< 24 H LARVAE	30 D	GRO [Growth] *		0.38	1103190	88
	Pimephales promelas; Fathead minnow	< 24 H LARVAE	30 D	MOR [Mortality] *	0.38		1103191	88
	Pimephales promelas; Fathead minnow	< 24 H LARVAE	30 D	LETH	0.73		1103192	88
	Pimephales promelas; Fathead minnow	0.59 G	96 H	LC_{50}	0.64		1105231	85
	Pimephales promelas; Fathead minnow	1.8–4.0 CM	48 H	LC_{50}	0.37		1122645	69
	Pimephales promelas; Fathead minnow	1.8–4.0 CM	96 H	LC_{50}	0.26		1122646	69
	Pimephales promelas; Fathead minnow	1–2 G	96 H	LC_{50} *	0.47		1125202	66
	Pimephales promelas; Fathead minnow	1–2 G	96 H	LC_{50} *	0.52		1125203	66
	Pimephales promelas; Fathead minnow	1–2 G	96 H	LC_{50} *	0.45		1125204	66
	Poecilia latipinna; Sailfin molly	36–49 MM	96 H	LC_{50}	0.63		1000700	74
	Poecilia reticulata; Guppy	2 MO, 10.0 MM, JUVENILE	12 H	LC_{50}	65.4		1085113	77
	Poecilia reticulata; Guppy	2 MO, 10.0 MM, JUVENILE	24 H	LC_{50}	11.9		1085114	77
	Poecilia reticulata; Guppy	2 MO, 10.0 MM, JUVENILE	48 H	LC_{50}	1.1		1085115	77
	Poecilia reticulata; Guppy	2 MO, 10.0 MM, JUVENILE	72 H	LC_{50}	0.5		1085116	77
	Poecilia reticulata; Guppy	2 MO, 10.0 MM, JUVENILE	12 H	LC_{50}	131.8		1085117	77
	Poecilia reticulata; Guppy	2 MO, 10.0 MM, JUVENILE	24 H	LC_{50}	4.8		1085118	77
	Poecilia reticulata; Guppy	2 MO, 10.0 MM, JUVENILE	48 H	LC_{50}	0.6		1085119	77
	Poecilia reticulata; Guppy	2 MO, 10.0 MM, JUVENILE	72 H	LC_{50}	0.3		1085120	77
	Poecilia reticulata; Guppy	2 MO, 10.0 MM, JUVENILE	12 H	LC_{50}	1.2		1085122	77
	Poecilia reticulata; Guppy	2 MO, 10.0 MM, JUVENILE	24 H	LC_{50}	0.5		1085123	77
	Poecilia reticulata; Guppy	2 MO, 10.0 MM, JUVENILE	48 H	LC_{50}	0.19		1085124	77
	Poecilia reticulata; Guppy	2 MO, 10.0 MM, JUVENILE	72 H	LC_{50}	0.12		1085125	77
	Poecilia reticulata; Guppy	2 MO, 10.0 MM, JUVENILE	12 H	LC_{50}	0.8		1085126	77
	Poecilia reticulata; Guppy	2 MO, 10.0 MM, JUVENILE	24 H	LC_{50}	0.3		1085127	77
	Poecilia reticulata; Guppy	2 MO, 10.0 MM, JUVENILE	48 H	LC_{50}	0.12		1085128	77
	Poecilia reticulata; Guppy	2 MO, 10.0 MM, JUVENILE	72 H	LC_{50}	0.08		1085129	77
	Poecilia reticulata; Guppy	2 MO, 10.0 MM, JUVENILE	12 H	LC_{50}	0.5		1085130	77
	Poecilia reticulata; Guppy	2 MO, 10.0 MM, JUVENILE	24 H	LC_{50}	0.2		1085131	77
	Poecilia reticulata; Guppy	2 MO, 10.0 MM, JUVENILE	48 H	LC_{50}	0.09		1085132	77
	Poecilia reticulata; Guppy	2 MO, 10.0 MM, JUVENILE	72 H	LC_{50}	0.06		1085133	77
	Poecilia reticulata; Guppy	0.75–1 IN, 0.3 G	72 H	LC_{50} *	1.10		1125280	61
	Poecilia reticulata; Guppy	0.75–1 IN, 0.3 G	96 H	LC_{50} *	0.90		1125281	61
	Pseudacris triseriata triseria; Western chorus frog	TADPOLE, 7 D	24 H	LC_{50}	290		1063068	70
	Pseudacris triseriata triseria; Western chorus frog	TADPOLE, 7 D	48 H	LC_{50}	290		1063069	70
	Pseudacris triseriata triseria; Western chorus frog	TADPOLE, 7 D	96 H	LC_{50}	180		1063070	70
	Pteronarcella badia; Stonefly	15–20 MM	24 H	LC_{50}	2.8		1008097	68
	Pteronarcella badia; Stonefly	15–20 MM	48 H	LC_{50}	1.7		1008098	68
	Pteronarcella badia; Stonefly	15–20 MM	96 H	LC_{50}	0.54		1008099	68

Table A−15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
Endrin (cont.)	Pteronarcella badia; Stonefly	NAIAD	96 H	LC_{50}	0.54		1074040	80
	Pteronarcys californica, Stonefly	4−6 CM, NAIAD	48 H	LC_{50}	7.8		1002431	64
	Pteronarcys californica, Stonefly	4−6 CM, NAIAD	72 H	LC_{50}	3 70		1002432	64
	Pteronarcys californica; Stonefly	4−6 CM, NAIAD	96 H	LC_{50}	2.40		1003015	64
	Pteronarcys californica; Stonefly	NAIAD; 4−6 CM	96 H	LC_{50}	2 4		1003554	65
	Pteronarcys californica; Stonefly	30−35 MM NAIADS	24 H	LC_{50}	4.0		1008094	68
	Pteronarcys californica, Stonefly	30−35 MM NAIADS	48 H	LC_{50}	0.96		1008095	68
	Pteronarcys californica; Stonefly	30−35 MM NAIADS	96 H	LC_{50}	0.25		1008096	68
	Pteronarcys californica; Stonefly	2ND YR CLASS	96 H	LC_{50}	0.25		1074041	80
	Pteronarcys californica; Stonefly	NR	15 D	LC_{50} *	4 00		1126152	66
	Pteronarcys californica; Stonefly	NR	20 D	LC_{50} *	2.70		1126153	66
	Pteronarcys californica; Stonefly	NR	25 D	LC_{50} *	2 10		1126154	66
	Pteronarcys californica; Stonefly	NR	30 D	LC_{50} *	1 200		1126155	66
	Rana catesbeiana; Bullfrog	NR	96 H	LC_{50}	7		1078640	88
	Rana catesbeiana, Bullfrog	LARVA	96 H	LC_{50} *	2		1080386	81
	Rana catesbeiana; Bullfrog	2 32 G	96 H	LC_{50}	2 5		1105232	85
	Rana hexadactyla; Frog	TADPOLE, 20(15−25) MM, *	12 H	LC_{50}	6 60		1092129	85
	Rana hexadactyla, Frog	TADPOLE, 20(15−25) MM, *	24 H	LC_{50}	4 94		1092130	85
	Rana hexadactyla, Frog	TADPOLE, 20(15−25) MM, *	48 H	LC_{50}	0.85		1092131	85
	Rana hexadactyla; Frog	TADPOLE, 20(15−25) MM, *	72 H	LC_{50}	0.372		1092132	85
	Rana hexadactyla; Frog	TADPOLE, 20(15−25) MM, *	96 H	LC_{50}	0.21		1092133	85
	Rana sphenocephala; Leopard frog	EGGS	24 H	LC_{50} *	25		1029536	80
	Rana sphenocephala; Leopard frog	YOUNG LARVAE	96 H	LC_{50} *	6		1029537	80
	Rana sphenocephala, Leopard frog	OLDER LARVAE	96 H	LC_{50} *	6		1029538	80
	Rana sphenocephala; Leopard frog	SUB−ADULT	96 H	LC_{50} *	5		1029539	80

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
Endrin (cont.)	Rana sphenocephala; Leopard frog	LARVA	96 H	LC_{50} *	9		1080385	81
	Rana sylvatica; Wood frog	LARVA	96 H	LC_{50} *	34		1080387	81
	Rana temporaria; Frog	45 D, 18.7 MM, TADPOLE *	72 H	LC_{50}	24 3		1085138	77
	Rana temporaria; Frog	86 D, 27.2 MM, TADPOLE *	12 H	LC_{50}	479 9		1085139	77
	Rana temporaria; Frog	86 D, 27 2 MM, TADPOLE *	24 H	LC_{50}	160.5		1085140	77
	Rana temporaria, Frog	86 D, 27 2 MM, TADPOLE *	48 H	LC_{50}	39.6		1085141	77
	Rana temporaria; Frog	86 D, 27.2 MM, TADPOLE *	72 H	LC_{50}	17 2		1085142	77
	Rana temporaria; Frog	2 D, 10.5 MM, TADPOLE *	12 H	LC_{50}	3,998.7		1085143	77
	Rana temporaria; Frog	2 D, 10.5 MM, TADPOLE *	24 H	LC_{50}	2,008.6		1085144	77
	Rana temporaria; Frog	2 D, 10.5 MM, TADPOLE *	48 H	LC_{50}	709 8		1085145	77
	Rana temporaria; Frog	2 D, 10 5 MM, TADPOLE *	72 H	LC_{50}	425 3		1085146	77
	Rana temporaria, Frog	8 D, 14.0 MM, TADPOLE *	12 H	LC_{50}	2,370 2		1085147	77
	Rana temporaria; Frog	8 D, 14.0 MM, TADPOLE *	24 H	LC_{50}	988 6		1085148	77
	Rana temporaria; Frog	8 D, 14 0 MM, TADPOLE *	48 H	LC_{50}	226 8		1085149	77
	Rana temporaria; Frog	8 D, 14 0 MM, TADPOLE *	72 H	LC_{50}	50 5		1085150	77
	Rana temporaria; Frog	16 D, 28 0 MM, TADPOLE *	12 H	LC_{50}	2,540.4		1085151	77
	Rana temporaria; Frog	16 D, 28.0 MM, TADPOLE *	24 H	LC_{50}	1,137 5		1085152	77
	Rana temporaria; Frog	16 D, 28.0 MM, TADPOLE *	48 H	LC_{50}	614.9		1085153	77
	Rana temporaria; Frog	16 D, 28.0 MM, TADPOLE *	72 H	LC_{50}	287.5		1085154	77
	Rana temporaria, Frog	45 D, 18 7 MM, TADPOLE *	12 H	LC_{50}	1,296 7		1085155	77
	Rana temporaria; Frog	45 D, 18 7 MM, TADPOLE *	24 H	LC_{50}	241.7		1085156	77
	Rana temporaria; Frog	45 D, 18.7 MM, TADPOLE *	48 H	LC_{50}	74 0		1085157	77
	Rana temporaria; Frog	107 D, 30.8 MM, TADPOLE *	12 H	LC_{50}	321 4		1085158	77
	Rana temporaria; Frog	107 D, 30.8 MM, TADPOLE *	24 H	LC_{50}	113 3		1085159	77
	Rana temporaria, Frog	107 D, 30 8 MM, TADPOLE *	48 H	LC_{50}	28.9		1085160	77
	Rana temporaria; Frog	107 D, 30.8 MM, TADPOLE *	72 H	LC_{50}	14.7		1085161	77
	Salvelinus fontinalis, Brook trout	1.15 G	24 H	LC_{50}	1.28		1004361	71
	Salvelinus fontinalis; Brook trout	1 15 G	48 H	LC_{50}	.59		1004362	71
	Salvelinus fontinalis; Brook trout	1.15 G	72 H	LC_{50}	.42		1004363	71
	Salvelinus fontinalis, Brook trout	1.15 G	96 H	LC_{50}	.355		1004364	71
	Salvelinus fontinalis; Brook trout	2.04 G	48 H	LC_{50}	1.2		1004377	71
	Salvelinus fontinalis; Brook trout	2.04 G	72 H	LC_{50}	.675		1004378	71
	Salvelinus fontinalis; Brook trout	2 04 G	96 H	LC_{50}	59		1004379	71
	Sphoeroides maculatus, Northern puffer	131 MM, 46 G	24 H	LC_{50}	3.1		1026006	70
	Sphoeroides maculatus; Northern puffer	131 MM, 46 G	48 H	LC_{50}	3.1		1026007	70
	Sphoeroides maculatus; Northern puffer	131 MM, 46 G	96 H	LC_{50}	3 1		1026008	70
	Strongyocentrotus droebachien; Green sea urchin	SPERM	1.3 H	REP [Reproduction]		342	1106926	89
	Strongyocentrotus droebachien, Green sea urchin	EMBRYO	120 H	DVP [Development]		>359	1106929	89
	Strongyocentrotus purpuratus; Purple sea urchin	SPERM	1.3 H	REP [Reproduction]		103	1106925	89
	Strongyocentrotus purpuratus; Purple sea urchin	EMBRYO	120 H	DVP [Development]		221	1106928	89
	Tanytarsus dissimilis; Midge	NR	48 H	LC_{50}	2		1078628	88
	Tanytarsus dissimilis; Midge	3RD AND 4TH INSTAR LARVAE	48 H	LC_{50}	0 83		1105222	85
	Thalassoma bifasciatum, Bluehead wrasse	90 MM, 7 0 G	24 H	LC_{50}	0 6		1026018	70
	Thalassoma bifasciatum, Bluehead wrasse	90 MM, 7 0 G	48 H	LC_{50}	0.5		1026019	70
	Thalassoma bifasciatum; Bluehead wrasse	90 MM, 7.0 G	96 H	LC_{50}	0 1		1026020	70
	Tilapia nilotica; Nile tilapia	1 5 G, 41.5 MM	24 H	LC_{50}	161		1012640	76
	Tilapia nilotica, Nile tilapia	1.5 G, 41.5 MM	48 H	LC_{50}	140		1012641	76
	Tilapia nilotica; Nile tilapia	13 8 G, 89 MM	24 H	LC_{50}	282		1012642	76
	Tilapia nilotica; Nile tilapia	13 8 G, 89 MM	48 H	LC_{50}	260		1012643	76

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration Lethal	Effect Concentration Sublethal	AQUIRE Reference Number	Year of Publication
Endrin (cont.)	Tilapia nilotica; Nile tilapia	5 36 G, 64 MM	24 H	LC_{50}	2.4		1012644	76
	Tilapia nilotica; Nile tilapia	5.36 G, 64 MM	48 H	LC_{50}	1.8		1012645	76
	Tilapia nilotica; Nile tilapia	5.36 G, 64 MM	24 H	LC_{50}	4		1012646	76
	Tilapia nilotica; Nile tilapia	5.36 G, 64 MM	48 H	LC_{50}	3.1		1012647	76
	Tilapia nilotica; Nile tilapia	5.36 G, 64 MM	24 H	LC_{50}	4		1012648	76
	Tilapia nilotica; Nile tilapia	5 36 G, 64 MM	48 H	LC_{50}	3 1		1012649	76
	Tilapia zillii; Tilapia	BEHERA STRAIN FRY, 3.36 CM, 825 MG	24 H	LC_{50}	24.34		1108958	86
	Tilapia zillii; Tilapia	BEHERA STRAIN FRY, 3.36 CM, 825 MG	96 H	LC_{50}	10 09		1108959	86
	Tilapia zillii; Tilapia	ALEXANDRIA STRAIN FRY *	24 H	LC_{50}	1.20		1108960	86
	Tilapia zillii, Tilapia	ALEXANDRIA STRAIN FRY *	96 H	LC_{50}	0 26		1108961	86
	Tinca tinca; Tench	4 MO, 84.5 MM, JUVENILE	12 H	LC_{50}	58.5		1085103	77
	Tinca tinca; Tench	4 MO, 84 5 MM, JUVENILE	24 H	LC_{50}	34 0		1085104	77
	Tinca tinca, Tench	4 MO, 84.5 MM, JUVENILE	48 H	LC_{50}	19.6		1085105	77
	Tinca tinca, Tench	4 MO, 84.5 MM, JUVENILE	72 H	LC_{50}	16 0		1085106	77
	Tinca tinca; Tench	4 MO, 84 5 MM, JUVENILE	12 H	LC_{50}	22 2		1085107	77
	Tinca tinca; Tench	4 MO, 84.5 MM, JUVENILE	24 H	LC_{50}	13.3		1085108	77
	Tinca tinca; Tench	4 MO, 84.5 MM, JUVENILE	48 H	LC_{50}	11.8		1085109	77
	Tinca tinca; Tench	4 MO, 84.5 MM, JUVENILE	72 H	LC_{50}	9.1		1085110	77
	Tinca tinca; Tench	4 MO, 84 5 MM, JUVENILE	12 H	LC_{50}	13.4		1085111	77
	Tinca tinca, Tench	4 MO, 84.5 MM, JUVENILE	24 H	LC_{50}	2.6		1085112	77
	Tipula sp; Cranefly	JUVENILE	96 H	LC_{50}	12		1074048	80
Inorganic Compounds								
Aluminum	Brachionus calyciflorus; Rotifer;	NEONATE	24 H	LC_{50}	> 3,000		219385	91
	Myriophyllum spicatum; Water–milfoil,	4 CM APEX	32 D	EC_{50}GR *		12700	212262	74
	Myriophyllum spicatum; Water–milfoil,	4 CM APEX	32 D	EC_{50}BM *		7600	212262	74
	Myriophyllum spicatum; Water–milfoil;	4 CM APEX	32 D	EC_{50}BM *		2500	212262	74
	Myriophyllum spicatum; Water–milfoil;	4 CM APEX	32 D	EC_{50}GR *		5100	212262	74
	Salmo trutta; Brown trout;	ALEVIN	28 D	LC_{50}	19		213472	90
	Salmo trutta, Brown trout;	ALEVIN	42 D	LC_{50}	72		213472	90
	Salmo trutta; Brown trout;	ALEVIN	21 D	LC_{50}	84 to 105		213472	90
	Salmo trutta; Brown trout;	ALEVIN	42 D	LC_{50}	15		213472	90
	Salmo trutta; Brown trout;	ALEVIN	28 D	LC_{50}	79		213472	90
	Salmo trutta; Brown trout;	FERT EGG	<4 MO	HAT		<677	213472	90
	Salvelinus fontinalis; Brook trout;	FRY	43.2 H	LT_{50}	1000		216632	80
	Salvelinus fontinalis; Brook trout;	FRY	7.3 D	LT_{50}	630		216632	80
	Salvelinus fontinalis; Brook trout;	FRY	79 2 H	LT_{50}	500		216632	80
	Salvelinus fontinalis; Brook trout;	ADULT, 25–30 CM	5 D	LET	320		216632	80
	Salvelinus fontinalis; Brook trout;	FRY	86.4 H	LT_{50}	1000		216632	80
	Salvelinus fontinalis; Brook trout;	FRY	11.5 D	LT_{50}	100		216632	80
	Salvelinus fontinalis, Brook trout;	FRY, 22–23 MM	10.67 D	LT_{50}	480		216188	80
	Salvelinus fontinalis; Brook trout;	FRY	4.7 D	LT_{50}	650		216632	80
	Salvelinus fontinalis; Brook trout;	FRY, 22–23 MM	19.67 D	LT_{50}	470		216188	80
	Salvelinus fontinalis; Brook trout;	FRY	5 D	LT_{50}	1000		216632	80
	Salvelinus fontinalis, Brook trout;	FRY, 22–23 MM	20.83 D	LT_{50}	20		216188	80
	Salvelinus fontinalis; Brook trout;	FRY	50 4 H	LT_{50}	500		216632	80
	Salvelinus fontinalis; Brook trout;	FRY, 22–23 MM	4.79 D	LT_{50}	42		216188	80
	Salvelinus fontinalis; Brook trout,	FRY	67 2 H	LT_{50}	500		216632	80
	Salvelinus fontinalis; Brook trout;	FRY, 22–23 MM	8 42 D	LT_{50}	500		216188	80

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
Aluminum (cont.)	Salvelinus fontinalis; Brook trout;	EYED EGGS	5 D	MOR *	320		216632	80
	Salvelinus fontinalis; Brook trout,	FRY, 22–23 MM	>20.83 D	LT_{50}	10		216188	80
	Salvelinus fontinalis, Brook trout,	0.2 G, 30 D	3 D	GRO *		268	213592	91
	Salvelinus fontinalis; Brook trout;	FRY, 22–23 MM	>20.83 D	LT_{50}	500		216188	80
	Salvelinus fontinalis, Brook trout;	FRY	55.2 H	LT_{50}	500		216632	80
	Salvelinus fontinalis; Brook trout;	FRY, 22–23 MM	>20.83 D	LT_{50}	500		216188	80
	Salvelinus fontinalis; Brook trout;	FRY	38.4 H	LT_{50}	500		216632	80
	Salvelinus fontinalis; Brook trout;	0.2 G, 30 D	56 D	MOR *	268		213592	91
	Salvelinus fontinalis; Brook trout,	FRY	5.2 D	LT_{50}	100		216632	80
	Salvelinus fontinalis; Brook trout;	RECENTLY HATCHED FRY	5 D	LET	320		216632	80
	Salvelinus fontinalis; Brook trout;	YEARLINGS, 13–17 CM	5 D	LET	320		216632	80
	Salvelinus fontinalis, Brook trout;	EGGS	8 D	LC_{50}	2280		216199	78
Aluminum chloride	Ambystoma opacum; Marbled salamander;	LARVAE, 7–8 D POST–SPAWN	48 H	LC_{50}	106000		311199	85
	Brachydanio rerio; Zebra danio, zebrafish,	LARVAE, 7–8 D POST–SPAWN	48 H	LC_{50}	80000		311199	85
	Brachydanio rerio; Zebra danio, zebrafish;	EGGS	7 D	LC_{50} *	150		215305	78
	Carassius auratus; Goldfish;	NR	0.17 H	LET	2400		212863	73
	Chilomonas paramecium; Cryptomonad;	7.5–8.5 CM, 10.5–12.5 G	24 H	MOR *	8000		315166	81
	Cyprinus carpio, Common, mirror, colored, carp;	7.5–8.5 CM, 10.5–12.5 G	48 H	MOR *	2000		315166	81
	Cyprinus carpio; Common, mirror, colored, carp;	7.5–8.5 CM, 10.5–12.5 G	24 H	MOR *	4000		315166	81
	Cyprinus carpio; Common, mirror, colored, carp,	7.5–8.5 CM, 10.5–12.5 G	48 H	MOR *	2000		315166	81
	Cyprinus carpio; Common, mirror, colored, carp;	7.5–8.5 CM, 10.5–12.5 G	24 H	MOR *	8000		315166	81
	Cyprinus carpio; Common, mirror, colored, carp;	7.5–8.5 CM, 10.5–12.5 G	48 H	MOR *	8000		315166	81
	Cyprinus carpio, Common, mirror, colored, carp;	12 H	21 D	EC_{50}IM ?		1400	212022	72
	Daphnia magna; Water flea;	4 H	64 H	EC_{50}IM (Calc)		1400	212054	48
	Daphnia magna; Water flea;	12 H	48 H	EC_{50}IM ?		3900	212022	72
	Daphnia magna, Water flea;	12 H	21 D	EC_{50}RE ?		680	212022	72
	Daphnia magna; Water flea;	NR	3 H	MOR *	1000000		212863	73
	Euglena gracilis; Flagellate euglenoid;	ADULT, FEMALE	48 H	LC_{50} ? (Calc)	27500		210508	57
	Gambusia affinis; Mosquitofish; Poeciliidae;	ADULT, FEMALE	24 H	LC_{50} ? (Calc)	29600		210508	57
	Gambusia affinis; Mosquitofish, Poeciliidae;	ADULT, FEMALE	96 H	LC_{50} ? (Calc)	27100		210508	57
	Gambusia affinis; Mosquitofish; Poeciliidae,	ADULT, FEMALE	96 H	MOR * (Calc)	20400		210508	57
	Gambusia affinis; Mosquitofish; Poeciliidae;	EGGS	7 D	LC_{50} *	50		215305	78
	Microhyla carolinensis; Narrow mouthed frog;	EGGS	8 D	LC_{50}	170		216199	78
	Micropterus salmoides; Largemouth bass;	EGGS	28 D	LC_{50} *	560		215305	78
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	FINGERLING, 6 WK	9.25 D	PHY *		5,140; 1,570	218830	73
	Oncorhynchus mykiss; Rainbow trout, donaldson trout,	EGGS	28 D	LC_{50}	560		216199	78
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	FINGERLING, 6 MO	45 D	PHY *		514; 514	218830	73
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	FINGERLING, 11 WK	43.9 D	LT_{50}	513		219328	71
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	FINGERLING, 6 WK	4.7 D	PHY *		5,200; 5,050	218830	73
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	FINGERLING, 6 MO	31.96 D	LT_{50}	5230		219328	71
	Oncorhynchus mykiss; Rainbow trout, donaldson trout,	FINGERLING, 6 WK	7.46 D	LT_{50}	5140		219328	71
	Oncorhynchus mykiss; Rainbow trout, donaldson trout,	FINGERLING, 6 MO	45 D	GRO *		51.6, 51.6	218830	73
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	FINGERLING, 6 WK	71.52 H	LT_{50}	5200		219328	71
	Oncorhynchus mykiss; Rainbow trout, donaldson trout,	FINGERLING, 11 WK	45 D	GRO *		513	219328	71
	Oncorhynchus mykiss; Rainbow trout, donaldson trout,	FINGERLING, 6 MO	45 D	GRO *		514	219328	71
	Oncorhynchus mykiss, Rainbow trout, donaldson trout;	FINGERLING, 6 MO	38.9 D	GRO *		51.6	219328	71
	Oncorhynchus mykiss; Rainbow trout, donaldson trout,	FINGERLING, 11 WK	0.17 H	LT_{50}	5140		219328	71
	Peranema trichophorum; Flagellate;	NR	14 D	LET	>1,000,000		212863	73
	Pimephales promelas; Fathead minnow;	LARVAE, <24 H		GRO *		66; 35	213070	89

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
Aluminum chloride (cont.)	Pimephales promelas; Fathead minnow,	EMBRYO	4 D	HAT *		66; 35	213070	89
	Pimephales promelas, Fathead minnow;	30 D	to 109 D	HIS		30 to 60	213182	90
	Pimephales promelas; Fathead minnow;	12 D LARVAE	to 96 H	MOR	50 to 400		210836	89
	Pimephales promelas; Fathead minnow;	JUVENILE	to 96 H	MOR	50 to 400		210836	89
	Pimephales promelas; Fathead minnow;	1 D LARVAE	to 96 H	MOR	50 to 400		210836	89
	Pimephales promelas, Fathead minnow,	LARVAE, <24 H	14 D	MOR *	66; 35		213070	89
	Pimephales promelas; Fathead minnow,	ADULT	2 MO	REP *		66, 35	213070	89
	Tetrahymena pyriformis; Ciliate,	NR	0 17 H	LET	3200		212863	73
	Tropisternus lateralis; Beetle;	ADULT	14 D	PHY * (Calc)		27000	212868	69
Aluminum sulfate	Asellus aquaticus; Aquatic sowbug;	ADULT, 7 MM, 1.5 MG DRY WT	48 H	EC_{50}IM ?		6570	311972	86
	Asellus aquaticus, Aquatic sowbug,	ADULT, 7 MM, 1.5 MG DRY WT	72 H	EC_{50}IM ?		4370	311972	86
	Biomphalaria glabrata; Snail;	ADULT, 4–4.5 SUTURE WHORL	24 H	STR *		100	212853	63
	Biomphalaria glabrata, Snail;	ADULT, 4–4.5 SUTURE WHORL	24 H	STR *		1000	212853	63
	Cladocera; Water flea order;	NR	2 MO *	POP *		500	217183	78
	Crangonyx pseudogracilis, Amphipod;	ADULT, 4 MM, 0 2 MG DRY WT	48 H	EC_{50}IM ?		12800	311972	86
	Crangonyx pseudogracilis; Amphipod;	ADULT, 4 MM, 0 2 MG DRY WT	96 H	EC_{50}IM ?		9190	311972	86
	Crustacea; Crustacean class;	NR	2 MO *	ABD *		500	217183	78
	Cyprinus carpio, Common, mirror, colored, carp;	7.5–8.5 CM, 10.5–12 5 G	24 H	MOR *	8000		315166	81
	Cyprinus carpio; Common, mirror, colored, carp;	7 5–8.5 CM, 10 5–12 5 G	24 H	MOR *	8000		315166	81
	Cyprinus carpio; Common, mirror, colored, carp;	7 5–8.5 CM, 10 5–12.5 G	48 H	MOR *	2000		315166	81
	Cyprinus carpio; Common, mirror, colored, carp;	7.5–8.5 CM, 10 5–12 5 G	48 H	MOR *	4000		315166	81
	Cyprinus carpio, Common, mirror, colored, carp;	7 5–8.5 CM, 10.5–12.5 G	48 H	MOR *	4000		315166	81
	Cyprinus carpio, Common, mirror, colored, carp,	7 5–8.5 CM, 10.5–12 5 G	48 H	MOR *	8000		315166	81
	Daphnia magna; Water flea,	8 H, YOUNG	0.25 H *	LOC *		136000	212171	44
	Fundulus heteroclitus; Mummichog;	NR	36 H	LC_{100} (Calc)	2200		212865	15
	Fundulus heteroclitus; Mummichog;	NR	5 D	LC_{100} (Calc)	1100		212865	15
	Gambusia affinis; Mosquitofish;	ADULT, FEMALE	24 H	LC_{50} ? (Calc)	69000		210508	57
	Gambusia affinis; Mosquitofish;	ADULT, FEMALE	48 H	LC_{50} ? (Calc)	38000		210508	57
	Gambusia affinis; Mosquitofish;	ADULT, FEMALE	48 H	MOR * (Calc)	< 28,000		210508	57
	Gambusia affinis, Mosquitofish;	ADULT, FEMALE	96 H	LC_{50} ? (Calc)	37000		210508	57
	Micropterus dolomieui; Smallmouth bass;	13 8(12–17) MM, 32.5(9–59) MG	30 D	GRO *		251.6	312723	87
	Micropterus dolomieui; Smallmouth bass,	LARVAE	30 D	MOR *	251 6		312723	87
	Micropterus dolomieui; Smallmouth bass;	LARVAE, 48 H POST–HATCH	96 H	MOR *	100		312723	87
	Micropterus dolomieui; Smallmouth bass;	LARVAE, 48 H POST–HATCH	96 H	MOR *	196		312723	87
	Micropterus dolomieui, Smallmouth bass;	LARVAE, 48 H POST–HATCH	96 H	MOR *	217		312723	87
	Micropterus dolomieui; Smallmouth bass,	LARVAE, 48 H POST–HATCH	96 H	MOR *	32		312723	87
	Micropterus dolomieui; Smallmouth bass;	LARVAE, 48 H POST–HATCH	96 H	MOR *	320		312723	87
	Micropterus dolomieui; Smallmouth bass;	LARVAE, 48 H POST–HATCH	96 H	MOR *	56		312723	87
	Micropterus dolomieui; Smallmouth bass;	LARVAE, 48 H POST–HATCH	96 H	MOR *	560		312723	87
	Notemigonus crysoleucas; Golden shiner,	NR	45 D	MOR *	100000		312756	86
	Notemigonus crysoleucas, Golden shiner,	NR	45 D	MOR *	100000		312756	86
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	118–355 G, 22–31 CM FORK LENGTH	24 H	MOR *	910		212508	88
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	118–355 G, 22–31 CM FORK LENGTH	24 H	MOR *	9100		212508	88
	Oncorhynchus mykiss, Rainbow trout, donaldson trout;	118–355 G, 22–31 CM FORK LENGTH	48 H	LET	9100		212508	88
	Oncorhynchus mykiss, Rainbow trout, donaldson trout;	118–355 G, 22–31 CM FORK LENGTH	48 H	MOR *	910		212508	88
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	118–355 G, 22–31 CM FORK LENGTH	72 H	MOR *	910		212508	88
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	118–355 G, 22–31 CM FORK LENGTH	96 H	HEM *		90	212508	88
	Oncorhynchus mykiss, Rainbow trout, donaldson trout;	118–355 G, 22–31 CM FORK LENGTH	96 H	HEM *		910	212508	88
	Oncorhynchus mykiss, Rainbow trout, donaldson trout;	118–355 G, 22–31 CM FORK LENGTH	96 H	HEM *		910	212508	88

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
Aluminum sulfate (cont)	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	118–355 G, 22–31 CM FORK LENGTH	96 H	MOR *	90		212508	88
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	118–355 G, 22–31 CM FORK LENGTH	96 H	MOR *	910		212508	88
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	50–80 MM	10 D	LC0	200000		216520	80
	Oncorhynchus mykiss; Rainbow trout, donaldson trout,	50–80 MM	10 D	LC0	50000		216520	80
	Oncorhynchus mykiss, Rainbow trout, donaldson trout;	50–80 MM	42 H	LC_{100}	50000		216520	80
	Oncorhynchus mykiss, Rainbow trout, donaldson trout;	50–80 MM	42 H	LC_{100}	50000		216520	80
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	50–80 MM	96 H	MOR *	50000		216520	80
	Oncorhynchus mykiss, Rainbow trout, donaldson trout;	FINGERLING, 11 WK	45 D	PHY *		513	218830	73
	Salvelinus fontinalis: Brook trout;	14 MO, 210 MM, 130 G	24 H	LC_{50} ?	4000		216115	75
	Salvelinus fontinalis; Brook trout,	14 MO, 210 MM, 130 G	24 H	LC_{50} ?	4450		216115	75
	Salvelinus fontinalis; Brook trout;	14 MO, 210 MM, 130 G	24 H	MOR *	5000		216115	75
	Salvelinus fontinalis; Brook trout,	14 MO, 210 MM, 130 G	24 H	MOR *	5000		216115	75
	Salvelinus fontinalis; Brook trout;	14 MONTHS, 210 MM, 130 G	96 H	LC_{50} ?	3600		216115	75
	Salvelinus fontinalis; Brook trout;	EYED EMBRYO – LARVAE	45 D	GRO *		283	312720	87
	Salvelinus fontinalis; Brook trout,	EYED EMBRYO – LARVAE	60 D	BEH *		283	312720	87
	Salvelinus fontinalis; Brook trout;	EYED EMBRYO – LARVAE	60 D	MOR *	283		312720	87
	Stizostedion lucioperca; Pikeperch;	11 5–16 MM	24 H	MOR *	400		212700	75
Barium	Daphnia magna; Water flea.	<= 24 H	24 H	LC_{50}	> 530,000		215184	80
	Daphnia magna; Water flea,	<= 24 H	48 H	LC_{50}	410000		215184	80
	Daphnia magna; Water flea;	<= 24 H	48 H	MOR *	68000		215184	80
	Lemna minor, Duckweed;	20 COLONIES OR 40 FRONDS	4 D	EC_{50}GR		26000	311789	86
	Myriophyllum spicatum; Water–milfoil;	4 CM APEX	32 D	EC_{50}BM *		103000	212262	74
	Myriophyllum spicatum; Water–milfoil;	4 CM APEX	32 D	EC_{50}BM *		41200	212262	74
	Myriophyllum spicatum; Water–milfoil,	4 CM APEX	32 D	EC_{50}GR *		113000	212262	74
	Myriophyllum spicatum; Water–milfoil;	4 CM APEX	32 D	EC_{50}GR *		83800	212262	74
Barium chloride	Austropotamobius pallipes pall; Crayfish	19–32 MM	96 H	LC_{50}	46000		228813	73
	Daphnia magna; Water flea	12 H	21 D	REP		8900	228734	72
	Daphnia magna; Water flea	12 H	48 H	IMM		14500	228732	72
	Echinogammarus berilloni, Scud	NR	24 H	LC_{50}	336000		307710	86
	Gambusia affinis; Mosquitofish	ADULT, FEMALE	96 H	MOR	66200		215457	57
	Gambusia affinis; Mosquitofish	ADULT, FEMALE	24 H	LC_{50}	2910000		215454	57
	Gammarus pulex; Scud	NR	24 H	LC_{50}	3980000		307706	86
	Lemna minor, Duckweed	FRONDS	96 H	GRO		25000	283261	88
	Orconectes limosus, Crayfish	19–32 MM	96 H	LC_{50}	78000		228816	73
	Salmo trutta; Brown trout	YEARLING	48 H	LC_{50}	150000		240072	74
Beryllium chloride	Daphnia magna; Water flea	<=24H OLD	24 H	LC_{50}	1900		211148	80
	Gammarus fasciatus; Scud	JUVENILE, 0.007 G	96 H	LC_{50}	700		298192	86
	Pimephales promelas; Fathead minnow	NR	96 H	LC_{50}	150		287114	60
	Daphnia magna; Water flea	<= 24 H	48 H	MOR	250		211150	80
Beryllium nitrate	Cyprinus carpio, Common carp	FERTILIZED EGGS	72 H	HAT		80	215613	78
Beryllium sulfate	Daphnia magna; Water flea	NR	24 H	IMM		4640	305745	89
	Tubifex tubifex, Tubificid worm	NR	24 H	IMM		25970	234436	91
	Ambystoma maculatum; Spotted salamander	41.2 MG, 20 1 MM	24 H	LC_{50}	6830		247921	75
	Ambystoma opacum; Marbled salamander	333 MG, 35.9 MM	24 H	LC_{50}	31500		247915	75
	Lepomis macrochirus; Bluegill	NR	96 H	LC_{50}	1300		287110	60
	Pimephales promelas; Fathead minnow	NR	96 H	LC_{50}	200		287102	60
	Poecilia reticulata; Guppy	0.1–0.25 G ADULT, 2.4–3 6 CM,	24 H	LC_{50}	22200		242842	73

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
Beryllium sulfate (cont.)	Poecilia reticulata; Guppy	0 1–0.25 G ADULT, 2 4–3 6 CM,	24 H	MOR	1000		242848	73
	Poecilia reticulata; Guppy	0 1–0 25 G ADULT, 2.4–3 6 CM,	96 H	MOR	10		242849	73
Cobalt	Anabolia nervosa; Quiver fly	LARVAE	7 D	LET	400000		210725	57
	Chironomus thummi; Midge	LARVAE	7 D	LET	600000		210725	57
	Corbicula fluminea, Asiatic clam	NR	NR	RSD		130 to 150	215024	80
	Cyprinidae, Minnow, carp family	1 SUMMER	7 D	MOR *	90000		210725	57
	Cyprinidae; Minnow, carp family	1 SUMMER	29 H	LET *	500000		210725	57
	Cyprinidae, Minnow, carp family	1 SUMMER	10 H	LET *	1000000		210725	57
	Cyprinidae; Minnow, carp family	1 SUMMER	4 5 D	LET *	150000		210725	57
	Cyprinidae; Minnow, carp family	1 SUMMER	7 D	MOR *	100000		210725	57
	Cyprinidae; Minnow, carp family	2 SUMMERS	66 H	LET *	300000		210725	57
	Cyprinidae; Minnow, carp family	1 SUMMER	65 H	LET *	200000		210725	57
	Cyprinidae; Minnow, carp family	1 SUMMER	43 H	LET *	300000		210725	57
	Cyprinidae; Minnow, carp family	1 SUMMER	7.08 D	LET *	125000		210725	57
	Gammarus roeseli; Scud	NR	7 D	LET	8000		210725	57
	Lemna minor; Duckweed	NR	NR	BCF *		15	218581	75
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	1 SUMMER	7 D	MOR *	30000		210725	57
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	2 SUMMERS	58 H	LET *	50000		210725	57
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	1 SUMMER	36 H	LET *	50000		210725	57
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	1 SUMMER	63 H	LET *	40000		210725	57
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	1 SUMMER	14 H	LET *	100000		210725	57
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	1 SUMMER	26 H	LET *	55000		210725	57
	Oncorhynchus mykiss; Rainbow trout, donaldson trout	1 SUMMER	4 08 D	LET *	35000		210725	57
	Salvelinus fontinalis; Brook trout	1 SUMMER	3.58 D	LET *	45000		210725	57
	Salvelinus fontinalis; Brook trout	1 SUMMER	7 D	MOR *	40000		210725	57
	Salvelinus fontinalis; Brook trout	2 SUMMERS	75 H	LET *	50000		210725	57
	Salvelinus fontinalis, Brook trout	1 SUMMER	67 H	LET *	50000		210725	57
	Salvelinus fontinalis; Brook trout	1 SUMMER	20 H	LET *	100000		210725	57
	Salvelinus fontinalis, Brook trout	1 SUMMER	60 H	LET *	55000		210725	57
	Tinca tinca; Tench	1 SUMMER	6.42 D	LET *	150000		210725	57
	Tinca tinca; Tench	2 SUMMERS	72 H	LET *	300000		210725	57
	Tinca tinca; Tench	1 SUMMER	32 H	LET *	500000		210725	57
	Tinca tinca; Tench	1 SUMMER	72 H	LET *	200000		210725	57
	Tinca tinca; Tench	1 SUMMER	7 D	MOR *	125000		210725	57
	Tinca tinca; Tench	1 SUMMER	46 H	LET *	300000		210725	57
	Tinca tinca, Tench	1 SUMMER	14 H	LET *	1000000		210725	57
	Tubifex tubifex; Tubificid worm	NR	7 D	LET	400000		210725	57
Copper	Algae; Algae, phytoplankton, algal mat;	EXPO GRO PHASE	24 H	PSE		<=1270	213095	89
	Algae; Algae, phytoplankton, algal mat;	PHYTOPLANKTON	124 H	PGR		10 to 400	311876	83
	Algae; Algae, phytoplankton, algal mat,	PHYTOPLANKTON	14 D	BMS *		100	313109	88
	Aquatic community; Aquatic community,	OLIGOTROPHIC STREAM	NR	POP *		2 5 to 15	218766	88
	Brachionus calyciflorus; Rotifer;	NEONATE	24 H	LC_{50}	26		219385	91
	Brachionus calyciflorus; Rotifer;	NEONATE	24 H	LC_{50}	31		219385	91
	Callitriche platycarpa; Macrophyte,	NR	28 D	LT50 (Calc)	6000		218344	78
	Carassius auratus; Goldfish,	NR	to 4 WK	PHY		100 to 4000	213419	89
	Ceriodaphnia dubia; Water flea,	NEONATE, < 12 H, FIRST INSTAR	48 H	LC_{50}	26		213110	89
	Ceriodaphnia dubia; Water flea,	ADULT	48 H	LC_{50}	110		213110	89

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
Copper (cont.)	Ceriodaphnia dubia; Water flea;	NEONATE, <12 H, FIRST INSTAR	48 H	LC_{50}	27		213110	89
	Ceriodaphnia dubia, Water flea;	ADULT	48 H	LC_{50}	63		213110	89
	Ceriodaphnia dubia; Water flea;	NEONATE, <12 H, FIRST INSTAR	48 H	LC_{50}	28		213110	89
	Ceriodaphnia dubia; Water flea,	ADULT	48 H	LC_{50}	71		213110	89
	Ceriodaphnia dubia; Water flea;	NEONATE, <12 H, FIRST INSTAR	48 H	LC_{50}	30		213110	89
	Ceriodaphnia dubia; Water flea;	ADULT	48 H	LC_{50}	79		213110	89
	Ceriodaphnia dubia, Water flea,	NEONATE, <12 H, FIRST INSTAR	48 H	LC_{50}	95		213110	89
	Ceriodaphnia dubia; Water flea;	< 4 H	48 H	LC_{50}	17		311181	84
	Ceriodaphnia dubia; Water flea;	NEONATE, <12 H, FIRST INSTAR	48 H	LC_{50}	31		213110	89
	Ceriodaphnia dubia; Water flea;	NEONATE, <12 H, FIRST INSTAR	48 H	LC_{50}	17		213110	89
	Ceriodaphnia dubia, Water flea,	NEONATE, <12 H, FIRST INSTAR	48 H	LC_{50}	32		213110	89
	Ceriodaphnia dubia, Water flea;	NEONATE, <12 H, FIRST INSTAR	48 H	LC_{50}	20		213110	89
	Ceriodaphnia dubia; Water flea;	NEONATE, <12 H, FIRST INSTAR	48 H	LC_{50}	34		213110	89
	Ceriodaphnia dubia, Water flea,	NEONATE, <12 H, FIRST INSTAR	48 H	LC_{50}	23		213110	89
	Ceriodaphnia dubia; Water flea;	NEONATE, <12 H, FIRST INSTAR	48 H	LC_{50}	37		213110	89
	Ceriodaphnia dubia; Water flea;	NEONATE, <12 H, FIRST INSTAR	48 H	LC_{50}	25		213110	89
	Ceriodaphnia dubia; Water flea,	NEONATE, <12 H, FIRST INSTAR	48 H	LC_{50}	38		213110	89
	Ceriodaphnia dubia; Water flea;	ADULT	48 H	LC_{50}	66		213110	89
	Ceriodaphnia dubia; Water flea,	NEONATE, <12 H, FIRST INSTAR	48 H	LC_{50}	42		213110	89
	Ceriodaphnia dubia; Water flea;	NEONATE, <12 H, FIRST INSTAR	48 H	LC_{50}	104		213110	89
	Ceriodaphnia dubia; Water flea;	NEONATE, <12 H, FIRST INSTAR	48 H	LC_{50}	49		213110	89
	Ceriodaphnia dubia; Water flea,	NEONATE, <12 H, FIRST INSTAR	48 H	LC_{50}	21		213110	89
	Ceriodaphnia dubia; Water flea;	NEONATE, <12 H, FIRST INSTAR	48 H	LC_{50}	58		213110	89
	Ceriodaphnia dubia; Water flea;	ADULT	48 H	LC_{50}	127		213110	89
	Ceriodaphnia dubia; Water flea,	NEONATE, <12 H, FIRST INSTAR	48 H	LC_{50}	67		213110	89
	Ceriodaphnia dubia; Water flea;	NEONATE, <12 H, FIRST INSTAR	48 H	LC_{50}	19		213110	89
	Ceriodaphnia dubia; Water flea,	NEONATE, <12 H, FIRST INSTAR	48 H	LC_{50}	81		213110	89
	Ceriodaphnia dubia; Water flea,	NEONATE, <12 H, FIRST INSTAR	48 H	LC_{50}	24		213110	89
	Ceriodaphnia dubia; Water flea;	NEONATE, <12 H, FIRST INSTAR	48 H	LC_{50}	78		213110	89
	Ceriodaphnia dubia; Water flea;	FIRST INSTAR NEONATES, 2–8 H	7 D	MOR	1.5 to 122.5		213110	89
	Ceriodaphnia dubia, Water flea;	FIRST INSTAR NEONATES, 2–8 H	7 D	REP *		1.5	213110	89
	Ceriodaphnia dubia; Water flea,	FIRST INSTAR NEONATES, 2–8 H	7 D	REP *		6.3	213110	89
	Ceriodaphnia dubia; Water flea,	LARVAE	12 MO	POP		67	213176	88
	Chironomidae; Midge family,	LARVA–STATE L1	24 H	LC_{50}	3160		215356	89
	Chironomus plumosus; Midge;	LARVA–STATE L2	24 H	LC_{50}	8590		215356	89
	Chironomus plumosus; Midge,	LARVA–STATE L2	48 H	LC_{50}	3760		215356	89
	Chironomus plumosus; Midge;	LARVA–STATE L2	72 H	LC_{50}	1990		215356	89
	Chironomus plumosus; Midge;	LARVA–STATE L2	96 H	LC_{50}	1580		215356	89
	Chironomus plumosus, Midge;	LARVA–STATE L3	24 H	LC_{50}	>10000		215356	89
	Chironomus plumosus; Midge;	LARVA–STATE L3	48 H	LC_{50}	2050		215356	89
	Chironomus plumosus; Midge;	LARVA–STATE L3	72 H	LC_{50}	980		215356	89
	Chironomus plumosus; Midge;	LARVA–STATE L3	96 H	LC_{50}	530		215356	89
	Chironomus plumosus; Midge;	LARVA–STATE L4	24 H	LC_{50}	23600		215356	89
	Chironomus plumosus; Midge;	LARVA–STATE L4	48 H	LC_{50}	12510		215356	89
	Chironomus plumosus; Midge,	LARVA–STATE L4	72 H	LC_{50}	6260		215356	89
	Chironomus plumosus; Midge,	LARVA–STATE L4	96 H	LC_{50}	2200		215356	89
	Chironomus plumosus; Midge;	2ND INSTAR LARVAE	240 H	LC_{50}	200		215023	91
	Chironomus riparius, Midge;	2ND INSTAR LARVAE	48 H	LC_{50}	1200		215023	91
	Chironomus riparius; Midge,	2ND INSTAR LARVAE	96 H	LC_{50}	700		215023	91
	Chironomus riparius; Midge;							

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
Copper (cont.)	Chironomus riparius; Midge;	LARVA–STATE L1	24 H	LC_{50}	3400		215356	89
	Chironomus riparius; Midge,	LARVA–STATE L2	24 H	LC_{50}	9070		215356	89
	Chironomus riparius; Midge;	LARVA–STATE L2	48 H	LC_{50}	3910		215356	89
	Chironomus riparius, Midge;	LARVA–STATE L2	72 H	LC_{50}	1860		215356	89
	Chironomus riparius; Midge;	LARVA–STATE L2	96 H	LC_{50}	1270		215356	89
	Chironomus riparius; Midge;	LARVA–STATE L3	24 H	LC_{50}	13430		215356	89
	Chironomus riparius; Midge;	LARVA–STATE L3	48 H	LC_{50}	4220		215356	89
	Chironomus riparius; Midge;	LARVA–STATE L3	72 H	LC_{50}	1630		215356	89
	Chironomus riparius; Midge,	LARVA–STATE L3	96 H	LC_{50}	1260		215356	89
	Chironomus riparius; Midge;	LARVA–STATE L4	24 H	LC_{50}	8990		215356	89
	Chironomus riparius; Midge;	LARVA–STATE L4	48 H	LC_{50}	2940		215356	89
	Chironomus riparius; Midge;	LARVA–STATE L4	72 H	LC_{50}	1120		215356	89
	Chironomus riparius; Midge;	LARVA–STATE L4	96 H	LC_{50}	640		215356	89
	Chironomus tentans; Midge,	LARVA–STATE L1	24 H	LC_{50}	2700		215356	89
	Chironomus tentans; Midge,	LARVA–STATE L2	24 H	LC_{50}	7100		215356	89
	Chironomus tentans; Midge;	LARVA–STATE L2	48 H	LC_{50}	2400		215356	89
	Chironomus tentans; Midge;	LARVA–STATE L2	72 H	LC_{50}	1350		215356	89
	Chironomus tentans, Midge;	LARVA–STATE L2	96 H	LC_{50}	540		215356	89
	Chironomus tentans, Midge;	LARVA–STATE L3	24 H	LC_{50}	10100		215356	89
	Chironomus tentans, Midge;	LARVA–STATE L3	48 H	LC_{50}	3100		215356	89
	Chironomus tentans; Midge,	LARVA–STATE L3	72 H	LC_{50}	850		215356	89
	Chironomus tentans; Midge;	LARVA–STATE L3	96 H	LC_{50}	550		215356	89
	Chironomus tentans; Midge;	LARVA–STATE L4	24 H	LC_{50}	> 10000		215356	89
	Chironomus tentans; Midge;	LARVA–STATE L4	48 H	LC_{50}	2200		215356	89
	Chironomus tentans; Midge;	LARVA–STATE L4	72 H	LC_{50}	870		215356	89
	Chironomus tentans, Midge;	LARVA–STATE L4	96 H	LC_{50}	310		215356	89
	Chlorella vulgaris; Green algae;	NR	8 D	PGR		10 to 400	311876	83
	Cypris subglobosa; Ostracod;	NR	12 H	LC_{50}	13581		312365	88
	Cypris subglobosa; Ostracod;	NR	24 H	LC_{50}	12200		312365	88
	Cypris subglobosa; Ostracod;	NR	48 H	LC_{50}	5363		312365	88
	Cypris subglobosa; Ostracod,	NR	96 H	LC_{50}	277 3		312365	88
	Daphnia lumholzi; Water flea;	NR	12 H	LC_{50}	83		312365	88
	Daphnia lumholzi, Water flea;	NR	24 H	LC_{50}	67 2		312365	88
	Daphnia lumholzi; Water flea;	NR	48 H	LC_{50}	54 6		312365	88
	Daphnia lumholzi; Water flea;	NR	96 H	LC_{50}	9 4		312365	88
	Daphnia magna; Water flea;	> 24 H	48 H	EC_{50}IM (Calc)		266	310633	84
	Daphnia magna; Water flea;	> 24 H	48 H	EC_{50}IM (Calc)		341	310633	84
	Daphnia magna; Water flea;	<= 24 H	48 H	EC_{50}IM (Calc)		31 8	310529	83
	Daphnia magna; Water flea,	> 24 H	48 H	EC_{50}IM (Calc)		36	310633	84
	Daphnia magna; Water flea;	> 24 H	48 H	EC_{50}IM (Calc)		146	310633	84
	Daphnia magna; Water flea;	> 24 H	48 H	EC_{50}IM (Calc)		55	310633	84
	Daphnia magna; Water flea;	> 24 H	48 H	EC_{50}IM (Calc)		257	310633	84
	Daphnia magna; Water flea;	> 24 H	48 H	EC_{50}IM (Calc)		92.8	310633	84
	Daphnia magna; Water flea,	> 24 H	48 H	EC_{50}IM (Calc)		102	310633	84
	Daphnia magna, Water flea,	> 24 H	48 H	EC_{50}IM (Calc)		96.6	310633	84
	Daphnia magna; Water flea;	> 24 H	48 H	EC_{50}IM (Calc)		207	310633	84
	Daphnia magna, Water flea;	< 24 H	48 H	LC_{50}	54		311181	84
	Daphnia magna; Water flea,	NR	24 H	MOR	772		312372	85
	Daphnia pulex; Water flea,	< 24 H	36 D	LPT	10.1		310453	84

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
Copper (cont.)	Daphnia pulex; Water flea;	< 24 H	42 D	REP *		10.1	310453	84
	Daphnia pulex; Water flea;	< 24 H	48 H	LC_{50}	53		311181	84
	Daphnia pulicaria; Water flea;	NR	48 H	LC_{50}	10.8		215081	78
	Daphnia pulicaria; Water flea;	NR	48 H	LC_{50}	11.4		215081	78
	Daphnia pulicaria; Water flea;	NR	48 H	LC_{50}	113		215081	78
	Daphnia pulicaria; Water flea;	NR	48 H	LC_{50}	165		215081	78
	Daphnia pulicaria; Water flea;	NR	48 H	LC_{50}	184		215081	78
	Daphnia pulicaria; Water flea;	NR	48 H	LC_{50}	199		215081	78
	Daphnia pulicaria; Water flea;	NR	48 H	LC_{50}	213		215081	78
	Daphnia pulicaria; Water flea;	NR	48 H	LC_{50}	240		215081	78
	Daphnia pulicaria; Water flea;	NR	48 H	LC_{50}	35.5		215081	78
	Daphnia pulicaria; Water flea;	NR	48 H	LC_{50}	53.3		215081	78
	Daphnia pulicaria; Water flea;	NR	48 H	LC_{50}	55.3		215081	78
	Daphnia pulicaria; Water flea;	NR	48 H	LC_{50}	55.4		215081	78
	Daphnia pulicaria; Water flea;	NR	48 H	LC_{50}	627		215081	78
	Daphnia pulicaria; Water flea;	NR	48 H	LC_{50}	7.24		215081	78
	Daphnia pulicaria; Water flea;	NR	48 H	LC_{50}	76.4		215081	78
	Daphnia pulicaria; Water flea;	NR	48 H	LC_{50}	78.8		215081	78
	Daphnia pulicaria; Water flea;	NR	48 H	LC_{50}	84.7		215081	78
	Daphnia pulicaria; Water flea;	NR	48 H	LC_{50}	9.06		215081	78
	Daphnia pulicaria; Water flea;	NR	48 H	LC_{50}	9.3		215081	78
	Daphnia pulicaria; Water flea;	NR	48 H	LC_{50}	97.2		215081	78
	Daphnia pulicaria; Water flea;	NR	48 H	LC_{50}		20 to 200	310581	91
	Dugesia dorotocephala; Turbellarian, flatworm;	18–20 MM	1 H	BEH *			218709	74
	Dugesia tigrina; Turbellarian, flatworm;	NR	96 H	LC_{50}	2,450		218344	78
	Elodea nuttallii; Waterweed, ditchmoss;	NR	14 D	LT50 (Calc)	6,000		315578	78
	Gambusia affinis; Mosquitofish;	NR	12 H	LC_{50} ?	49		315578	78
	Gambusia affinis; Mosquitofish;	NR	133 D	MOR *	3.2		313098	88
	Gambusia affinis; Mosquitofish;	NR	48 H	MOR *	160		315578	78
	Gammarus lacustris; Scud;	NR	96 H	LC_{50} ?	56		311804	83
	Gammarus lacustris; Scud;	ADULT	0.12 H	BEH		0.05 to 5000	313058	88
	Gammarus pulex; Scud;	NR	96 H	LC_{50}	212		215023	91
	Gammarus pulex; Scud;	JUVENILE, 2–3 MOLT, 3–5 MM	240 H	LC_{50}	33		215023	91
	Gammarus pulex; Scud;	JUVENILE, 2–3 MOLT, 3–5 MM	48 H	LC_{50}	47		215023	91
	Gammarus pulex; Scud;	JUVENILE, 2–3 MOLT, 3–5 MM	96 H	LC_{50}	37		215023	91
	Gnathonemus petersii, Electric fish;	JUVENILE, 5–20 G	4 H	PHY *		500	310685	84
	Invertebrates; Invertebrates;	MACRO–INVERTEBRATES	14 D	BEH *		5.5	213398	89
	Invertebrates; Invertebrates;	MACROINVERTEBRATES	10 D	LC_{50}	15		210388	89
	Invertebrates; Invertebrates;	MACROINVERTEBRATES	10 D	LC_{50}	6		210388	89
	Invertebrates; Invertebrates;	MACROINVERTEBRATES	4 D	LC_{50}	14		210388	89
	Invertebrates; Invertebrates;	MACROINVERTEBRATES	4 D	LC_{50}	26		210388	89
	Lamellidens marginalis; Mussel;	5.0–6.0 CM	1 to 30 D	GRO		250 to 1000	213776	91
	Lamellidens marginalis; Mussel;	5.0–6.0 CM	1 to 30 D	OC		250 to 1000	213776	91
	Lamellidens marginalis; Mussel;	5.0–6.0 CM	96 H	LC_{50}	5,000		213776	91
	Lamellidens marginalis; Mussel;	7 CM	to 9.75 H	PHY *		250 to 1000	213311	89
	Lamellidens marginalis; Mussel;	NR	96 H	LC_{50}	5,000		213311	89
	Lemna minor; Duckweed;	NR	96 H	LC_{50}	5,000		213875	91
	Lemna minor; Duckweed;	20 COLONIES OR 40 FRONDS	4 D	EC_{50}GR		1,100	311789	86
	Lepomis macrochirus; Bluegill;	NR	21 D	LT50 (Calc)	6,000		218344	78
		5.3–7.2 CM, 3.5–3.9 G	96 H	LC_{50}	1,250		212406	68

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
Copper (cont)	Lepomis macrochirus; Bluegill,	NR	4 D	BEH		36 to 130	212858	89
	Lepomis macrochirus; Bluegill;	NR	NR	BEH		25 to 1800	212858	89
	Lophopodella carteri; Bryozoa;	ANCENSTRULAE, 2–3 DAYS	96 H	LC_{50}	510		216703	80
	Macrobrachium hendersodayanus; Prawn;	NR	96 H	OC *		1,750	311545	84
	Myriophyllum spicatum; Water–milfoil;	4 CM APEX	32 D	EC_{50}BM *		250	212262	74
	Myriophyllum spicatum, Water–milfoil;	4 CM APEX	32 D	EC_{50}BM *		380	212262	74
	Myriophyllum spicatum; Water–milfoil,	4 CM APEX	32 D	EC_{50}GR *		1,500	212262	74
	Myriophyllum spicatum; Water–miltoil;	4 CM APEX	32 D	EC_{50}GR *		700	212262	74
	Oncorhynchus kisutch; Coho salmon, silver salmon,	JUVENILE, 6 G	96 H	LC_{50}	164 ; 17		310541	83
	Oncorhynchus mykiss; Rainbow trout, donaldson trout,	11 CM, 13 G	96 H	LC_{50} ?	250		212122	72
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	32 MM, 0.36 G	15 H *	MOR *	200		218499	74
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	32 MM, 0 36 G	16.67 H *	MOR *	200		218499	74
	Oncorhynchus mykiss, Rainbow trout, donaldson trout;	32 MM, 0.36 G	24 H	LC_{50}	130		218499	74
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	32 MM, 0 36 G	24 H	LC_{50}	140		218499	74
	Oncorhynchus mykiss, Rainbow trout, donaldson trout;	32 MM, 0.36 G	4.33 H *	MOR *	2,000		218499	74
	Oncorhynchus mykiss, Rainbow trout, donaldson trout,	32 MM, 0.36 G	5.5 H *	MOR *	2,000		218499	74
	Oncorhynchus mykiss, Rainbow trout, donaldson trout,	55.5 G	40 D	GRO *		225	218386	76
	Oncorhynchus mykiss, Rainbow trout, donaldson trout,	6–8 G	48 H	HEM *		30	219917	80
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	75–100 G	48 H	MOR *	85		315401	82
	Oncorhynchus mykiss, Rainbow trout, donaldson trout;	75–100 G	8 H	PHY *		170	315401	82
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	FINGERLING, 0 2 G	1 WK	MOR *	4.0		315625	79
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	FINGERLING, 0.2 G	1 WK	MOR *	5.8		315625	79
	Oncorhynchus mykiss; Rainbow trout, donaldson trout,	FINGERLING, 0 2 G	1 WK	MOR *	9 6		315625	79
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	FINGERLING, 0.2 G	7 D	PHY *		4 0	315625	79
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	FINGERLING, 0.25 G	1 WK	MOR *	5.1		315625	79
	Oncorhynchus mykiss: Rainbow trout, donaldson trout;	FINGERLING, 0.25 G	1 WK	MOR *	9.5		315625	79
	Oncorhynchus mykiss; Rainbow trout, donaldson trout,	FINGERLING, 0 25 G	7 D	PHY *		2 1	315625	79
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	FINGERLING, 0 25 G	7 D	PHY *		3.9	315625	79
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	FINGERLING, 0 6 G	7 D	PHY *		6	315625	79
	Oncorhynchus mykiss; Rainbow trout. donaldson trout;	NR	13 MO	MOR *	10		212122	72
	Oncorhynchus mykiss; Rainbow trout, donaldson trout,	NR	13 MO	MOR *	19		212122	72
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	NR	48 H	LC_{50}	400		218317	68
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	NR	48 H	LC_{50}	500		218317	68
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	SAC–FRY	42 D	GRO * (Calc)		3	310527	83
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	SAC–FRY	42 D	MOR *	17		310527	83
	Oncorhynchus mykiss; Rainbow trout, donaldson trout,	SAC–FRY	42 D	MOR *	31		310527	83
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	SAC–FRY	42 D	MOR * (Calc)	10		310527	83
	Oncorhynchus mykiss, Rainbow trout, donaldson trout,	ADULT GUPPY, 20–30 MM	48 H	LC_{50}	21		212882	88
	Osteichthyes, Bony fish class;	ADULT GUPPY, 20–30 MM	96 H	LC_{50}	16		212882	88
	Osteichthyes; Bony fish class,	JUVENILE GUPPY, 8–15 MM	48 H	LC_{50}	14		212882	88
	Osteichthyes, Bony fish class;	JUVENILE GUPPY, 8–15 MM	96 H	LC_{50}	8 7		212882	88
	Osteichthyes; Bony fish class,	ANCENSTRULAE, 2–3 DAYS	96 H	LC_{50}	140		216703	80
	Pectinatella magnifica, Bryozoa;	EMBRYO, 1 D	30 D	GRO *		221 8	215081	78
	Pimephales promelas; Fathead minnow;	NEWLY HAT, < 24 H	7 D	GRO *		9.89	311182	85
	Pimephales promelas; Fathead minnow;	NEWLY HAT, < 24 H	7 D	GRO *		25.8	311182	85
	Pimephales promelas; Fathead minnow;	NEWLY HAT, < 24 H	7 D	LC_{50}	70		311182	85
	Pimephales promelas; Fathead minnow,	NR	96 H	LC_{50}	1,129		215081	78
	Pimephales promelas, Fathead minnow;	NR	96 H	LC_{50}	114		215081	78
	Pimephales promelas; Fathead minnow;	NR	96 H	LC_{50}	2,336		215081	78
	Pimephales promelas; Fathead minnow;							

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
Copper (cont.)	Pimephales promelas; Fathead minnow;	NR	96 H	LC_{50}	121		215081	78
	Pimephales promelas, Fathead minnow;	NR	96 H	LC_{50}	1,001		215081	78
	Pimephales promelas; Fathead minnow,	NR	96 H	LC_{50}	550		215081	78
	Pimephales promelas, Fathead minnow;	NR	96 H	LC_{50}	2,050		215081	78
	Pimephales promelas; Fathead minnow;	NR	96 H	LC_{50}	436		215081	78
	Pimephales promelas, Fathead minnow;	NR	96 H	LC_{50}	516		215081	78
	Pimephales promelas; Fathead minnow,	NR	96 H	LC_{50}	88.5		215081	78
	Pimephales promelas; Fathead minnow;	NR	96 H	LC_{50}	1,586		215081	78
	Pimephales promelas, Fathead minnow;	20–69 MM	96 H	LC_{50} ?	5,600		218320	76
	Pimephales promelas, Fathead minnow;	20–69 MM	96 H	LC_{50} ?	20,000		218320	76
	Pimephales promelas, Fathead minnow;	20–69 MM	96 H	LC_{50} ?	21,000		218320	76
	Pimephales promelas; Fathead minnow;	20–69 MM	96 H	LC_{50} ?	21,000		218320	76
	Pimephales promelas, Fathead minnow;	20–69 MM	96 H	LC_{50} ?	> 16,000		218320	76
	Pimephales promelas, Fathead minnow,	20–69 MM	96 H	LC_{50} ?	20,000		218320	76
	Pimephales promelas; Fathead minnow,	20–69 MM	96 H	LC_{50} ?	21,000		218320	76
	Pimephales promelas; Fathead minnow,	EMBRYO, 1 D	30 D	MOR *	221 8		215081	78
	Plumatella emargmata, Bryozoan;	ANCENSTRULAE, 2–3 DAYS	96 H	LC_{50}	140		216703	80
	Poecilia reticulata, Guppy,	JUVENILE	96 H	LC_{50}	112		212010	76
	Poecilia reticulata; Guppy;	JUVENILE	96 H	LC_{50}	138		212010	76
	Procambarus clarkii, Red swamp crayfish;	ADULT, 24.8 G, 9.3 CM	1045 H	LC_{50}	890		311758	83
	Procambarus clarkii; Red swamp crayfish,	ADULT, 24 8 G, 9.3 CM	1227 H	LC_{50}	776		311758	83
	Procambarus clarkii; Red swamp crayfish;	ADULT, 24 8 G, 9.3 CM	1358 H	LC_{50}	657		311758	83
	Procambarus clarkii, Red swamp crayfish;	ADULT, 24.8 G, 9.3 CM	146 H	LC_{50}	3,024		311758	83
	Procambarus clarkii, Red swamp crayfish;	ADULT, 24.8 G, 9.3 CM	246 H	LC_{50}	2,330		311758	83
	Procambarus clarkii, Red swamp crayfish;	ADULT, 24.8 G, 9.3 CM	342 H	LC_{50}	1,780		311758	83
	Procambarus clarkii; Red swamp crayfish;	ADULT, 24 8 G, 9.3 CM	453 H	LC_{50}	1,520		311758	83
	Procambarus clarkii; Red swamp crayfish;	ADULT, 24.8 G, 9.3 CM	49 H	LC_{50}	11,000		311758	83
	Procambarus clarkii, Red swamp crayfish;	ADULT, 24.8 G, 9.3 CM	549 H	LC_{50}	1,380		311758	83
	Procambarus clarkii; Red swamp crayfish,	ADULT, 24.8 G, 9.3 CM	622 H	LC_{50}	1,190		311758	83
	Procambarus clarkii; Red swamp crayfish;	ADULT, 24.8 G, 9.3 CM	72 H	LC_{50}	8,100		311758	83
	Procambarus clarkii; Red swamp crayfish;	ADULT, 24.8 G, 9 3 CM	734 H	LC_{50}	1,150		311758	83
	Procambarus clarkii; Red swamp crayfish,	ADULT, 24.8 G, 9.3 CM	843 H	LC_{50}	1,090		311758	83
	Procambarus clarkii; Red swamp crayfish,	ADULT, 24.8 G, 9.3 CM	945 H	LC_{50}	1,000		311758	83
	Procambarus clarkii; Red swamp crayfish:	EMBRYO	1147 H	LC_{50}	206		311758	83
	Procambarus clarkii; Red swamp crayfish;	EMBRYO	1267 H	LC_{50}	184		311758	83
	Procambarus clarkii; Red swamp crayfish,	EMBRYO	436 H	LC_{50}	3,350		311758	83
	Procambarus clarkii; Red swamp crayfish;	EMBRYO	598 H	LC_{50}	1,700		311758	83
	Procambarus clarkii; Red swamp crayfish,	EMBRYO	855 H	LC_{50}	1,140		311758	83
	Procambarus clarkii; Red swamp crayfish;	EMBRYO	903 H	LC_{50}	716		311758	83
	Procambarus clarkii; Red swamp crayfish,	EMBRYO	927 H	LC_{50}	556		311758	83
	Procambarus clarkii; Red swamp crayfish;	LARVAE	12 H	LC_{50}	4,170		311758	83
	Procambarus clarkii, Red swamp crayfish;	LARVAE	140 H	LC_{50}	527		311758	83
	Procambarus clarkii, Red swamp crayfish;	LARVAE	24 H	LC_{50}	1,990		311758	83
	Procambarus clarkii; Red swamp crayfish;	LARVAE	247 H	LC_{50}	242		311758	83
	Procambarus clarkii, Red swamp crayfish;	LARVAE	344 H	LC_{50}	199		311758	83
	Procambarus clarkii; Red swamp crayfish;	LARVAE	456 H	LC_{50}	146		311758	83
	Procambarus clarkii, Red swamp crayfish;	LARVAE	48 H	LC_{50}	1,350		311758	83
	Procambarus clarkii, Red swamp crayfish;	LARVAE	504 H	LC_{50}	67		311758	83
	Procambarus clarkii; Red swamp crayfish;	LARVAE	98 H	LC_{50}	720		311758	83

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
Copper (cont)	Salmo salar, Atlantic salmon;	2–3 YR	96 H	LC_{50}	125		212068	72
	Salmo trutta; Brown trout;	78 G, 3RD YR CLASS	53 D	HIS *		15	310527	83
	Salvelinus fontinalis; Brook trout;	YEARLING, 14–16 CM, 30–42 G *	720 D	GRO *		9.4	218397	74
	Salvelinus fontinalis; Brook trout;	YEARLING, 14–16 CM, 30–42 G *	720 D	HAT *		9 4	218397	74
	Salvelinus fontinalis; Brook trout;	YEARLING, 14–16 CM, 30–42 G *	720 D	MOR *	9 4		218397	74
	Salvelinus fontinalis; Brook trout;	YEARLING, 14–16 CM, 30–42 G *	720 D	REP *		9 4	218397	74
	Simocephalus vetulus; Water flea;	< 24 H	48 H	LC_{50}	57		311181	84
Cyanide	Carassius auratus, Goldfish;	39–60 MM	0.17 H	AVO		20,000	215692	76
	Dugesia tigrina; Turbellarian, flatworm	NR	96 H	LC_{50}	19,400		218709	74
	Gnathonemus petersii, Electric fish	JUVENILE, 5–20 G	4 H	PHY *		100	310685	84
	Lepomis macrochirus; Bluegill;	NR	96 H	LC_{50} ?	180		210949	68
	Myriophyllum spicatum, Water–milfoil	4 CM, APEX	32 D	$EC_{50}BM$ *		20,000	212262	74
	Myriophyllum spicatum, Water–milfoil	4 CM, APEX	32 D	$EC_{50}BM$ *		22,400	212262	74
	Myriophyllum spicatum; Water–milfoil	4 CM, APEX	32 D	$EC_{50}GR$ *		27,300	212262	74
	Myriophyllum spicatum; Water–milfoil	4 CM, APEX	32 D	$EC_{50}GR$ *		28,600	212262	74
	Physella heterostropha; Snail	NR	96 H	LC_{50} ?	432		210949	68
Iron	Dugesia dorotocephala, Turbellarian, flatworm;	18–20 MM	1 H	BEH *		1,000 to 50,000	310581	91
	Lemna minor; Duckweed;	20 COLONIES OR 40 FRONDS	4 D	$EC_{50}GR$		3,700	311789	86
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	EGGS AND LARVA	NR	DVP *		5,700	315523	82
	Salmo trutta, Brown trout;	ALEVIN	NR	MOR *	5,170		311637	83
	Salmo trutta; Brown trout;	EGG	NR	HAT *		460	311637	83
	Salmo trutta, Brown trout;	EYED EGGS	NR	MOR *	5,170		311637	83
	Salmo trutta; Brown trout,	NEWLY HAT ALEVIN	NR	MOR *	3,020		311637	83
	Tilapia sparrmanii; Banded bream;	10 24–99.43 G	2 to 72 H	OC *		88,000	213066	89
Lead	Astacus astacus; European crayfish;	8–10 CM	2 WK	ENZ *		20	210376	91
	Astacus astacus, European crayfish;	8–10 CM	to 10 WK	HIS		20	210376	91
	Barbus arulius; Barb;	1 24 G	4 D	HIS		200,000 to 400,000	219972	87
	Brachionus calyciflorus; Rotifer;	NEONATE	24 H	LC_{50}	> 4,000		219385	91
	Brachydanio rerio; Zebra danio, zebrafish;	DECHLORIONATED EGG	24 H			72	219870	80
	Brachydanio rerio, Zebra danio, zebrafish;	EGG	48 H			72	219870	80
	Bufo arenarum; Toad;	EMBRYO	24 H	DVP *		1,000	213162	90
	Bufo arenarum; Toad;	EMBRYO	24 H	MOR *	1,000		213162	90
	Carassius auratus, Goldfish;	UNDERYEARLING	1 WK *	ENZ *		470	315460	77
	Ceriodaphnia reticulata; Water flea;	< 4 H	48 H	LC_{50}	530		311181	84
	Daphnia magna; Water flea,	< 24 H	48 H	LC_{50}	4,400		311181	84
	Daphnia pulex, Water flea;	< 24 H	48 H	LC_{50}	5,100		311181	84
	Dugesia dorotocephala; Turbellarian, flatworm;	18–20 MM	1 H	BEH *		100 to 1,000	310581	91
	Dugesia tigrina; Turbellarian, flatworm;	NR	96 H	LC_{50}	160,000		218709	74
	Hyalella azteca; Scud,	NR	5 D	LC_{100}	5,000		219804	80
	Lemna minor; Duckweed;	20 COLONIES OR 40 FRONDS	4 D	$EC_{50}GR$		8,000	311789	86
	Lepomis gibbosus; Pumpkinseed,	> 1 75 YR	<=2 WK *	ENZ *		90	315460	77
	Micropterus dolomieui; Smallmouth bass,	EGG	96 H	MOR *	<=15,900		312153	86
	Micropterus dolomieui; Smallmouth bass;	FINGERLING	10 WK	LOC *		405	312153	86
	Micropterus dolomieui; Smallmouth bass;	FINGERLING	90 D	GRO *		405	312153	86
	Micropterus dolomieui; Smallmouth bass;	FINGERLING	90 D	HEM *		405	312153	86
	Micropterus dolomieui; Smallmouth bass;	FINGERLING	96 H	LC_{50}	29,000		312153	86

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
Lead (cont.)	Micropterus dolomieui; Smallmouth bass;	SAC FRY, 7 D POST–SPAWN	96 H	MOR *	<=15,900		312153	86
	Micropterus dolomieui; Smallmouth bass;	SWIM–UP FRY, 17 D POST–SPAWN	96 H	LC_{50}	2,800		312153	86
	Micropterus dolomieui, Smallmouth bass,	SWIM–UP, FRY 17 D POST–SPAWN	96 H	LC_{50}	2,200		312153	86
	Micropterus salmoides; Largemouth bass;	NR	24 H	BEH *		1,500	311127	78
	Micropterus salmoides; Largemouth bass;	NR	24 H	RES *		1,050	311127	78
	Myriophyllum spicatum, Water–milfoil,	4 CM APEX	32 D	EC_{50}BM *		363,000	212262	74
	Myriophyllum spicatum: Water–milfoil,	4 CM APEX	32 D	EC_{50}BM *		808,000	212262	74
	Myriophyllum spicatum, Water–milfoil;	4 CM APEX	32 D	EC_{50}GR *		725,000	212262	74
	Myriophyllum spicatum; Water–milfoil;	4 CM APEX	32 D	EC_{50}GR *		767,000	212262	74
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	10.5 G	32 WK	HIS *			310573	83
	Oncorhynchus mykiss, Rainbow trout, donaldson trout,	15 G	24 H	HEM *		130	315719	78
	Oncorhynchus mykiss, Rainbow trout, donaldson trout,	4 MO, 15 G	4 to 72 H	MOR *	110		315719	78
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	4 MO, 15 G	4 to 72 H	MOR *	120		315719	78
	Oncorhynchus mykiss, Rainbow trout, donaldson trout,	4 MO, 15 G	4 to 72 H	MOR *	120		315719	78
	Oncorhynchus mykiss, Rainbow trout, donaldson trout;	4 MO, 15 G	4 to 72 H	MOR *	210		315719	78
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	4 MO, 15 G	4 to 72 H	MOR *	300		315719	78
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	4 MO, 15 G	4 to 72 H	MOR *	470		315719	78
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	4 MO, 15 G	4 to 72 H	MOR *	490		315719	78
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	4 MO, 15 G	4 to 72 H	MOR *	500		315719	78
	Oncorhynchus mykiss, Rainbow trout, donaldson trout;	4 MO, 15 G	4 to 72 H	MOR *	52		315719	78
	Oncorhynchus mykiss; Rainbow trout, donaldson trout,	4 MO, 15 G	4 to 72 H	MOR *	53		315719	78
	Oncorhynchus mykiss, Rainbow trout, donaldson trout;	4 MO, 15 G	4 to 72 H	MOR *	740		315719	78
	Oncorhynchus mykiss; Rainbow trout, donaldson trout,	4 MO, 15 G	4 to 72 H	MOR *	80		315719	78
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	4 MO, 15 G	4 to 72 H	MOR *	85		315719	78
	Oncorhynchus mykiss, Rainbow trout, donaldson trout;	4 MO, 15 G	4 to 72 H	MOR *	900		315719	78
	Oncorhynchus mykiss, Rainbow trout, donaldson trout;	4 MO, 15 G	4 to 72 H	MOR *	910		315719	78
	Oncorhynchus mykiss, Rainbow trout, donaldson trout;	53 G	1 WK	MOR *	1,000		315719	78
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	6–18 MO	<=2 WK *	ENZ *		10	315460	77
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	6.5 G	30 WK	HIS *		120	310573	83
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	NEWLY HAT, SAC FRY	189 D	ABN *		32	219830	80
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	NEWLY HAT, SAC FRY	189 D	ENZ *		100	219830	80
	Oncorhynchus mykiss, Rainbow trout, donaldson trout;	NEWLY HAT, SAC FRY	189 D	HEM *		100	219830	80
	Pimephales promelas, Fathead minnow;	JUVENILE	4 WK	PHY		500 to 1,000	210204	89
	Potamogeton crispus; Curled pondweed;	NR	NR	PSE *		25,000	217552	77
	Salvelinus fontinalis, Brook trout;	6–18 MO	<=2 WK *	ENZ *		90	315460	77
	Simocephalus vetulus, Water flea,	< 24 H	48 H	LC_{50}	4,500		311181	84
Manganese	Algae, Algae, phytoplankton, algal mat,	NATURAL COLONY	38 D	POP *		280	212862	69
	Anabolia nervosa; Quiver fly;	LARVAE	7 D	LET	2,000,000		210725	57
	Chironomus thummi; Midge;	LARVAE	7 D	LET	1,000,000		210725	57
	Cyprinidae; Minnow, carp family;	1 SUMMER	2.25 H	LET *	1,000,000		210725	57
	Cyprinidae; Minnow, carp family;	1 SUMMER	24 H	LET *	2,000,000		210725	57
	Cyprinidae; Minnow, carp family;	1 SUMMER	25 H	LET *	1,800,000		210725	57
	Cyprinidae; Minnow, carp family;	1 SUMMER	4.17 D	LET *	800,000		210725	57
	Cyprinidae; Minnow, carp family,	1 SUMMER	5.13 D	LET *	700,000		210725	57
	Cyprinidae; Minnow, carp family;	1 SUMMER	6.63 D	LET *	650,000		210725	57
	Cyprinidae; Minnow, carp family,	1 SUMMER	7 D	MOR *	600,000		210725	57
	Cyprinidae, Minnow, carp family,	1 SUMMER	78 H	LET *	900,000		210725	57
	Cyprinidae; Minnow, carp family,	2 SUMMERS	48 H	LET *	2,000,000		210725	57

Table A–15
AQUIRE Freshwater Toxicity Information
Units = µg/L

Remedial Investigation
Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field
Jacksonville, Florida

Chemical Name	Species	Age	Exposure	Effect	Effect Concentration		AQUIRE Reference Number	Year of Publication
					Lethal	Sublethal		
Manganese (cont.)	Gammarus roeseli, Scud;	NR	7 D	LET	70,000		210725	57
	Lemna minor; Duckweed;	20 COLONIES OR 40 FRONDS	4 D	EC_{50}GR		31,000	311789	86
	Oncorhynchus mykiss, Rainbow trout, donaldson trout;	1 SUMMER	10 H	LET *	700,000		210725	57
	Oncorhynchus mykiss, Rainbow trout, donaldson trout;	1 SUMMER	13 H	LET *	600,000		210725	57
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	1 SUMMER	34 H	LET *	300,000		210725	57
	Oncorhynchus mykiss, Rainbow trout, donaldson trout,	1 SUMMER	5 D	LET *	100,000		210725	57
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	1 SUMMER	7 D	MOR *	75,000		210725	57
	Oncorhynchus mykiss, Rainbow trout, donaldson trout,	1 SUMMER	77 H	LET *	150,000		210725	57
	Oncorhynchus mykiss; Rainbow trout, donaldson trout;	2 SUMMERS	34 H	LET *	600,000		210725	57
	Salvelinus fontinalis; Brook trout,	1 SUMMER	15 H	LET *	700,000		210725	57
	Salvelinus fontinalis; Brook trout;	1 SUMMER	23 H	LET *	600,000		210725	57
	Salvelinus fontinalis; Brook trout;	1 SUMMER	4.79 D	LET *	150,000		210725	57
	Salvelinus fontinalis; Brook trout;	1 SUMMER	66 H	LET *	300,000		210725	57
	Salvelinus fontinalis; Brook trout;	1 SUMMER	7 D	MOR *	100,000		210725	57
	Salvelinus fontinalis, Brook trout;	2 SUMMERS	41 H	LET *	600,000		210725	57
	Tinca tinca; Tench;	1 SUMMER	48 H	LET *	2,000,000		210725	57
	Tinca tinca, Tench;	1 SUMMER	6.75 D	LET *	1,500,000		210725	57
	Tinca tinca; Tench;	1 SUMMER	7 D	MOR *	1,200,000		210725	57
	Tinca tinca; Tench,	1 SUMMER	7 D	MOR *	1,300,000		210725	57
	Tinca tinca; Tench;	1 SUMMER	96 H	LET *	1,800,000		210725	57
	Tinca tinca; Tench;	2 SUMMERS	7 D	LET *	2,000,000		210725	57
	Tubifex tubifex; Tubificid worm;	NR .	7 D	LET	700,000		210725	57
Silver	Brachionus calyciflorus, Rotifer	NEONATE	24 H	LC_{50}	7.5		219385	91
	Ceriodaphnia reticulata; Water flea	< 4 H	48 H	LC_{50}	11		311181	84
	Daphnia pulex; Water flea	< 24 H	48 H	LC_{50}	14		311181	84
	Simocephalus vetulus; Water flea	< 24 H	48 H	LC_{50}	15		311181	84
Thallium	Caenorhabditis elegans; Nematode	ADULT, 3–4 D	24 H	LC_{50}	>200,000		1121305	90
	Caenorhabditis elegans; Nematode	ADULT, 3–4 D	48 H	LC_{50}	194000		1121306	90
	Caenorhabditis elegans; Nematode	ADULT, 3–4 D	72 H	LC_{50}	172000		1121307	90
	Caenorhabditis elegans; Nematode	ADULT, 3–4 D	96 H	LC_{50}	123000		1121308	90
	Crangon crangon; Common shrimp	ADULT	96 H	LC_{50}	10000		1125254	71
	Cyprinodon variegatus; Sheepshead minnow	8–15 MM, 14–28 D	24 H	LC_{50}	>45,000		1126432	81
	Cyprinodon variegatus; Sheepshead minnow	8–15 MM, 14–28 D	48 H	LC_{50}	>26,000 to <45,000		1126433	81
	Cyprinodon variegatus; Sheepshead minnow	8–15 MM, 14–28 D	96 H	LC_{50}	21,000		1126434	81
	Dunaliella tertiolecta; Green algae	NR	NR	GRO [Growth] *		82	1078710	88
	Dunaliella tertiolecta; Green algae	NR	NR	GRO [Growth] *		184	1078711	88
	Mysidopsis bahia, Opossum shrimp	NR	96 H	LC_{50}	2,130		1123480	78
	Phaeodactylum tricornutum, Diatom	NR	NR	GRO [Growth] *		143	1078706	88
	Phaeodactylum tricornutum; Diatom	NR	NR	GRO [Growth] *		225	1078709	88
	Selenastrum capricornutum; Green algae	NR	24 H	CLR [Chlorophyll] *		>320	1123476	78
	Selenastrum capricornutum, Green algae	NR	48 H	CLR [Chlorophyll] *		>320	1123477	78
	Selenastrum capricornutum; Green algae	NR	96 H	CLR [Chlorophyll] *		140	1123478	78
	Selenastrum capricornutum, Green algae	NR	96 H	PGR [Population growth]		130	1123479	78
Vanadium oxide sulfate	Carassius auratus; Goldfish	3–5 CM, 0.3–2.9 G	6 D	LC_{50}	1,020		228999	79
	Lepomis macrochirus, Bluegill	NR	96 H	LC_{50}	6,000		287133	60
	Pimephasles promelas; Fathead minnow	NR	96 H	LC_{50}	4,800		287131	60

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APPENDIX B

APPENDIX B

RISK ASSESSMENT CALCULATIONS

SITE 14

TABLE B 14.1

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT RESIDENT
SITE 14, OPERABLE UNIT 5
NAS, CECIL FIELD
EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	100	mg/day	USEPA, 1995
FRACTION INGESTED	FI	100%	unitless	USEPA, 1995
ADHERENCE FACTOR	AF	1	mg/cm²-event	USEPA, 1995
ABSORPTION FRACTION	ABS_d	chemical-specific	unitless	USEPA, 1995
SURFACE AREA EXPOSED	SA	5,750	cm²	USEPA, 1992
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm²-event	USEPA, 1992
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	350	days/year [1]	Assumption
EXPOSURE DURATION	ED	24	years	USEPA, 1995
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	24	years	USEPA, 1995

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose.

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285 6-03

USEPA, 1992. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January 1992.

USEPA, 1995 Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE_{-INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE_{-DERMAL} = \frac{DA_{event} \times SA \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

$$DA_{event} = CS \times AF \times ABS_d \times CF$$

Note: For noncarcinogenic effects, AT = ED.

TABLE B.14.1

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT RESIDENT
SITE 14, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] (mg/kg-day)$^{-1}$	CANCER RISK INGESTION	DERMAL ABS [2]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [3] (mg/kg-day)$^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
No carcinogenic CPCs											
SUMMARY CANCER RISK						0E+00				0E+00	0E+00

[1]Relative potency factors were applied to the CSFs for carcinogenic PAHs Relative potency factors are derived in "Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons," USEPA, 1993.
[2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (Supplemental Guidance to RAGS: Region IV, Human Health Risk Assessment Bulletin No. 3, 1995).
[3] Calculated from oral CSFs.

TABLE B.14 1

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT RESIDENT
SITE 14, OPERABLE UNIT 5
NAS, CECIL FIELD
NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Aluminum	I	8510	mg/kg	1.2E-02	1.0E+00	1.2E-02	0.001	6.7E-04	2.0E-01	3.4E-03	1.5E-02
Iron	I	2480	mg/kg	3.4E-03	3.0E-01	1.1E-02	0.001	2.0E-04	6.0E-03	3.3E-02	4.4E-02
Total Petroleum Hydrocarbons	O	93000	ug/kg	1.3E-04	3.0E-02	4.2E-03	0.01	7.3E-05	2.7E-02	2.7E-03	7.0E-03
SUMMARY HAZARD INDEX						3E-02				4E-02	7E-02

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (February 10, 1992).
[2] Calculated from oral RfDs.
ND = no data available

TABLE B.14.2

INHALATION OF PARTICULATES - SURFACE SOIL
ADULT RESIDENT
SITE 14, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1.24E+09	m^3/kg	default [1]
CONCENTRATION AIR	CA	chemical-specific	mg/m^3	
INHALATION RATE	IR	0.833	$m^3/hour$	USEPA, 1995
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE TIME	ET	24	hours/day	Assumption
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1995
EXPOSURE DURATION	ED	24	years	USEPA, 1995
CONVERSION FACTOR	CF	0.001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	24	years	USEPA, 1995

[1] PEF has been derived in the PEF Appendix to this report (default FDEP value)

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.

USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / INHALATION REFFRENCE DOSE (mg/kg-day)

$$\text{INTAKE} = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

CA = C x CF x (1/PEF)

Note:

For noncarcinogenic effects: AT = ED

TABLE B.14.2

INHALATION OF PARTICULATES - SURFACE SOIL
ADULT RESIDENT
SITE 14, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION CSF (mg/kg-day)-1	CANCER RISK
No carcinogenic CPCs							
SUMMARY CANCER RISK							0E+00

ND = no data available.

TABLE B.14.2

INHALATION OF PARTICULATES - SURFACE SOIL
ADULT RESIDENT
SITE 14, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Aluminum	I	8510	mg/kg	6.86E-06	1.9E-06	ND	
Iron	I	2480	mg/kg	2.00E-06	5.5E-07	ND	
Total Petroleum Hydrocarbons	O	93000	ug/kg	7.50E-08	2.1E-08	ND	
						SUMMARY HAZARD INDEX	0E+00

ND = no data available.

TABLE B.14.3

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
CHILD RESIDENT
SITE 14, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	200	mg/day	USEPA, 1995
FRACTION INGESTED	FI	100%	unitless	USEPA, 1995
ADHERENCE FACTOR	AF	1	mg/cm²-event	USEPA, 1995
AGE-SPECIFIC SURFACE AREA	SA	age-specific	cm²	USEPA, 1989
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1995
CONVERSION FACTOR	CF	1 00E-06	kg/mg	Inorganic conversion
CONVERSION FACTOR	CF	1 00E-09	kg/ug	Organic conversion
BODY WEIGHT	BW	15	kg	USEPA, 1991
AGE-SPECIFIC BODY WEIGHT	BW	age-specific	kg	USEPA, 1989
EXPOSURE FREQUENCY	EF	350	days/year [1]	USEPA, 1995
EXPOSURE DURATION	ED	6	years	USEPA, 1995
AGE-SPECIFIC EXPOSURE DURATION	ED	age-specific	years	Assumption
AGE-WEIGHTED SURFACE AREA [2]	$SA_{soil/adj}$	766	cm²-year/kg	USEPA, 1992
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm²-event	USEPA, 1992
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	6	years	USEPA, 1995

[1] Units for exposure frequency are in events/year in the calculation of the dermally absorbed dose

[2] In estimating the dermally absorbed dose for children age1 through 6, the time-weighted, bodyweight normalized surface area exposed is calculated from surface area, exposure duration, and body weight for each of 6 age periods, age 1 through 6, per USEPA, 1992.

USEPA, 1989 Exposure Factors Handbook,EPA/600/8-89/043, May 1989.

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors", OSWER Directive 9285.6-03.

USEPA, 1992 Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January 1992.

USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No 3.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE_{-INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE_{-DERMAL} = (DA_{event} \times EF / AT \times 365\ days/year) \times SA_{soil/adj}$$

Where:

$SA_{soil/adj}$ = SUM (SA x ED / BW)

DA_{event} = CS x AF x ABS x CF

Note: For noncarcinogenic effects, AT = ED.

TABLE B 14.3

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
CHILD RESIDENT
SITE 14, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] $(mg/kg\text{-}day)^{-1}$	CANCER RISK INGESTION	DERMAL ABS [2]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [1, 3] $(mg/kg\text{-}day)^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
No carcinogenic CPCs											
										0E+00	0E+00
SUMMARY CANCER RISK						0E+00					

[1] Relative potency factors were applied to the CSFs of carcinogenic PAHs. Relative potency factors are derived in "Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons," USEPA, 1993.
[2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (Supplemental Guidance to RAGS: Region IV, Human Health Risk Assessment Bulletin No. 3, 1995).
[3] Calculated from oral CSFs.
NE = not evaluated

TABLE B.14.3

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
CHILD RESIDENT
SITE 14, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Aluminum	I	8510	mg/kg	1.1E-01	1.0E+00	1.1E-01	0.001	1.0E-03	2.0E-01	5.2E-03	1.1E-01
Iron	I	2480	mg/kg	3.2E-02	3.0E-01	1.1E-01	0.001	3.0E-04	6.0E-03	5.1E-02	1.6E-01
Total Petroleum Hydrocarbons	O	93000	ug/kg	1.2E-03	3.0E-02	4.0E-02	0.01	1.1E-04	2.7E-02	4.2E-03	4.4E-02
					SUMMARY HAZARD INDEX	3E-01				6E-02	3E-01

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (Supplemental Guidance to RAGS: Region IV, Human Health Risk Assessment Bulletin No. 3, 1995).
[2] Calculated from oral RfDs.
ND = no data available.

TABLE B.14.4

INHALATION OF PARTICULATES - SURFACE SOIL
CHILD RESIDENT
SITE 14, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1.24E+09	m^3/kg	default [1]
CONCENTRATION IN AIR	CA	chemical-specific	mg/m^3	
INHALATION RATE	IR	0 625	$m^3/hour$	USEPA, 1995
BODY WEIGHT	BW	15	kg	USEPA, 1991
EXPOSURE TIME	ET	24	hours/day	Assumption
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1991
EXPOSURE DURATION	ED	6	years	USEPA, 1991
CONVERSION FACTOR	CF	0 001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	6	years	USEPA, 1991

[1] PEF has been derived in the PEF Appendix to this report.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.
USEPA, 1995. Supplemental Guidance to RAGS: Region 4 Bulletins, Bulletin No. 3, November 1995.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / INHALATION REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE} = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

CA = C x CF x (1/PEF)

Note:

For noncarcinogenic effects: AT = ED

TABLE B.14.4

INHALATION OF PARTICULATES - SURFACE SOIL
CHILD RESIDENT
SITE 14, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m^3)	INTAKE (mg/kg-day)	INHALATION CSF (mg/kg-day)-1	CANCER RISK
No carcinogenic CPCs							
SUMMARY CANCER RISK							0E+00

NE = not evaluated.

TABLE B.14.4

INHALATION OF PARTICULATES - SURFACE SOIL
CHILD RESIDENT
SITE 14, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Aluminum	I	8510	mg/kg	6.86E-06	6.6E-06	ND	
Iron	I	2480	mg/kg	2.00E-06	1.9E-06	ND	
Total Petroleum Hydrocarbons	O	93000	ug/kg	7.50E-08	7.2E-08	ND	
						SUMMARY HAZARD INDEX	0E+00

ND = no data available

TABLE B.14.5

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT TRESPASSER
SITE 14, OPERABLE UNIT 5
NAS, CECIL FIELD
EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	100	mg/day	USEPA, 1995
FRACTION INGESTED	FI	100%	unitless	USEPA, 1995
ADHERENCE FACTOR	AF	1	mg/cm²-event	USEPA, 1995
ABSORPTION FRACTION	ABS_d	chemical specific	unitless	USEPA, 1995
SURFACE AREA EXPOSED	SA	5,750	cm²	USEPA, 1992
DOSE ABSORBED PER EVENT	DAevent	chemical specific	mg/cm²-event	USEPA, 1992
CONVERSION FACTOR	CF	1.00E-06	kg/mg	inorganics
	CF	1.00E-09	kg/ug	organics
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	45	days/year [1]	Assumption
EXPOSURE DURATION	ED	20	years	Assumption
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	20	years	Assumption

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose.

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285 6-03.

USEPA, 1992. Dermal Exposure Assessment. Principles and Applications; EPA/600/8-91/011B; 1/92.

USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.

EQUATIONS

CANCER RI INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD Q INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE\text{-}_{INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE\text{-}_{DERMAL} = \frac{DAevent \times SA \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

$DAevent = AF \times ABS_d \times CF$

Note: For noncarcinogenic effects: AT = ED

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TABLE B.14.5

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT TRESPASSER
SITE 14, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF $(mg/kg\text{-}day)^{-1}$	CANCER RISK INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2] $(mg/kg\text{-}day)^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
No carcinogenic CPCs											
SUMMARY CANCER RISK						0E+00				0E+00	0E+00

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (Supplemental Guidance to RAGS: Region IV, Human Health Risk Assessment Bulletin No. 3, 1995).
[2] Calculated from oral CSFs.

TABLE B.14.5

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT TRESPASSER
SITE 14, OPERABLE UNIT 5
NAS, CECIL FIELD
NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC O ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Aluminum	I	8510	mg/kg	1.5E-03	1.0E+00	1.5E-03	0.001	8.6E-05	2.0E-01	4 3E-04	1.9E-03
Iron	I	2480	mg/kg	4.4E-04	3.0E-01	1.5E-03	0.001	2.5E-05	6.0E-03	4 2E-03	5 6E-03
Total Petroleum Hydrocarbons	O	93000	ug/kg	1.6E-05	3.0E-02	5.5E-04	0.01	9 4E-06	2.7E-02	3 5E-04	8 9E-04
SUMMARY HAZARD INDEX						4E-03				5E-03	8E-03

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (Supplemental Guidance to RAGS: Region IV, Human Health Risk Assessment Bulletin No 3, 1995).
[2] Calculated from oral RfDs.
ND = no data available.

TABLE B.14.6

INHALATION OF PARTICULATES - SURFACE SOIL
ADULT TRESPASSER
SITE 14, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1.24E+09	m^3/kg	default [1]
CONCENTRATION AIR	CA	chemical-specific	mg/m^3	
INHALATION RATE	IR	0.833	$m^3/hour$	USEPA, 1995
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE TIME	ET	4	hours/day	Assumption
EXPOSURE FREQUENCY	EF	45	days/year	Assumption
EXPOSURE DURATION	ED	20	years	Assumption
CONVERSION FACTOR	CF	0 001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	20	years	USEPA, 1991

[1] PEF has been derived in the PEF Appendix to this report (default FDEP Value).
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors", OSWER Directive 9285 6-03.
USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / INHALATION REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE} = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

CA = C x CF x (1/PEF)

Note: For noncarcinogenic effects, AT = ED

TABLE B.14.6

INHALATION OF PARTICULATES - SURFACE SOIL
ADULT TRESPASSER
SITE 14, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m^3)	INTAKE (mg/kg-day)	INHALATION CSF $(mg/kg\text{-}day)^{-1}$	CANCER RISK
No carcinogenic CPCs							
						SUMMARY CANCER RISK	0E+00

NE = not evaluated.

TABLE B.14.6

INHALATION OF PARTICULATES - SURFACE SOIL
ADULT TRESPASSER
SITE 14, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Aluminum	I	8510	mg/kg	6.86E-06	4.0E-08	ND	
Iron	I	2480	mg/kg	2.00E-06	1.2E-08	ND	
Total Petroleum Hydrocarbons	O	93000	ug/kg	7.50E-08	4.4E-10	ND	
SUMMARY HAZARD INDEX							0E+00

ND = no data available.

TABLE B.14.7

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADOLESCENT TRESPASSER
SITE 14, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	100	mg/day	USEPA, 1995
FRACTION INGESTED	FI	100%	unitless	Assumption
ADHERENCE FACTOR	AF	1	mg/cm²-event	USEPA, 1995
AGE-SPECIFIC SURFACE AREA	SA_i	age-specific	cm²	USEPA, 1989
ABSORPTION FRACTION	ABS_d	chemical-specific	unitless	USEPA, 1995
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganics
	CF	1.00E-09	kg/mg	Organics
BODY WEIGHT	BW	45	kg	USEPA, 1995
AGE-SPECIFIC BODY WEIGHT	BW_i	age-specific	kg	USEPA, 1989
EXPOSURE FREQUENCY	EF	45	days/year [1]	Assumption
EXPOSURE DURATION	ED	10	years	USEPA, 1995
AGE-SPECIFIC EXPOSURE DURATION	ED_i	age-specific	years	Assumption
AGE-WEIGHTED SURFACE AREA [2]	$SA_{soil/adj}$	1013	cm²-year/kg	Per USEPA, 1992
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm²-event	Per USEPA, 1992
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	10	years	USEPA, 1995

[1] Units for exposure frequency are in events/year in the calculation of the dermally absorbed dose.
[2] In estimating the dermally absorbed dose for children age 7 through 16, the time-weighted, bodyweight normalized surface area exposed is calculated from surface area, exposure duration, and body weight for each of 10 age periods, age 7 through 16, per USEPA, 1992.

USEPA, 1989. Exposure Factors Handbook,EPA/600/8-89/043; May 1989.
USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285 6-03.
USEPA, 1992. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January 1992 and Appendix 7 to this report.
USEPA, 1995. Supplemental Guidance to RAGS: Region 4 Bulletins, Bulletin No. 3, November 1995

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE_{INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE_{DERMAL} = AT \times 365\ days/year) \times SA_{soil/adj}$$

Where:

$SA_{soil/adj}$ = SUM $(SA_i \times ED_i / BW_i)$

DA_{event} = $CS \times AF \times ABS_d \times CF$

Note: For noncarcinogenic effects: AT = ED.

TABLE B.14.7

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADOLESCENT TRESPASSER
SITE 14, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] (mg/kg-day)$^{-1}$	CANCER RISK INGESTION	DERMAL ABS [2]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [1,3] (mg/kg-day)$^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
No carcinogenic CPCs											
SUMMARY CANCER RISK						0E+00				0E+00	0E+00

[1] Relative potency factors were applied to the CSFs for carcinogenic PAHs. Relative potency factors are derived in "Provisional Guidance for Quantitative Risk Assessment for Polycyclic Aromatic Hydrocarbons," USEPA, 1993.
[2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (Supplemental Guidance to RAGS Region IV, Human Health Risk Assessment Bulletin No 3, 1995).
[3] Calculated from oral CSFs
NE = not evaluated

TABLE B.14.7

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADOLESCENT TRESPASSER
SITE 14, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Aluminum	I	8510	mg/kg	2.3E-03	1.0E+00	2.3E-03	0.001	1.1E-04	2.0E-01	5.3E-04	2.9E-03
Iron	I	2480	mg/kg	6.8E-04	3.0E-01	2.3E-03	0.001	3.1E-05	6.0E-03	5.2E-03	7.4E-03
Total Petroleum Hydrocarbons	O	93000	ug/kg	2.5E-05	3.0E-02	8.5E-04	0.01	1.2E-05	2.7E-02	4.3E-04	1.3E-03
					SUMMARY HAZARD INDEX	5E-03				6E-03	1E-02

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (Supplemental Guidance to RAGS: Region IV, Human Health Risk Assessment Bulletin No. 3, 1995).
[2] Calculated from oral RfDs.
ND = no data available.

TABLE B.14.8

INHALATION OF PARTICULATES - SURFACE SOIL
ADOLESCENT TRESPASSER
SITE 14, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1.24E+09	m^3/kg	default [1]
CONCENTRATION AIR	CA	chemical-specific	mg/m^3	
INHALATION RATE	IR	0.625	$m^3/hour$	USEPA, 1995
BODY WEIGHT	BW	45	kg	USEPA, 1995
EXPOSURE TIME	ET	4	ours/da	Assumption
EXPOSURE FREQUENCY	EF	45	days/yea	Assumption
EXPOSURE DURATION	ED	10	years	USEPA, 1995
CONVERSION FACTOR	CF	0.001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	10	years	USEPA, 1995

[1] PEF has been derived in the PEF Appendix to this report.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors", OSWER Directive 9285.6-03.
USEPA 1995. Supplemental Guidance to RAGS, Region 4 Bulletins, Bulletin No. 3, November 1995.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR (mg/kg-day)$^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / INHALATION REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE} = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT \times 365\ \text{days/yr}}$$

Where:

CA = C x CF x (1/PEF)

Note: For noncarcinogenic effects: AT = ED

TABLE B.14.8

INHALATION OF PARTICULATES - SURFACE SOIL
ADOLESCENT TRESPASSER
SITE 14, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m^3)	INTAKE (mg/kg-day)	INHALATION CSF (mg/kg-day)^-1	CANCER RISK
No carcinogenic CPCs							
						SUMMARY CANCER RISK	0E+00

NE = not evaluated.

TABLE B.14.8

INHALATION OF PARTICULATES - SURFACE SOIL
ADOLESCENT TRESPASSER
SITE 14, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Aluminum	I	8510	mg/kg	6.86E-06	4.7E-08	ND	
Iron	I	2480	mg/kg	2.00E-06	1.4E-08	ND	
Total Petroleum Hydrocarbons	O	93000	ug/kg	7.50E-08	5.1E-10	ND	
						SUMMARY HAZARD INDEX	0E+00

ND = no data available.

TABLE B.14.9

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
OCCUPATIONAL WORKER
SITE 14, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	50	mg/day	USEPA, 1991
FRACTION INGESTED	FI	100%	unitless	Assumption
ADHERENCE FACTOR	AF	1	mg/cm²-event	USEPA, 1995
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1995
SURFACE AREA EXPOSED	SA	2,300	cm²	USEPA, 1992
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm²-event	USEPA, 1992
CONVERSION FACTOR	CF	1 00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1 00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	250	days/year [1]	USEPA, 1995
EXPOSURE DURATION	ED	25	years	USEPA, 1995
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	25	years	USEPA, 1995

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose.
USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance. "Standard Default Exposure Factors"; OSWER Directive 9285 6-03.
USEPA, 1992. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January 1992.
USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No. 3.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE_{-INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE_{-DERMAL} = \frac{DA_{event} \times SA \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

DA_{event} = CS x AF x ABS x CF

Note: For noncarcinogenic effects, AT = ED

TABLE B.14.9

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
OCCUPATIONAL WORKER
SITE 14, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF $(mg/kg\text{-}day)^{-1}$	CANCER RISK INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2] $(mg/kg\text{-}day)^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
No carcinogenic CPCs											
SUMMARY CANCER RISK						0E+00				0E+00	0E+00

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (Supplemental Guidance to RAGS: Region IV, Human Health Risk Assessment Bulletin No. 3, 1995).
[2] Calculated from oral CSFs.
NE = not evaluated.

SITE 15

TABLE B.15.1

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT RESIDENT
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	100	mg/day	USEPA, 1995
FRACTION INGESTED	FI	100%	unitless	USEPA, 1995
ADHERENCE FACTOR	AF	1	mg/cm^2-event	USEPA, 1995
ABSORPTION FRACTION	ABS_d	chemical-specific	unitless	USEPA, 1995
SURFACE AREA EXPOSED	SA	5,750	cm^2	USEPA, 1992
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm^2-event	USEPA, 1992
CONVERSION FACTOR	CF	1 00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1 00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	350	days/year [1]	Assumption
EXPOSURE DURATION	ED	24	years	USEPA, 1995
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	24	years	USEPA, 1995

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose

USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance. "Standard Default Exposure Factors", OSWER Directive 9285 6-03

USEPA, 1992 Dermal Exposure Assessment Principles and Applications, EPA/600/8-91/011B, January 1992

USEPA, 1995 Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No 3

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE_{-INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE_{-DERMAL} = \frac{DA_{event} \times SA \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

$$DA_{event} = CS \times AF \times ABS_d \times CF$$

Note: **For noncarcinogenic effects, AT = ED.**

TABLE B.15.1

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT RESIDENT
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] (mg/kg-day)$^{-1}$	CANCER RISK INGESTION	DERMAL ABS [2]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [3] (mg/kg-day)$^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
Benzo(a)anthracene	O	340000	ug/kg	1.6E-04	7.3E-01	1.2E-04	0.01	9.2E-05	8 00E-01	7.3E-05	1.9E-04
Benzo(a)pyrene	O	340000	ug/kg	1.6E-04	7.3E+00	1.2E-03	0.01	9 2E-05	8 00E+00	7.3E-04	1 9E-03
Benzo(b)fluoranthene	O	510000	ug/kg	2.4E-04	7.3E-01	1.7E-04	0 01	1.4E-04	8 00E-01	1.1E-04	2.9E-04
Benzo(k)fluoranthene	O	130000	ug/kg	6.1E-05	7.3E-02	4.5E-06	0.01	3.5E-05	8.00E-02	2.8E-06	7.3E-06
Carbazole	O	6600	ug/kg	3.1E-06	2.0E-02	6.2E-08	0.01	1.8E-06	4.00E-02	7.1E-08	1.3E-07
Chrysene	O	400000	ug/kg	1.9E-04	7.3E-03	1.4E-06	0.01	1.1E-04	8.00E-03	8.6E-07	2.2E-06
Dibenzo(a,h)anthracene	O	13000	ug/kg	6.1E-06	7.3E+00	4.5E-05	0 01	3 5E-06	8.00E+00	2.8E-05	7.3E-05
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	4.7E-05	7.3E-01	3.4E-05	0.01	2.7E-05	8.00E-01	2.2E-05	5.6E-05
Arsenic	I	22	mg/kg	1.0E-05	1.5E+00	1.5E-05	0.001	5.9E-07	1.50E+00	8.9E-07	1.6E-05
Lead	I	4200	mg/kg	2.0E-03	ND		0.001	1.1E-04	ND		
SUMMARY CANCER RISK						2E-03				1E-03	3E-03

[1] Relative potency factors were applied to the CSFs for carcinogenic PAHs Relative potency factors are derived in "Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons," USEPA, 1993
[2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (November 1995)
[3] Calculated from oral CSFs
ND = no data available

TABLE B.15.1

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT RESIDENT
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Benzo(a)anthracene	O	340000	ug/kg	4.7E-04	ND		0 01	2 7E-04	ND		
Benzo(a)pyrene	O	340000	ug/kg	4 7E-04	ND		0.01	2.7E-04	ND		
Benzo(b)fluoranthene	O	510000	ug/kg	7.0E-04	ND		0.01	4.0E-04	ND		
Benzo(k)fluoranthene	O	130000	ug/kg	1.8E-04	ND		0.01	1.0E-04	ND		
Carbazole	O	6600	ug/kg	9.0E-06	ND		0.01	5.2E-06	ND		
Chrysene	O	400000	ug/kg	5.5E-04	ND		0.01	3.2E-04	ND		
Dibenzo(a,h)anthracene	O	13000	ug/kg	1 8E-05	ND		0.01	1.0E-05	ND		
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	1.4E-04	ND		0.01	7 9E-05	ND		
Benzo(g,h,i)perylene	O	54000	ug/kg	7.4E-05	ND		0.01	4.3E-05	ND		
Fluoranthene	O	660000	ug/kg	9.0E-04	0.04	2.3E-02	0.01	5.2E-04	0.036	1.4E-02	3.7E-02
Phenanthrene	O	260000	ug/kg	3.6E-04	ND		0.01	2.0E-04	ND		
Pyrene	O	500000	ug/kg	6 8E-04	0.03	2.3E-02	0.01	3 9E-04	0.027	1.5E-02	3.7E-02
Arsenic	I	22	mg/kg	3.0E-05	0.0003	1.0E-01	0.001	1.7E-06	0.00029	6.0E-03	1.1E-01
Antimony	I	74	mg/kg	1.0E-04	0.0004	2.5E-01	0.001	5.8E-06	0.000004	1 5E+00	1.7E+00
Lead	I	4200	mg/kg	5.8E-03	ND		0.001	3.3E-04			
TPH	O	130000	ug/kg	1.8E-04	0.03	5.9E-03	0.01	1.0E-04	0.027	3.8E-03	9.7E-03
HMX	O	1100	ug/kg	1.5E-06	ND		0.01	8.7E-07	ND		
					SUMMARY HAZARD INDEX	**4E-01**				**1E+00**	**2E+00**

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (November, 1995)
[2] Calculated from oral RfDs
ND = no data available.

TABLE B.15.2

INHALATION OF PARTICULATES - SURFACE SOIL
ADULT RESIDENT
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1 24E+09	m^3/kg	default [1]
CONCENTRATION AIR	CA	chemical-specific	mg/m^3	
INHALATION RATE	IR	0 833	$m^3/hour$	USEPA, 1995
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE TIME	ET	16	hours/day	Assumption
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1995
EXPOSURE DURATION	ED	24	years	USEPA, 1995
CONVERSION FACTOR	CF	0.001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	24	years	USEPA, 1995

[1] PEF has been derived in the PEF Appendix to this report (default FDEP value)
USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance. "Standard Default Exposure Factors"; OSWER Directive 9285 6-03
USEPA, 1995 Supplemental Guidance to RAGS Region IV, Human Health Risk Assessment Bulletin No 3

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / INHALATION REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE} = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

CA = C x CF x (1/PEF)

Note:

For noncarcinogenic effects: AT = ED

TABLE B.15.2

INHALATION OF PARTICULATES - SURFACE SOIL
ADULT RESIDENT
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION CSF (mg/kg-day)-1	CANCER RISK
Benzo(a)anthracene	O	340000	ug/kg	2.74E-07	1.7E-08	3 1E-01	5.3E-09
Benzo(a)pyrene	O	340000	ug/kg	2.74E-07	1.7E-08	3.1E+00	5.3E-08
Benzo(b)fluoranthene	O	510000	ug/kg	4.11E-07	2 6E-08	3.1E-01	8.0E-09
Benzo(k)fluoranthene	O	130000	ug/kg	1.05E-07	6.6E-09	3.1E-02	2.0E-10
Carbazole	O	6600	ug/kg	5.32E-09	3.3E-10	ND	
Chrysene	O	400000	ug/kg	3.23E-07	2.0E-08	3.1E-03	6.3E-11
Dibenzo(a,h)anthracene	O	13000	ug/kg	1.05E-08	6.6E-10	3.1E+00	2.0E-09
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	8.06E-08	5 0E-09	3.1E-01	1.6E-09
Arsenic	I	22	mg/kg	1.77E-08	1.1E-09	1.5E+01	1.7E-08
						SUMMARY CANCER RISK	9E-08

ND = no data available.

TABLE B.15.2

INHALATION OF PARTICULATES - SURFACE SOIL
ADULT RESIDENT
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Benzo(a)anthracene	O	340000	ug/kg	2.74E-07	5.0E-08	ND	
Benzo(a)pyrene	O	340000	ug/kg	2.74E-07	5 0E-08	ND	
Benzo(b)fluoranthene	O	510000	ug/kg	4.11E-07	7.5E-08	ND	
Benzo(k)fluoranthene	O	130000	ug/kg	1 05E-07	1.9E-08	ND	
Carbazole	O	6600	ug/kg	5 32E-09	9.7E-10	ND	
Chrysene	O	400000	ug/kg	3.23E-07	5.9E-08	ND	
Dibenzo(a,h)anthracene	O	13000	ug/kg	1.05E-08	1.9E-09	ND	
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	8 06E-08	1.5E-08	ND	
Benzo(g,h,i)perylene	O	54000	ug/kg	4 35E-08	8.0E-09	ND	
Fluoranthene	O	660000	ug/kg	5.32E-07	9.7E-08	ND	
Phenanthrene	O	260000	ug/kg	2.10E-07	3.8E-08	ND	
Pyrene	O	500000	ug/kg	4.03E-07	7.4E-08	ND	
Arsenic	I	22	mg/kg	1.77E-08	3.2E-09	ND	
Antimony	I	74	mg/kg	5.97E-08	1.1E-08	ND	
Lead	I	4200	mg/kg	3.39E-06	6.2E-07	ND	
TPH	O	130000	ug/kg	1.05E-07	1.9E-08	ND	
HMX	O	1100	ug/kg	8.87E-10	1.6E-10	ND	
SUMMARY HAZARD INDEX							0E+00

TABLE B.15.3

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
CHILD RESIDENT
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	200	mg/day	USEPA, 1995
FRACTION INGESTED	FI	100%	unitless	USEPA, 1995
ADHERENCE FACTOR	AF	1	mg/cm²-event	USEPA, 1995
AGE-SPECIFIC SURFACE AREA	SA	age-specific	cm²	USEPA, 1989
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1995
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
BODY WEIGHT	BW	15	kg	USEPA, 1991
AGE-SPECIFIC BODY WEIGHT	BW	age-specific	kg	USEPA, 1989
EXPOSURE FREQUENCY	EF	350	days/year [1]	USEPA, 1995
EXPOSURE DURATION	ED	6	years	USEPA, 1995
AGE-SPECIFIC EXPOSURE DURATION	ED	age-specific	years	Assumption
AGE-WEIGHTED SURFACE AREA [2]	$SA_{soil/adj}$	766	cm²-year/kg	USEPA, 1992
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm²-event	USEPA, 1992
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	6	years	USEPA, 1995

[1] Units for exposure frequency are in events/year in the calculation of the dermally absorbed dose

[2] In estimating the dermally absorbed dose for children age1 through 6, the time-weighted, bodyweight normalized surface area exposed is calculated from surface area, exposure duration, and body weight for each of 6 age periods, age 1 through 6, per USEPA, 1992

USEPA, 1989 Exposure Factors Handbook,EPA/600/8-89/043, May 1989

USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285 6-03

USEPA, 1992 Dermal Exposure Assessment Principles and Applications, EPA/600/8-91/011B, January 1992

USEPA, 1995 Supplemental Guidance to RAGS Region IV, Human Health Risk Assessment Bulletin No 3

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE_{-INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE_{-DERMAL} = (DA_{event} \times EF / AT \times 365\ days/year) \times SA_{soil/adj}$$

Where:

$SA_{soil/adj}$ = SUM (SA x ED / BW)

DA_{event} = CS x AF x ABS x CF

Note: For noncarcinogenic effects, AT = ED.

TABLE B.15.3

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
CHILD RESIDENT
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] (mg/kg-day)$^{-1}$	CANCER RISK INGESTION	DERMAL ABS [2]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [1, 3] (mg/kg-day)$^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
Benzo(a)anthracene	O	340000	ug/kg	3.7E-04	0.73	2.7E-04	0.01	3.6E-05	0.8	2.9E-05	3.0E-04
Benzo(a)pyrene	O	340000	ug/kg	3.7E-04	7.3	2.7E-03	0.01	3.6E-05	8	2.9E-04	3.0E-03
Benzo(b)fluoranthene	O	510000	ug/kg	5.6E-04	0.73	4.1E-04	0.01	5.4E-05	0.8	4.3E-05	4.5E-04
Benzo(k)fluoranthene	O	130000	ug/kg	1.4E-04	0.073	1.0E-05	0.01	1.4E-05	0.08	1.1E-06	1.1E-05
Carbazole	O	6600	ug/kg	7.2E-06	0.02	1.4E-07	0.01	6.9E-07	0.04	2.8E-08	1.7E-07
Chrysene	O	400000	ug/kg	4.4E-04	0.0073	3.2E-06	0.01	4.2E-05	0.002	3.4E-07	3.5E-06
Dibenzo(a,h)anthracene	O	13000	ug/kg	1.4E-05	7.3	1.0E-04	0.01	1.4E-06	8	1.1E-05	1.1E-04
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	1.1E-04	0.73	8.0E-05	0.01	1.0E-05	0.8	8.4E-06	8.8E-05
Arsenic	I	22	mg/kg	2.4E-05	1.5	3.6E-05	0.001	2.3E-07	1.5	3.5E-07	3.7E-05
Lead	I	4200	mg/kg	4.6E-03	ND		0.001	4.4E-05	ND		
				SUMMARY CANCER RISK		4E-03				4E-04	4E-03

[1] Relative potency factors were applied to the CSFs of carcinogenic PAHs Relative potency factors are derived in "Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons," USEPA, 1993
[2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (November 1995).
[3] Calculated from oral CSFs
NE = not evaluated

TABLE B.15.3

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
CHILD RESIDENT
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Benzo(a)anthracene	O	340000	ug/kg	4.3E-03	ND		0.01	4.2E-04	ND		
Benzo(a)pyrene	O	340000	ug/kg	4 3E-03	ND		0.01	4.2E-04	ND		
Benzo(b)fluoranthene	O	510000	ug/kg	6.5E-03	ND		0.01	6.2E-04	ND		
Benzo(k)fluoranthene	O	130000	ug/kg	1.7E-03	ND		0.01	1.6E-04	ND		
Carbazole	O	6600	ug/kg	8.4E-05	ND		0 01	8.1E-06	ND		
Chryzene	O	400000	ug/kg	5.1E-03	ND		0.01	4.9E-04	ND		
Dibenzo(a,h)anthracene	O	13000	ug/kg	1.7E-04	ND		0.01	1.6E-05	ND		
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	1.3E-03	ND		0.01	1 2E-04	ND		
Benzo(g,h,i)perylene	O	54000	ug/kg	6.9E-04	ND		0.01	6.6E-05	ND		
Fluoranthene	O	660000	ug/kg	8.4E-03	0.04	2 1E-01	0.01	8.1E-04	0.036	2 2E-02	2.3E-01
Phenanthrene	O	260000	ug/kg	3.3E-03	ND		0.01	3.2E-04	ND		
Pyrene	O	500000	ug/kg	6 4E-03	0.03	2.1E-01	0.01	6.1E-04	0.027	2.3E-02	2 4E-01
Arsenic	I	22	mg/kg	2 8E-04	0.0003	9.4E-01	0.001	2.7E-06	0.00029	9.3E-03	9.5E-01
Antimony	I	74	mg/kg	9.5E-04	0.0004	2.4E+00	0.001	9.1E-06	0.000004	2.3E+00	4.6E+00
Lead	I	4200	mg/kg	5.4E-02	ND		0.001	5.1E-04	0		
TPH	O	130000	ug/kg	1.7E-03	0.03	5.5E-02	0.01	1.6E-04	0.027	5.9E-03	6.1E-02
HMX	O	1100	ug/kg	1.4E-05	ND		0.01	1.3E-06	ND		
SUMMARY HAZARD INDEX						4E+00				2E+00	6E+00

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for morganics (November 1995)
[2] Calculated from oral RfDs
ND = no data available

TABLE B.15.4

INHALATION OF PARTICULATES - SURFACE SOIL
CHILD RESIDENT
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1.24E+09	m^3/kg	default [1]
CONCENTRATION IN AIR	CA	chemical-specific	mg/m^3	
INHALATION RATE	IR	0.625	m^3/hour	USEPA, 1995
BODY WEIGHT	BW	15	kg	USEPA, 1991
EXPOSURE TIME	ET	16	hours/day	Assumption
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1991
EXPOSURE DURATION	ED	6	years	USEPA, 1991
CONVERSION FACTOR	CF	0 001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	6	years	USEPA, 1991

[1] PEF has been derived in the PEF Appendix to this report.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.
USEPA, 1995 Supplemental Guidance to RAGS. Region 4 Bulletins, Bulletin No 3, November 1995

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / INHALATION REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE} = \frac{\text{CA x IR x ET x EF x ED}}{\text{BW x AT x 365 days/yr}}$$

Where:

CA = C x CF x (1/PEF)

Note:

For noncarcinogenic effects: AT = ED

TABLE B.15.4

INHALATION OF PARTICULATES - SURFACE SOIL
CHILD RESIDENT
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION CSF (mg/kg-day)-1	CANCER RISK
Benzo(a)anthracene	O	340000	ug/kg	2.74E-07	1.5E-08	3.1E-01	4.7E-09
Benzo(a)pyrene	O	340000	ug/kg	2.74E-07	1.5E-08	3.1E+00	4.7E-08
Benzo(b)fluoranthene	O	510000	ug/kg	4.11E-07	2.3E-08	3.1E-01	7.0E-09
Benzo(k)fluoranthene	O	130000	ug/kg	1.05E-07	5.7E-09	3.1E-02	1.8E-10
Carbazole	O	6600	ug/kg	5.32E-09	2.9E-10	ND	
Chrysene	O	400000	ug/kg	3.23E-07	1.8E-08	3.1E-03	5.5E-11
Dibenzo(a,h)anthracene	O	13000	ug/kg	1.05E-08	5.7E-10	3.1E+00	1.8E-09
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	8.06E-08	4.4E-09	3.1E-01	1.4E-09
Arsenic	I	22	mg/kg	1.77E-08	9.7E-10	1.5E+01	1.5E-08
						SUMMARY CANCER RISK	8E-08

NE = not evaluated.

TABLE B.15.4

INHALATION OF PARTICULATES - SURFACE SOIL
CHILD RESIDENT
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Benzo(a)anthracene	O	340000	ug/kg	2.74E-07	1.8E-07	ND	
Benzo(a)pyrene	O	340000	ug/kg	2.74E-07	1.8E-07	ND	
Benzo(b)fluoranthene	O	510000	ug/kg	4.11E-07	2.6E-07	ND	
Benzo(k)fluoranthene	O	130000	ug/kg	1.05E-07	6.7E-08	ND	
Carbazole	O	6600	ug/kg	5.32E-09	3.4E-09	ND	
Chrysene	O	400000	ug/kg	3.23E-07	2.1E-07	ND	
Dibenzo(a,h)anthracene	O	13000	ug/kg	1.05E-08	6.7E-09	ND	
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	8.06E-08	5.2E-08	ND	
Benzo(g,h,i)perylene	O	54000	ug/kg	4.35E-08	2.8E-08	ND	
Fluoranthene	O	660000	ug/kg	5.32E-07	3.4E-07	ND	
Phenanthrene	O	260000	ug/kg	2.10E-07	1.3E-07	ND	
Pyrene	O	500000	ug/kg	4.03E-07	2.6E-07	ND	
Arsenic	I	22	mg/kg	1.77E-08	1.1E-08	ND	
Antimony	I	74	mg/kg	5.97E-08	3.8E-08	ND	
Lead	I	4200	mg/kg	3.39E-06	2.2E-06	ND	
TPH	O	130000	ug/kg	1.05E-07	6.7E-08	ND	
HMX	O	1100	ug/kg	8.87E-10	5.7E-10	ND	
						SUMMARY HAZARD INDEX	0E+00

TABLE B.15.5

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT TRESPASSER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	100	mg/day	USEPA, 1991
FRACTION INGESTED	FI	100%	unitless	USEPA, 1995
ADHERENCE FACTOR	AF	1	mg/cm²-event	USEPA, 1992a
ABSORPTION FRACTION	ABS_d	chemical specific	unitless	USEPA, 1992a
SURFACE AREA EXPOSED	SA	5,750	cm²	USEPA, 1992
DOSE ABSORBED PER EVENT	DAevent	chemical specific	mg/cm²-event	USEPA, 1992
CONVERSION FACTOR	CF	1 00E-06	kg/mg	inorganics
	CF	1 00E-09	kg/ug	organics
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	45	days/year [1]	Assumption
EXPOSURE DURATION	ED	20	years	Assumption
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	20	years	Assumption

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors"; OSWER Directive 9285.6-03.
USEPA, 1992. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B; January 1992.

EQUATIONS

CANCER RI INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD Q INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE_{-INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE_{-DERMAL} = \frac{DAevent \times SA \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

$_{DAevent=}$ $AF \times ABS_d \times CF$

Note: For noncarcinogenic effects: AT = ED

TABLE B.15.5

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT TRESPASSER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF $(mg/kg\text{-}day)^{-1}$	CANCER RISK INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2] $(mg/kg\text{-}day)^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
Benzo(a)anthracene	O	340000	ug/kg	1 7E-05	0.73	1 2E-05	0.01	9 8E-06	0.8	7 9E-06	2 0E-05
Benzo(a)pyrene	O	340000	ug/kg	1.7E-05	7.3	1 2E-04	0 01	9 8E-06	8	7 9E-05	2 0E-04
Benzo(b)fluoranthene	O	510000	ug/kg	2 6E-05	0.73	1 9E-05	0 01	1.5E-05	0.8	1 2E-05	3.1E-05
Benzo(k)fluoranthene	O	130000	ug/kg	6 5E-06	0.073	4.8E-07	0 01	3 8E-06	0.08	3.0E-07	7 8E-07
Carbazole	O	6600	ug/kg	3 3E-07	0.02	6 6E-09	0 01	1.9E-07	0.04	7 6E-09	1.4E-08
Chrysene	O	400000	ug/kg	2.0E-05	0.0073	1 5E-07	0 01	1 2E-05	0.008	9 3E-08	2.4E-07
Dibenzo(a,h)anthracene	O	13000	ug/kg	6 5E-07	7.3	4 8E-06	0 01	3.8E-07	8	3 0E-06	7 8E-06
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	5 0E-06	0.73	3 7E-06	0 01	2 9E-06	0.8	2 3E-06	6.0E-06
Arsenic	I	22	mg/kg	1 1E-06	1.5	1 7E-06	0 001	6 4E-08	1.5	9.5E-08	1 8E-06
Lead	I	4200	mg/kg	2 1E-04	ND		0 001	1 2E-05	ND		
SUMMARY CANCER RISK						2E-04				1E-04	3E-04

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (February 10, 1992)
[2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November 1995)

TABLE B.15.5

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADULT TRESPASSER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Benzo(a)anthracene	O	340000	ug/kg	6 0E-05	ND		0 01	3 4E-05	ND		
Benzo(a)pyrene	O	340000	ug/kg	6 0E-05	ND		0 01	3 4E-05	ND		
Benzo(b)fluoranthene	O	510000	ug/kg	9 0E-05	ND		0 01	5 2E-05	ND		
Benzo(k)fluoranthene	O	130000	ug/kg	2 3E-05	ND		0 01	1.3E-05	ND		
Carbazole	O	6600	ug/kg	1 2E-06	ND		0 01	6 7E-07	ND		
Chrysene	O	400000	ug/kg	7 0E-05	ND		0 01	4 1E-05	ND		
Dibenzo(a,h)anthracene	O	13000	ug/kg	2 3E-06	ND		0 01	1.3E-06	ND		
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	1 8E-05	ND		0 01	1 0E-05	ND		
Benzo(g,h,i)perylene	O	54000	ug/kg	9 5E-06	ND		0.01	5 5E-06	ND		
Fluoranthene	O	660000	ug/kg	1.2E-04	0.04	2 9E-03	0 01	6 7E-05	0.036	1 9E-03	4.8E-03
Phenanthrene	O	260000	ug/kg	4 6E-05	ND		0 01	2 6E-05	ND		
Pyrene	O	500000	ug/kg	8 8E-05	0.03	2 9E-03	0 01	5 1E-05	0.027	1 9E-03	4 8E-03
Arsenic	I	22	mg/kg	3 9E-06	0.0003	1 3E-02	0 001	2 2E-07	0.00029	7 7E-04	1 4E-02
Antimony	I	74	mg/kg	1 3E-05	0.0004	3 3E-02	0.001	7.5E-07	0.000004	1 9E-01	2 2E-01
Lead	I	4200	mg/kg	7 4E-04	ND		0.001	4 3E-05	0		
TPH	O	130000	ug/kg	2 3E-05	0.03	7 6E-04	0 01	1 3E-05	0.027	4 9E-04	1 3E-03
HMX	O	1100	ug/kg	1 9E-07	ND		0 01	1.1E-07	ND		
					SUMMARY HAZARD INDEX	5E-02				2E-01	2E-01

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (February 10, 1992)
[2] Calculated from oral RfDs
ND = no data available.

TABLE B.15.6

INHALATION OF PARTICULATES - SURFACE SOIL
ADULT TRESPASSER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1 24E+09	m^3/kg	default [1]
CONCENTRATION AIR	CA	chemical-specific	mg/m^3	
INHALATION RATE	IR	0 833	m^3/hour	USEPA, 1995
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE TIME	ET	4	hours/day	Assumption
EXPOSURE FREQUENCY	EF	45	days/year	Assumption
EXPOSURE DURATION	ED	20	years	Assumption
CONVERSION FACTOR	CF	0 001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	20	years	USEPA, 1991

[1] PEF has been derived in the PEF Appendix to this report (default FDEP value)
USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance "Standard Default Exposure Factors", OSWER Directive 9285 6-03.
USEPA, 1995 Supplemental Guidance to RAGS Region IV, Human Health Risk Assessment Bulletin No 3

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / INHALATION REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE} = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

CA = C x CF x (1/PEF)

Note: For noncarcinogenic effects, AT = ED

TABLE B.15.6

INHALATION OF PARTICULATES - SURFACE SOIL
ADULT TRESPASSER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION CSF (mg/kg-day)$^{-1}$	CANCER RISK
Benzo(a)anthracene	O	340000	ug/kg	2.74E-07	4.6E-10	3.1E-01	1.4E-10
Benzo(a)pyrene	O	340000	ug/kg	2.74E-07	4.6E-10	3.1E+00	1.4E-09
Benzo(b)fluoranthene	O	510000	ug/kg	4.11E-07	6.9E-10	3.1E-01	2.1E-10
Benzo(k)fluoranthene	O	130000	ug/kg	1.05E-07	1.8E-10	3.1E-02	5.4E-12
Carbazole	O	6600	ug/kg	5.32E-09	8.9E-12	ND	
Chrysene	O	400000	ug/kg	3.23E-07	5.4E-10	3.1E-03	1.7E-12
Dibenzo(a,h)anthracene	O	13000	ug/kg	1.05E-08	1.8E-11	3.1E+00	5.4E-11
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	8.06E-08	1.4E-10	3.1E-01	4.2E-11
Arsenic	I	22	mg/kg	1.77E-08	3.0E-11	1.5E+01	4.5E-10
						SUMMARY CANCER RISK	2E-09

NE = not evaluated.

TABLE B.15.6

INHALATION OF PARTICULATES - SURFACE SOIL
ADULT TRESPASSER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Benzo(a)anthracene	O	340000	ug/kg	2.74E-07	1.6E-09	ND	
Benzo(a)pyrene	O	340000	ug/kg	2.74E-07	1.6E-09	ND	
Benzo(b)fluoranthene	O	510000	ug/kg	4.11E-07	2.4E-09	ND	
Benzo(k)fluoranthene	O	130000	ug/kg	1.05E-07	6.2E-10	ND	
Carbazole	O	6600	ug/kg	5.32E-09	3.1E-11	ND	
Chrysene	O	400000	ug/kg	3.23E-07	1.9E-09	ND	
Dibenzo(a,h)anthracene	O	13000	ug/kg	1.05E-08	6.2E-11	ND	
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	8.06E-08	4.7E-10	ND	
Benzo(g,h,i)perylene	O	54000	ug/kg	4.35E-08	2.6E-10	ND	
Fluoranthene	O	660000	ug/kg	5.32E-07	3.1E-09	ND	
Phenanthrene	O	260000	ug/kg	2.10E-07	1.2E-09	ND	
Pyrene	O	500000	ug/kg	4.03E-07	2.4E-09	ND	
Arsenic	I	22	mg/kg	1.77E-08	1.0E-10	ND	
Antimony	I	74	mg/kg	5.97E-08	3.5E-10	ND	
Lead	I	4200	mg/kg	3.39E-06	2.0E-08	ND	
TPH	O	130000	ug/kg	1.05E-07	6.2E-10	ND	
HMX	O	1100	ug/kg	8.87E-10	5.2E-12	ND	
				SUMMARY HAZARD INDEX			0E+00

TABLE B.15.7

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADOLESCENT TRESPASSER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	100	mg/day	USEPA, 1991
FRACTION INGESTED	FI	100%	unitless	Assumption
ADHERENCE FACTOR	AF	1	mg/cm²-event	USEPA, 1992
AGE-SPECIFIC SURFACE AREA	SA_i	age-specific	cm²	USEPA, 1989
ABSORPTION FRACTION	ABS_d	chemical-specific	unitless	USEPA, 1995
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganics
	CF	1.00E-09	kg/mg	Organics
BODY WEIGHT	BW	45	kg	USEPA, 1995
AGE-SPECIFIC BODY WEIGHT	BW_i	age-specific	kg	USEPA, 1989
EXPOSURE FREQUENCY	EF	45	days/year [1]	Assumption
EXPOSURE DURATION	ED	10	years	USEPA, 1995
AGE-SPECIFIC EXPOSURE DURATION	ED_i	age-specific	years	USEPA, 1992
AGE-WEIGHTED SURFACE AREA [2]	$SA_{soil/adj}$	1013	cm²-year/kg	USEPA, 1992
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm²-event	Per USEPA, 1992
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	10	years	USEPA, 1995

[1] Units for exposure frequency are in events/year in the calculation of the dermally absorbed dose
[2] In estimating the dermally absorbed dose for children age 7 through 16, the time-weighted, bodyweight normalized surface area exposed is calculated from surface area, exposure duration, and body weight for each of 10 age periods, age 7 through 16, per USEPA, 1992
USEPA, 1989 Exposure Factors Handbook, EPA/600/8-89/043, May 1989
USEPA, 1992. Dermal Exposure Assessment Principles and Applications, EPA/600/8-91/011B, January 1992
USEPA, 1995. Supplemental Guidance to RAGS Region 4 Bulletins, Bulletin No 3, November 1995

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE_{INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE_{DERMAL} = AT \times 365\ days/year) \times SA_{soil/adj}$$

Where:

$SA_{soil/adj}$ = SUM (SA_i x ED_i / BW_i)

DA_{event} = CS x AF x ABS_d x CF

Note: For noncarcinogenic effects: AT = ED.

TABLE B.15.7

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADOLESCENT TRESPASSER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] (mg/kg-day)$^{-1}$	CANCER RISK INGESTION	DERMAL ABS [2]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [1,3] (mg/kg-day)$^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
Benzo(a)anthracene	O	340000	ug/kg	1.3E-05	0.73	9.7E-06	0 01	6.1E-06	0.8	4.9E-06	1.5E-05
Benzo(a)pyrene	O	340000	ug/kg	1.3E-05	7.3	9.7E-05	0.01	6.1E-06	8	4.9E-05	1.5E-04
Benzo(b)fluoranthene	O	510000	ug/kg	2.0E-05	0.73	1.5E-05	0.01	9.1E-06	0.8	7.3E-06	2 2E-05
Benzo(k)fluoranthene	O	130000	ug/kg	5.1E-06	0.073	3.7E-07	0 01	2.3E-06	0.08	1.9E-07	5.6E-07
Carbazole	O	6600	ug/kg	2.6E-07	0.02	5.2E-09	0.01	1.2E-07	0.04	4.7E-09	9.9E-09
Chrysene	O	400000	ug/kg	1.6E-05	0.0073	1.1E-07	0.01	7.1E-06	0.008	5.7E-08	1.7E-07
Dibenzo(a,h)anthracene	O	13000	ug/kg	5.1E-07	7.3	3.7E-06	0.01	2.3E-07	8	1.9E-06	5.6E-06
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	3.9E-06	0.73	2.9E-06	0.01	1.8E-06	0.8	1.4E-06	4.3E-06
Arsenic	I	22	mg/kg	8.6E-07	1.5	1 3E-06	0.001	3.9E-08	1.5	5.9E-08	1.4E-06
Lead	I	4200	mg/kg	1.6E-04	ND		0.001	7.5E-06	ND		
				SUMMARY CANCER RISK		**1E-04**				**6E-05**	**2E-04**

[1] Relative potency factors were applied to the CSFs for carcinogenic PAHs Relative potency factors are derived in "Provisional Guidance for Quantitative Risk Assessment for Polycyclic Aromatic Hydrocarbons," USEPA, 1993.
[2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (November 1995)
[3] Calculated from oral CSFs
NE = not evaluated

TABLE B.15.7

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
ADOLESCENT TRESPASSER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Benzo(a)anthracene	O	340000	ug/kg	9 3E-05	ND		0.01	4.2E-05	ND		
Benzo(a)pyrene	O	340000	ug/kg	9.3E-05	ND		0 01	4 2E-05	ND		
Benzo(b)fluoranthene	O	510000	ug/kg	1.4E-04	ND		0.01	6 4E-05	ND		
Benzo(k)fluoranthene	O	130000	ug/kg	3.6E-05	ND		0.01	1.6E-05	ND		
Carbazole	O	6600	ug/kg	1.8E-06	ND		0 01	8.2E-07	ND		
Chrysene	O	400000	ug/kg	1.1E-04	ND		0.01	5.0E-05	ND		
Dibenzo(a,h)anthracene	O	13000	ug/kg	3 6E-06	ND		0.01	1 6E-06	ND		
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	2.7E-05	ND		0.01	1.2E-05	ND		
Benzo(g,h,i)perylene	O	54000	ug/kg	1.5E-05	ND		0.01	6.7E-06	ND		
Fluoranthene	O	660000	ug/kg	1 8E-04	0.04	4.5E-03	0.01	8 2E-05	0.036	2.3E-03	6.8E-03
Phenanthrene	O	260000	ug/kg	7.1E-05	ND		0.01	3.2E-05	ND		
Pyrene	O	500000	ug/kg	1 4E-04	0.03	4.6E-03	0.01	6.2E-05	0.027	2.3E-03	6.9E-03
Arsenic	I	22	mg/kg	6.0E-06	0.0003	2.0E-02	0.001	2.7E-07	0.00029	9.5E-04	2.1E-02
Antimony	I	74	mg/kg	2.0E-05	0.0004	5.1E-02	0.001	9.2E-07	0.000004	2.3E-01	2.8E-01
Lead	I	4200	mg/kg	1.2E-03	ND		0.001	5.2E-05	0		
TPH	O	130000	ug/kg	3.6E-05	0.03	1.2E-03	0.01	1.6E-05	0.027	6.0E-04	1.8E-03
HMX	O	1100	ug/kg	3.0E-07	ND		0.01	1.4E-07	ND		
					SUMMARY HAZARD INDEX	8E-02				2E-01	3E-01

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (November 1995)
[2] Calculated from oral RfDs
ND = no data available

TABLE B.15.8

INHALATION OF PARTICULATES - SURFACE SOIL
ADOLESCENT TRESPASSER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1.24E+09	m^3/kg	default [1]
CONCENTRATION AIR	CA	chemical-specific	mg/m^3	
INHALATION RATE	IR	0 625	$m^3/hour$	USEPA, 1995
BODY WEIGHT	BW	45	kg	USEPA, 1995
EXPOSURE TIME	ET	4	hours/day	Assumption
EXPOSURE FREQUENCY	EF	45	days/year	Assumption
EXPOSURE DURATION	ED	10	years	USEPA, 1995
CONVERSION FACTOR	CF	0.001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	10	years	USEPA, 1995

[1] PEF has been derived in the PEF Appendix to this report
USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance "Standard Default Exposure Factors"; OSWER Directive 9285 6-03
USEPA 1995 Supplemental Guidance to RAGS, Region 4 Bulletins, Bulletin No 3, November 1995

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR (mg/kg-day)$^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / INHALATION REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE} = \frac{\text{CA x IR x ET x EF x ED}}{\text{BW x AT x 365 days/yr}}$$

Where:

CA = C x CF x (1/PEF)

Note: For noncarcinogenic effects: AT = ED

TABLE B.15.8

INHALATION OF PARTICULATES - SURFACE SOIL
ADOLESCENT TRESPASSER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION CSF (mg/kg-day)^-1	CANCER RISK
Benzo(a)anthracene	O	340000	ug/kg	2.74E-07	2.7E-10	3.1E-01	8.3E-11
Benzo(a)pyrene	O	340000	ug/kg	2.74E-07	2.7E-10	3.1E+00	8.3E-10
Benzo(b)fluoranthene	O	510000	ug/kg	4.11E-07	4.0E-10	3.1E-01	1.2E-10
Benzo(k)fluoranthene	O	130000	ug/kg	1.05E-07	1.0E-10	3.1E-02	3.2E-12
Carbazole	O	6600	ug/kg	5.32E-09	5.2E-12	ND	
Chrysene	O	400000	ug/kg	3.23E-07	3.2E-10	3.1E-03	9.8E-13
Dibenzo(a,h)anthracene	O	13000	ug/kg	1.05E-08	1.0E-11	3.1E+00	3.2E-11
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	8.06E-08	7.9E-11	3.1E-01	2.4E-11
Arsenic	I	22	mg/kg	1.77E-08	1.7E-11	1.5E+01	2.6E-10
						SUMMARY CANCER RISK	1E-09

NE = not evaluated.

TABLE B.15.8

INHALATION OF PARTICULATES - SURFACE SOIL
ADOLESCENT TRESPASSER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Benzo(a)anthracene	O	340000	ug/kg	2.74E-07	1.9E-09	ND	
Benzo(a)pyrene	O	340000	ug/kg	2.74E-07	1.9E-09	ND	
Benzo(b)fluoranthene	O	510000	ug/kg	4.11E-07	2.8E-09	ND	
Benzo(k)fluoranthene	O	130000	ug/kg	1.05E-07	7.2E-10	ND	
Carbazole	O	6600	ug/kg	5.32E-09	3.6E-11	ND	
Chrysene	O	400000	ug/kg	3.23E-07	2.2E-09	ND	
Dibenzo(a,h)anthracene	O	13000	ug/kg	1.05E-08	7.2E-11	ND	
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	8.06E-08	5.5E-10	ND	
Benzo(g,h,i)perylene	O	54000	ug/kg	4.35E-08	3.0E-10	ND	
Fluoranthene	O	660000	ug/kg	5.32E-07	3.6E-09	ND	
Phenanthrene	O	260000	ug/kg	2.10E-07	1.4E-09	ND	
Pyrene	O	500000	ug/kg	4.03E-07	2.8E-09	ND	
Arsenic	I	22	mg/kg	1.77E-08	1.2E-10	ND	
Antimony	I	74	mg/kg	5.97E-08	4.1E-10	ND	
Lead	I	4200	mg/kg	3.39E-06	2.3E-08	ND	
TPH	O	130000	ug/kg	1.05E-07	7.2E-10	ND	
HMX	O	1100	ug/kg	8.87E-10	6.1E-12	ND	
						SUMMARY HAZARD INDEX	0E+00

B.15.9

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
OCCUPATIONAL WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	50	mg/day	USEPA, 1995
FRACTION INGESTED	FI	100%	unitless	Assumption
ADHERENCE FACTOR	AF	1	mg/cm²-event	USEPA, 1995
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1995
SURFACE AREA EXPOSED	SA	2,300	cm²	USEPA, 1992
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm²-event	USEPA, 1992
CONVERSION FACTOR	CF	1 00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1 00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	250	days/year [1]	USEPA, 1995
EXPOSURE DURATION	ED	25	years	USEPA, 1995
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	25	years	USEPA, 1995

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose
USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance. "Standard Default Exposure Factors", OSWER Directive 9285 6-03
USEPA, 1992 Dermal Exposure Assessment Principles and Applications, EPA/600/8-91/011B, January 1992.
USEPA, 1995 Supplemental Guidance to RAGS · Region IV, Human Health Risk Assessment Bulletin No 3

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE_{-INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE_{-DERMAL} = \frac{DA_{event} \times SA \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

$$DA_{event} = CS \times AF \times ABS \times CF$$

Note: **For noncarcinogenic effects, AT = ED**

B.15.9

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
OCCUPATIONAL WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF $(mg/kg\text{-}day)^{-1}$	CANCER RISK INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2] $(mg/kg\text{-}day)^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
Benzo(a)anthracene	O	340000	ug/kg	5.9E-05	0.73	4.3E-05	0 01	2.7E-05	0.8	2.2E-05	6.5E-05
Benzo(a)pyrene	O	340000	ug/kg	5.9E-05	7.3	4.3E-04	0.01	2 7E-05	8	2.2E-04	6 5E-04
Benzo(b)fluoranthene	O	510000	ug/kg	8.9E-05	0.73	6.5E-05	0 01	4.1E-05	0.8	3.3E-05	9.8E-05
Benzo(k)fluoranthene	O	130000	ug/kg	2.3E-05	0.073	1.7E-06	0.01	1.0E-05	0.08	8.4E-07	2.5E-06
Carbazole	O	6600	ug/kg	1 2E-06	0.02	2.3E-08	0.01	5.3E-07	0.04	2.1E-08	4.4E-08
Chrysene	O	400000	ug/kg	7.0E-05	0.0073	5.1E-07	0.01	3.2E-05	0.008	2.6E-07	7.7E-07
Dibenzo(a,h)anthracene	O	13000	ug/kg	2.3E-06	7.3	1.7E-05	0 01	1.0E-06	8	8.4E-06	2.5E-05
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	1.7E-05	0.73	1.3E-05	0.01	8.0E-06	0.8	6.4E-06	1.9E-05
Arsenic	I	22	mg/kg	3.8E-06	1.5	5.8E-06	0.001	1.8E-07	1.5	2.7E-07	6.0E-06
Lead	I	4200	mg/kg	7.3E-04	ND		0.001	3.4E-05	ND		
SUMMARY CANCER RISK						6E-04				3E-04	9E-04

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (November, 1995)
[2] Calculated from oral CSFs
NE = not evaluated

B.15.9

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
OCCUPATIONAL WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Benzo(a)anthracene	O	340000	ug/kg	1.7E-04	ND		0.01	7.7E-05	ND		
Benzo(a)pyrene	O	340000	ug/kg	1.7E-04	ND		0.01	7.7E-05	ND		
Benzo(b)fluoranthene	O	510000	ug/kg	2.5E-04	ND		0.01	1.1E-04	ND		
Benzo(k)fluoranthene	O	130000	ug/kg	6.4E-05	ND		0.01	2.9E-05	ND		
Carbazole	O	6600	ug/kg	3.2E-06	ND		0 01	1 5E-06	ND		
Chrysene	O	400000	ug/kg	2.0E-04	ND		0.01	9 0E-05	ND		
Dibenzo(a,h)anthracene	O	13000	ug/kg	6.4E-06	ND		0.01	2 9E-06	ND		
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	4.9E-05	ND		0 01	2 3E-05	ND		
Benzo(g,h,i)perylene	O	54000	ug/kg	2.6E-05	ND		0 01	1.2E-05	ND		
Fluoranthene	O	660000	ug/kg	3.2E-04	0.04	8.1E-03	0 01	1.5E-04	0.036	4.1E-03	1.2E-02
Phenanthrene	O	260000	ug/kg	1.3E-04	ND		0.01	5.9E-05	ND		
Pyrene	O	500000	ug/kg	2.4E-04	0.03	8.2E-03	0.01	1.1E-04	0.027	4.2E-03	1.2E-02
Arsenic	I	22	mg/kg	1.1E-05	0.0003	3.6E-02	0.001	5.0E-07	0.00029	1.7E-03	3 8E-02
Antimony	I	74	mg/kg	3.6E-05	0.0004	9.1E-02	0.001	1.7E-06	0.000004	4.2E-01	5.1E-01
Lead	I	4200	mg/kg	2 1E-03	ND		0.001	9.5E-05	0		
TPH	O	130000	ug/kg	6.4E-05	0.03	2.1E-03	0.01	2.9E-05	0.027	1.1E-03	3.2E-03
HMX	O	1100	ug/kg	5.4E-07	ND		0.01	2.5E-07	ND		
SUMMARY HAZARD INDEX						1E-01				4E-01	6E-01

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (February 10, 1992).
[2] Calculated from oral RfDs
ND = not detected.

TABLE B.15.10

INHALATION OF PARTICULATES - SURFACE SOIL
OCCUPATIONAL WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1.24E+09	m^3/kg	default [1]
CONCENTRATION AIR	CA	chemical-specific	mg/m^3	
INHALATION RATE	IR	0.833	$m^3/hour$	USEPA, 1995
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE TIME	ET	8	hours/day	Assumption
EXPOSURE FREQUENCY	EF	250	days/year	Assumption
EXPOSURE DURATION	ED	25	years	USEPA, 1995
CONVERSION FACTOR	CF	0.001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	25	years	USEPA, 1995

[1] PEF has been derived in the PEF Appendix to this report
USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance
"Standard Default Exposure Factors", OSWER Directive 9285.6-03
USEPA, 1995 Supplemental Guidance to RAGS: Region 4 Bulletins, Bulletin No. 3, November 1995.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / INHALATION REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE} = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

CA = C x CF x (1/PEF)

Note: **For noncarcinogenic effects, AT = ED.**

TABLE B.15.10

INHALATION OF PARTICULATES - SURFACE SOIL
OCCUPATIONAL WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION CSF (mg/kg-day)^-1	CANCER RISK
Benzo(a)anthracene	O	340000	ug/kg	2.74E-07	6.4E-09	3.1E-01	2.0E-09
Benzo(a)pyrene	O	340000	ug/kg	2.74E-07	6.4E-09	3.1E+00	2.0E-08
Benzo(b)fluoranthene	O	510000	ug/kg	4.11E-07	9.6E-09	3.1E-01	3.0E-09
Benzo(k)fluoranthene	O	130000	ug/kg	1.05E-07	2.4E-09	3.1E-02	7.6E-11
Carbazole	O	6600	ug/kg	5.32E-09	1.2E-10	ND	
Chrysene	O	400000	ug/kg	3.23E-07	7.5E-09	3.1E-03	2.3E-11
Dibenzo(a,h)anthracene	O	13000	ug/kg	1.05E-08	2.4E-10	3.1E+00	7.6E-10
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	8.06E-08	1.9E-09	3.1E-01	5.8E-10
Arsenic	I	22	mg/kg	1.77E-08	4.1E-10	1.5E+01	6.2E-09
						SUMMARY CANCER RISK	3E-08

NE = not evaluated

TABLE B.15.10

INHALATION OF PARTICULATES - SURFACE SOIL
OCCUPATIONAL WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Benzo(a)anthracene	O	340000	ug/kg	2.74E-07	1.8E-08	ND	
Benzo(a)pyrene	O	340000	ug/kg	2.74E-07	1.8E-08	ND	
Benzo(b)fluoranthene	O	510000	ug/kg	4.11E-07	2.7E-08	ND	
Benzo(k)fluoranthene	O	130000	ug/kg	1.05E-07	6.8E-09	ND	
Carbazole	O	6600	ug/kg	5.32E-09	3.5E-10	ND	
Chrysene	O	400000	ug/kg	3.23E-07	2.1E-08	ND	
Dibenzo(a,h)anthracene	O	13000	ug/kg	1.05E-08	6.8E-10	ND	
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	8.06E-08	5.3E-09	ND	
Benzo(g,h,i)perylene	O	54000	ug/kg	4.35E-08	2.8E-09	ND	
Fluoranthene	O	660000	ug/kg	5.32E-07	3.5E-08	ND	
Phenanthrene	O	260000	ug/kg	2.10E-07	1.4E-08	ND	
Pyrene	O	500000	ug/kg	4.03E-07	2.6E-08	ND	
Arsenic	I	22	mg/kg	1.77E-08	1.2E-09	ND	
Antimony	I	74	mg/kg	5.97E-08	3.9E-09	ND	
Lead	I	4200	mg/kg	3.39E-06	2.2E-07	ND	
TPH	O	130000	ug/kg	1.05E-07	6.8E-09	ND	
HMX	O	1100	ug/kg	8.87E-10	5.8E-11	ND	
						SUMMARY HAZARD INDEX	0E+00

TABLE B.15.11

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
SITE MAINTENANCE WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	50	mg/day	USEPA, 1992
FRACTION INGESTED	FI	100%	unitless	Assumption
ADHERENCE FACTOR	AF	1	mg/cm²-event	USEPA, 1992
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1995
SURFACE AREA EXPOSED	SA	5,750	cm²	USEPA, 1992
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm²-event	USEPA, 1992
CONVERSION FACTOR	CF	1 00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1 00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	30	days/year [1]	Assumption
EXPOSURE DURATION	ED	25	years	USEPA, 1995
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	25	years	USEPA, 1995

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose
USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance "Standard Default Exposure Factors"; OSWER Directive 9285 6-03
USEPA, 1992 Dermal Exposure Assessment· Principles and Applications, EPA/600/8-91/011B, January 1992
USEPA, 1995 Supplemental Guidance to RAGS Region IV, Human Health Risk Assessment Bulletin No 3

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE_{-INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE_{-DERMAL} = \frac{DA_{event} \times SA \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

DA_{event} = CS x AF x ABS x CF

Note: **For noncarcinogenic effects, AT = ED**

TABLE B.15.11

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
SITE MAINTENANCE WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF $(mg/kg\text{-}day)^{-1}$	CANCER RISK INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2] $(mg/kg\text{-}day)^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
Benzo(a)anthracene	O	340000	ug/kg	7.1E-06	0.73	5.2E-06	0.01	8.2E-06	0.8	6.6E-06	1.2E-05
Benzo(a)pyrene	O	340000	ug/kg	7.1E-06	7.3	5.2E-05	0.01	8 2E-06	8	6.6E-05	1.2E-04
Benzo(b)fluoranthene	O	510000	ug/kg	1.1E-05	0.73	7.8E-06	0.01	1.2E-05	0.8	9.8E-06	1.8E-05
Benzo(k)fluoranthene	O	130000	ug/kg	2 7E-06	0.073	2.0E-07	0.01	3.1E-06	0.08	2.5E-07	4.5E-07
Carbazole	O	6600	ug/kg	1.4E-07	0.02	2.8E-09	0.01	1.6E-07	0.04	6.4E-09	9.1E-09
Chrysene	O	400000	ug/kg	8.4E-06	0.0073	6.1E-08	0.01	9.6E-06	0.008	7.7E-08	1.4E-07
Dibenzo(a,h)anthracene	O	13000	ug/kg	2.7E-07	7.3	2.0E-06	0.01	3.1E-07	8	2.5E-06	4.5E-06
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	2.1E-06	0.73	1.5E-06	0.01	2.4E-06	0.8	1.9E-06	3.5E-06
Arsenic	I	22	mg/kg	4.6E-07	1.5	6.9E-07	0.001	5.3E-08	1.5	8.0E-08	7 7E-07
Lead	I	4200	mg/kg	8.8E-05	ND		0.001	1.0E-05	ND		
SUMMARY CANCER RISK						7E-05				9E-05	2E-04

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (November, 1995).
[2] Calculated from oral CSFs
NE = not evaluated

TABLE B.15.11

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
SITE MAINTENANCE WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Benzo(a)anthracene	O	340000	ug/kg	2 0E-05	ND		0.01	2.3E-05	ND		
Benzo(a)pyrene	O	340000	ug/kg	2.0E-05	ND		0.01	2.3E-05	ND		
Benzo(b)fluoranthene	O	510000	ug/kg	3.0E-05	ND		0.01	3.4E-05	ND		
Benzo(k)fluoranthene	O	130000	ug/kg	7.6E-06	ND		0.01	8.8E-06	ND		
Carbazole	O	6600	ug/kg	3.9E-07	ND		0.01	4.5E-07	ND		
Chrysene	O	400000	ug/kg	2.3E-05	ND		0.01	2.7E-05	ND		
Dibenzo(a,h)anthracene	O	13000	ug/kg	7.6E-07	ND		0.01	8 8E-07	ND		
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	5.9E-06	ND		0.01	6 8E-06	ND		
Benzo(g,h,i)perylene	O	54000	ug/kg	3.2E-06	ND		0.01	3.6E-06	ND		
Fluoranthene	O	660000	ug/kg	3.9E-05	0.04	9.7E-04	0.01	4.5E-05	0.036	1.2E-03	2.2E-03
Phenanthrene	O	260000	ug/kg	1.5E-05	ND		0.01	1.8E-05	ND		
Pyrene	O	500000	ug/kg	2.9E-05	0.03	9.8E-04	0.01	3.4E-05	0.027	1.3E-03	2.2E-03
Arsenic	I	22	mg/kg	1.3E-06	0.0003	4.3E-03	0.001	1 5E-07	0.00029	5.1E-04	4.8E-03
Antimony	I	74	mg/kg	4.3E-06	0.0004	1.1E-02	0.001	5 0E-07	0.000004	1.2E-01	1.4E-01
Lead	I	4200	mg/kg	2.5E-04	ND		0.001	2.8E-05	0		
TPH	O	130000	ug/kg	7.6E-06	0.03	2.5E-04	0.01	8.8E-06	0.027	3.3E-04	5.8E-04
HMX	O	1100	ug/kg	6.5E-08	ND		0.01	7.4E-08	ND		
SUMMARY HAZARD INDEX						2E-02				1E-01	1E-01

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (February 10, 1992).
[2] Calculated from oral RfDs
ND = no data available

TABLE B.15.12

INHALATION OF PARTICULATES - SURFACE SOIL
SITE MAINTENANCE WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART EMISSION FACTOR	PEF	1 24E+09	m^3/kg	default [1]
CONCENTRATION AIR	CA	chemical-specific	mg/m^3	
INHALATION RATE	IR	0 833	$m^3/hour$	USEPA, 1995
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE TIME	ET	8	hours/day	Assumption
EXPOSURE FREQUENCY	EF	30	days/year	Assumption
EXPOSURE DURATION	ED	25	years	USEPA, 1995
CONVERSION FACTOR	CF	0 001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	25	years	USEPA, 1995

[1] PEF has been derived in the PEF Appendix to this report
USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance
"Standard Default Exposure Factors", OSWER Directive 9285 6-03
USEPA, 1995 Supplemental Guidance to RAGS Region 4 Bulletins, Bulletin No 3, November 1995.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / INHALATION REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE} = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

CA = C x CF x (1/PEF)

Note: **For noncarcinogenic effects, AT = ED**

TABLE B.15.12

INHALATION OF PARTICULATES - SURFACE SOIL
SITE MAINTENANCE WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION CSF (mg/kg-day)^-1	CANCER RISK
Benzo(a)anthracene	O	340000	ug/kg	2.74E-07	7.7E-10	3.1E-01	2.4E-10
Benzo(a)pyrene	O	340000	ug/kg	2.74E-07	7.7E-10	3.1E+00	2.4E-09
Benzo(b)fluoranthene	O	510000	ug/kg	4.11E-07	1.1E-09	3.1E-01	3.6E-10
Benzo(k)fluoranthene	O	130000	ug/kg	1.05E-07	2.9E-10	3.1E-02	9.1E-12
Carbazole	O	6600	ug/kg	5.32E-09	1.5E-11	ND	
Chrysene	O	400000	ug/kg	3.23E-07	9.0E-10	3.1E-03	2.8E-12
Dibenzo(a,h)anthracene	O	13000	ug/kg	1.05E-08	2.9E-11	3.1E+00	9.1E-11
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	8.06E-08	2.3E-10	3.1E-01	7.0E-11
Arsenic	I	22	mg/kg	1.77E-08	5.0E-11	1.5E+01	7.4E-10
						SUMMARY CANCER RISK	4E-09

NE = not evaluated.

TABLE B.15.12

INHALATION OF PARTICULATES - SURFACE SOIL
SITE MAINTENANCE WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Benzo(a)anthracene	O	340000	ug/kg	2.74E-07	2.1E-09	ND	
Benzo(a)pyrene	O	340000	ug/kg	2.74E-07	2.1E-09	ND	
Benzo(b)fluoranthene	O	510000	ug/kg	4.11E-07	3.2E-09	ND	
Benzo(k)fluoranthene	O	130000	ug/kg	1.05E-07	8.2E-10	ND	
Carbazole	O	6600	ug/kg	5.32E-09	4.2E-11	ND	
Chrysene	O	400000	ug/kg	3.23E-07	2.5E-09	ND	
Dibenzo(a,h)anthracene	O	13000	ug/kg	1.05E-08	8.2E-11	ND	
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	8.06E-08	6.3E-10	ND	
Benzo(g,h,i)perylene	O	54000	ug/kg	4.35E-08	3.4E-10	ND	
Fluoranthene	O	660000	ug/kg	5.32E-07	4.2E-09	ND	
Phenanthrene	O	260000	ug/kg	2.10E-07	1.6E-09	ND	
Pyrene	O	500000	ug/kg	4.03E-07	3.2E-09	ND	
Arsenic	I	22	mg/kg	1.77E-08	1.4E-10	ND	
Antimony	I	74	mg/kg	5.97E-08	4.7E-10	ND	
Lead	I	4200	mg/kg	3.39E-06	2.7E-08	ND	
TPH	O	130000	ug/kg	1.05E-07	8.2E-10	ND	
HMX	O	1100	ug/kg	8.87E-10	6.9E-12	ND	
						SUMMARY HAZARD INDEX	0E+00

TABLE B.15.13

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
EXCAVATION WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	480	mg/day	USEPA, 1995
FRACTION INGESTED	FI	100%	unitless	Assumption
ADHERENCE FACTOR	AF	1	mg/cm²-event	USEPA, 1995
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1995
SURFACE AREA EXPOSED	SA	5,750	cm²	USEPA, 1992
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm²-event	USEPA, 1992
CONVERSION FACTOR	CF	1 00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1 00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	30	days/year [1]	Assumption
EXPOSURE DURATION	ED	1	years	USEPA, 1991
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	1	years	USEPA, 1991

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose

USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance "Standard Default Exposure Factors", OSWER Directive 9285 6-03

USEPA, 1992 Dermal Exposure Assessment Principles and Applications, EPA/600/8-91/011B, January 1992

USEPA, 1995 Supplemental Guidance to RAGS · Region IV, Human Health Risk Assessment Bulletin No 3

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE_{-INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE_{-DERMAL} = \frac{DAevent \times SA \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

$$DA_{event} = CS \times AF \times ABS \times CF$$

Note: **For noncarcinogenic effects, AT = ED**

TABLE B.15.13

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
EXCAVATION WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF $(mg/kg\text{-}day)^{-1}$	CANCER RISK INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2] $(mg/kg\text{-}day)^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
Benzo(a)anthracene	O	340000	ug/kg	2.7E-06	0.73	2.0E-06	0.01	3.3E-07	0.8	2.6E-07	2.3E-06
Benzo(a)pyrene	O	340000	ug/kg	2.7E-06	7.3	2.0E-05	0.01	3.3E-07	8	2.6E-06	2.3E-05
Benzo(b)fluoranthene	O	510000	ug/kg	4.1E-06	0.73	3.0E-06	0.01	4.9E-07	0.8	3.9E-07	3.4E-06
Benzo(k)fluoranthene	O	130000	ug/kg	1.0E-06	0.073	7.6E-08	0.01	1.3E-07	0.08	1.0E-08	8.6E-08
Carbazole	O	6600	ug/kg	5.3E-08	0.02	1.1E-09	0 01	6.4E-09	0.04	2.5E-10	1.3E-09
Chrysene	O	400000	ug/kg	3.2E-06	0.0073	2.4E-08	0 01	3.9E-07	0.008	3.1E-09	2.7E-08
Dibenzo(a,h)anthracene	O	13000	ug/kg	1.0E-07	7.3	7.6E-07	0.01	1.3E-08	8	1.0E-07	8.6E-07
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	8.1E-07	0.73	5.9E-07	0.01	9.6E-08	0.8	7.7E-08	6.6E-07
Arsenic	I	22	mg/kg	1.8E-07	1.5	2.7E-07	0.001	2.1E-09	1.5	3.2E-09	2.7E-07
Lead	I	4200	mg/kg	3.4E-05	ND		0.001	4.1E-07	ND		
SUMMARY CANCER RISK						3E-05				3E-06	3E-05

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November, 1995)
[2] Calculated from oral CSFs
NE = not evaluated

TABLE B.15.13

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL
EXCAVATION WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Benzo(a)anthracene	O	340000	ug/kg	1.9E-04	ND		0.01	2.3E-05	ND		
Benzo(a)pyrene	O	340000	ug/kg	1.9E-04	ND		0.01	2.3E-05	ND		
Benzo(b)fluoranthene	O	510000	ug/kg	2.9E-04	ND		0.01	3.4E-05	ND		
Benzo(k)fluoranthene	O	130000	ug/kg	7.3E-05	ND		0.01	8.8E-06	ND		
Carbazole	O	6600	ug/kg	3.7E-06	ND		0.01	4.5E-07	ND		
Chrysene	O	400000	ug/kg	2.3E-04	ND		0.01	2.7E-05	ND		
Dibenzo(a,h)anthracene	O	13000	ug/kg	7.3E-06	ND		0.01	8.8E-07	ND		
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	5.6E-05	ND		0.01	6.8E-06	ND		
Benzo(g,h,i)perylene	O	54000	ug/kg	3.0E-05	ND		0.01	3.6E-06	ND		
Fluoranthene	O	660000	ug/kg	3 7E-04	0.04	9.3E-03	0.01	4 5E-05	0.036	1.2E-03	1 1E-02
Phenanthrene	O	260000	ug/kg	1.5E-04	ND		0.01	1 8E-05	ND		
Pyrene	O	500000	ug/kg	2.8E-04	0.03	9.4E-03	0.01	3.4E-05	0.027	1.3E-03	1.1E-02
Arsenic	I	22	mg/kg	1 2E-05	0.0003	4.1E-02	0 001	1 5E-07	0.00029	5.1E-04	4.2E-02
Antimony	I	74	mg/kg	4.2E-05	0.0004	1.0E-01	0.001	5.0E-07	0.000004	1.2E-01	2 3E-01
Lead	I	4200	mg/kg	2.4E-03	ND		0.001	2.8E-05	0		
TPH	O	130000	ug/kg	7.3E-05	0.03	2.4E-03	0.01	8 8E-06	0.027	3.3E-04	2.8E-03
HMX	O	1100	ug/kg	6 2E-07	ND		0.01	7.4E-08	ND		
SUMMARY HAZARD INDEX						2E-01				1E-01	3E-01

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (November 1995)
[2] Calculated from oral RfDs
ND = no data available

TABLE B.15.14

INHALATION OF PARTICULATES - SURFACE SOIL
EXCAVATION WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	1 24E+09	m^3/kg	default [1]
CONCENTRATION AIR	CA	chemical-specific	mg/m^3	
INHALATION RATE	IR	2 5	m^3/hour	USEPA, 1995
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE TIME	ET	8	hours/day	Assumption
EXPOSURE FREQUENCY	EF	30	days/year	Assumption
EXPOSURE DURATION	ED	1	years	Assumption
CONVERSION FACTOR	CF	0 001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	1	years	USEPA, 1991

[1] PEF has been derived in the PEF Appendix to this report
USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance
Standard Default Exposure Factors, OSWER Directive 9285 6-03
USEPA, 1995 Supplemental Guidance to RAGS Region IV, Human Health Risk Assessment Bulletin No 3

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR (mg/kg-day)$^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / INHALATION REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE} = \frac{\text{CA x IR x ET x EF x ED}}{\text{BW x AT x 365 days/yr}}$$

Where:

CA = C x CF x (1/PEF)

Note: For noncarcinogens, AT = ED.

TABLE B.15.14

INHALATION OF PARTICULATES - SURFACE SOIL
EXCAVATION WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION CSF (mg/kg-day)^-1	CANCER RISK
Benzo(a)anthracene	O	340000	ug/kg	2.74E-07	9.2E-11	3.1E-01	2.9E-11
Benzo(a)pyrene	O	340000	ug/kg	2.74E-07	9.2E-11	3.1E+00	2.9E-10
Benzo(b)fluoranthene	O	510000	ug/kg	4.11E-07	1.4E-10	3.1E-01	4.3E-11
Benzo(k)fluoranthene	O	130000	ug/kg	1.05E-07	3.5E-11	3.1E-02	1.1E-12
Carbazole	O	6600	ug/kg	5.32E-09	1.8E-12	ND	
Chrysene	O	400000	ug/kg	3.23E-07	1.1E-10	3.1E-03	3.4E-13
Dibenzo(a,h)anthracene	O	13000	ug/kg	1.05E-08	3.5E-12	3.1E+00	1.1E-11
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	8.06E-08	2.7E-11	3.1E-01	8.4E-12
Arsenic	I	22	mg/kg	1.77E-08	6.0E-12	1.5E+01	8.9E-11
						SUMMARY CANCER RISK	5E-10

NE = not evaluated.

TABLE B.15.14

INHALATION OF PARTICULATES - SURFACE SOIL
EXCAVATION WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Benzo(a)anthracene	O	340000	ug/kg	2.74E-07	6.4E-09	ND	
Benzo(a)pyrene	O	340000	ug/kg	2.74E-07	6.4E-09	ND	
Benzo(b)fluoranthene	O	510000	ug/kg	4.11E-07	9.7E-09	ND	
Benzo(k)fluoranthene	O	130000	ug/kg	1.05E-07	2.5E-09	ND	
Carbazole	O	6600	ug/kg	5.32E-09	1.2E-10	ND	
Chrysene	O	400000	ug/kg	3.23E-07	7.6E-09	ND	
Dibenzo(a,h)anthracene	O	13000	ug/kg	1.05E-08	2.5E-10	ND	
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	8.06E-08	1.9E-09	ND	
Benzo(g,h,i)perylene	O	54000	ug/kg	4.35E-08	1.0E-09	ND	
Fluoranthene	O	660000	ug/kg	5.32E-07	1.2E-08	ND	
Phenanthrene	O	260000	ug/kg	2.10E-07	4.9E-09	ND	
Pyrene	O	500000	ug/kg	4.03E-07	9.5E-09	ND	
Arsenic	I	22	mg/kg	1.77E-08	4.2E-10	ND	
Antimony	I	74	mg/kg	5.97E-08	1.4E-09	ND	
Lead	I	4200	mg/kg	3.39E-06	8.0E-08	ND	
TPH	O	130000	ug/kg	1.05E-07	2.5E-09	ND	
HMX	O	1100	ug/kg	8.87E-10	2.1E-11	ND	
						SUMMARY HAZARD INDEX	0E+00

TABLE B.15.15

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SUBSURFACE SOIL
EXCAVATION WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	480	mg/day	USEPA, 1995
FRACTION INGESTED	FI	100%	unitless	Assumption
ADHERENCE FACTOR	AF	1	mg/cm^2-event	USEPA, 1995
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1995
SURFACE AREA EXPOSED	SA	5,750	cm^2	USEPA, 1992
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm^2-event	USEPA, 1992
CONVERSION FACTOR	CF	1 00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1 00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	30	days/year [1]	Assumption
EXPOSURE DURATION	ED	1	years	USEPA, 1991
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	1	years	USEPA, 1991

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose
USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance "Standard Default Exposure Factors", OSWER Directive 9285 6-03
USEPA, 1992 Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/011B, January 1992
USEPA, 1995 Supplemental Guidance to RAGS Region IV, Human Health Risk Assessment Bulletin No 3

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE_{-INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE_{-DERMAL} = \frac{DAevent \times SA \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

$$DA_{event} = CS \times AF \times ABS \times CF$$

Note: For noncarcinogenic effects, AT = ED

TABLE B.15.15

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SUBSURFACE SOIL
EXCAVATION WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF (mg/kg-day)$^{-1}$	CANCER RISK INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2] (mg/kg-day)$^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
Benzo(a)anthracene	O	10700	ug/kg	8.6E-08	7.3E-01	6.3E-08	0.01	1.0E-08	8.0E-01	8.3E-09	7.1E-08
Benzo(a)pyrene	O	10500	ug/kg	8.5E-08	7.3E+00	6.2E-07	0.01	1.0E-08	8.0E+00	8.1E-08	7.0E-07
Benzo(b)fluoranthene	O	17000	ug/kg	1.4E-07	7.3E-01	1.0E-07	0.01	1.6E-08	8.0E-01	1.3E-08	1.1E-07
Benzo(k)fluoranthene	O	3800	ug/kg	3.1E-08	7.3E-02	2.2E-09	0.01	3.7E-09	8.0E-02	2.9E-10	2.5E-09
Chrysene	O	11000	ug/kg	8.9E-08	7.3E-03	6.5E-10	0.01	1.1E-08	8.0E-03	8.5E-11	7.3E-10
Dibenzo(a,h)anthracene	O	930	ug/kg	7.5E-09	7.3E+00	5.5E-08	0.01	9.0E-10	8.0E+00	7.2E-09	6.2E-08
Indeno(1,2,3-cd)pyrene	O	2800	ug/kg	2.3E-08	7.3E-01	1.6E-08	0.01	2.7E-09	8.0E-01	2.2E-09	1.9E-08
SUMMARY CANCER RISK						9E-07				1E-07	1E-06

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November 1995).
[2] Calculated from oral CSFs
NE = not evaluated

TABLE B.15.15

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SUBSURFACE SOIL
EXCAVATION WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Benzo(a)anthracene	O	10700	ug/kg	6.0E-06	ND		0.01	7.2E-07	ND		
Benzo(a)pyrene	O	10500	ug/kg	5.9E-06	ND		0.01	7.1E-07	ND		
Benzo(b)fluoranthene	O	17000	ug/kg	9.6E-06	ND		0.01	1.1E-06	ND		
Benzo(k)fluoranthene	O	3800	ug/kg	2.1E-06	ND		0.01	2.6E-07	ND		
Chrysene	O	11000	ug/kg	6 2E-06	ND		0.01	7.4E-07	ND		
Dibenzo(a,h)anthracene	O	930	ug/kg	5 2E-07	ND		0.01	6.3E-08	ND		
Indeno(1,2,3-cd)pyrene	O	2800	ug/kg	1 6E-06	ND		0 01	1.9E-07	ND		
TPH	O	47500	ug/kg	2 7E-05	3.0E-01	8 9E-05	0.01	3.2E-06	0.27	1.2E-05	1.0E-04
				SUMMARY HAZARD INDEX		**0.0001**				**0.00001**	**0.0001**

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for morganics (November 1995)
[2] Calculated from oral RfDs
ND = no data available

TABLE B.15.16

INHALATION OF PARTICULATES - SUBSURFACE SOIL
EXCAVATION WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
SOIL CONCENTRATION	C	chemical-specific	chemical-specific	
PART. EMISSION FACTOR	PEF	12000000	m^3/kg	site-specific value
CONCENTRATION AIR	CA	chemical-specific	mg/m^3	
INHALATION RATE	IR	2 5	m^3/hour	USEPA, 1995
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE TIME	ET	8	hours/day	Assumption
EXPOSURE FREQUENCY	EF	30	days/year	Assumption
EXPOSURE DURATION	ED	1	years	Assumption
CONVERSION FACTOR	CF	0 001	mg/ug	Organics only
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	1	years	USEPA, 1991

[1] PEF has been derived in the PEF Appendix to this report
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance
Standard Default Exposure Factors; OSWER Directive 9285.6-03
USEPA, 1995 Supplemental Guidance to RAGS Region IV, Human Health Risk Assessment Bulletin No 3

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x INHALATION CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / INHALATION REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE} = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

CA = C x CF x (1/PEF)

Note: For noncarcinogens, AT = ED.

TABLE B.15.16

INHALATION OF PARTICULATES - SUBSURFACE SOIL
EXCAVATION WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION CSF (mg/kg-day)^-1	CANCER RISK
Benzo(a)anthracene	O	10700	ug/kg	8.92E-07	3.0E-10	3.1E-01	**9.3E-11**
Benzo(a)pyrene	O	10500	ug/kg	8.75E-07	2.9E-10	3.1E+00	**9.1E-10**
Benzo(b)fluoranthene	O	17000	ug/kg	1.42E-06	4.8E-10	3.1E-01	**1.5E-10**
Benzo(k)fluoranthene	O	3800	ug/kg	3.17E-07	1.1E-10	3.1E-02	**3.3E-12**
Chrysene	O	11000	ug/kg	9.17E-07	3.1E-10	3.1E-03	**9.5E-13**
Dibenzo(a,h)anthracene	O	930	ug/kg	7.75E-08	2.6E-11	3.1E+00	**8.1E-11**
Indeno(1,2,3-cd)pyrene	O	2800	ug/kg	2.33E-07	7.8E-11	3.1E-01	**2.4E-11**
						SUMMARY CANCER RISK	**1E-09**

NE = not evaluated

TABLE B.15.16

INHALATION OF PARTICULATES - SUBSURFACE SOIL
EXCAVATION WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	AIR CONCENTRATION (mg/m³)	INTAKE (mg/kg-day)	INHALATION RfD (mg/kg-day)	HAZARD QUOTIENT
Benzo(a)anthracene	O	10700	ug/kg	8.92E-07	2.1E-08	ND	
Benzo(a)pyrene	O	10500	ug/kg	8.75E-07	2.1E-08	ND	
Benzo(b)fluoranthene	O	17000	ug/kg	1.42E-06	3.3E-08	ND	
Benzo(k)fluoranthene	O	3800	ug/kg	3.17E-07	7.4E-09	ND	
Chrysene	O	11000	ug/kg	9.17E-07	2.2E-08	ND	
Dibenzo(a,h)anthracene	O	930	ug/kg	7.75E-08	1.8E-09	ND	
Indeno(1,2,3-cd)pyrene	O	2800	ug/kg	2.33E-07	5.5E-09	ND	
TPH	O	47500	ug/kg	3.96E-06	9.3E-08	ND	
						SUMMARY HAZARD INDEX	**0E+00**

ND = no data available

TABLE B.15 18

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES)
CHILD RESIDENT
SITE 15, OPERABLE UNIT 5
NAS CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION WATER	CW	chemical-specific	ug/liter	
INGESTION RATE	IR	1	liters/day	USEPA, 1995
BODY WEIGHT	BW	15	kg	USEPA, 1991
CONVERSION FACTOR	CF	0.001	mg/ug	
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1991
EXPOSURE DURATION	ED	6	years	USEPA, 1991
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	6	years	USEPA, 1991

USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance
"Standard Default Exposure Factors", OSWER Directive 9285.6-03.
USEPA, 1995 Region IV Supplemental Gudance to RAGS, Bulletin No. 3, November.

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)-1

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE} = \frac{\text{CW x IR x EF x ED x CF}}{\text{BW x AT x 365 days/year}}$$

Note: For noncarcinogenic effects, AT = ED.

TABLE B.15.18

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES)
CHILD RESIDENT
SITE 15, OPERABLE UNIT 5
NAS CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	CANCER SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK INGESTION
bis(2-Ethylhexyl)phthalate	32.9	ug/L	1 8E-04	1.4E-02	2 5E-06
4,4-DDD	0.029	ug/L	1 6E-07	2.4E-01	3 8E-08
4,4-DDE	0.06	ug/L	3 3E-07	3 4E-01	1 1E-07
4,4-DDT	0 034	ug/L	1 9E-07	3.4E-01	6 3E-08
Beryllium	1	ug/L	5 5E-06	4.3E+00	2 4E-05
			TOTAL CANCER RISK		3E-05

ND = No Data

TABLE B.15.18

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES)
CHILD RESIDENT
SITE 15, OPERABLE UNIT 5
NAS CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT INGESTION
bis(2-Ethylhexyl)phthalate	32 9	UG/LITER	2 1E-03	2 0E-02	1 1E-01
4,4-DDD	0 029	UG/LITER	1 9E-06	ND	
4,4-DDE	0 06	UG/LITER	3 8E-06	ND	
4,4-DDT	0 034	UG/LITER	2 2E-06	5 0E-04	4 3E-03
Aluminum	427	UG/LITER	2 7E-02	1 0E+00	2 7E-02
Antimony	2 2	UG/LITER	1 4E-04	4 0E-04	3 5E-01
Beryllium	1	UG/LITER	6 4E-05	5 0E-03	1.3E-02
Iron	1750	UG/LITER	1 1E-01	3 0E-01	3 7E-01
Thallium	5 2	UG/LITER	3 3E-04	8.0E-05	4 2E+00
RDX	0 24	UG/LITER	1.5E-05	ND	
TOTAL HAZARD INDEX					5

TABLE B-15.19

INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER
ADULT RESIDENT - WADING
SITE 15, OPERABLE UNIT
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION WATER	CW	chemical-specific	ug/liter	
INGESTION RATE [1]	IR	0 026	liters/day	USEPA, 1995
SURFACE AREA [2]	SA	5,750	cm2	USEPA, 1989
EVENT FREQUENCY	EV	1	events/day	Assumption
BODY WEIGHT	BW	70	kg	USEPA, 1991
DOSE ABSORBED PER EVENT	DAevent	chemical-specific	mg/cm2-event	Calculated
EXPOSURE TIME	ET	2 6	hours/day	Assumption
EXPOSURE FREQUENCY	EF	100	days/year	Assumption
EXPOSURE DURATION	ED	24	years	Assumption
DIFFUSION DEPTH PER EVENT	PCevent	chemical-specific	cm/event	Calculated per USEPA, 1992 [3]
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	24	years	USEPA, 1995
CONVERSION FACTOR	CF1	0 001	mg/ug	
CONVERSION FACTOR	CF2	0 001	liter/cm3	

[1] Ingestion Rate = 0 026 l/day = 10 ml/hour x 2 6 hours/day x 0 001 l/ml
[2] Surface area assumes lower legs, hands, and feet are exposed
[3] PCevent is calculated in the Dermal Guidance Appendix to this report
USEPA, 1989 Exposure Factors Handbook, EPA/600/8-89/043, May 1989
USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance "Standard Default Exposure Parameters"
USEPA, 1992 Dermal Exposure Assessment Principles and Applications, EPA/600/8-91/011B
USEPA, 1995 Supplemental Guidance to RAGS: Region 4 Bulletins, Bulletin No 3, November 1995

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)-1

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE-INGESTION} = \frac{CW \times IR \times EF \times ED \times CF1}{BW \times AT \times 365\ \text{days/yr}}$$

$$\text{INTAKE-DERMAL} = \frac{DAevent \times EV \times EF \times ED \times SA}{AT \times BW \times 365\ \text{days/yr}}$$

Where:
DAevent = PCevent x CW x CF1 x CF2

Note: For noncarcinogenic effects, AT = ED.

TABLE B.15.19

INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER
ADULT RESIDENT - WADING
SITE 15, OPERABLE UNIT
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND		WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] (mg/kg-day)^-1	CANCER RISK INGESTION	PCEVENT[2] (cm/event)	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [1, 3] (mg/kg-day)^-1	CANCER RISK DERMAL	TOTAL CANCER RISK
Arsenic	I	12	ug/L	4 2E-07	1 5	6.3E-07	0.0026	2.4E-07	1.5	3.6E-07	9.9E-07
Lead	I	400	ug/L	1.4E-05	ND		0 0026	8.0E-06	ND		
SUMMARY CANCER RISK						6E-07				4E-07	1E-06

[1] Relative potency factors were applied to the CSFs of carcinogenic PAHs Relative potency factors are derived in "Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons," USEPA, 1993
[2] This chemical-specific value is calculated in Table B 15 23 of this appendix.
[3] Calculated from oral CSFs
ND = no data available

TABLE B.15.19

INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER
ADULT RESIDENT - WADING
SITE 15, OPERABLE UNIT
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND		WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg day)	HAZARD QUOTIENT INGESTION	PCEVENT[1] (cm/event)	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)^-1	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
1,3,5-Trinitrobenzene	O	6.73	ug/L	6 8E-07	5.0E-05	1.4E-02	1.9E-03	2 9E-07	ND		1.4E-02
3-Nitrotoluene	O	4.95	ug/L	5.0E-07	1.0E-02	5.0E-05	ND		ND		5.0E-05
4-Nitrotoluene	O	46.1	ug/L	4.7E-06	1.0E-02	4.7E-04	ND		ND		4.7E-04
TETRYL	O	18.4	ug/L	1.9E-06	1.0E-02	1.9E-04	ND		ND		1.9E-04
Aluminum	I	649	ug/L	6.6E-05	1.0E+00	6.6E-05	2.6E-03	3.8E-05	0.2	1.9E-04	2.6E-04
Arsenic	I	12	ug/L	1.2E-06	3.0E-04	4.1E-03	2.6E-03	7.0E-07	0.00029	2.4E-03	6 5E-03
Iron	I	1980	ug/L	2.0E-04	3 0E-01	6.7E-04	2.6E-03	1.2E-04	0.006	1.9E-02	2.0E-02
Lead	I	400	ug/L	4.1E-05	ND		2.6E-03	2.3E-05	ND		
Vanadium	I	3.3	ug/L	3.4E-07	7.0E-03	4 8E-05	2.6E-03	1.9E-07	0.00021	9.2E-04	9.7E-04
TPH	O	600	ug/L	6.1E-05	3.0E-02	2.0E-03	2.9E+00	3.9E-02	0.027	1 4E+00	1.4E+00
					SUMMARY HAZARD INDEX	2E-02				1E+00	1E+00

[1] This chemical-specific value is calculated in Table B 15 23 of this appendix
[2] Calculated from oral RfDs
ND = no data available

TABLE B.15.20

INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER
ADULT TRESPASSER - WADING
SITE 15, OPERABLE UNIT
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION WATER	CW	chemical-specific	ug/liter	
INGESTION RATE [1]	IR	0.026	liters/day	USEPA, 1995
SURFACE AREA [2]	SA	5,750	cm^2	USEPA, 1992
EVENT FREQUENCY	EV	1	events/day	Assumption
BODY WEIGHT	BW	70	kg	USEPA, 1991
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm^2-event	Calculated
EXPOSURE TIME	ET	2.6	hours/day	Assumption
EXPOSURE FREQUENCY	EF	45	days/year	Assumption
EXPOSURE DURATION	ED	20	years	Assumption
DIFFUSION DEPTH PER EVENT	PC_{event}	chemical-specific	cm/event	[3]
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	20	years	Assumption
CONVERSION FACTOR	CF1	0.001	mg/ug	
CONVERSION FACTOR	CF2	0.001	$liter/cm^3$	

[1] Ingestion Rate = 0.026 l/day = 10 ml/hour x 2.6 hours/day x 0.001 l/ml
[2] Surface area assumes lower legs, hands, and feet are exposed
[3] PC_{event} is calculated per Dermal Guidance Appendix to this report
USEPA, 1989 Exposure Factors Handbook, EPA/600/8-89/043, May 1989
USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance "Standard Default Exposure Parameters",
USEPA, 1992 Dermal Exposure Assessment Principles and Applications; EPA/600/8-91/011B
USEPA, 1995 Supplemental Guidance to RAGS Region 4 Bulletins, Bulletin No. 3, November 1995

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

INTAKE-INGESTION = $\frac{CW \times IR \times EF \times ED \times CF1}{BW \times AT \times 365\ days/yr}$

INTAKE-DERMAL = $\frac{DA_{event} \times EV \times EF \times ED \times SA}{AT \times BW \times 365\ days/yr}$

Where:
$DA_{event} = PC_{event} \times CW \times CF1 \times CF2$

Note: For noncarcinogenic effects, AT = ED.

TABLE B.15.20

INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER
ADULT TRESPASSER - WADING
SITE 15, OPERABLE UNIT
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF	CANCER RISK INGESTION	PCEVENT [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2]	CANCER RISK DERMAL	TOTAL CANCER RISK
Arsenic	I	12	mg/kg	1 6E-07	1.5	2.4E-07	0 0026	9 0E-08	1.5	1 4E-07	3.7E-07
Lead	I	275	mg/kg	3 6E-06	ND		0 0026	2.1E-06	ND		
SUMMARY CANCER RISK						2E-07				1E-07	4E-07

[1] This chemical-specific value is calculated in Table B 15 23 of this appendix
[2] Calculated from oral CSFs
NE = not evaluated

TABLE B 15.20

INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER
ADULT TRESPASSER - WADING
SITE 15, OPERABLE UNIT
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	PCEVENT[1] (cm/event)	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
1,3,5-Trinitrobenzene	O	6 73	ug/kg	3 1E-07	ND		0 00384	2.6E-07	ND		
3-Nitrotoluene	O	4.95	ug/kg	2 3E-07	ND		ND		ND		
4-Nitrotoluene	O	46.1	ug/kg	2.1E-06	ND		ND		ND		
TETRYL	O	18 4	ug/kg	8.4E-07	0 01	8 4E-05	ND		ND		8.4E-05
Aluminum	I	649	mg/kg	3.0E-05	1	3 0E-05	0 0026	1.7E-05	0.2	8.5E-05	1.2E-04
Arsenic	I	12	mg/kg	5.5E-07	0 0003	1.8E-03	0 0026	3 2E-07	0 00029	1.1E-03	2.9E-03
Iron	I	1980	mg/kg	9 1E-05	0 3	3 0E-04	0 0026	5.2E-05	0 006	8.7E-03	9.0E-03
Lead	I	275	mg/kg	1.3E-05	ND		0 0026	7.2E-06	ND		
Vanadium	I	3.3	mg/kg	1.5E-07	0.007	2 2E-05	0.0026	8.7E-08	0.00021	4.1E-04	4.4E-04
TPH	O	600	ug/kg	2.7E-05	0.03	9.2E-04	2.89	1.8E-02	0 027	6.5E-01	6.5E-01
					SUMMARY HAZARD INDEX	3E-03				7E-01	7E-01

[1] This chemical-specific value is calculated in Table B 15 23 of this appendix
[2] Calculated from oral RfDs
ND = no data available

SW_TMPL XLS

TABLE B.15.21

INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER
CHILD RESIDENT - WADING
SITE 15, OPERABLE UNIT
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION WATER	CW	chemical-specific	ug/liter	
INGESTION RATE [1]	IR	0 13	liters/day	USEPA, 1995
AGE-SPECIFIC SURFACE AREA [2]	SA	age-specific	cm^2	USEPA, 1989
EVENT FREQUENCY	EV	1	events/day	Assumption
BODY WEIGHT	BW	15	kg	USEPA, 1991
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm^2-event	Calculated
EXPOSURE FREQUENCY	EF	100	days/year	Assumption
EXPOSURE DURATION	ED	6	years	Assumption
AGE-WEIGHTED SURFACE AREA [3]	SAsw/adj	766	cm^2-yr/kg	Calculated per USEPA, 1992
DIFFUSION DEPTH PER EVENT [4]	PC_{event}	chemical-specific	cm/event	Calculated per USEPA, 1992
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	6	years	Assumption
CONVERSION FACTOR	CF1	0 001	mg/ug	
CONVERSION FACTOR	CF2	0 001	liter/cm^3	

[1] Ingestion Rate = 0 13 l/day = 50 ml/hour x 2 6 hours/day x 0 001 l/ml
[2] Surface area assumes lower legs, hands, and feet are exposed
[3] Age-weighted, body weight normalized surface area
[4] PC_{event} calculated per the Dermal Guidance appendix to this report
USEPA, 1989 Exposure Factors Handbook, EPA/600/8-89/043, May 1989
USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance "Standard Default Exposure Parameters",
USEPA, 1992 Dermal Exposure Assessment Principles and Applications, EPA/600/8-91/011B

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg day) $^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

INTAKE-INGESTION = $\frac{CW \times IR \times EF \times ED \times CF1}{BW \times AT \times 365\ days/yr}$

INTAKE-DERMAL = $\frac{DA_{event} \times EV \times EF \times SAsw/adj}{AT \times 365\ days/yr}$

Where:

SAsw/adj = Sum (SA x ED / BW)

DA_{event} = PC_{event} x CW x CF1 x CF2

Note: For noncarcinogenic effects, AT = ED.

TABLE B.15.21

INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER
CHILD RESIDENT - WADING
SITE 15, OPERABLE UNIT
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF	CANCER RISK INGESTION	PCEVENT [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2]	CANCER RISK DERMAL	TOTAL CANCER RISK
Arsenic	I	12	ug/L	2.4E-06	1.5	3.7E-06	0.0026	9.4E-08	1.5	1.4E-07	3.8E-06
Lead	I	400	ug/L	8.1E-05	ND		0.0026	3.1E-06	ND		
SUMMARY CANCER RISK						4E-06				1E-07	4E-06

[1] This chemical-specific value has been calculated in Table B.15.23 of this appendix
[2] Calculated from oral CSFs
ND = no data available

TABLE B.15.21

INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER
CHILD RESIDENT - WADING
SITE 15, OPERABLE UNIT
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	PCEVENT [1] (cm/event)	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
1,3,5-Trinitrobenzene	O	6.73	ug/L	1.6E-05	5.0E-05	3.2E-01	1.9E-03	4.5E-07	ND		**3.2E-01**
3-Nitrotoluene	O	4.95	ug/L	1.2E-05	1.0E-02	1 2E-03	ND		ND		**1.2E-03**
4-Nitrotoluene	O	46.1	ug/L	1 1E-04	1.0E-02	1.1E-02	ND		ND		**1.1E-02**
TETRYL	O	18.4	ug/L	4 4E-05	1.0E-02	4.4E-03	ND		ND		**4.4E-03**
Aluminum	I	649	ug/L	1 5E-03	1 0E+00	1 5E-03	2 6E-03	5.9E-05	2 0E-01	3.0E-04	**1.8E-03**
Arsenic	I	12	ug/L	2 8E-05	3 0E-04	9 5E-02	2 6E-03	1 1E-06	2 9E-04	3 8E-03	**9.9E-02**
Iron	I	1980	ug/L	4 7E-03	3 0E-01	1 6E-02	2 6E-03	1.8E-04	6 0E-03	3.0E-02	**4.6E-02**
Lead	I	400	ug/L	9 5E-04	ND		2 6E-03	3.6E-05	ND		
Vanadium	I	3.3	ug/L	7 8E-06	7 0E-03	1.1E-03	2.6E-03	3.0E-07	2.1E-04	1.4E-03	**2.5E-03**
TPH	O	600	ug/L	1 4E-03	3 0E-02	4.7E-02	2.9E+00	6.1E-02	2 7E-02	2.2E+00	**2.3E+00**
					SUMMARY HAZARD INDEX	5E-01				2E+00	**3E+00**

[1] This chemical-specific value has been calculated in Table B 15 23 of this appendix
[2] Calculated from oral RfDs
ND = no data available

TABLE B 15 22

INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER
ADOLESCENT TRESPASSER - WADING
SITE 15, OPERABLE UNIT
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION WATER	CW	chemical-specific	ug/liter	
INGESTION RATE [1]	IR	0 026	liters/day	USEPA, 1995
AGE-SPECIFIC SURFACE AREA [2]	SA	age-specific	cm^2	USEPA, 1989
EVENT FREQUENCY	EV	1	events/day	Assumption
BODY WEIGHT	BW	45	kg	USEPA, 1995
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm^2-event	Calculated
EXPOSURE FREQUENCY	EF	45	days/year	Assumption
EXPOSURE DURATION	ED	10	years	USEPA, 1995
AGE-WEIGHTED SURFACE AREA [3]	SAsw/adj	1013	cm^2-yr/kg	Calculated per USEPA, 1992
DIFFUSION DEPTH PER EVENT [4]	PC_{event}	chemical-specific	cm/event	Calculated per USEPA, 1992
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	10	years	USEPA, 1995
CONVERSION FACTOR	CF1	0 001	mg/ug	
CONVERSION FACTOR	CF2	0 001	$liter/cm^3$	

[1] Ingestion Rate = 0 026 l/day = 10 ml/hour x 2 6 hours/day x 0.001 l/ml
[2] Surface area assumes lower legs, hands, and feet are exposed
[3] Age-weighted, body weight normalized surface area
[4] PC_{event} calculated per the Dermal Guidance appendix to this report
USEPA, 1989 Exposure Factors Handbook, EPA/600/8-89/043, May 1989
USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance "Standard Default Exposure Parameters",
USEPA, 1992 Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/011B

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day) [1]

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE-INGESTION} = \frac{CW \times IR \times EF \times ED \times CF1}{BW \times AT \times 365\ days/yr}$$

$$\text{INTAKE-DERMAL} = \frac{DA_{event} \times EV \times EF \times SAsw/adj}{AT \times 365\ days/yr}$$

Where:

SAsw/adj = Sum (SA x ED / BW)

DA_{event} = PC_{event} x CW x CF1 x CF2

Note: For noncarcinogenic effects, AT = ED.

TABLE B.15.22

INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER
ADOLESCENT TRESPASSER - WADING
SITE 15, OPERABLE UNIT
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF	CANCER RISK INGESTION	PCEVENT [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2]	CANCER RISK DERMAL	TOTAL CANCER RISK
Arsenic	I	12	ug/L	1.2E-07	1.5	1.8E-07	0.0026	5.6E-08	1.5	8.3E-08	2.7E-07
Lead	I	400	ug/L	4.1E-06	ND		0.0026	1.9E-06	ND		
SUMMARY CANCER RISK						2E-07				8E-08	3E-07

[1] The chemical-specific value has been calculated in Table B.15.23 of this appendix
[2] Calculated from oral CSFs
ND = no data available.

TABLE B.15.22

INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER
ADOLESCENT TRESPASSER - WADING
SITE 15, OPERABLE UNIT
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	PCEVENT [1] (cm/event)	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
1,3,5-Trinitrobenzene	O	6 73	ug/L	4 8E-07	5.0E-05	9 6E-03	1 9E-03	1.6E-07	ND		9.6E-03
3-Nitrotoluene	O	4.95	ug/L	3.5E-07	1 0E-02	3.5E-05	ND		ND		3.5E-05
4-Nitrotoluene	O	46.1	ug/L	3.3E-06	1 0E-02	3 3E-04	ND		ND		3.3E-04
TETRYL	O	18.4	ug/L	1.3E-06	1 0E-02	1.3E-04	ND		ND		1 3E-04
Aluminum	I	649	ug/L	4.6E-05	1 0E+00	4.6E-05	2.6E-03	2.1E-05	2.0E-01	1.1E-04	1.5E-04
Arsenic	I	12	ug/L	8.5E-07	3 0E-04	2.8E-03	2.6E-03	3.9E-07	2.9E-04	1.3E-03	4 2E-03
Iron	I	1980	ug/L	1.4E-04	3.0E-01	4.7E-04	2.6E-03	6.4E-05	6.0E-03	1.1E-02	1.1E-02
Lead	I	400	ug/L	2.8E-05	ND		2.6E-03	1 3E-05	ND		
Vanadium	I	3 3	ug/L	2.4E-07	7.0E-03	3.4E-05	2.6E-03	1 1E-07	2.1E-04	5.1E-04	5.4E-04
TPH	O	600	ug/L	4.3E-05	3.0E-02	1.4E-03	2.9E+00	2 2E-02	2.7E-02	8.0E-01	8.0E-01
					SUMMARY HAZARD INDEX	1E-02				8E-01	8E-01

[1] This chemical-specific value has been calculated in Table B 15 23 of this appendix
[2] Calculated from oral RfDs
ND = no data available

TABLE B 15.23

CALCULATION OF PC_{event} FOR DIRECT CONTACT WITH SURFACE WATER
ADULT, CHILD, OR ADOLESCENT
NAVAL AIR STATION CECIL FIELD
SITE 15
OPERABLE UNIT 5

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
Diffusion depth per event	PC_{event}	chemical-specific	cm/event	
Permeability Constant from Water	K_p	chemical-specific	cm/hr	USEPA, 1992
Duration of a Single Event	t_{event}	2 6	hr	USEPA,1989
Thickness of Stratum Corneum	L_{sc}	10	um	USEPA, 1992
Octanol-water partition coefficient/104	B	chemical-specific	dimensionless	USEPA, 1992
Pi	Pi	3 14	dimensionless	USEPA, 1992
T [1]	T	chemical-specific	hr	USEPA, 1992
Time to Reach Steady State	t^*	chemical-specific	hr	USEPA, 1992
Stratum Corneum Diffusion Coefficient	D_{sc}	chemical-specific	cm^2/hr	USEPA, 1992

EQUATIONS

INORGANICS

$$PC_{event} = K_p \times t_{event}$$

ORGANICS

$$PC_{event} = 2K_p \times (6T \times t_{event}/Pi)^{0.5}$$

Where $t_{event} < t^*$

and:

$$PC_{event} = K_p \times [(t_{event}/(1+B)) + 2T \times ((1+3B)/(1+B))]$$

Where $t_{event} > t^*$

Note: $T = L_{sc}^2/6D_{sc}$

[1] The term T is not calculated here Values are provided in USEPA, 1992

REFERENCES

USEPA, 1989 Risk Assessment Guidance for Superfund, Volume I, Part A, EPA/540/1-89/002, December 1989 This value is receptor-specific

USEPA, 1992 Dermal Exposure Assessment Principles and Applications; EPA/600/8-91/011B, January, 1992

TABLE B.15 23

CALCULATION OF PC_{event} FOR DIRECT CONTACT WITH SURFACE WATER
ADULT, CHILD, OR ADOLESCENT
NAVAL AIR STATION CECIL FIELD
SITE 15
OPERABLE UNIT 5

COMPOUND	INORGANIC OR ORGANIC? (I/O)	K_p (cm/hr) [1]	T (hr) [1]	t* (hr) [1]	B (unitless) [1]	PCevent (cm/event)
1,3,5-Trinitrobenzene	O	6 6E-04	1 7E+00	4 2E+00	1 5E-03	3 84E-03
3-Nitrotoluene	O	ND	ND	ND	ND	
4-Nitrotoluene	O	ND	ND	ND	ND	
TETRYL	O	ND	ND	ND	ND	
Aluminum	I	1 0E-03	NA	NA	NA	2 60E-03
Arsenic	I	1 0E-03	NA	NA	NA	2 60E-03
Iron	I	1 0E-03	NA	NA	NA	2 60E-03
Lead	I	1 0E-03	NA	NA	NA	2.60E-03
Vanadium	I	1 0E-03	NA	NA	NA	2.60E-03
TPH	O	5 3E-01	1 5E+00	7 2E+00	1 5E+01	2 89E+00

NA = not applicable For inorganic analytes, this term is not used to calculate PC_{event} ND = no data available
[1] Values are taken from USEPA, 1992 Dermal Exposure Assessment Principles and Applications, EPA/600/8-91/011B. For Acetone values Kp, T, and t* were calculated using molecular weight and log Kow, calculated as presented in USEPA, 1992

TABLE B.15.24

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SEDIMENT
ADULT RESIDENT
SITE 15, OPERABLE UNIT 5
CECIL FIELD NAVAL AIR STATION
JACKSONVILLE, FLORIDA

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SEDIMENT	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	100	mg/day	USEPA, 1995
FRACTION INGESTED	FI	100%	unitless	Assumption
ADHERENCE FACTOR	AF	1	mg/cm²-event	USEPA, 1995
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1995
SURFACE AREA EXPOSED	SA	5,750	cm²	USEPA, 1992
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm²-event	USEPA, 1992
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	100	days/year [1]	Assumption
EXPOSURE DURATION	ED	24	years	USEPA, 1991
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	24	years	USEPA, 1991

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose
USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance "Standard Default Exposure Factors", OSWER Directive 9285.6-03
USEPA, 1992 Dermal Exposure Assessment Principles and Applications, EPA/600/8-91/011B, January 1992
USEPA, 1995 Supplemental Guidance to RAGS Region IV, Human Health Risk Assessment Bulletin No. 3

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg day) / REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE-INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$\text{INTAKE-DERMAL} = \frac{(DA_{event} \times EF \times ED \times SA)}{BW \times AT \times 365\ days/yr}$$

Where:

$$DA_{event} = CS \times AF \times ABS \times CF$$

Note: For noncarcinogenic effects, AT = ED.

TABLE B.15.24

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SEDIMENT
ADULT RESIDENT
SITE 15, OPERABLE UNIT 5
CECIL FIELD NAVAL AIR STATION
JACKSONVILLE, FLORIDA

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SEDIMENT CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] (mg/kg-day)$^{-1}$	CANCER RISK INGESTION	DERMAL ABS [2]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [1, 3] (mg/kg-day)$^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
Benzo(a)anthracene	O	560	ug/kg	7.5E-08	0 73	5 5E-08	0.01	4 3E-08	0 8	3 5E-08	8 9E-08
Benzo(a)pyrene	O	760	ug/kg	1 0E-07	7.3	7.4E-07	0 01	5.9E-08	8	4 7E-07	1 2E-06
Benzo(b)fluoranthene	O	1100	ug/kg	1 5E-07	0.73	1.1E-07	0 01	8.5E-08	0.8	6 8E-08	1 8E-07
Benzo(k)fluoranthene	O	460	ug/kg	6.2E-08	0.073	4.5E-09	0 01	3.5E-08	0.08	2.8E-09	7.3E-09
Chrysene	O	760	ug/kg	1.0E-07	0.0073	7.4E-10	0.01	5.9E-08	0.008	4.7E-10	1.2E-09
Dibenzo(a,h)anthracene	O	110	ug/kg	1 5E-08	7.3	1.1E-07	0.01	8 5E-09	8	6 8E-08	1 8E-07
Indeno(1,2,3-cd)pyrene	O	340	ug/kg	4.6E-08	0.73	3.3E-08	0.01	2.6E-08	0.8	2.1E-08	5 4E-08
SUMMARY CANCER RISK						1E-06				7E-07	2E-06

[1] Relative potency factors have been applied to the CSFs for carcinogenic PAHs Relative potency factors are derived in "Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons," USEPA, 1993
[2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (November, 1995)
[3] Calculated from oral CSFs
NE = not evaluated

TABLE B 15 2 4

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SEDIMENT
ADULT RESIDENT
SITE 15, OPERABLE UNIT 5
CECIL FIELD NAVAL AIR STATION
JACKSONVILLE, FLORIDA

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SEDIMENT CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Benzo(a)anthracene	O	560	ug/kg	2 2E-07	ND		0 01	1.3E-07	ND		
Benzo(a)pyrene	O	760	ug/kg	3.0E-07	ND		0.01	1.7E-07	ND		
Benzo(b)fluoranthene	O	1100	ug/kg	4 3E-07	ND		0.01	2.5E-07	ND		
Benzo(k)fluoranthene	O	460	ug/kg	1 8E-07	ND		0 01	1.0E-07	ND		
Chrysene	O	760	ug/kg	3 0E-07	ND		0.01	1.7E-07	ND		
Dibenzo(a,h)anthracene	O	110	ug/kg	4.3E-08	ND		0.01	2.5E-08	ND		
Indeno(1,2,3-cd)pyrene	O	340	ug/kg	1.3E-07	ND		0.01	7.7E-08	ND		
TPH	O	110	ug/kg	4 3E-08	0.03	1.4E-06	0.01	2.5E-08	0.027	9.2E-07	2.4E-06
SUMMARY HAZARD INDEX						1E-06				9E-07	2E-06

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (November, 1995)
[2] Calculated from oral RfDs
ND = no data available

TABLE B.15.25

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SEDIMENT
ADULT TRESPASSER
SITE 15, OPERABLE UNIT 5
CECIL FIELD NAVAL AIR STATION
JACKSONVILLE, FLORIDA

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SEDIMENT	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	100	mg/day	USEPA, 1995
FRACTION INGESTED	FI	100%	unitless	Assumption
ADHERENCE FACTOR	AF	1	mg/cm²-event	USEPA, 1995
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1995
SURFACE AREA EXPOSED	SA	5,750	cm²	USEPA, 1992
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm²-event	USEPA, 1992
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	45	days/year [1]	Assumption
EXPOSURE DURATION	ED	20	years	USEPA, 1991
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	20	years	USEPA, 1991

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose
USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance "Standard Default Exposure Factors", OSWER Directive 9285.6-03
USEPA, 1992. Dermal Exposure Assessment Principles and Applications; EPA/600/8-91/011B, January 1992
USEPA, 1995 Supplemental Guidance to RAGS . Region IV, Human Health Risk Assessment Bulletin No 3

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE-INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$\text{INTAKE-DERMAL} = \frac{(DA_{event} \times EF \times ED \times SA)}{BW \times AT \times 365\ days/yr}$$

Where:

DA_{event} = CS x AF x ABS x CF

Note: For noncarcinogenic effects, AT = ED.

TABLE B.15.25

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SEDIMENT
ADULT TRESPASSER
SITE 15, OPERABLE UNIT 5
CECIL FIELD NAVAL AIR STATION
JACKSONVILLE, FLORIDA

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SEDIMENT CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] (mg/kg-day)$^{-1}$	CANCER RISK INGESTION	DERMAL ABS [2]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [1, 3] (mg/kg-day)$^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
Benzo(a)anthracene	O	560	ug/kg	2 8E-08	0.73	2 1E-08	0 01	1 6E-08	0 8	1 3E-08	3 4E-08
Benzo(a)pyrene	O	760	ug/kg	3.8E-08	7.3	2 8E-07	0.01	2.2E-08	8	1 8E-07	4.6E-07
Benzo(b)fluoranthene	O	1100	ug/kg	5.5E-08	0 73	4.0E-08	0 01	3 2E-08	0.8	2.5E-08	6 6E-08
Benzo(k)fluoranthene	O	460	ug/kg	2.3E-08	0.073	1.7E-09	0.01	1.3E-08	0 08	1.1E-09	2 8E-09
Chrysene	O	760	ug/kg	3.8E-08	0.0073	2.8E-10	0 01	2.2E-08	0 008	1.8E-10	4.6E-10
Dibenzo(a,h)anthracene	O	110	ug/kg	5.5E-09	7.3	4.0E-08	0 01	3.2E-09	8	2 5E-08	6 6E-08
Indeno(1,2,3-cd)pyrene	O	340	ug/kg	1 7E-08	0.73	1 2E-08	0 01	9.8E-09	0.8	7.9E-09	2.0E-08
SUMMARY CANCER RISK						4E-07				2E-07	6E-07

[1] Relative potency factors were applied to the CSFs for carcinogenic PAHs Relative potency factors are derived in "Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons," USEPA, 1993
[2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (November, 1995)
[3] Calculated from oral CSFs
NE = not evaluated

TABLE B.15.25

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SEDIMENT
ADULT TRESPASSER
SITE 15, OPERABLE UNIT 5
CECIL FIELD NAVAL AIR STATION
JACKSONVILLE, FLORIDA

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SEDIMENT CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Benzo(a)anthracene	O	560	ug/kg	9 9E-08	ND		0 01	5.7E-08	ND		
Benzo(a)pyrene	O	760	ug/kg	1 3E-07	ND		0.01	7.7E-08	ND		
Benzo(b)fluoranthene	O	1100	ug/kg	1.9E-07	ND		0.01	1 1E-07	ND		
Benzo(k)fluoranthene	O	460	ug/kg	8 1E-08	ND		0 01	4.7E-08	ND		
Chrysene	O	760	ug/kg	1.3E-07	ND		0.01	7.7E-08	ND		
Dibenzo(a,h)anthracene	O	110	ug/kg	1.9E-08	ND		0.01	1 1E-08	ND		
Indeno(1,2,3-cd)pyrene	O	340	ug/kg	6.0E-08	ND		0.01	3.4E-08	ND		
TPH	O	110	ug/kg	1.9E-08	0.03	6.5E-07	0 01	1.1E-08	0.027	4.1E-07	1.1E-06
SUMMARY HAZARD INDEX						6E-07				4E-07	1E-06

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (November, 1995)
[2] Calculated from oral RfDs
ND = no data available

TABLE B.15.26

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SEDIMENT
CHILD RESIDENT
SITE 15, OPERABLE UNIT 5
CECIL FIELD NAVAL AIR STATION
JACKSONVILLE, FLORIDA

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SEDIMENT	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	200	mg/day	USEPA, 1995
FRACTION INGESTED	FI	100%	unitless	Assumption
ADHERENCE FACTOR	AF	1	mg/cm²-event	USEPA, 1995
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1992b
AGE WEIGHTED SURFACE AREA	$SA_{soil/adj}$	766	cm²	[1]
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm²-event	USEPA, 1992a
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	15	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	100	days/year [2]	Assumption
EXPOSURE DURATION	ED	6	years	USEPA, 1995
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	6	years	USEPA, 1995

[1] In estimating the dermally absorbed dose for children age 1 through 6, the time-weighted, bodyweight normalized surface area exposed is calculated from surface area, exposure duration, and body weight for each of 6 age periods, age 1 through 6, per USEPA, 1992 (see Appendix x to this report)
[2] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose
USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance "Standard Default Exposure Factors"; OSWER Directive 9285.6-03
USEPA, 1992a Dermal Exposure Assessment Principles and Applications; EPA/600/8-91/011B, January 1992
USEPA, 1992b USEPA Region IV Guidance Memorandum, February 10, 1992
USEPA, 1995 Supplemental Guidance to RAGS Region IV, Human Health Risk Assessment Bulletin No. 3

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE-INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

INTAKE-DERMAL = (DAevent x EF/ AT x 365 days/year) x SAsoil/adj

Where:

$SA_{soil/adj}$ = SUM(SAI x EDI/BWI)
DA_{event} = CS x AF x ABS x CF

Note: For noncarcinogenic effects, AT = ED.

TABLE B 15.26

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SEDIMENT
CHILD RESIDENT
SITE 15, OPERABLE UNIT 5
CECIL FIELD NAVAL AIR STATION
JACKSONVILLE, FLORIDA

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SEDIMENT CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] (mg/kg-day)$^{-1}$	CANCER RISK INGESTION	DERMAL ABS [2]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [1,3] (mg/kg-day)$^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
Benzo(a)anthracene	O	560	ug/kg	1.8E-07	0.73	1 3E-07	0 01	1 7E-08	0.8	1.3E-08	1.4E-07
Benzo(a)pyrene	O	760	ug/kg	2 4E-07	7.3	1.7E-06	0 01	2 3E-08	8	1 8E-07	1 9E-06
Benzo(b)fluoranthene	O	1100	ug/kg	3 4E-07	0.73	2.5E-07	0 01	3 3E-08	0.8	2 6E-08	2.8E-07
Benzo(k)fluoranthene	O	460	ug/kg	1 4E-07	0.073	1 1E-08	0.01	1 4E-08	0 08	1.1E-09	1.2E-08
Chrysene	O	760	ug/kg	2 4E-07	0.0073	1.7E-09	0 01	2.3E-08	0.008	1.8E-10	1 9E-09
Dibenzo(a,h)anthracene	O	110	ug/kg	3 4E-08	7.3	2 5E-07	0 01	3.3E-09	8	2 6E-08	2 8E-07
Indeno(1,2,3-cd)pyrene	O	340	ug/kg	1.1E-07	0.73	7 8E-08	0.01	1.0E-08	0.8	8.2E-09	8 6E-08
SUMMARY CANCER RISK						**2E-06**				**3E-07**	**3E-06**

[1] Relative potency factors were applied to the CSFs for carcinogenic PAHs Relative potency factors are derived in "Provisional Guidance for Quantitative Risk Assessment for Polycyclic Aromatic Hydrocarbons," USEPA, 1993
[2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (November, 1995)
[3] Calculated from oral CSFs
NE = not evaluated

TABLE B.15.26

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SEDIMENT
CHILD RESIDENT
SITE 15, OPERABLE UNIT 5
CECIL FIELD NAVAL AIR STATION
JACKSONVILLE, FLORIDA

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC	SEDIMENT CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Benzo(a)anthracene	O	560	ug/kg	2.0E-06	ND		0.01	2.0E-07	ND		
Benzo(a)pyrene	O	760	ug/kg	2.8E-06	ND		0.01	2.7E-07	ND		
Benzo(b)fluoranthene	O	1100	ug/kg	4.0E-06	ND		0.01	3.8E-07	ND		
Benzo(k)fluoranthene	O	460	ug/kg	1.7E-06	ND		0.01	1.6E-07	ND		
Chrysene	O	760	ug/kg	2.8E-06	ND		0.01	2.7E-07	ND		
Dibenzo(a,h)anthracene	O	110	ug/kg	4.0E-07	ND		0.01	3.8E-08	ND		
Indeno(1,2,3-cd)pyrene	O	340	ug/kg	1.2E-06	ND		0.01	1.2E-07	ND		
TPH	O	110	ug/kg	4.0E-07	0.03	1.3E-05	0.01	3.8E-08	0.027	1.4E-06	1.5E-05
SUMMARY HAZARD INDEX						**1E-05**				**1E-06**	**1E-05**

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0.1% for inorganics (November, 1995)
[2] Calculated from oral RfDs
ND = no data available

TABLE B.15.27

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SEDIMENT
ADOLESCENT TRESPASSER
SITE 15, OPERABLE UNIT 5
CECIL FIELD NAVAL AIR STATION
JACKSONVILLE, FLORIDA

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SEDIMENT	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	100	mg/day	USEPA, 1995
FRACTION INGESTED	FI	100%	unitless	Assumption
ADHERENCE FACTOR	AF	1	mg/cm²-event	USEPA, 1995
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1992b
AGE-WEIGHTED SURFACE AREA	$SA_{soil/adj}$	1,013	cm²	[1]
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm²-event	USEPA, 1992a
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	45	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	45	days/year [2]	Assumption
EXPOSURE DURATION	ED	10	years	USEPA, 1995
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	10	years	USEPA, 1995

[1] In estimating the dermally absorbed dose for children age 1 through 6, the time-weighted, bodyweight normalized surface area exposed is calculated from surface area, exposure duration, and body weight for each of 6 age periods, age 1 through 6, per USEPA, 1992 (see Appendix x to this report)
[2] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose

USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance "Standard Default Exposure Factors"; OSWER Directive 9285.6-03
USEPA, 1992a Dermal Exposure Assessment Principles and Applications, EPA/600/8-91/011B, January 1992
USEPA, 1992b USEPA Region IV Guidance Memorandum; February 10, 1992.
USEPA, 1995. Supplemental Guidance to RAGS : Region IV, Human Health Risk Assessment Bulletin No 3.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE-INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

INTAKE-DERMAL = (DAevent x EF/ AT x 365 days/year) x SAsoil/sd]

Where:

$SA_{soil/adj}$ = SUM(SAi x EDi/BWi)
DA_{event} = CS x AF x ABS x CF

Note: For noncarcinogenic effects, AT = ED.

TABLE B.15.28

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL (CENTRAL TENDENCY)
ADULT RESIDENT
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	50	mg/day	USEPA, 1996
FRACTION INGESTED	FI	100%	unitless	USEPA, 1995
ADHERENCE FACTOR	AF	0.046	mg/cm²-event	USEPA, 1996
ABSORPTION FRACTION	ABS_d	chemical-specific	unitless	USEPA, 1995
SURFACE AREA EXPOSED	SA	5,000	cm²	ABB, 1996
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm²-event	USEPA, 1992
CONVERSION FACTOR	CF	1.00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	40	days/year [1]	USEPA, 1996
EXPOSURE DURATION	ED	7	years	USEPA, 1989
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	7	years	USEPA, 1995

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose

ABB, 1996, General Infromation Report, 1996

USEPA, 1989 Exposure Factors Handbook. May 1989

USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance "Standard Default Exposure Factors", OSWER Directive 9285.6-03

USEPA, 1992 Dermal Exposure Assessment Principles and Applications, EPA/600/8-91/011B, January 1992

USEPA, 1995 Supplemental Guidance to RAGS Region IV, Human Health Risk Assessment Bulletin No. 3

USEPA, 1996 Exposure Factors Handbook, 1996

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE_{-INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE_{-DERMAL} = \frac{DA_{event} \times SA \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

$$DA_{event} = CS \times AF \times ABS_d \times CF$$

Note: **For noncarcinogenic effects, AT = ED.**

TABLE B 15 28

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL (CENTRAL TENDENCY)
ADULT RESIDENT
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] (mg/kg-day)$^{-1}$	CANCER RISK INGESTION	DERMAL ABS [2]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [3] (mg/kg-day)$^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
Benzo(a)anthracene	O	340000	ug/kg	2.7E-06	7.3E-01	1 9E-06	0.01	1.2E-07	8 00E-01	9 8E-08	2 0E-06
Benzo(a)pyrene	O	340000	ug/kg	2 7E-06	7.3E+00	1 9E-05	0.01	1 2E-07	8.00E+00	9.8E-07	2.0E-05
Benzo(b)fluoranthene	O	510000	ug/kg	4 0E-06	7.3E-01	2.9E-06	0 01	1 8E-07	8.00E-01	1 5E-07	3.1E-06
Benzo(k)fluoranthene	O	130000	ug/kg	1 0E-06	7.3E-02	7.4E-08	0 01	4 7E-08	8.00E-02	3.7E-09	7 8E-08
Carbazole	O	6600	ug/kg	5.2E-08	2.0E-02	1 0E-09	0.01	2.4E-09	4 00E-02	9.5E-11	1.1E-09
Chrysene	O	400000	ug/kg	3.1E-06	7 3E-03	2 3E-08	0.01	1 4E-07	8 00E-03	1 2E-09	2 4E-08
Dibenzo(a,h)anthracene	O	13000	ug/kg	1 0E-07	7.3E+00	7.4E-07	0.01	4.7E-09	8.00E+00	3.7E-08	7 8E-07
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	7 8E-07	7.3E-01	5.7E-07	0.01	3.6E-08	8.00E-01	2 9E-08	6 0E-07
Arsenic	I	22	mg/kg	1.7E-07	1 5E+00	2.6E-07	0 001	7 9E-10	1 50E+00	1 2E-09	2.6E-07
Lead	I	4200	mg/kg	3.3E-05	ND		0.001	1 5E-07	ND		
SUMMARY CANCER RISK						3E-05				1E-06	3E-05

[1] Relative potency factors were applied to the CSFs for carcinogenic PAHs Relative potency factors are derived in "Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons," USEPA, 1993
[2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (November 1995)
[3] Calculated from oral CSFs
ND = no data available

TABLE B 15.28

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL (CENTRAL TENDENCY)
ADULT RESIDENT
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Benzo(a)anthracene	O	340000	ug/kg	2 7E-05	ND		0.01	1 2E-06	ND		
Benzo(a)pyrene	O	340000	ug/kg	2 7E-05	ND		0.01	1 2E-06	ND		
Benzo(b)fluoranthene	O	510000	ug/kg	4 0E-05	ND		0.01	1 8E-06	ND		
Benzo(k)fluoranthene	O	130000	ug/kg	1 0E-05	ND		0.01	4 7E-07	ND		
Carbazole	O	6600	ug/kg	5 2E-07	ND		0.01	2 4E-08	ND		
Chrysene	O	400000	ug/kg	3 1E-05	ND		0.01	1 4E-06	ND		
Dibenzo(a,h)anthracene	O	13000	ug/kg	1 0E-06	ND		0.01	4 7E-08	ND		
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	7.8E-06	ND		0.01	3 6E-07	ND		
Benzo(g,h,i)perylene	O	54000	ug/kg	4.2E-06	ND		0.01	1 9E-07	ND		
Fluoranthene	O	660000	ug/kg	5 2E-05	0 04	1.3E-03	0.01	2 4E-06	0.036	6 6E-05	1 4E-03
Phenanthrene	O	260000	ug/kg	2.0E-05	ND		0.01	9 4E-07	ND		
Pyrene	O	500000	ug/kg	3.9E-05	0 03	1.3E-03	0.01	1 8E-06	0.027	6 7E-05	1 4E-03
Arsenic	I	22	mg/kg	1.7E-06	0 0003	5.7E-03	0 001	7 9E-09	0.00029	2 7E-05	5 8E-03
Antimony	I	74	mg/kg	5 8E-06	0.0004	1.4E-02	0 001	2 7E-08	0.000004	6 7E-03	2 1E-02
Lead	I	4200	mg/kg	3.3E-04	ND		0.001	1 5E-06			
TPH	O	130000	ug/kg	1.0E-05	0 03	3.4E-04	0.01	4 7E-07	0.027	1 7E-05	3 6E-04
HMX	O	1100	ug/kg	8.6E-08	ND		0.01	4 0E-09	ND		
				SUMMARY HAZARD INDEX		**2E-02**				**7E-03**	**3E-02**

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (November, 1995)
[2] Calculated from oral RfDs
ND = no data available

TABLE B 15.29

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL (CENTRAL TENDENCY)
CHILD RESIDENT
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	100	mg/day	USEPA, 1996
FRACTION INGESTED	FI	100%	unitless	USEPA, 1995
ADHERENCE FACTOR	AF	0 66	mg/cm²-event	USEPA, 1996
AGE-SPECIFIC SURFACE AREA	SA	age specific	cm²	USEPA, 1989
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1995
CONVERSION FACTOR	CF	1 00E-06	kg/mg	Inorganic conversion
CONVERSION FACTOR	CF	1 00E-09	kg/ug	Organic conversion
BODY WEIGHT	BW	15	kg	USEPA, 1991
AGE-SPECIFIC BODY WEIGHT	BW	age-specific	kg	USEPA, 1989
EXPOSURE FREQUENCY	EF	40	days/year [1]	USEPA, 1996
EXPOSURE DURATION	ED	2	years	USEPA, 1989
AGE-SPECIFIC EXPOSURE DURATION	ED	age-specific	years	Assumption
AGE-WEIGHTED SURFACE AREA [2]	$SA_{soil/adj}$	662 8	cm²-year/kg	ABB, 1996
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm²-event	USEPA, 1992
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	2	years	USEPA, 1995

[1] Units for exposure frequency are in events/year in the calculation of the dermally absorbed dose

[2] In estimating the dermally absorbed dose for children age1 through 6, the time-weighted, bodyweight normalized surface area exposed is calculated from surface area, exposure duration, and body weight for each of 6 age periods, age 1 through 6, per USEPA, 1992

ABB, 1996 General Information Report, 1996

USEPA, 1989 Exposure Factors Handbook,EPA/600/8-89/043, May 1989

USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance "Standard Default Exposure Factors", OSWER Directive 9285 6-03.

USEPA, 1992 Dermal Exposure Assessment Principles and Applications, EPA/600/8-91/011B, January 1992

USEPA, 1995 Supplemental Guidance to RAGS Region IV, Human Health Risk Assessment Bulletin No 3

USEPA, 1996 Exposure Factors Handbook, 1996

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE_{-INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE_{-DERMAL} = (DA_{event} \times EF / AT \times 365\ days/year) \times SA_{soil/adj}$$

Where:

$SA_{soil/adj}$ = SUM (SA x ED / BW)

DA_{event} = CS x AF x ABS x CF

Note: For noncarcinogenic effects, AT = ED.

TABLE B.15.29

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL (CENTRAL TENDENCY)
CHILD RESIDENT
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] (mg/kg-day)$^{-1}$	CANCER RISK INGESTION	DERMAL ABS [2]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [1, 3] (mg/kg-day)$^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
Benzo(a)anthracene	O	340000	ug/kg	7 1E-06	0.73	5 2E-06	0 01	2 3E-06	0.8	1.9E-06	7 0E-06
Benzo(a)pyrene	O	340000	ug/kg	7 1E-06	7.3	5.2E-05	0.01	2 3E-06	8	1 9E-05	7.0E-05
Benzo(b)fluoranthene	O	510000	ug/kg	1.1E-05	0.73	7.8E-06	0 01	3.5E-06	0.8	2.8E-06	1 1E-05
Benzo(k)fluoranthene	O	130000	ug/kg	2.7E-06	0.073	2.0E-07	0.01	8 9E-07	0.08	7.1E-08	2.7E-07
Carbazole	O	6600	ug/kg	1.4E-07	0.02	2.8E-09	0.01	4.5E-08	0.04	1.8E-09	4.6E-09
Chrysene	O	400000	ug/kg	8 3E-06	0.0073	6 1E-08	0.01	2.7E-06	0.008	2 2E-08	8.3E-08
Dibenzo(a,h)anthracene	O	13000	ug/kg	2.7E-07	7.3	2.0E-06	0.01	8.9E-08	8	7.1E-07	2 7E-06
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	2 1E-06	0.73	1.5E-06	0 01	6.8E-07	0.8	5 5E-07	2.1E-06
Arsenic	I	22	mg/kg	4 6E-07	1.5	6.9E-07	0 001	1 5E-08	1.5	2 3E-08	7.1E-07
Lead	I	4200	mg/kg	8 8E-05	ND		0.001	2.9E-06	ND		
				SUMMARY CANCER RISK		7E-05				2E-05	9E-05

[1] Relative potency factors were applied to the CSFs of carcinogenic PAHs Relative potency factors are derived in "Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons," USEPA, 1993
[2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (November 1995)
[3] Calculated from oral CSFs
NE = not evaluated

TABLE B.15.29

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL (CENTRAL TENDENCY)
CHILD RESIDENT
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Benzo(a)anthracene	O	340000	ug/kg	2 5E-04	ND		0 01	8.1E-05	ND		
Benzo(a)pyrene	O	340000	ug/kg	2.5E-04	ND		0 01	8.1E-05	ND		
Benzo(b)fluoranthene	O	510000	ug/kg	3 7E-04	ND		0.01	1.2E-04	ND		
Benzo(k)fluoranthene	O	130000	ug/kg	9.5E-05	ND		0 01	3 1E-05	ND		
Carbazole	O	6600	ug/kg	4.8E-06	ND		0 01	1 6E-06	ND		
Chrysene	O	400000	ug/kg	2 9E-04	ND		0 01	9.6E-05	ND		
Dibenzo(a,h)anthracene	O	13000	ug/kg	9.5E-06	ND		0 01	3 1E-06	ND		
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	7.3E-05	ND		0.01	2.4E-05	ND		
Benzo(g,h,i)perylene	O	54000	ug/kg	3 9E-05	ND		0 01	1 3E-05	ND		
Fluoranthene	O	660000	ug/kg	4 8E-04	0.04	1.2E-02	0 01	1 6E-04	0 036	4 4E-03	1 6E-02
Phenanthrene	O	260000	ug/kg	1 9E-04	ND		0.01	6.2E-05	ND		
Pyrene	O	500000	ug/kg	3 7E-04	0.03	1.2E-02	0 01	1 2E-04	0 027	4 4E-03	1 7E-02
Arsenic	I	22	mg/kg	1.6E-05	0.0003	5 4E-02	0.001	5 3E-07	0.00029	1.8E-03	5 5E-02
Antimony	I	74	mg/kg	5.4E-05	0.0004	1 4E-01	0.001	1 8E-06	0.000004	4.4E-01	5 8E-01
Lead	I	4200	mg/kg	3.1E-03	ND		0 001	1.0E-04	0		
TPH	O	130000	ug/kg	9 5E-05	0.03	3 2E-03	0.01	3.1E-05	0.027	1.2E-03	4.3E-03
HMX	O	1100	ug/kg	8.0E-07	ND		0.01	2.6E-07	ND		
SUMMARY HAZARD INDEX						2E-01				5E-01	7E-01

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (November 1995)
[2] Calculated from oral RfDs
ND = no data available

TABLE B.15.30

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL (CENTRAL TENDENCY)
ADULT TRESPASSER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	50	mg/day	USEPA, 1996
FRACTION INGESTED	FI	100%	unitless	USEPA, 1995
ADHERENCE FACTOR	AF	0 11	mg/cm²-event	USEPA, 1996
ABSORPTION FRACTION	ABS_d	chemical specific	unitless	USEPA, 1992a
SURFACE AREA EXPOSED	SA	5,000	cm²	ABB, 1996
DOSE ABSORBED PER EVENT	DAevent	chemical specific	mg/cm²-event	USEPA, 1992
CONVERSION FACTOR	CF	1.00E-06	kg/mg	inorganics
	CF	1 00E-09	kg/ug	organics
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	40	days/year [1]	USEPA, 1996
EXPOSURE DURATION	ED	6	years	USEPA, 1989
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	6	years	Assumption

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose

USEPA, 1989 Exposure Factors Handbook, May 1989.

USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance "Standard Default Exposure Factors", OSWER Directive 9285 6-03

USEPA, 1992 Dermal Exposure Assessment Principles and Applications, EPA/600/8-91/011B, January 1992.

USEPA, 1996. Exposure Factors Handbook, 1996.

EQUATIONS

CANCER RI INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD Q INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE_{-INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE_{-DERMAL} = \frac{DAevent \times SA \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

$$DAevent = AF \times ABS_d \times CF$$

Note: For noncarcinogenic effects: AT = ED

TABLE B.15.30

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL (CENTRAL TENDENCY)
ADULT TRESPASSER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF $(mg/kg\text{-}day)^{-1}$	CANCER RISK INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2] $(mg/kg\text{-}day)^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
Benzo(a)anthracene	O	340000	ug/kg	2 3E-06	0 73	1 7E-06	0 01	2 5E-07	0.8	2 0E-07	1 9E-06
Benzo(a)pyrene	O	340000	ug/kg	2 3E-06	7.3	1 7E-05	0 01	2 5E-07	8	2 0E-06	1 9E-05
Benzo(b)fluoranthene	O	510000	ug/kg	3 4E-06	0.73	2 5E-06	0 01	3 8E-07	0.8	3 0E-07	2 8E-06
Benzo(k)fluoranthene	O	130000	ug/kg	8 7E-07	0.073	6 4E-08	0 01	9 6E-08	0.08	7 7E-09	7 1E-08
Carbazole	O	6600	ug/kg	4 4E-08	0.02	8 9E-10	0 01	4 9E-09	0.04	1 9E-10	1 1E-09
Chrysene	O	400000	ug/kg	2 7E-06	0.0073	2 0E-08	0 01	3 0E-07	0.008	2 4E-09	2 2E-08
Dibenzo(a,h)anthracene	O	13000	ug/kg	8 7E-08	7.3	6 4E-07	0 01	9 6E-09	8	7 7E-08	7 1E-07
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	6 7E-07	0.73	4 9E-07	0 01	7 4E-08	0.8	5 9E-08	5 5E-07
Arsenic	I	22	mg/kg	1 5E-07	1.5	2 2E-07	0 001	1 6E-09	1.5	2 4E-09	2 2E-07
Lead	I	4200	mg/kg	2 8E-05	ND		0 001	3 1E-07	ND		
SUMMARY CANCER RISK						**2E-05**				**3E-06**	**2E-05**

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (February 10, 1992)
[2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (November 1995)

TABLE B 15.30

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL (CENTRAL TENDENCY)
ADULT TRESPASSER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Benzo(a)anthracene	O	340000	ug/kg	2 7E-05	ND		0 01	2 9E-06	ND		
Benzo(a)pyrene	O	340000	ug/kg	2 7E-05	ND		0 01	2 9E-06	ND		
Benzo(b)fluoranthene	O	510000	ug/kg	4 0E-05	ND		0 01	4 4E-06	ND		
Benzo(k)fluoranthene	O	130000	ug/kg	1 0E-05	ND		0 01	1 1E-06	ND		
Carbazole	O	6600	ug/kg	5 2E-07	ND		0 01	5.7E-08	ND		
Chrysene	O	400000	ug/kg	3 1E-05	ND		0 01	3 4E-06	ND		
Dibenzo(a,h)anthracene	O	13000	ug/kg	1 0E-06	ND		0 01	1 1E-07	ND		
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	7 8E-06	ND		0 01	8 6E-07	ND		
Benzo(g,h,i)perylene	O	54000	ug/kg	4 2E-06	ND		0 01	4 6E-07	ND		
Fluoranthene	O	660000	ug/kg	5 2E-05	0 04	1 3E-03	0 01	5 7E-06	0.036	1 6E-04	1 4E-03
Phenanthrene	O	260000	ug/kg	2 0E-05	ND		0 01	2 2E-06	ND		
Pyrene	O	500000	ug/kg	3 9E-05	0.03	1 3E-03	0 01	4 3E-06	0.027	1 6E-04	1 5E-03
Arsenic	I	22	mg/kg	1 7E-06	0 0003	5 7E-03	0 001	1 9E-08	0.00029	6 5E-05	5 8E-03
Antimony	I	74	mg/kg	5 8E-06	0.0004	1 4E-02	0 001	6 4E-08	0.000004	1 6E-02	3 0E-02
Lead	I	4200	mg/kg	3 3E-04	ND		0 001	3 6E-06	0		
TPH	O	130000	ug/kg	1 0E-05	0.03	3 4E-04	0 01	1 1E-06	0.027	4 1E-05	3 8E-04
HMX	O	1100	ug/kg	8 6E-08	ND		0 01	9 5E-09	ND		
					SUMMARY HAZARD INDEX	2E-02				2E-02	4E-02

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (February 10, 1992)
[2] Calculated from oral RfDs
ND = no data available

TABLE B.15.31

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL (CENTRAL TENDENCY)
ADOLESCENT TRESPASSER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	50	mg/day	USEPA, 1996
FRACTION INGESTED	FI	100%	unitless	Assumption
ADHERENCE FACTOR	AF	0.4	mg/cm²-event	USEPA, 1996
AGE-SPECIFIC SURFACE AREA	SA_i	age-specific	cm²	USEPA, 1989
ABSORPTION FRACTION	ABS_d	chemical-specific	unitless	USEPA, 1995
CONVERSION FACTOR	CF	1.00E-06	kg/mg	Inorganics
	CF	1.00E-09	kg/mg	Organics
BODY WEIGHT	BW	45	kg	USEPA, 1995
AGE-SPECIFIC BODY WEIGHT	BW_i	age-specific	kg	USEPA, 1989
EXPOSURE FREQUENCY	EF	40	days/year [1]	USEPA, 1996
EXPOSURE DURATION	ED	3	years	USEPA, 1989
AGE-SPECIFIC EXPOSURE DURATION	ED_i	age-specific	years	USEPA, 1992
AGE-WEIGHTED SURFACE AREA [2]	$SA_{soil/adj}$	821	cm²-year/kg	ABB, 1996
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm²-event	Per USEPA, 1992
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	3	years	USEPA, 1995

[1] Units for exposure frequency are in events/year in the calculation of the dermally absorbed dose
[2] In estimating the dermally absorbed dose for children age 7 through 16, the time-weighted, bodyweight normalized surface area exposed is calculated from surface area, exposure duration, and body weight for each of 10 age periods, age 7 through 16, per USEPA, 1992

ABB, 1996 General Information Report, 1996
USEPA, 1989 Exposure Factors Handbook,EPA/600/8-89/043, May 1989
USEPA, 1992 Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/011B, January 1992
USEPA, 1995 Supplemental Guidance to RAGS Region 4 Bulletins, Bulletin No 3, November 1995
USEPA, 1996 Exposure Factors Handbook, 1996

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE_{-INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE_{-DERMAL} = AT \times 365\ days/year) \times SA_{soil/adj}$$

Where:

$SA_{soil/adj}$ = SUM (SA_i x ED_i / BW_i)

DA_{event} = CS x AF x ABS_d x CF

Note: For noncarcinogenic effects: AT = ED.

TABLE B.15.31

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL (CENTRAL TENDENCY)
ADOLESCENT TRESPASSER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] (mg/kg-day)$^{-1}$	CANCER RISK INGESTION	DERMAL ABS [2]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [1,3] (mg/kg-day)$^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
Benzo(a)anthracene	O	340000	ug/kg	1 8E-06	0.73	1.3E-06	0 01	1 7E-06	0 8	1 4E-06	2.7E-06
Benzo(a)pyrene	O	340000	ug/kg	1.8E-06	7.3	1 3E-05	0 01	1.7E-06	8	1 4E-05	2.7E-05
Benzo(b)fluoranthene	O	510000	ug/kg	2 7E-06	0.73	1 9E-06	0.01	2 6E-06	0.8	2.1E-06	4.0E-06
Benzo(k)fluoranthene	O	130000	ug/kg	6 8E-07	0 073	5.0E-08	0 01	6 7E-07	0 08	5.3E-08	1 0E-07
Carbazole	O	6600	ug/kg	3.4E-08	0.02	6.9E-10	0.01	3 4E-08	0.04	1 4E-09	2.0E-09
Chrysene	O	400000	ug/kg	2 1E-06	0.0073	1.5E-08	0.01	2.1E-06	0.008	1.6E-08	3.2E-08
Dibenzo(a,h)anthracene	O	13000	ug/kg	6 8E-08	7.3	5.0E-07	0 01	6.7E-08	8	5 3E-07	1 0E-06
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	5.2E-07	0.73	3.8E-07	0 01	5.1E-07	0.8	4.1E-07	7.9E-07
Arsenic	I	22	mg/kg	1 1E-07	1.5	1 7E-07	0 001	1.1E-08	1.5	1 7E-08	1.9E-07
Lead	I	4200	mg/kg	2 2E-05	ND		0.001	2 2E-06	ND		
					SUMMARY CANCER RISK	2E-05				2E-05	4E-05

[1] Relative potency factors were applied to the CSFs for carcinogenic PAHs Relative potency factors are derived in "Provisional Guidance for Quantitative Risk Assessment for Polycyclic Aromatic Hydrocarbons," USEPA, 1993
[2] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (November 1995)
[3] Calculated from oral CSFs
NE = not evaluated

TABLE B.15.31

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL (CENTRAL TENDENCY)
ADOLESCENT TRESPASSER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Benzo(a)anthracene	O	340000	ug/kg	4 1E-05	ND		0.01	4.1E-05	ND		
Benzo(a)pyrene	O	340000	ug/kg	4.1E-05	ND		0 01	4.1E-05	ND		
Benzo(b)fluoranthene	O	510000	ug/kg	6.2E-05	ND		0.01	6.1E-05	ND		
Benzo(k)fluoranthene	O	130000	ug/kg	1 6E-05	ND		0.01	1.6E-05	ND		
Carbazole	O	6600	ug/kg	8.0E-07	ND		0.01	7.9E-07	ND		
Chrysene	O	400000	ug/kg	4.9E-05	ND		0.01	4.8E-05	ND		
Dibenzo(a,h)anthracene	O	13000	ug/kg	1 6E-06	ND		0.01	1.6E-06	ND		
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	1.2E-05	ND		0.01	1 2E-05	ND		
Benzo(g,h,i)perylene	O	54000	ug/kg	6.6E-06	ND		0.01	6.5E-06	ND		
Fluoranthene	O	660000	ug/kg	8 0E-05	0.04	2.0E-03	0.01	7.9E-05	0.036	2 2E-03	4 2E-03
Phenanthrene	O	260000	ug/kg	3.2E-05	ND		0.01	3 1E-05	ND		
Pyrene	O	500000	ug/kg	6 1E-05	0 03	2.0E-03	0.01	6.0E-05	0.027	2 2E-03	4.3E-03
Arsenic	I	22	mg/kg	2 7E-06	0.0003	8.9E-03	0 001	2.6E-07	0.00029	9.1E-04	9 8E-03
Antimony	I	74	mg/kg	9.0E-06	0.0004	2 3E-02	0 001	8 9E-07	0.000004	2 2E-01	2.4E-01
Lead	I	4200	mg/kg	5.1E-04	ND		0.001	5.0E-05	0		
TPH	O	130000	ug/kg	1 6E-05	0.03	5.3E-04	0.01	1.6E-05	0 027	5 8E-04	1.1E-03
HMX	O	1100	ug/kg	1.3E-07	ND		0.01	1 3E-07	ND		
				SUMMARY HAZARD INDEX		4E-02				2E-01	3E-01

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (November 1995)
[2] Calculated from oral RfDs
ND = no data available

B.15.32

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL (CENTRAL TENDENCY)
OCCUPATIONAL WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	50	mg/day	USEPA, 1996
FRACTION INGESTED	FI	100%	unitless	Assumption
ADHERENCE FACTOR	AF	0 046	mg/cm²-event	USEPA, 1996
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1995
SURFACE AREA EXPOSED	SA	2,000	cm²	ABB, 1996
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm²-event	USEPA, 1992
CONVERSION FACTOR	CF	1 00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1 00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	40	days/year [1]	USEPA, 1996
EXPOSURE DURATION	ED	6 6	years	USEPA, 1996
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	6 6	years	USEPA, 1995

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose
ABB, 1996 General Information Report
USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance "Standard Default Exposure Factors", OSWER Directive 9285 6-03
USEPA, 1992 Dermal Exposure Assessment Principles and Applications, EPA/600/8-91/011B, January 1992
USEPA, 1995 Supplemental Guidance to RAGS Region IV, Human Health Risk Assessment Bulletin No 3
USEPA, 1996. Exposure Factors Handbook, 1996

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE_{-INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE_{-DERMAL} = \frac{DA_{event} \times SA \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

$$DA_{event} = CS \times AF \times ABS \times CF$$

Note: **For noncarcinogenic effects, AT = ED**

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DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL (CENTRAL TENDENCY)
OCCUPATIONAL WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF (mg/kg-day)$^{-1}$	CANCER RISK INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2] (mg/kg-day)$^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
Benzo(a)anthracene	O	340000	ug/kg	2.5E-06	0.73	1 8E-06	0.01	4 6E-08	0.8	3 7E-08	1.9E-06
Benzo(a)pyrene	O	340000	ug/kg	2.5E-06	7.3	1 8E-05	0 01	4 6E-08	8	3.7E-07	1.9E-05
Benzo(b)fluoranthene	O	510000	ug/kg	3.8E-06	0 73	2.7E-06	0.01	6.9E-08	0.8	5.5E-08	2.8E-06
Benzo(k)fluoranthene	O	130000	ug/kg	9 6E-07	0 073	7.0E-08	0.01	1.8E-08	0.08	1 4E-09	7.1E-08
Carbazole	O	6600	ug/kg	4.9E-08	0 02	9 7E-10	0.01	9.0E-10	0 04	3.6E-11	1 0E-09
Chrysene	O	400000	ug/kg	3 0E-06	0.0073	2.2E-08	0.01	5.4E-08	0 008	4 3E-10	2.2E-08
Dibenzo(a,h)anthracene	O	13000	ug/kg	9 6E-08	7 3	7.0E-07	0.01	1.8E-09	8	1.4E-08	7 1E-07
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	7.4E-07	0 73	5 4E-07	0.01	1 4E-08	0.8	1 1E-08	5 5E-07
Arsenic	I	22	mg/kg	1 6E-07	1.5	2.4E-07	0.001	3 0E-10	1.5	4 5E-10	2.4E-07
Lead	I	4200	mg/kg	3.1E-05	ND		0.001	5.7E-08	ND		
SUMMARY CANCER RISK						2E-05				5E-07	2E-05

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (November, 1995)
[2] Calculated from oral CSFs
NE = not evaluated

B.15.32

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL (CENTRAL TENDENCY)
OCCUPATIONAL WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Benzo(a)anthracene	O	340000	ug/kg	2.7E-05	ND		0 01	4.9E-07	ND		
Benzo(a)pyrene	O	340000	ug/kg	2.7E-05	ND		0 01	4.9E-07	ND		
Benzo(b)fluoranthene	O	510000	ug/kg	4 0E-05	ND		0 01	7.3E-07	ND		
Benzo(k)fluoranthene	O	130000	ug/kg	1 0E-05	ND		0 01	1.9E-07	ND		
Carbazole	O	6600	ug/kg	5.2E-07	ND		0 01	9.5E-09	ND		
Chrysene	O	400000	ug/kg	3 1E-05	ND		0 01	5.8E-07	ND		
Dibenzo(a,h)anthracene	O	13000	ug/kg	1 0E-06	ND		0 01	1 9E-08	ND		
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	7 8E-06	ND		0.01	1.4E-07	ND		
Benzo(g,h,i)perylene	O	54000	ug/kg	4 2E-06	ND		0.01	7.8E-08	ND		
Fluoranthene	O	660000	ug/kg	5 2E-05	0.04	1 3E-03	0.01	9.5E-07	0.036	2.6E-05	1 3E-03
Phenanthrene	O	260000	ug/kg	2 0E-05	ND		0.01	3.7E-07	ND		
Pyrene	O	500000	ug/kg	3 9E-05	0.03	1 3E-03	0.01	7.2E-07	0.027	2.7E-05	1 3E-03
Arsenic	I	22	mg/kg	1 7E-06	0 0003	5 7E-03	0.001	3 2E-09	0.00029	1 1E-05	5 8E-03
Antimony	I	74	mg/kg	5 8E-06	0 0004	1 4E-02	0 001	1.1E-08	0.000004	2.7E-03	1 7E-02
Lead	I	4200	mg/kg	3 3E-04	ND		0.001	6.0E-07	0		
TPH	O	130000	ug/kg	1.0E-05	0.03	3 4E-04	0.01	1.9E-07	0.027	6.9E-06	3 5E-04
HMX	O	1100	ug/kg	8 6E-08	ND		0.01	1.6E-09	ND		
			SUMMARY HAZARD INDEX			2E-02				3E-03	3E-02

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (February 10, 1992)
[2] Calculated from oral RfDs
ND = not detected

TABLE B 15 33

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL (CENTRAL TENDENCY)
SITE MAINTENANCE WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION SOIL	CS	chemical-specific	chemical-specific	
INGESTION RATE	IR	50	mg/day	USEPA, 1996
FRACTION INGESTED	FI	100%	unitless	Assumption
ADHERENCE FACTOR	AF	0 046	mg/cm²-event	USEPA, 1996
ABSORPTION FRACTION	ABS	chemical-specific	unitless	USEPA, 1995
SURFACE AREA EXPOSED	SA	5,000	cm²	ABB, 1996
DOSE ABSORBED PER EVENT	DA_{event}	chemical-specific	mg/cm²-event	USEPA, 1992
CONVERSION FACTOR	CF	1 00E-09	kg/ug	Organic conversion
CONVERSION FACTOR	CF	1 00E-06	kg/mg	Inorganic conversion
BODY WEIGHT	BW	70	kg	USEPA, 1991
EXPOSURE FREQUENCY	EF	30	days/year [1]	Assumption
EXPOSURE DURATION	ED	6 6	years	USEPA, 1996
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	6 6	years	USEPA, 1995

[1] Units for exposure frequency are events/year in the calculation of the dermally absorbed dose
ABB, 1996 General Information Report
USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance "Standard Default Exposure Factors", OSWER Directive 9285 6-03
USEPA, 1992 Dermal Exposure Assessment Principles and Applications, EPA/600/8-91/011B, January 1992
USEPA, 1995 Supplemental Guidance to RAGS Region IV, Human Health Risk Assessment Bulletin No 3
USEPA, 1996 Exposure Factors Handbook, 1996

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$INTAKE_{INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$INTAKE_{DERMAL} = \frac{DA_{event} \times SA \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

Where:

$$DA_{event} = CS \times AF \times ABS \times CF$$

Note: **For noncarcinogenic effects, AT = ED**

TABLE B 15.33

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL (CENTRAL TENDENCY)
SITE MAINTENANCE WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF (mg/kg-day)$^{-1}$	CANCER RISK INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [2] (mg/kg-day)$^{-1}$	CANCER RISK DERMAL	TOTAL CANCER RISK
Benzo(a)anthracene	O	340000	ug/kg	1 9E-06	0.73	1 4E-06	0.01	8 7E-08	0.8	6.9E-08	1.4E-06
Benzo(a)pyrene	O	340000	ug/kg	1 9E-06	7.3	1 4E-05	0.01	8.7E-08	8	6 9E-07	1 4E-05
Benzo(b)fluoranthene	O	510000	ug/kg	2 8E-06	0.73	2.1E-06	0 01	1 3E-07	0.8	1.0E-07	2.2E-06
Benzo(k)fluoranthene	O	130000	ug/kg	7.2E-07	0.073	5.3E-08	0 01	3.3E-08	0.08	2.6E-09	5 5E-08
Carbazole	O	6600	ug/kg	3 7E-08	0 02	7 3E-10	0.01	1.7E-09	0.04	6 7E-11	8 0E-10
Chrysene	O	400000	ug/kg	2 2E-06	0.0073	1.6E-08	0 01	1 0E-07	0.008	8 1E-10	1 7E-08
Dibenzo(a,h)anthracene	O	13000	ug/kg	7.2E-08	7.3	5 3E-07	0.01	3.3E-09	8	2.6E-08	5 5E-07
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	5 5E-07	0.73	4.0E-07	0.01	2.5E-08	0.8	2 0E-08	4.2E-07
Arsenic	I	22	mg/kg	1 2E-07	1.5	1 8E-07	0.001	5.6E-10	1.5	8.4E-10	1.8E-07
Lead	I	4200	mg/kg	2.3E-05	ND		0 001	1.1E-07	ND		
SUMMARY CANCER RISK						2E-05				9E-07	2E-05

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (November, 1995)
[2] Calculated from oral CSFs
NE = not evaluated

TABLE B.15.33

DIRECT CONTACT WITH AND INCIDENTAL INGESTION OF SURFACE SOIL (CENTRAL TENDENCY)
SITE MAINTENANCE WORKER
SITE 15, OPERABLE UNIT 5
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	SOIL CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	DERMAL ABS [1]	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
Benzo(a)anthracene	O	340000	ug/kg	2.0E-05	ND		0.01	9.2E-07	ND		
Benzo(a)pyrene	O	340000	ug/kg	2 0E-05	ND		0.01	9.2E-07	ND		
Benzo(b)fluoranthene	O	510000	ug/kg	3 0E-05	ND		0.01	1.4E-06	ND		
Benzo(k)fluoranthene	O	130000	ug/kg	7 6E-06	ND		0.01	3.5E-07	ND		
Carbazole	O	6600	ug/kg	3.9E-07	ND		0 01	1.8E-08	ND		
Chrysene	O	400000	ug/kg	2.3E-05	ND		0.01	1 1E-06	ND		
Dibenzo(a,h)anthracene	O	13000	ug/kg	7 6E-07	ND		0.01	3 5E-08	ND		
Indeno(1,2,3-cd)pyrene	O	100000	ug/kg	5.9E-06	ND		0 01	2 7E-07	ND		
Benzo(g,h,i)perylene	O	54000	ug/kg	3.2E-06	ND		0.01	1 5E-07	ND		
Fluoranthene	O	660000	ug/kg	3.9E-05	0.04	9.7E-04	0 01	1 8E-06	0.036	5.0E-05	1.0E-03
Phenanthrene	O	260000	ug/kg	1 5E-05	ND		0.01	7 0E-07	ND		
Pyrene	O	500000	ug/kg	2.9E-05	0 03	9.8E-04	0.01	1 4E-06	0.027	5.0E-05	1.0E-03
Arsenic	I	22	mg/kg	1 3E-06	0.0003	4 3E-03	0.001	5 9E-09	0.00029	2.0E-05	4.3E-03
Antimony	I	74	mg/kg	4 3E-06	0 0004	1.1E-02	0 001	2 0E-08	0.000004	5.0E-03	1.6E-02
Lead	I	4200	mg/kg	2 5E-04	ND		0.001	1 1E-06	0		
TPH	O	130000	ug/kg	7 6E-06	0.03	2.5E-04	0 01	3 5E-07	0 027	1 3E-05	2.7E-04
HMX	O	1100	ug/kg	6 5E-08	ND		0.01	3 0E-09	ND		
			SUMMARY HAZARD INDEX			**2E-02**				**5E-03**	**2E-02**

[1] USEPA Region IV guidance specifies absorption factors of 1% for organics and 0 1% for inorganics (February 10, 1992)
[2] Calculated from oral RfDs
ND = no data available

TABLE B.15 34

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) CENTRAL TENDENCY
ADULT RESIDENT
SITE 15, OPERABLE UNIT 5
NAS CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION WATER	CW	chemical-specific	ug/liter	
INGESTION RATE	IR	1.4	liters/day	USEPA, 1996
BODY WEIGHT	BW	70	kg	USEPA, 1991
CONVERSION FACTOR	CF	0.001	mg/ug	
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1991
EXPOSURE DURATION	ED	7	years	USEPA, 1989
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	7	years	USEPA, 1991

USEPA, 1989 Exposure Factors Handbook, May 1989
USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance
"Standard Default Exposure Factors", OSWER Directive 9285 6-03
USEPA, 1996 Exposure Factors Handbook, 1996

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)-1

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE} = \frac{\text{CW x IR x EF x ED x CF}}{\text{BW x AT x 365 days/year}}$$

Note: For noncarcinogenic effects, AT = ED.

TABLE B.15.34

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) CENTRAL TENDENCY
ADULT RESIDENT
SITE 15, OPERABLE UNIT 5
NAS CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	CANCER SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK INGESTION
bis(2-Ethylhexyl)phthalate	32.9	ug/L	6 3E-05	0.014	8 8E-07
4,4-DDD	0 029	ug/L	5 6E-08	0.24	1 3E-08
4,4-DDE	0.06	ug/L	1 2E-07	0.34	3 9E-08
4,4-DDT	0.034	ug/L	6 5E-08	0.34	2 2E-08
Beryllium	1	ug/L	1 9E-06	4.3	8 2E-06
			TOTAL CANCER RISK		9E-06

ND = No Data.

NONCARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT INGESTION
bis(2-Ethylhexyl)phthalate	32.9	UG/LITER	6 3E-04	0.02	3 2E-02
4,4-DDD	0.029	UG/LITER	5 6E-07	ND	
4,4-DDE	0.06	UG/LITER	1 2E-06	ND	
4,4-DDT	0.034	UG/LITER	6 5E-07	0.0005	1 3E-03
Aluminum	427	UG/LITER	8 2E-03	1	8 2E-03
Antimony	2.2	UG/LITER	4 2E-05	0 0004	1 1E-01
Beryllium	1	UG/LITER	1 9E-05	0.005	3 8E-03
Iron	1750	UG/LITER	3 4E-02	0.3	1 1E-01
Thallium	5.2	UG/LITER	1 0E-04	0.00008	1 2E+00
RDX	0.24	UG/LITER	4 6E-06	ND	
			TOTAL HAZARD INDEX		2

ND = no data available

TABLE B.15.35

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) CENTRAL TENDENCY
CHILD RESIDENT
SITE 15, OPERABLE UNIT 5
NAS CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION WATER	CW	chemical-specific	ug/liter	
INGESTION RATE	IR	0 87	liters/day	USEPA, 1996
BODY WEIGHT	BW	15	kg	USEPA, 1991
CONVERSION FACTOR	CF	0 001	mg/ug	
EXPOSURE FREQUENCY	EF	350	days/year	USEPA, 1991
EXPOSURE DURATION	ED	2	years	USEPA, 1989
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	2	years	USEPA, 1991

USEPA, 1989 Exposure Factors Handbook, May, 1989
USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance
"Standard Default Exposure Factors", OSWER Directive 9285 6-03
USEPA, 1995 Region IV Supplemental Guidance to RAGS, Bulletin No 3, November
USEPA, 1996 Exposure Factors Handbook, 1996

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)-1

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE} = \frac{\text{CW x IR x EF x ED x CF}}{\text{BW x AT x 365 days/year}}$$

Note: For noncarcinogenic effects, AT = ED.

TABLE B.15.35

INGESTION OF GROUNDWATER AS DRINKING WATER (UNFILTERED SAMPLES) CENTRAL TENDENCY
CHILD RESIDENT
SITE 15, OPERABLE UNIT 5
NAS CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	CANCER SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK INGESTION
bis(2-Ethylhexyl)phthalate	32.9	ug/L	5 2E-05	1.4E-02	7 3E-07
4,4-DDD	0.029	ug/L	4 6E-08	2.4E-01	1 1E-08
4,4-DDE	0 06	ug/L	9 5E-08	3.4E-01	3 2E-08
4,4-DDT	0 034	ug/L	5 4E-08	3 4E-01	1 8E-08
Beryllium	1	ug/L	1 6E-06	4.3E+00	6 8E-06
			TOTAL CANCER RISK		8E-06

ND = No Data.

NONCARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT INGESTION
bis(2-Ethylhexyl)phthalate	32 9	UG/LITER	1 8E-03	2 0E-02	9 1E-02
4,4-DDD	0 029	UG/LITER	1 6E-06	ND	
4,4-DDE	0 06	UG/LITER	3 3E-06	ND	
4,4-DDT	0 034	UG/LITER	1 9E-06	5 0E-04	3 8E-03
Aluminum	427	UG/LITER	2 4E-02	1 0E+00	2 4E-02
Antimony	2 2	UG/LITER	1 2E-04	4 0E-04	3 1E-01
Beryllium	1	UG/LITER	5 6E-05	5 0E-03	1 1E-02
Iron	1750	UG/LITER	9 7E-02	3 0E-01	3 2E-01
Thallium	5 2	UG/LITER	2 9E-04	8 0E-05	3 6E+00
RDX	0 24	UG/LITER	1 3E-05	ND	
			TOTAL HAZARD INDEX		4

ND = no data available.

TABLE B.15.36

INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER (CENTRAL TENDENCY)
ADULT RESIDENT - WADING
SITE 15, OPERABLE UNIT
NAS, CECIL FIELD

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION WATER	CW	chemical-specific	ug/liter	
INGESTION RATE [1]	IR	0.025	liters/day	USEPA, 1996
SURFACE AREA [2]	SA	5,000	cm2	ABB, 1996
EVENT FREQUENCY	EV	1	events/day	Assumption
BODY WEIGHT	BW	70	kg	USEPA, 1991
DOSE ABSORBED PER EVENT	DAevent	chemical-specific	mg/cm2-event	Calculated
EXPOSURE TIME	ET	0.5	hours/day	USEPA, 1996
EXPOSURE FREQUENCY	EF	5	days/year	USEPA, 1996
EXPOSURE DURATION	ED	7	years	USEPA, 1989
DIFFUSION DEPTH PER EVENT	PCevent	chemical-specific	cm/event	Calculated per USEPA, 1992 [3]
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991
NONCANCER	AT	7	years	USEPA, 1995
CONVERSION FACTOR	CF1	0.001	mg/ug	
CONVERSION FACTOR	CF2	0.001	liter/cm3	

[1] Ingestion Rate = 0.026 l/day = 10 ml/hour x 2.6 hours/day x 0.001 l/ml
[2] Surface area assumes lower legs, hands, and feet are exposed
[3] PCevent is calculated in the Dermal Guidance Appendix to this report
ABB, 1996 General Information Report
USEPA, 1989 Exposure Factors Handbook, EPA/600/8-89/043, May 1989
USEPA, 1991 Human Health Evaluation Manual, Supplemental Guidance "Standard Default Exposure Parameters"
USEPA, 1992 Dermal Exposure Assessment Principles and Applications, EPA/600/8-91/011B
USEPA, 1995 Supplemental Guidance to RAGS Region 4 Bulletins, Bulletin No 3, November 1995
USEPA, 1996 Exposure Factors Handbook, 1996

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)-1

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE-INGESTION} = \frac{CW \times IR \times EF \times ED \times CF1}{BW \times AT \times 365\ \text{days/yr}}$$

$$\text{INTAKE-DERMAL} = \frac{DAevent \times EV \times EF \times ED \times SA}{AT \times BW \times 365\ \text{days/yr}}$$

Where:
DAevent = PCevent x CW x CF1 x CF2

Note: For noncarcinogenic effects, AT = ED.

TABLE B.15 36

INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER (CENTRAL TENDENCY)
ADULT RESIDENT - WADING
SITE 15, OPERABLE UNIT
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND		WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF [1] (mg/kg-day)^-1	CANCER RISK INGESTION	PCEVENT [2] (cm/event)	INTAKE DERMAL (mg/kg-day)	DERMAL CSF [1, 3] (mg/kg day)^-1	CANCER RISK DERMAL	TOTAL CANCER RISK
Arsenic	I	12	ug/L	5.9E-09	1.5	8 8E-09	0 0026	3 1E-09	1.5	4 6E-09	1.3E-08
Lead	I	400	ug/L	2.0E-07	ND		0 0026	1.0E-07	ND		
SUMMARY CANCER RISK						9E-09				5E-09	1E-08

[1] Relative potency factors were applied to the CSFs of carcinogenic PAHs Relative potency factors are derived in "Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons," USEPA, 1993
[2] This chemical-specific value is calculated in Table B 15 23 of this appendix
[3] Calculated from oral CSFs
ND = no data available

TABLE B.15.36

INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER (CENTRAL TENDENCY)
ADULT RESIDENT - WADING
SITE 15, OPERABLE UNIT
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND		WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	PCEVENT[1] (cm/event)	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)^-1	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
1,3,5-Trinitrobenzene	O	6 73	ug/L	3 3E-08	5.0E-05	6 6E-04	1.9E-03	1.3E-08	ND		6 6E-04
3-Nitrotoluene	O	4.95	ug/L	2 4E-08	1.0E-02	2 4E-06	ND		ND		2.4E-06
4-Nitrotoluene	O	46 1	ug/L	2.3E-07	1.0E-02	2 3E-05	ND		ND		2.3E-05
TETRYL	O	18.4	ug/L	9 0E-08	1.0E-02	9.0E-06	ND		ND		9.0E-06
Aluminum	I	649	ug/L	3 2E-06	1 0E+00	3.2E-06	2.6E-03	1.7E-06	0.2	8.3E-06	1 1E-05
Arsenic	I	12	ug/L	5 9E-08	3.0E-04	2 0E-04	2.6E-03	3.1E-08	0 00029	1.1E-04	3 0E-04
Iron	I	1980	ug/L	9 7E-06	3 0E-01	3.2E-05	2.6E-03	5 0E-06	0.006	8.4E-04	8.7E-04
Lead	I	400	ug/L	2.0E-06	ND		2.6E-03	1.0E-06	ND		
Vanadium	I	3.3	ug/L	1 6E-08	7.0E-03	2.3E-06	2.6E-03	8.4E-09	0.00021	4 0E-05	4.2E-05
TPH	O	600	ug/L	2 9E-06	3.0E-02	9.8E-05	2.9E+00	1 7E-03	0.027	6.3E-02	6.3E-02
					SUMMARY HAZARD INDEX	1E-03				6E-02	6E-02

[1] This chemical-specific value is calculated in Table B 15 23 of this appendix
[2] Calculated from oral RfDs
ND = no data available

TABLE B 15.37

INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER (CENTRAL TENDENCY)
CHILD RESIDENT - WADING
SITE 15, OPERABLE UNIT
NAS, CECIL FIELD

CARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF	CANCER RISK INGESTION	PCEVENT [1]	INTAKE DERMAL (mg/kg day)	DERMAL CSF [2]	CANCER RISK DERMAL	TOTAL CANCER RISK
Arsenic	I	12	ug/L	2 3E-08	1.5	3.5E-08	0.0026	4 0E-09	1.5	6 1E-09	4.1E-08
Lead	I	400	ug/L	7.8E-07	ND		0 0026	1 3E-07	ND		
SUMMARY CANCER RISK						4E-08				6E-09	4E-08

[1] This chemical-specific value has been calculated in Table B 15 23 of this appendix
[2] Calculated from oral CSFs
ND = no data available

TABLE B 15 37

INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER (CENTRAL TENDENCY)
CHILD RESIDENT - WADING
SITE 15, OPERABLE UNIT
NAS, CECIL FIELD

NONCARCINOGENIC EFFECTS

COMPOUND	INORGANIC OR ORGANIC I/O	WATER CONCENTRATION	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	PCEVENT [1] (cm/event)	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
1,3,5-Trinitrobenzene	O	6 73	ug/L	1 5E-07	5.0E-05	3 1E-03	1.9E-03	2.0E-08	ND		**3.1E-03**
3-Nitrotoluene	O	4.95	ug/L	1 1E-07	1.0E-02	1.1E-05	ND		ND		**1.1E-05**
4-Nitrotoluene	O	46 1	ug/L	1.1E-06	1.0E-02	1.1E-04	ND		ND		**1.1E-04**
TETRYL	O	18 4	ug/L	4 2E-07	1 0E-02	4.2E-05	ND		ND		**4.2E-05**
Aluminum	I	649	ug/L	1 5E-05	1 0E+00	1.5E-05	2 6E-03	2 6E-06	2 0E-01	1.3E-05	**2.8E-05**
Arsenic	I	12	ug/L	2 7E-07	3 0E-04	9 1E-04	2.6E-03	4 7E-08	2.9E-04	1 6E-04	**1.1E-03**
Iron	I	1980	ug/L	4.5E-05	3 0E-01	1 5E-04	2.6E-03	7 8E-06	6 0E-03	1 3E-03	**1.4E-03**
Lead	I	400	ug/L	9 1E-06	ND		2 6E-03	1.6E-06	ND		
Vanadium	I	3.3	ug/L	7 5E-08	7.0E-03	1.1E-05	2 6E-03	1.3E-08	2 1E-04	6 2E-05	**7.3E-05**
TPH	O	600	ug/L	1 4E-05	3 0E-02	4 6E-04	2 9E+00	2.6E-03	2.7E-02	9 7E-02	**9.8E-02**
					SUMMARY HAZARD INDEX	5E-03				1E-01	**1E-01**

[1] This chemical-specific value has been calculated in Table B 15 23 of this appendix
[2] Calculated from oral RfDs
ND = no data available

Table B.15-38
Estimated Chronic Exposure to Terrestrial Receptors from Ingestion of Maximum Exposure Concentrations of ECPCs in Food and Surface Soil
Site 15
Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

EXPOSURE CONCENTRATION DATA		ESTIMATED CONTAMINANT CONCENTRATIONS IN PRIMARY FOOD ITEMS				BAF VALUES FOR OTHER FOOD ITEMS	
ANALYTE	MAXIMUM EXPOSURE CONCENTRATION (mg/kg)	Invert BAF [a]	Concentration in Invertebrate Tissue [b] (mg/kg)	Plant BAF [a]	Concentration in Plant Tissue [c] (mg/kg)	Small Mammal BAF [a]	Small Bird BAF [a]
Acenaphthene	2.5E+00	5.0E-02	1.2E-01	6.7E-03	1.7E-02	3.0E-01	NA
Anthracene	1.1E+01	5.0E-02	5.5E-01	6.7E-03	7.4E-02	3.0E-01	NA
Benzo (a) anthracene	3.4E+02	5.0E-02	1.7E+01	6.7E-03	2.3E+00	3.0E-01	NA
Benzo (a) pyrene	3.4E+02	5.0E-02	1.7E+01	6.7E-03	2.3E+00	3.0E-01	NA
Benzo (b) fluoranthene	5.1E+02	5.0E-02	2.6E+01	6.7E-03	3.4E+00	3.0E-01	NA
Benzo (g,h,i) perylene	5.4E+01	5.0E-02	2.7E+00	6.7E-03	3.6E-01	3.0E-01	NA
Benzo (k) fluoranthene	1.3E+02	5.0E-02	6.5E+00	6.7E-03	8.7E-01	3.0E-01	NA
Butylbenzylphthalate	4.4E-01	5.0E-02	2.2E-02	3.3E-02	1.5E-02	1.5E-01	NA
Carbazole	6.6E+00	5.0E-02	3.3E-01	5.2E-02	3.4E-01	1.5E-01	NA
Chrysene	4.0E+02	5.0E-02	2.0E+01	6.7E-03	2.7E+00	3.0E-01	NA
Dibenz (a,h) anthracene	1.3E+01	5.0E-02	6.5E-01	6.7E-03	8.7E-02	3.0E-01	NA
Dibenzofuran	1.1E+00	5.0E-02	5.5E-02	3.3E-02	3.6E-02	1.5E-01	NA
Di-n-butylphthalate	5.5E+00	5.0E-02	2.8E-01	3.3E-02	1.8E-01	1.5E-01	NA
bis(2-Ethylhexyl) phthalate	5.2E-01	5.0E-02	2.6E-02	3.3E-02	1.7E-02	1.5E-01	NA
Fluoranthene	6.6E+02	5.0E-02	3.3E+01	6.7E-03	4.4E+00	3.0E-01	NA
Fluorene	1.3E+00	5.0E-02	6.5E-02	6.7E-03	8.7E-03	3.0E-01	NA
Indeno (1,2,3-cd) pyrene	1.0E+02	5.0E-02	5.1E+00	6.7E-03	6.8E-01	3.0E-01	NA
2-Methylnaphthalene	9.4E-01	5.0E-02	4.7E-02	6.7E-03	6.3E-03	3.0E-01	NA
Naphthalene	2.2E+00	5.0E-02	1.1E-01	6.7E-03	1.5E-02	3.0E-01	NA
Phenanthrene	2.6E+02	5.0E-02	1.3E+01	6.7E-03	1.7E+00	3.0E-01	NA
Pyrene	5.0E+02	5.0E-02	2.5E+01	6.7E-03	3.3E+00	3.0E-01	NA
HMX	1.1E+00	5.0E-02	5.5E-02	5.5E+00	6.0E+00	1.5E-01	NA
3-Nitrotoluene	1.2E+00	5.0E-02	6.0E-02	3.2E-01	3.8E-01	1.5E-01	NA
4-Nitrotoluene	1.4E+00	5.0E-02	7.0E-02	3.2E-01	4.4E-01	1.5E-01	NA
4,4'-DDE	1.3E-03	1.7E+00	2.2E-03	1.0E-02	1.3E-05	1.2E+00	2.9E+00
4,4'-DDT	1.1E-02	5.7E-01	6.3E-03	1.0E-02	1.1E-04	1.2E+00	2.9E+00
Dieldrin	3.7E-04	5.5E+00	2.0E-03	1.7E-02	6.3E-06	1.5E+00	4.4E-01
Endosulfan II	2.1E-03	5.5E+00	1.2E-02	6.4E-02	1.4E-04	1.1E-02	NA
Aluminum	1.9E+03	1.0E-01	1.9E+02	8.0E-04	1.5E+00	7.5E-02	NA
Antimony	1.5E+01	2.2E+00	3.3E+01	4.0E-02	6.1E-01	5.0E-02	NA
Arsenic	2.2E+01	7.3E-01	1.6E+01	3.0E-01	6.7E+00	1.0E-01	NA
Barium	2.9E+01	5.5E+00	1.6E+02	3.0E-02	8.8E-01	7.5E-03	NA

Table B.15–38
Estimated Chronic Exposure to Terrestrial Receptors from Ingestion of Maximum Exposure Concentrations of ECPCs in Food and Surface Soil
Site 15
Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

EXPOSURE CONCENTRATION DATA		ESTIMATED CONTAMINANT CONCENTRATIONS IN PRIMARY FOOD ITEMS				BAF VALUES FOR OTHER FOOD ITEMS	
ANALYTE	MAXIMUM EXPOSURE CONCENTRATION (mg/kg)	Invert BAF [a]	Concentration in Invertebrate Tissue [b] (mg/kg)	Plant BAF [a]	Concentration in Plant Tissue [c] (mg/kg)	Small Mammal BAF [a]	Small Bird BAF [a]
Cadmium	5.5E-01	3.1E+00	1.7E+00	3.3E+01	1.8E+01	2.1E+00	3.8E-01
Chromium	2.0E+00	1.6E-01	3.2E-01	1.5E-03	3.0E-03	2.8E-01	NA
Cobalt	2.7E+00	5.5E-01	1.5E+00	4.0E-03	1.1E-02	1.0E+00	NA
Copper	3.2E+00	1.6E-01	5.1E-01	7.8E-01	2.5E+00	6.0E-01	NA
Cyanide	2.7E-01	0.0E+00	0.0E+00	1.0E+00	2.7E-01	0.0E+00	NA
Lead	4.2E+03	2.9E-01	1.2E+03	0.0E+00	0.0E+00	1.5E-02	NA
Manganese	6.4E+00	1.6E+00	9.9E+00	5.0E-02	3.2E-01	2.0E-02	NA
Nickel	2.2E+00	3.7E+00	8.2E+00	1.2E-02	2.6E-02	3.0E-01	NA
Vanadium	2.5E+00	5.0E+00	1.3E+01	1.1E-03	2.8E-03	1.2E-01	NA
Zinc	2.9E+00	9.2E-01	2.7E+00	6.1E-01	1.8E+00	2.1E+00	NA

ECPC = Ecological Contaminant of Potential Concern
[a] Bioaccumulation data presented in: Appendix A, Table A–8
[b] ECPC concentrations in invertebrate tissue equals the invertebrate BAF multiplied by the maximum soil concentration of the contaminan
[c] ECPC concentrations in plant tissue equals the plant BAF multiplied by the maximum soil concentration of the contaminant

Table B.15-38
Estimated Chronic Exposure to Terrestrial Receptors from Ingestion of Maximum Exposure Concentrations of ECPCs in Food and Surface Soil
Site 15
Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

POTENTIAL DIETARY EXPOSURE (mg/kgBW/day) [d]

ANALYTE	*Short-tailed shrew*	*Rufous-sided towhee*	*American woodcock*	*Red fox*	*Great horned owl*
Acenaphthene	4.9E-02	3.2E-02	3.6E-02	5.3E-04	5.4E-03
Anthracene	2.2E-01	1.4E-01	1.6E-01	2.3E-03	2.4E-02
Benzo (a) anthracene	6.7E+00	4.3E+00	4.9E+00	7.2E-02	7.4E-01
Benzo (a) pyrene	6.7E+00	4.3E+00	4.9E+00	7.2E-02	7.4E-01
Benzo (b) fluoranthene	1.0E+01	6.4E+00	7.3E+00	1.1E-01	1.1E+00
Benzo (g,h,i) perylene	1.1E+00	6.8E-01	7.7E-01	1.1E-02	1.2E-01
Benzo (k) fluoranthene	2.6E+00	1.6E+00	1.9E+00	2.7E-02	2.8E-01
Butylbenzylphthalate	8.9E-03	6.9E-03	6.4E-03	8.0E-05	5.9E-04
Carbazole	1.4E-01	1.2E-01	9.7E-02	1.2E-03	9.0E-03
Chrysene	7.9E+00	5.1E+00	5.7E+00	8.4E-02	8.7E-01
Dibenz (a,h) anthracene	2.6E-01	1.6E-01	1.9E-01	2.7E-03	2.8E-02
Dibenzofuran	2.2E-02	1.7E-02	1.6E-02	2.0E-04	1.5E-03
Di-n-butylphthalate	1.1E-01	8.7E-02	8.0E-02	1.0E-03	7.4E-03
bis(2-Ethylhexyl) phthalate	1.0E-02	8.2E-03	7.6E-03	9.4E-05	7.0E-04
Fluoranthene	1.3E+01	8.3E+00	9.4E+00	1.4E-01	1.4E+00
Fluorene	2.6E-02	1.6E-02	1.9E-02	2.7E-04	2.8E-03
Indeno (1,2,3-cd) pyrene	2.0E+00	1.3E+00	1.5E+00	2.1E-02	2.2E-01
2-Methylnaphthalene	1.9E-02	1.2E-02	1.3E-02	2.0E-04	2.0E-03
Naphthalene	4.3E-02	2.8E-02	3.1E-02	4.6E-04	4.8E-03
Phenanthrene	5.1E+00	3.3E+00	3.7E+00	5.5E-02	5.6E-01
Pyrene	9.9E+00	6.3E+00	7.1E+00	1.1E-01	1.1E+00
HMX	1.2E-01	7.3E-01	7.7E-02	2.4E-03	5.8E-03
3-Nitrotoluene	3.0E-02	5.9E-02	2.1E-02	3.4E-04	1.9E-03
4-Nitrotoluene	3.5E-02	6.9E-02	2.4E-02	4.0E-04	2.2E-03
4,4'-DDE	2.6E-04	1.3E-04	1.9E-04	6.8E-06	1.2E-04
4,4'-DDT	8.5E-04	4.6E-04	6.2E-04	2.3E-05	4.1E-04
Dieldrin	2.3E-04	1.2E-04	1.7E-04	6.1E-06	1.0E-04
Endosulfan II	1.3E-03	6.7E-04	9.6E-04	8.0E-06	5.1E-06
Aluminum	4.7E+01	2.8E+01	3.5E+01	3.5E-01	1.9E+00
Antimony	3.9E+00	2.0E+00	2.8E+00	2.6E-02	6.2E-02
Arsenic	2.2E+00	1.9E+00	1.6E+00	1.8E-02	7.4E-02
Barium	1.8E+01	9.2E+00	1.3E+01	1.1E-01	5.3E-02

Table B.15–38
Estimated Chronic Exposure to Terrestrial Receptors from Ingestion of Maximum Exposure Concentrations of ECPCs in Food and Surface Soil
Site 15
Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

POTENTIAL DIETARY EXPOSURE (mg/kgBW/day) [d]

ANALYTE	*Short–tailed shrew*	*Rufous–sided towhee*	*American woodcock*	*Red fox*	*Great horned owl*
Cadmium	5.0E–01	2.2E+00	3.3E–01	2.2E–02	3.2E–01
Chromium	6.4E–02	3.6E–02	4.6E–02	6.4E–04	6.0E–03
Cobalt	2.0E–01	1.1E–01	1.5E–01	3.9E–03	5.8E–02
Copper	1.4E–01	3.5E–01	9.9E–02	2.6E–03	2.6E–02
Cyanide	8.4E–03	3.4E–02	5.5E–03	1.1E–04	1.3E–04
Lead	1.9E+02	1.0E+02	1.4E+02	1.2E+00	2.9E+00
Manganese	1.2E+00	6.4E–01	8.7E–01	7.5E–03	9.9E–03
Nickel	9.3E–01	4.7E–01	6.9E–01	9.2E–03	8.0E–02
Vanadium	1.4E+00	7.1E–01	1.0E+00	1.1E–02	5.1E–02
Zinc	3.6E–01	3.8E–01	2.6E–01	1.3E–02	2.2E–01

[d] Calculated by summing the products of individual prey type concentrations and percent in diet, multiplying by the ingestion rate, and dividing by body weight (Table 7–8)

Table B.15–38
Exposure Parameters and Assumptions for Terrestrial Receptors [a]
Site 15
Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

Representative Wildlife Species		Percent Prey in Diet: Inverts	Plants	Small Mammals	Small Birds	Soil	Home Range (acres)	ED [b]	Site Foraging Frequency [c]	Food Ingestion Rate (kg/day)	Body Weight (kg)
Short–tailed shrew	(Small omn mammal)	78%	12%	0%	0%	10%	0.96	1	1.00E+00	0.0024	0.017
Rufous–sided towhee	(Small omn. bird)	30%	65%	0%	0%	5%	1.5	1	1.00E+00	0.0071	0.039
American woodcock	(Small omn. bird)	80%	10%	0%	0%	10%	80 1	1	1.00E+00	0.020	0 197
Red fox	(Predatory mammal)	20%	10%	57%	10%	3%	1727	1	6 37E–02	0.24	4 69
Great horned owl	(Predatory Bird)	0%	0%	80%	19%	1%	15	1	1.00E+00	0 079	1 59

NOTES.

SITE AREA:	110.0 acres

[a] Documentation of exposure parameters presented in Table 7–7

[b] ED = Exposure Duration (percentage of year receptor is expected to be found at study area) ED is assumed to be 1 for this risk assessment.

[c] SFF = Site Foraging Frequency (calculated by dividing site area by receptor home range (cannot exceed 1 0)). SFF is assumed to be 1 for lethal exposure scenario.

Table B.15-39
Estimated Chronic Exposure to Terrestrial Receptors from Ingestion of Average Exposure Concentrations of ECPCs in Food and Surface Soil
Site 15
Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

EXPOSURE CONCENTRATION DATA		ESTIMATED CONTAMINANT CONCENTRATIONS IN PRIMARY FOOD ITEMS				BAF VALUES FOR OTHER FOOD ITEMS	
ANALYTE	AVERAGE EXPOSURE CONCENTRATION (mg/kg)	Invert BAF [a]	Concentration in Invertebrate Tissue [b] (mg/kg)	Plant BAF [a]	Concentration in Plant Tissue [c] (mg/kg)	Small Mammal BAF [a]	Small Bird BAF [a]
Acenaphthene	1.8E+00	5.0E-02	9.0E-02	6.7E-03	1.2E-02	3.0E-01	NA
Anthracene	5.5E+00	5.0E-02	2.8E-01	6.7E-03	3.7E-02	3.0E-01	NA
Benzo (a) anthracene	3.4E+01	5.0E-02	1.7E+00	6.7E-03	2.3E-01	3.0E-01	NA
Benzo (a) pyrene	3.3E+01	5.0E-02	1.7E+00	6.7E-03	2.2E-01	3.0E-01	NA
Benzo (b) fluoranthene	4.8E+01	5.0E-02	2.4E+00	6.7E-03	3.2E-01	3.0E-01	NA
Benzo (g,h,i) perylene	1.4E+01	5.0E-02	7.0E-01	6.7E-03	9.4E-02	3.0E-01	NA
Benzo (k) fluoranthene	1.7E+01	5.0E-02	8.5E-01	6.7E-03	1.1E-01	3.0E-01	NA
Butylbenzylphthalate	4.4E-01	5.0E-02	2.2E-02	3.3E-02	1.5E-02	1.5E-01	NA
Carbazole	3.5E+00	5.0E-02	1.8E-01	5.2E-02	1.8E-01	1.5E-01	NA
Chrysene	4.0E+01	5.0E-02	2.0E+00	6.7E-03	2.7E-01	3.0E-01	NA
Dibenz (a,h) anthracene	5.6E+00	5.0E-02	2.8E-01	6.7E-03	3.7E-02	3.0E-01	NA
Dibenzofuran	9.1E-01	5.0E-02	4.6E-02	3.3E-02	3.0E-02	1.5E-01	NA
Di-n-butylphthalate	2.3E+00	5.0E-02	1.1E-01	3.3E-02	7.6E-02	1.5E-01	NA
bis(2-Ethylhexyl) phthalate	5.2E-01	5.0E-02	2.6E-02	3.3E-02	1.7E-02	1.5E-01	NA
Fluoranthene	6.2E+01	5.0E-02	3.1E+00	6.7E-03	4.1E-01	3.0E-01	NA
Fluorene	1.0E+00	5.0E-02	5.0E-02	6.7E-03	6.7E-03	3.0E-01	NA
Indeno (1,2,3-cd) pyrene	1.6E+01	5.0E-02	8.0E-01	6.7E-03	1.1E-01	3.0E-01	NA
2-Methylnaphthalene	6.4E-01	5.0E-02	3.2E-02	6.7E-03	4.3E-03	3.0E-01	NA
Naphthalene	1.5E+00	5.0E-02	7.5E-02	6.7E-03	1.0E-02	3.0E-01	NA
Phenanthrene	2.7E+01	5.0E-02	1.4E+00	6.7E-03	1.8E-01	3.0E-01	NA
Pyrene	4.7E+01	5.0E-02	2.4E+00	6.7E-03	3.1E-01	3.0E-01	NA
HMX	8.1E-01	5.0E-02	4.1E-02	5.5E+00	4.4E+00	1.5E-01	NA
3-Nitrotoluene	8.7E-01	5.0E-02	4.4E-02	3.2E-01	2.8E-01	1.5E-01	NA
4-Nitrotoluene	9.3E-01	5.0E-02	4.7E-02	3.2E-01	3.0E-01	1.5E-01	NA
4,4'-DDE	1.3E-03	1.7E+00	2.2E-03	1.0E-02	1.3E-05	1.2E+00	2.9E+00
4,4'-DDT	1.1E-02	5.7E-01	6.3E-03	1.0E-02	1.1E-04	1.2E+00	2.9E+00
Dieldrin	3.7E-04	5.5E+00	2.0E-03	1.7E-02	6.3E-06	1.5E+00	4.4E-01
Endosulfan II	2.1E-03	5.5E+00	1.2E-02	6.4E-02	1.4E-04	1.1E-02	NA
Aluminum	1.1E+03	1.0E-01	1.1E+02	8.0E-04	8.7E-01	7.5E-02	NA
Antimony	1.5E+01	2.2E+00	3.3E+01	4.0E-02	6.1E-01	5.0E-02	NA
Arsenic	1.9E+01	7.3E-01	1.4E+01	3.0E-01	5.8E+00	1.0E-01	NA
Barium	1.5E+01	5.5E+00	8.4E+01	3.0E-02	4.6E-01	7.5E-03	NA

Table B.15-39
Estimated Chronic Exposure to Terrestrial Receptors from Ingestion of Average Exposure Concentrations of ECPCs in Food and Surface Soil
Site 15
Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

EXPOSURE CONCENTRATION DATA		ESTIMATED CONTAMINANT CONCENTRATIONS IN PRIMARY FOOD ITEMS				BAF VALUES FOR OTHER FOOD ITEMS	
ANALYTE	AVERAGE EXPOSURE CONCENTRATION (mg/kg)	Invert BAF [a]	Concentration in Invertebrate Tissue [b] (mg/kg)	Plant BAF [a]	Concentration in Plant Tissue [c] (mg/kg)	Small Mammal BAF [a]	Small Bird BAF [a]
Cadmium	5.2E-01	3.1E+00	1.6E+00	3.3E+01	1.7E+01	2.1E+00	3.8E-01
Chromium	2.0E+00	1.6E-01	3.2E-01	1.5E-03	3.0E-03	2.8E-01	NA
Cobalt	2.7E+00	5.5E-01	1.5E+00	4.0E-03	1.1E-02	1.0E+00	NA
Copper	3.0E+00	1.6E-01	4.8E-01	7.8E-01	2.3E+00	6.0E-01	NA
Cyanide	2.5E-01	0.0E+00	0.0E+00	1.0E+00	2.5E-01	0.0E+00	NA
Lead	7.3E+02	2.9E-01	2.1E+02	0.0E+00	0.0E+00	1.5E-02	NA
Manganese	4.8E+00	1.6E+00	7.4E+00	5.0E-02	2.4E-01	2.0E-02	NA
Nickel	2.2E+00	3.7E+00	8.2E+00	1.2E-02	2.6E-02	3.0E-01	NA
Vanadium	1.9E+00	5.0E+00	9.5E+00	1.1E-03	2.1E-03	1.2E-01	NA
Zinc	2.9E+00	9.2E-01	2.7E+00	6.1E-01	1.8E+00	2.1E+00	NA

ECPC = Ecological Contaminant of Potential Concern

[a] Bioaccumulation data presented in: Appendix A, Table A-8

[b] ECPC concentrations in invertebrate tissue equals the invertebrate BAF multiplied by the maximum soil concentration of the contaminan

[c] ECPC concentrations in plant tissue equals the plant BAF multiplied by the maximum soil concentration of the contaminant

Table B.15-39
Estimated Chronic Exposure to Terrestrial Receptors from Ingestion of Average Exposure Concentrations of ECPCs in Food and Surface Soil
Site 15
Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

POTENTIAL DIETARY EXPOSURE (mg/kgBW/day) [d]

ANALYTE	*Short-tailed shrew*	*Rufous-sided towhee*	*American woodcock*
Acenaphthene	3.6E-02	2.3E-02	2.6E-02
Anthracene	1.1E-01	6.9E-02	7.9E-02
Benzo (a) anthracene	6.7E-01	4.3E-01	4.9E-01
Benzo (a) pyrene	6.5E-01	4.2E-01	4.7E-01
Benzo (b) fluoranthene	9.5E-01	6.1E-01	6.9E-01
Benzo (g,h,i) perylene	2.8E-01	1.8E-01	2.0E-01
Benzo (k) fluoranthene	3.4E-01	2.1E-01	2.4E-01
Butylbenzylphthalate	8.9E-03	6.9E-03	6.4E-03
Carbazole	7.2E-02	6.3E-02	5.2E-02
Chrysene	7.9E-01	5.1E-01	5.7E-01
Dibenz (a,h) anthracene	1.1E-01	7.1E-02	8.0E-02
Dibenzofuran	1.8E-02	1.4E-02	1.3E-02
Di-n-butylphthalate	4.6E-02	3.6E-02	3.3E-02
bis(2-Ethylhexyl) phthalate	1.0E-02	8.2E-03	7.6E-03
Fluoranthene	1.2E+00	7.8E-01	8.9E-01
Fluorene	2.0E-02	1.3E-02	1.4E-02
Indeno (1,2,3-cd) pyrene	3.2E-01	2.0E-01	2.3E-01
2-Methylnaphthalene	1.3E-02	8.1E-03	9.1E-03
Naphthalene	3.0E-02	1.9E-02	2.1E-02
Phenanthrene	5.3E-01	3.4E-01	3.9E-01
Pyrene	9.3E-01	5.9E-01	6.7E-01
HMX	9.1E-02	5.3E-01	5.7E-02
3-Nitrotoluene	2.2E-02	4.3E-02	1.5E-02
4-Nitrotoluene	2.3E-02	4.6E-02	1.6E-02
4,4'-DDE	2.6E-04	1.3E-04	1.9E-04
4,4-DDT	8.5E-04	4.6E-04	6.2E-04
Dieldrin	2.3E-04	1.2E-04	1.7E-04
Endosulfan II	1.3E-03	6.7E-04	9.6E-04
Aluminum	2.8E+01	1.6E+01	2.0E+01
Antimony	3.9E+00	2.0E+00	2.8E+00
Arsenic	1.9E+00	1.6E+00	1.4E+00
Barium	9.5E+00	4.8E+00	7.0E+00

Table B.15–39
Estimated Chronic Exposure to Terrestrial Receptors from Ingestion of Average Exposure Concentrations of ECPCs in Food and Surface Soil
Site 15
Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

POTENTIAL DIETARY EXPOSURE (mg/kgBW/day) [d]

ANALYTE	*Short–tailed shrew*	*Rufous–sided towhee*	*American woodcock*
Cadmium	4.7E–01	2.1E+00	3.1E–01
Chromium	6.4E–02	3.6E–02	4.6E–02
Cobalt	2.0E–01	1.1E–01	1.5E–01
Copper	1.3E–01	3.3E–01	9.3E–02
Cyanide	7.8E–03	3.2E–02	5.1E–03
Lead	3.3E+01	1.8E+01	2.4E+01
Manganese	8.9E–01	4.8E–01	6.6E–01
Nickel	9.3E–01	4.7E–01	6.9E–01
Vanadium	1.1E+00	5.4E–01	7.9E–01
Zinc	3.6E–01	3.8E–01	2.6E–01

[d] Calculated by summing the products of individual prey type concentrations and percent in diet, multiplying by the ingestion rate, and dividing by body weight (Table 7–8)

Table B.15–39
Exposure Parameters and Assumptions for Terrestrial Receptors [a]
Site 15
Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

Representative Wildlife Species		Percent Prey in Diet					Home Range (acres)	ED [b]	Site Foraging Frequency [c]	Food Ingestion Rate (kg/day)	Body Weight (kg)
		Inverts	Plants	Small Mammals	Small Birds	Soil					
Short–tailed shrew	(Small omn. mammal)	78%	12%	0%	0%	10%	0.96	1	1.00E+00	0.0024	0.017
Rufous–sided towhee	(Small omn. bird)	30%	65%	0%	0%	5%	1.5	1	1.00E+00	0.0071	0.039
American woodcock	(Small omn. bird)	80%	10%	0%	0%	10%	80.1	1	1.00E+00	0.020	0.197

NOTES:

SITE AREA:	110.0 acres

[a] Documentation of exposure parameters presented in: Table 7–7

[b] ED = Exposure Duration (percentage of year receptor is expected to be found at study area). ED is assumed to be 1 for this risk assessment.

[c] SFF = Site Foraging Frequency (calculated by dividing site area by receptor home range (cannot exceed 1.0)). SFF is assumed to be 1 for lethal exposure scenario

Table B.15–40
Estimated Chronic Exposure to Semi–Aquatic Receptors from Ingestion of Maximum Exposure Concentrations of ECPCs in Food, Surface Water, and Sediment
Site 15

Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

EXPOSURE CONCENTRATION DATA			ESTIMATED TISSUE LEVELS IN PRIMARY PREY ITEMS					
			Aquatic Organism					
CHEMICAL	MAXIMUM SEDIMENT CONCENTRATION (mg/kg)	MAXIMUM SURFACE WATER CONCENTRATION (mg/L)	Aquatic Organism BCF [a]	Aquatic Organism BAF [a]	Tissue Level (mg/kg)	Plant BAF [a]	Mammal BAF [a]	Bird BAF [a]
2–Butanone	1.8E–02	NA	NA	NA	0.0E+00	NA	NA	NA
Anthracene	5.5E–01	NA	NA	NA	0.0E+00	NA	3.0E–01	NA
Benzo (a) anthracene	6.1E+00	NA	NA	NA	0.0E+00	NA	3.0E–01	NA
Benzo (a) pyrene	8.0E+00	NA	NA	NA	0.0E+00	NA	3.0E–01	NA
Benzo (b) fluoranthene	1.0E+01	NA	NA	NA	0.0E+00	NA	3.0E–01	NA
Benzo (g,h,i) perylene	3.5E+00	NA	NA	NA	0.0E+00	NA	3.0E–01	NA
Benzo (k) fluoranthene	3.7E+00	NA	NA	NA	0.0E+00	NA	3.0E–01	NA
Carbazole	5.8E–02	NA	NA	NA	0.0E+00	NA	1.5E–01	NA
Chrysene	7.3E+00	NA	NA	NA	0.0E+00	NA	3.0E–01	NA
Dibenz (a,h) anthracene	1.1E+00	NA	NA	NA	0.0E+00	NA	3.0E–01	NA
Di–n–butylphthalate	3.1E+00	NA	NA	NA	0.0E+00	NA	1.5E–01	NA
Fluoranthene	1.0E+01	NA	NA	NA	0.0E+00	NA	3.0E–01	NA
Indeno (1,2,3–cd) pyrene	4.3E+00	NA	NA	NA	0.0E+00	NA	3.0E–01	NA
Phenanthrene	3.1E+00	NA	NA	NA	0.0E+00	NA	3.0E–01	NA
Pyrene	9.1E+00	NA	NA	NA	0.0E+00	NA	3.0E–01	NA
3–Nitrotoluene	NA	5.0E–03	NA	NA	0.0E+00	NA	1.5E–01	NA
4–Nitrotoluene	3.7E+01	4.6E–02	NA	NA	0.0E+00	NA	1.5E–01	NA
TETRYL	NA	1.8E–02	NA	NA	0.0E+00	NA	1.5E–01	NA
1,3,5–Trinitrobenzene	NA	6.7E–03	NA	NA	0.0E+00	NA	1.5E–01	NA
4,4'–DDD	1.1E–02	NA	3.4E+03	2.1E+01	2.3E–01	NA	1.2E+00	2.9E+00
4,4'–DDE	8.3E–03	NA	3.4E+03	2.1E+01	1.7E–01	NA	1.2E+00	2.9E+00
4,4'–DDT	8.1E–03	NA	3.4E+03	2.1E+01	1.7E–01	NA	1.2E+00	2.9E+00
Dieldrin	1.4E–03	NA	NA	2.1E+01	2.9E–02	NA	1.5E+00	4.4E–01
Aluminum	2.6E+03	6.5E–01	NA	NA	0.0E+00	6.0E–03	7.5E–02	NA
Arsenic	NA	1.2E–02	NA	NA	0.0E+00	NA	1.0E–01	NA
Barium	3.9E+00	1.7E–02	NA	NA	0.0E+00	2.5E–02	7.5E–03	NA
Chromium	2.1E+00	NA	NA	NA	0.0E+00	6.3E–03	2.8E–01	NA
Copper	NA	1.1E–02	NA	NA	0.0E+00	6.0E–02	6.0E–01	NA
Iron	2.1E+02	2.0E+00	NA	NA	0.0E+00	NA	0.0E+00	NA
Lead	8.4E+02	4.0E–01	NA	NA	0.0E+00	5.6E–02	1.5E–02	NA
Vanadium	2.4E+00	3.3E–03	NA	NA	0.0E+00	NA	1.2E–01	NA

[a] Bioaccumulation data presented in: Appendix A, Table A–8 BAFs are multiplied by sediment concentrations and BCFs are multiplied by surface water concentrations The aquatic organism tissue level is equal to the greater of the two products. BCFs < 300 were not considered in the ERA.

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Table B.15–40
Estimated Chronic Exposure to Semi–Aquatic Receptors from Ingestion of Maximum Exposure Concentrations of ECPCs in Food, Surface Water, and Sediment
Site 15

Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

POTENTIAL DIETARY EXPOSURE (mg/kgBW–day) [b]

CHEMICAL	*Florida water rat*	*Raccoon*	*Great blue heron*
2–Butanone	2.9E–05	8.8E–08	2.2E–05
Anthracene	9.0E–04	2.7E–06	6.6E–04
Benzo (a) anthracene	1.0E–02	3.0E–05	7.3E–03
Benzo (a) pyrene	1.3E–02	3.9E–05	9.6E–03
Benzo (b) fluoranthene	1.6E–02	4.9E–05	1.2E–02
Benzo (g,h,i) perylene	5.7E–03	1.7E–05	4.2E–03
Benzo (k) fluoranthene	6.1E–03	1.8E–05	4.4E–03
Carbazole	9.5E–05	2.8E–07	7.0E–05
Chrysene	1.2E–02	3.6E–05	8.8E–03
Dibenz (a,h) anthracene	1.8E–03	5.4E–06	1.3E–03
Di–n–butylphthalate	5.1E–03	1.5E–05	3.7E–03
Fluoranthene	1.6E–02	4.9E–05	1.2E–02
Indeno (1,2,3–cd) pyrene	7.0E–03	2.1E–05	5.2E–03
Phenanthrene	5.1E–03	1.5E–05	3.7E–03
Pyrene	1.5E–02	4.4E–05	1.1E–02
3–Nitrotoluene	5.5E–04	5.5E–07	7.5E–05
4–Nitrotoluene	6.6E–02	1.9E–04	4.5E–02
TETRYL	2.1E–03	2.1E–06	2.8E–04
1,3,5–Trinitrobenzene	7.5E–04	7.5E–07	1.0E–04
4,4'–DDD	1.5E–03	1.5E–05	1.4E–02
4,4'–DDE	1.2E–03	1.1E–05	1.0E–02
4,4'–DDT	1.1E–03	1.1E–05	1.0E–02
Dieldrin	1.9E–04	1.9E–06	1.7E–03
Aluminum	5.5E+00	1.3E–02	3.2E+00
Arsenic	1.4E–03	1.4E–06	1.8E–04
Barium	1.5E–02	2.1E–05	4.9E–03
Chromium	4.4E–03	1.0E–05	2.5E–03
Copper	1.2E–03	1.2E–06	1.7E–04
Iron	5.6E–01	1.2E–03	2.8E–01
Lead	4.9E+00	4.1E–03	1.0E+00
Vanadium	4.3E–03	1.2E–05	2.9E–03

[b] Calculated by summing the products of individual prey type concentrations and percent in diet with surface water and sediment exposures, multiplying by the exposure duration, SFF and ingestion rate, and dividing by body weight (Table 7–8).

Table B.15-40
Exposure Parameters and Assumptions for Semi-Aquatic Receptors [a]
Site 15

Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

EXPOSURE PARAMETERS [a]

Indicator Species		Percent Prey in Diet					Home Range (acres)	ED [b]	Site Foraging Frequency [c]	Dietary Ingestion Rate (kg/day)	Water Ingestion Rate (L/day)	Body Weight (kg)
		Aquatic Organisms	Plants	Small Mammals	Small Birds	Sediment						
Florida water rat	(Small herb. mammal)	8%	90%	0%	0%	2%	0.42	1	1.00E+00	0.027	0.037	0.33
Raccoon	(Predatory mammal)	93%	0%	0%	0%	7%	385	1	1.30E-03	0.214	0.344	3.99
Great blue heron	(Predatory mammal)	98%	0%	0%	0%	2%	1.5	1	3.33E-01	0.401	0.101	2.23

NOTES
[a] Documentation of exposure parameters presented in Table 7-7
[b] ED = Exposure Duration (percentage of year receptor is expected to be found at study area)
[c] SFF = Site Foraging Frequency (calculated by dividing site area by receptor home range (cannot exceed 1.0))

SITE AREA: 0.5 acres

Table B.15–41
Estimated Chronic Exposure to Semi–Aquatic Receptors from Ingestion of Average Exposure Concentrations of ECPCs in Food, Surface Water, and Sediment
Site 15

Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

EXPOSURE CONCENTRATION DATA			ESTIMATED TISSUE LEVELS IN PRIMARY PREY ITEMS				
			Aquatic Organism				
CHEMICAL	AVERAGE SEDIMENT CONCENTRATION (mg/kg)	AVERAGE SURFACE WATER CONCENTRATION (mg/L)	Aquatic Organism BCF [a]	Aquatic Organism BAF [a]	Tissue Level (mg/kg)	Plant BAF [a]	Mammal BAF [a]	Bird BAF [a]
2–Butanone	1.1E–02	NA	NA	NA	0.0E+00	NA	NA	NA
Anthracene	2.6E–01	NA	NA	NA	0.0E+00	NA	3.0E–01	NA
Benzo (a) anthracene	1.1E+00	NA	NA	NA	0.0E+00	NA	3.0E–01	NA
Benzo (a) pyrene	1.4E+00	NA	NA	NA	0.0E+00	NA	3.0E–01	NA
Benzo (b) fluoranthene	1.8E+00	NA	NA	NA	0.0E+00	NA	3.0E–01	NA
Benzo (g,h,i) perylene	6.0E–01	NA	NA	NA	0.0E+00	NA	3.0E–01	NA
Benzo (k) fluoranthene	7.2E–01	NA	NA	NA	0.0E+00	NA	3.0E–01	NA
Carbazole	5.8E–02	NA	NA	NA	0.0E+00	NA	1.5E–01	NA
Chrysene	1.3E+00	NA	NA	NA	0.0E+00	NA	3.0E–01	NA
Dibenz (a,h) anthracene	3.0E–01	NA	NA	NA	0.0E+00	NA	3.0E–01	NA
Di–n–butylphthalate	1.9E+00	NA	NA	NA	0.0E+00	NA	1.5E–01	NA
Fluoranthene	1.8E+00	NA	NA	NA	0.0E+00	NA	3.0E–01	NA
Indeno (1,2,3–cd) pyrene	7.7E–01	NA	NA	NA	0.0E+00	NA	3.0E–01	NA
Phenanthrene	5.7E–01	NA	NA	NA	0.0E+00	NA	3.0E–01	NA
Pyrene	1.6E+00	NA	NA	NA	0.0E+00	NA	3.0E–01	NA
3–Nitrotoluene	NA	1.9E–03	NA	NA	0.0E+00	NA	1.5E–01	NA
4–Nitrotoluene	1.3E+01	1.6E–02	NA	NA	0.0E+00	NA	1.5E–01	NA
TETRYL	NA	1.2E–02	NA	NA	0.0E+00	NA	1.5E–01	NA
1,3,5–Trinitrobenzene	NA	2.4E–03	NA	NA	0.0E+00	NA	1.5E–01	NA
4,4'–DDD	5.6E–03	NA	3.4E+03	2.1E+01	1.2E–01	NA	1.2E+00	2.9E+00
4,4'–DDE	4.7E–03	NA	3.4E+03	2.1E+01	9.9E–02	NA	1.2E+00	2.9E+00
4,4'–DDT	4.5E–03	NA	3.4E+03	2.1E+01	9.4E–02	NA	1.2E+00	2.9E+00
Dieldrin	1.4E–03	NA	NA	2.1E+01	2.9E–02	NA	1.5E+00	4.4E–01
Aluminum	1.8E+03	5.6E–01	NA	NA	0.0E+00	6.0E–03	7.5E–02	NA
Arsenic	NA	7.1E–03	NA	NA	0.0E+00	NA	1.0E–01	NA
Barium	3.1E+00	1.3E–02	NA	NA	0.0E+00	2.5E–02	7.5E–03	NA
Chromium	1.4E+00	NA	NA	NA	0.0E+00	6.3E–03	2.8E–01	NA
Copper	NA	1.1E–02	NA	NA	0.0E+00	6.0E–02	6.0E–01	NA
Iron	1.3E+02	1.3E+00	NA	NA	0.0E+00	NA	0.0E+00	NA
Lead	2.5E+02	2.7E–01	NA	NA	0.0E+00	5.6E–02	1.5E–02	NA
Vanadium	1.8E+00	3.3E–03	NA	NA	0.0E+00	NA	1.2E–01	NA

[a] Bioaccumulation data presented in: Appendix A, Table A–8

BAFs are multiplied by sediment concentrations and BCFs are multiplied by surface water concentrations. The aquatic organism tissue level is equal to the greater of the two products. BCFs < 300 were not considered in the ERA.

Table B.15-41
Estimated Chronic Exposure to Semi-Aquatic Receptors from Ingestion of Average Exposure Concentrations of ECPCs in Food, Surface Water, and Sediment
Site 15

Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

POTENTIAL DIETARY EXPOSURE (mg/kgBW-day) [b]

CHEMICAL	*Florida water rat*	*Raccoon*	*Great blue heron*
2-Butanone	1.8E-05	5.4E-08	1.3E-05
Anthracene	4.3E-04	1.3E-06	3.1E-04
Benzo (a) anthracene	1.8E-03	5.4E-06	1.3E-03
Benzo (a) pyrene	2.3E-03	6.8E-06	1.7E-03
Benzo (b) fluoranthene	2.9E-03	8.8E-06	2.2E-03
Benzo (g,h,i) perylene	9.8E-04	2.9E-06	7.2E-04
Benzo (k) fluoranthene	1.2E-03	3.5E-06	8.6E-04
Carbazole	9.5E-05	2.8E-07	7.0E-05
Chrysene	2.1E-03	6.3E-06	1.6E-03
Dibenz (a,h) anthracene	4.9E-04	1.5E-06	3.6E-04
Di-n-butylphthalate	3.1E-03	9.3E-06	2.3E-03
Fluoranthene	2.9E-03	8.8E-06	2.2E-03
Indeno (1,2,3-cd) pyrene	1.3E-03	3.8E-06	9.2E-04
Phenanthrene	9.3E-04	2.8E-06	6.8E-04
Pyrene	2.6E-03	7.8E-06	1.9E-03
3-Nitrotoluene	2.1E-04	2.1E-07	2.9E-05
4-Nitrotoluene	2.3E-02	6.4E-05	1.5E-02
TETRYL	1.4E-03	1.4E-06	1.9E-04
1,3,5-Trinitrobenzene	2.7E-04	2.7E-07	3.6E-05
4,4'-DDD	7.8E-04	7.6E-06	6.9E-03
4,4'-DDE	6.5E-04	6.4E-06	5.8E-03
4,4'-DDT	6.3E-04	6.1E-06	5.6E-03
Dieldrin	1.9E-04	1.9E-06	1.7E-03
Aluminum	3.7E+00	8.6E-03	2.1E+00
Arsenic	8.0E-04	7.9E-07	1.1E-04
Barium	1.2E-02	1.7E-05	3.9E-03
Chromium	2.9E-03	6.8E-06	1.7E-03
Copper	1.2E-03	1.2E-06	1.7E-04
Iron	3.6E-01	7.9E-04	1.8E-01
Lead	1.5E+00	1.2E-03	3.0E-01
Vanadium	3.3E-03	9.1E-06	2.2E-03

[b] Calculated by summing the products of individual prey type concentrations and percent in diet with surface water and sediment exposures, multiplying by the exposure duration, SFF and ingestion rate, and dividing by body weight (Table 7-8)

Table B.15-41
Exposure Parameters and Assumptions for Semi-Aquatic Receptors [a]
Site 15

Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

EXPOSURE PARAMETERS [a]

Indicator Species		Percent Prey in Diet: Aquatic Organisms		Small Mammals	Small Birds	Sediment	Home Range (acres)	ED [b]	Site Foraging Frequency [c]	Dietary Ingestion Rate (kg/day)	Water Ingestion Rate (L/day)	Body Weight (kg)
Florida water rat	(Small herb mammal)	8%	90%	0%	0%	2%	0.42	1	1.00E+00	0.027	0.037	0.33
Raccoon	(Predatory mammal)	93%	0%	0%	0%	7%	385	1	1.30E-03	0.214	0.344	3.99
Great blue heron	(Predatory mammal)	98%	0%	0%	0%	2%	1.5	1	3.33E-01	0.401	0.101	2.23

NOTES
[a] Documentation of exposure parameters presented in. Table 7-7
[b] ED = Exposure Duration (percentage of year receptor is expected to be found at study area)
[c] SFF = Site Foraging Frequency (calculated by dividing site area by receptor home range (cannot exceed 1.0))

SITE AREA	0.5 acres

Table B.15-42
Risk from Potential Lethal Effects for Terrestrial Receptors from Maximum Exposure Concentrations of ECPCs in Food and Surface Soil
Site 15
Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

ANALYTE	Short-tailed shrew			Rufous-sided towhee			American woodcock		
	PDE	RTV	HQ	PDE	RTV	HQ	PDE	RTV	HQ
Acenaphthene	4.9E-02	1.2E+02	4.1E-04	3.2E-02	NA	NC	3.6E-02	NA	NC
Anthracene	2.2E-01	3.4E+03	6.4E-05	1.4E-01	NA	NC	1.6E-01	NA	NC
Benzo (a) anthracene	6.7E+00	1.2E+02	5.6E-02	4.3E+00	NA	NC	4.9E+00	NA	NC
Benzo (a) pyrene	6.7E+00	1.2E+02	5.6E-02	4.3E+00	NA	NC	4.9E+00	NA	NC
Benzo (b) fluoranthene	1.0E+01	1.2E+02	8.4E-02	6.4E+00	NA	NC	7.3E+00	NA	NC
Benzo (g,h,i) perylene	1.1E+00	1.2E+02	8.9E-03	6.8E-01	NA	NC	7.7E-01	NA	NC
Benzo (k) fluoranthene	2.6E+00	1.2E+02	2.1E-02	1.6E+00	NA	NC	1.9E+00	NA	NC
Butylbenzylphthalate	8.9E-03	4.7E+02	1.9E-05	6.9E-03	NA	NC	6.4E-03	NA	NC
Carbazole	1.4E-01	1.0E+02	1.4E-03	1.2E-01	NA	NC	9.7E-02	NA	NC
Chrysene	7.9E+00	1.2E+02	6.6E-02	5.1E+00	NA	NC	5.7E+00	NA	NC
Dibenz (a,h) anthracene	2.6E-01	1.2E+02	2.1E-03	1.6E-01	NA	NC	1.9E-01	NA	NC
Dibenzofuran	2.2E-02	1.3E+02	1.8E-04	1.7E-02	NA	NC	1.6E-02	NA	NC
Di-n-butylphthalate	1.1E-01	1.1E+00	1.0E-01	8.7E-02	NA	NC	8.0E-02	NA	NC
bis(2-Ethylhexyl) phthalate	1.0E-02	1.6E+02	6.6E-05	8.2E-03	NA	NC	7.6E-03	NA	NC
Fluoranthene	1.3E+01	4.0E+02	3.3E-02	8.3E+00	NA	NC	9.4E+00	NA	NC
Fluorene	2.6E-02	1.2E+02	2.1E-04	1.6E-02	NA	NC	1.9E-02	NA	NC
Indeno (1,2,3-cd) pyrene	2.0E+00	1.2E+02	1.7E-02	1.3E+00	NA	NC	1.5E+00	NA	NC
2-Methylnaphthalene	1.9E-02	3.3E+02	5.7E-05	1.2E-02	NA	NC	1.3E-02	NA	NC
Naphthalene	4.3E-02	1.1E+02	4.1E-04	2.8E-02	NA	NC	3.1E-02	NA	NC
Phenanthrene	5.1E+00	1.4E+02	3.7E-02	3.3E+00	NA	NC	3.7E+00	NA	NC
Pyrene	9.9E+00	1.6E+02	6.2E-02	6.3E+00	NA	NC	7.1E+00	NA	NC
HMX	1.2E-01	3.0E+02	4.1E-04	7.3E-01	NA	NC	7.7E-02	NA	NC
3-Nitrotoluene	3.0E-02	3.5E+01	8.6E-04	5.9E-02	NA	NC	2.1E-02	NA	NC
4-Nitrotoluene	3.5E-02	3.5E+01	1.0E-03	6.9E-02	NA	NC	2.4E-02	NA	NC
4,4'-DDE	2.6E-04	1.4E+02	1.8E-06	1.3E-04	1.2E+02	1.1E-06	1.9E-04	1.2E+02	1.6E-06
4,4'-DDT	8.5E-04	1.7E+01	4.9E-05	4.6E-04	1.2E+02	3.8E-06	6.2E-04	1.2E+02	5.2E-06
Dieldrin	2.3E-04	8.0E+00	2.9E-05	1.2E-04	6.0E-01	1.9E-04	1.7E-04	6.0E-01	2.8E-04
Endosulfan II	1.3E-03	5.0E+00	2.6E-04	6.7E-04	6.0E+00	1.1E-04	9.6E-04	6.0E+00	1.6E-04
Aluminum	4.7E+01	7.4E+02	6.4E-02	2.8E+01	NA	NC	3.5E+01	NA	NC
Antimony	3.9E+00	1.7E+04	2.3E-04	2.0E+00	NA	NC	2.8E+00	NA	NC
Arsenic	2.2E+00	2.9E+01	7.7E-02	1.9E+00	3.6E+00	5.2E-01	1.6E+00	3.6E+00	4.5E-01
Barium	1.8E+01	4.3E+02	4.2E-02	9.2E+00	NA	NC	1.3E+01	NA	NC

Table B.15–42
Risk from Potential Lethal Effects for Terrestrial Receptors from Maximum Exposure Concentrations of ECPCs in Food and Surface Soil
Site 15
Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

ANALYTE	*Short–tailed shrew*			*Rufous–sided towhee*			*American woodcock*		
	PDE	RTV	HQ	PDE	RTV	HQ	PDE	RTV	HQ
Cadmium	5.0E–01	3.0E+01	1.7E–02	2.2E+00	NA	NC	3.3E–01	NA	NC
Chromium	6.4E–02	4.0E+01	1.6E–03	3.6E–02	2.5E+01	1.4E–03	4.6E–02	2.5E+01	1.8E–03
Cobalt	2.0E–01	1.8E+01	1.1E–02	1.1E–01	NA	NC	1.5E–01	NA	NC
Copper	1.4E–01	1.9E+02	7.7E–04	3.5E–01	NA	NC	9.9E–02	NA	NC
Cyanide	8.4E–03	1.7E+00	4.9E–03	3.4E–02	1.1E+00	3.1E–02	5.5E–03	1.1E+00	5.0E–03
Lead	1.9E+02	6.0E+01	3.2E+00	1.0E+02	7.5E+01	1.4E+00	1.4E+02	7.5E+01	1.9E+00
Manganese	1.2E+00	4.5E+01	2.6E–02	6.4E–01	NA	NC	8.7E–01	NA	NC
Nickel	9.3E–01	1.3E+01	7.2E–02	4.7E–01	1.0E+02	4.7E–03	6.9E–01	1.0E+02	6.9E–03
Vanadium	1.4E+00	6.0E+00	2.4E–01	7.1E–01	1.9E+01	3.7E–02	1.0E+00	1.9E+01	5.4E–02
Zinc	3.6E–01	3.9E+02	9.3E–04	3.8E–01	NA	NC	2.6E–01	NA	NC
SUMMARY HAZARD INDEX			4.3E+00			2.0E+00			2.4E+00

PDE = Potential Dietary Exposure (mg/kgBW/day) RTV = Reference Toxicity Value (mg/kgBW/day) HQ = Hazard Quotient (calculated by dividing PDE by RTV)

Table B.15–42
Risk from Potential Lethal Effects for Terrestrial Receptors from Maximum Exposure Concentrations of ECPCs in Food and Surface Soil
Site 15
Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

ANALYTE	*Red fox*			*Great horned owl*		
	PDE	RTV	HQ	PDE	RTV	HQ
Acenaphthene	5.3E–04	1.2E+02	4 4E–06	5 4E–03	NA	NC
Anthracene	2.3E–03	3.4E+03	6 8E–07	2 4E–02	NA	NC
Benzo (a) anthracene	7.2E–02	1.2E+02	6.0E–04	7 4E–01	NA	NC
Benzo (a) pyrene	7.2E–02	1.2E+02	6.0E–04	7 4E–01	NA	NC
Benzo (b) fluoranthene	1.1E–01	1 2E+02	9.0E–04	1.1E+00	NA	NC
Benzo (g,h,i) perylene	1 1E–02	1 2E+02	9.5E–05	1.2E–01	NA	NC
Benzo (k) fluoranthene	2.7E–02	1 2E+02	2.3E–04	2.8E–01	NA	NC
Butylbenzylphthalate	8 0E–05	4.7E+02	1 7E–07	5.9E–04	NA	NC
Carbazole	1.2E–03	1.0E+02	1.2E–05	9 0E–03	NA	NC
Chrysene	8.4E–02	1.2E+02	7.0E–04	8.7E–01	NA	NC
Dibenz (a,h) anthracene	2.7E–03	1.2E+02	2.3E–05	2.8E–02	NA	NC
Dibenzofuran	2.0E–04	1.3E+02	1.6E–06	1 5E–03	NA	NC
Di–n–butylphthalate	1.0E–03	1.1E+00	9.0E–04	7.4E–03	NA	NC
bis(2–Ethylhexyl) phthalate	9 4E–05	1.6E+02	5.9E–07	7.0E–04	NA	NC
Fluoranthene	1 4E–01	4.0E+02	3.5E–04	1.4E+00	NA	NC
Fluorene	2.7E–04	1.2E+02	2 3E–06	2.8E–03	NA	NC
Indeno (1,2,3–cd) pyrene	2.1E–02	1.2E+02	1 8E–04	2.2E–01	NA	NC
2–Methylnaphthalene	2.0E–04	3.3E+02	6.1E–07	2.0E–03	NA	NC
Naphthalene	4.6E–04	1.1E+02	4.3E–06	4.8E–03	NA	NC
Phenanthrene	5.5E–02	1.4E+02	3.9E–04	5 6E–01	NA	NC
Pyrene	1.1E–01	1.6E+02	6.6E–04	1 1E+00	NA	NC
HMX	2.4E–03	3.0E+02	7.8E–06	5.8E–03	NA	NC
3–Nitrotoluene	3 4E–04	3 5E+01	9 7E–06	1.9E–03	NA	NC
4–Nitrotoluene	4.0E–04	3.5E+01	1.1E–05	2 2E–03	NA	NC
4,4'–DDE	6.8E–06	1 4E+02	4.9E–08	1.2E–04	1.2E+02	1.0E–06
4,4'–DDT	2.3E–05	1.2E+01	1 9E–06	4.1E–04	1 2E+02	3.4E–06
Dieldrin	6.1E–06	1.3E+01	4.7E–07	1.0E–04	6.0E–01	1.7E–04
Endosulfan II	8.0E–06	5.0E+00	1.6E–06	5.1E–06	6.0E+00	8.5E–07
Aluminum	3.5E–01	7.4E+02	4.8E–04	1.9E+00	NA	NC
Antimony	2.6E–02	1.7E+04	1.5E–06	6.2E–02	NA	NC
Arsenic	1 8E–02	2.9E+01	6.2E–04	7.4E–02	3.6E+00	2 0E–02
Barium	1.1E–01	4.3E+02	2.6E–04	5.3E–02	NA	NC
Cadmium	2.2E–02	3.0E+01	7.3E–04	3.2E–01	NA	NC

Table B.15–42
Risk from Potential Lethal Effects for Terrestrial Receptors from Maximum Exposure Concentrations of ECPCs in Food and Surface Soil
Site 15
Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

ANALYTE	*Red fox*			*Great horned owl*		
	PDE	RTV	HQ	PDE	RTV	HQ
Chromium	6.4E–04	4.0E+01	1.6E–05	6.0E–03	2.5E+01	2.4E–04
Cobalt	3.9E–03	1.8E+01	2.1E–04	5.8E–02	NA	NC
Copper	2.6E–03	1.9E+02	1.4E–05	2.6E–02	NA	NC
Cyanide	1.1E–04	1.7E+00	6.7E–05	1.3E–04	1.1E+00	1.2E–04
Lead	1.2E+00	6.0E+01	2.1E–02	2.9E+00	7.5E+01	3.9E–02
Manganese	7.5E–03	4.5E+01	1.7E–04	9.9E–03	NA	NC
Nickel	9.2E–03	1.3E+01	7.1E–04	8.0E–02	1.0E+02	8.0E–04
Vanadium	1.1E–02	6.0E+00	1.8E–03	5.1E–02	1.9E+01	2.7E–03
Zinc	1.3E–02	3.9E+02	3.2E–05	2.2E–01	NA	NC
SUMMARY HAZARD INDEX			3.1E–02			6.3E–02

PDE = Potential Dietary Exposure (mg/kgBW/day) RTV = Reference Toxicity Value (mg/kgBW/day) HQ = Hazard Quotient (calculated by dividing PDE by RTV)

Table B.15–42
Risk from Potential Sublethal Effects for Terrestrial Receptors from Maximum Exposure Concentrations of ECPCs in Food and Surface Soil
Site 15
Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

ANALYTE	*Short–tailed shrew*			*Rufous–sided towhee*			*American woodcock*		
	PDE	RTV	HQ	PDE	RTV	HQ	PDE	RTV	HQ
Acenaphthene	4.9E–02	1.0E+01	4.9E–03	3.2E–02	NA	NC	3.6E–02	NA	NC
Anthracene	2.2E–01	1.0E+01	2.2E–02	1.4E–01	NA	NC	1.6E–01	NA	NC
Benzo (a) anthracene	6.7E+00	1.0E+01	6.7E–01	4.3E+00	NA	NC	4.9E+00	NA	NC
Benzo (a) pyrene	6.7E+00	1.0E+01	6.7E–01	4.3E+00	NA	NC	4.9E+00	NA	NC
Benzo (b) fluoranthene	1.0E+01	1.0E+01	1.0E+00	6.4E+00	NA	NC	7.3E+00	NA	NC
Benzo (g,h,i) perylene	1.1E+00	1.0E+01	1.1E–01	6.8E–01	NA	NC	7.7E–01	NA	NC
Benzo (k) fluoranthene	2.6E+00	1.0E+01	2.6E–01	1.6E+00	NA	NC	1.9E+00	NA	NC
Butylbenzylphthalate	8.9E–03	4.9E+03	1.8E–06	6.9E–03	NA	NC	6.4E–03	NA	NC
Carbazole	1.4E–01	NA	NC	1.2E–01	NA	NC	9.7E–02	NA	NC
Chrysene	7.9E+00	1.0E+01	7.9E–01	5.1E+00	NA	NC	5.7E+00	NA	NC
Dibenz (a,h) anthracene	2.6E–01	1.0E+01	2.6E–02	1.6E–01	NA	NC	1.9E–01	NA	NC
Dibenzofuran	2.2E–02	NA	NC	1.7E–02	NA	NC	1.6E–02	NA	NC
Di–n–butylphthalate	1.1E–01	1.3E+02	8.9E–04	8.7E–02	NA	NC	8.0E–02	NA	NC
bis(2–Ethylhexyl) phthalate	1.0E–02	3.5E+01	3.0E–04	8.2E–03	NA	NC	7.6E–03	NA	NC
Fluoranthene	1.3E+01	1.0E+01	1.3E+00	8.3E+00	NA	NC	9.4E+00	NA	NC
Fluorene	2.6E–02	1.0E+01	2.6E–03	1.6E–02	NA	NC	1.9E–02	NA	NC
Indeno (1,2,3–cd) pyrene	2.0E+00	1.0E+01	2.0E–01	1.3E+00	NA	NC	1.5E+00	NA	NC
2–Methylnaphthalene	1.9E–02	1.0E+01	1.9E–03	1.2E–02	NA	NC	1.3E–02	NA	NC
Naphthalene	4.3E–02	3.6E+01	1.2E–03	2.8E–02	NA	NC	3.1E–02	NA	NC
Phenanthrene	5.1E+00	1.0E+01	5.1E–01	3.3E+00	NA	NC	3.7E+00	NA	NC
Pyrene	9.9E+00	1.0E+01	9.9E–01	6.3E+00	NA	NC	7.1E+00	NA	NC
HMX	1.2E–01	9.0E+01	1.4E–03	7.3E–01	NA	NC	7.7E–02	NA	NC
3–Nitrotoluene	3.0E–02	3.4E+01	8.8E–04	5.9E–02	NA	NC	2.1E–02	NA	NC
4–Nitrotoluene	3.5E–02	3.4E+01	1.0E–03	6.9E–02	NA	NC	2.4E–02	NA	NC
4,4'–DDE	2.6E–04	2.0E–01	1.3E–03	1.3E–04	3.9E–01	3.4E–04	1.9E–04	3.9E–01	4.8E–04
4,4'–DDT	8.5E–04	2.0E–01	4.2E–03	4.6E–04	1.4E–01	3.3E–03	6.2E–04	1.4E–01	4.4E–03
Dieldrin	2.3E–04	6.5E–01	3.5E–04	1.2E–04	NA	NC	1.7E–04	NA	NC
Endosulfan II	1.3E–03	2.6E–01	5.0E–03	6.7E–04	NA	NC	9.6E–04	NA	NC
Aluminum	4.7E+01	4.3E+02	1.1E–01	2.8E+01	NA	NC	3.5E+01	NA	NC
Antimony	3.9E+00	NA	NC	2.1E+00	NA	NC	2.9E+00	NA	NC
Arsenic	2.2E+00	5.8E–01	3.8E+00	1.9E+00	1.0E+00	1.9E+00	1.6E+00	1.0E+00	1.6E+00
Barium	1.8E+01	2.0E+02	9.2E–02	9.2E+00	NA	NC	1.3E+01	NA	NC

Table B.15–42
Risk from Potential Sublethal Effects for Terrestrial Receptors from Maximum Exposure Concentrations of ECPCs in Food and Surface Soil
Site 15
Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

ANALYTE	*Short–tailed shrew*			*Rufous–sided towhee*			*American woodcock*		
	PDE	RTV	HQ	PDE	RTV	HQ	PDE	RTV	HQ
Cadmium	5.0E–01	2.2E+01	2.3E–02	2.2E+00	1.0E+01	2.2E–01	3.3E–01	1.0E+01	3.3E–02
Chromium	6.4E–02	1.4E+03	4.5E–05	3.6E–02	2.0E+02	1.8E–04	4.6E–02	2.0E+02	2.3E–04
Cobalt	2.0E–01	4.2E+00	4.8E–02	1.1E–01	NA	NC	1.5E–01	NA	NC
Copper	1.4E–01	1.0E+02	1.4E–03	3.5E–01	NA	NC	9.9E–02	NA	NC
Cyanide	8.4E–03	1.2E+01	7.0E–04	3.4E–02	1.1E+01	3.1E–03	5.5E–03	1.1E+01	5.0E–04
Lead	1.9E+02	2.5E+00	7.7E+01	1.0E+02	1.3E+02	8.4E–01	1.4E+02	1.3E+02	1.1E+00
Manganese	1.2E+00	1.0E+02	1.2E–02	6.6E–01	NA	NC	9.0E–01	NA	NC
Nickel	9.3E–01	5.0E+01	1.9E–02	4.7E–01	NA	NC	6.8E–01	NA	NC
Vanadium	1.4E+00	8.4E+00	1.7E–01	7.1E–01	1.1E+01	6.4E–02	1.0E+00	1.1E+01	9.5E–02
Zinc	3.6E–01	2.0E+02	1.8E–03	3.8E–01	NA	NC	2.6E–01	NA	NC
SUMMARY HAZARD INDEX			8.8E+01			3.0E+00			2.9E+00

PDE = Potential Dietary Exposure (mg/kgBW/day) RTV = Reference Toxicity Value (mg/kgBW/day) HQ = Hazard Quotient (calculated by dividing PDE by RTV)

Table B.15–42
Risk from Potential Sublethal Effects for Terrestrial Receptors from Maximum Exposure Concentrations of ECPCs in Food and Surface Soil
Site 15
Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

ANALYTE	*Red fox*			*Great horned owl*		
	PDE	RTV	HQ	PDE	RTV	HQ
Acenaphthene	5.3E–04	1.0E+01	5.3E–05	5.4E–03	NA	NC
Anthracene	2.3E–03	1.0E+01	2.3E–04	2.4E–02	NA	NC
Benzo (a) anthracene	7.2E–02	1.0E+01	7.2E–03	7.4E–01	NA	NC
Benzo (a) pyrene	7.2E–02	1.0E+01	7.2E–03	7.4E–01	NA	NC
Benzo (b) fluoranthene	1.1E–01	1.0E+01	1.1E–02	1.1E+00	NA	NC
Benzo (g,h,i) perylene	1.1E–02	1.0E+01	1.1E–03	1.2E–01	NA	NC
Benzo (k) fluoranthene	2.7E–02	1.0E+01	2.7E–03	2.8E–01	NA	NC
Butylbenzylphthalate	8.0E–05	4.9E+03	1.6E–08	5.9E–04	NA	NC
Carbazole	1.2E–03	NA	NC	9.0E–03	NA	NC
Chrysene	8.4E–02	1.0E+01	8.4E–03	8.7E–01	NA	NC
Dibenz (a,h) anthracene	2.7E–03	1.0E+01	2.7E–04	2.8E–02	NA	NC
Dibenzofuran	2.0E–04	NA	NC	1.5E–03	NA	NC
Di–n–butylphthalate	1.0E–03	1.3E+02	8.0E–06	7.4E–03	NA	NC
bis(2–Ethylhexyl) phthalate	9.4E–05	3.5E+01	2.7E–06	7.0E–04	NA	NC
Fluoranthene	1.4E–01	1.0E+01	1.4E–02	1.4E+00	NA	NC
Fluorene	2.7E–04	1.0E+01	2.7E–05	2.8E–03	NA	NC
Indeno (1,2,3–cd) pyrene	2.1E–02	1.0E+01	2.1E–03	2.2E–01	NA	NC
2–Methylnaphthalene	2.0E–04	1.0E+01	2.0E–05	2.0E–03	NA	NC
Naphthalene	4.6E–04	3.6E+01	1.3E–05	4.8E–03	NA	NC
Phenanthrene	5.5E–02	1.0E+01	5.5E–03	5.6E–01	NA	NC
Pyrene	1.1E–01	1.0E+01	1.1E–02	1.1E+00	NA	NC
HMX	2.4E–03	9.0E+01	2.6E–05	5.8E–03	NA	NC
3–Nitrotoluene	3.4E–04	2.0E+01	1.7E–05	1.9E–03	NA	NC
4–Nitrotoluene	4.0E–04	2.0E+01	2.0E–05	2.2E–03	NA	NC
4,4'–DDE	6.8E–06	3.5E+03	1.9E–09	1.2E–04	3.9E–01	3.1E–04
4,4'–DDT	2.3E–05	3.5E+03	6.4E–09	4.1E–04	1.4E–01	2.9E–03
Dieldrin	6.1E–06	5.0E–02	1.2E–04	1.0E–04	NA	NC
Endosulfan II	8.0E–06	2.6E–01	3.1E–05	5.1E–06	NA	NC
Aluminum	3.5E–01	4.3E+02	8.4E–04	1.9E+00	NA	NC
Antimony	2.6E–02	NA	NC	6.3E–02	NA	NC
Arsenic	1.8E–02	5.8E–01	3.1E–02	7.4E–02	1.0E+00	7.4E–02
Barium	1.1E–01	2.0E+02	5.6E–04	5.3E–02	NA	NC
Cadmium	2.2E–02	2.2E+01	1.0E–03	3.3E–01	1.0E+01	3.3E–02

Table B.15–42
Risk from Potential Sublethal Effects for Terrestrial Receptors from Maximum Exposure Concentrations of ECPCs in Food and Surface Soil
Site 15
Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

ANALYTE	*Red fox*			*Great horned owl*		
	PDE	RTV	HQ	PDE	RTV	HQ
Chromium	6.4E–04	1.4E+03	4.6E–07	6.0E–03	2.0E+02	3.0E–05
Cobalt	3.9E–03	4.2E+00	9.3E–04	5.8E–02	NA	NC
Copper	2.6E–03	1.0E+02	2.6E–05	2.6E–02	NA	NC
Cyanide	1.1E–04	1.2E+01	9.6E–06	1.3E–04	1.1E+01	1.2E–05
Lead	1.2E+00	2.5E+00	5.0E–01	2.9E+00	1.3E+02	2.3E–02
Manganese	7.7E–03	1.0E+02	7.7E–05	1.0E–02	NA	NC
Nickel	9.2E–03	5.0E+01	1.8E–04	7.9E–02	NA	NC
Vanadium	1.1E–02	8.4E+00	1.3E–03	5.1E–02	1.1E+01	4.6E–03
Zinc	1.3E–02	2.0E+02	6.3E–05	2.2E–01	NA	NC
SUMMARY HAZARD INDEX			6.0E–01			1.4E–01

PDE = Potential Dietary Exposure (mg/kgBW/day) RTV = Reference Toxicity Value (mg/kgBW/day) HQ = Hazard Quotient (calculated by dividing PDE by RTV)

Table B.15-43
Risk from Potential Lethal Effects for Terrestrial Receptors from Average Exposure Concentrations of ECPCs in Food and Surface Soil
Site 15
Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

ANALYTE	Short-tailed shrew			Rufous-sided towhee			American woodcock		
	PDE	RTV	HQ	PDE	RTV	HQ	PDE	RTV	HQ
Acenaphthene	3.6E-02	1.2E+02	3.0E-04	2.3E-02	NA	NC	2.6E-02	NA	NC
Anthracene	1.1E-01	3.4E+03	3.2E-05	6.9E-02	NA	NC	7.9E-02	NA	NC
Benzo (a) anthracene	6.7E-01	1.2E+02	5.6E-03	4.3E-01	NA	NC	4.9E-01	NA	NC
Benzo (a) pyrene	6.5E-01	1.2E+02	5.4E-03	4.2E-01	NA	NC	4.7E-01	NA	NC
Benzo (b) fluoranthene	9.5E-01	1.2E+02	7.9E-03	6.1E-01	NA	NC	6.9E-01	NA	NC
Benzo (g,h,i) perylene	2.8E-01	1.2E+02	2.3E-03	1.8E-01	NA	NC	2.0E-01	NA	NC
Benzo (k) fluoranthene	3.4E-01	1.2E+02	2.8E-03	2.1E-01	NA	NC	2.4E-01	NA	NC
Butylbenzylphthalate	8.9E-03	4.7E+02	1.9E-05	6.9E-03	NA	NC	6.4E-03	NA	NC
Carbazole	7.2E-02	1.0E+02	7.2E-04	6.3E-02	NA	NC	5.2E-02	NA	NC
Chrysene	7.9E-01	1.2E+02	6.6E-03	5.1E-01	NA	NC	5.7E-01	NA	NC
Dibenz (a,h) anthracene	1.1E-01	1.2E+02	9.2E-04	7.1E-02	NA	NC	8.0E-02	NA	NC
Dibenzofuran	1.8E-02	1.3E+02	1.5E-04	1.4E-02	NA	NC	1.3E-02	NA	NC
Di-n-butylphthalate	4.6E-02	1.1E+00	4.2E-02	3.6E-02	NA	NC	3.3E-02	NA	NC
bis(2-Ethylhexyl) phthalate	1.0E-02	1.6E+02	6.6E-05	8.2E-03	NA	NC	7.6E-03	NA	NC
Fluoranthene	1.2E+00	4.0E+02	3.1E-03	7.8E-01	NA	NC	8.9E-01	NA	NC
Fluorene	2.0E-02	1.2E+02	1.6E-04	1.3E-02	NA	NC	1.4E-02	NA	NC
Indeno (1,2,3-cd) pyrene	3.2E-01	1.2E+02	2.6E-03	2.0E-01	NA	NC	2.3E-01	NA	NC
2-Methylnaphthalene	1.3E-02	3.3E+02	3.9E-05	8.1E-03	NA	NC	9.1E-03	NA	NC
Naphthalene	3.0E-02	1.1E+02	2.8E-04	1.9E-02	NA	NC	2.1E-02	NA	NC
Phenanthrene	5.3E-01	1.4E+02	3.8E-03	3.4E-01	NA	NC	3.9E-01	NA	NC
Pyrene	9.3E-01	1.6E+02	5.8E-03	5.9E-01	NA	NC	6.7E-01	NA	NC
HMX	9.1E-02	3.0E+02	3.0E-04	5.3E-01	NA	NC	5.7E-02	NA	NC
3-Nitrotoluene	2.2E-02	3.5E+01	6.2E-04	4.3E-02	NA	NC	1.5E-02	NA	NC
4-Nitrotoluene	2.3E-02	3.5E+01	6.6E-04	4.6E-02	NA	NC	1.6E-02	NA	NC
4,4'-DDE	2.6E-04	1.4E+02	1.8E-06	1.3E-04	1.2E+02	1.1E-06	1.9E-04	1.2E+02	1.6E-06
4,4'-DDT	8.5E-04	1.7E+01	4.9E-05	4.6E-04	1.2E+02	3.8E-06	6.2E-04	1.2E+02	5.2E-06
Dieldrin	2.3E-04	8.0E+00	2.9E-05	1.2E-04	6.0E-01	1.9E-04	1.7E-04	6.0E-01	2.8E-04
Endosulfan II	1.3E-03	5.0E+00	2.6E-04	6.7E-04	6.0E+00	1.1E-04	9.6E-04	6.0E+00	1.6E-04
Aluminum	2.8E+01	7.4E+02	3.7E-02	1.6E+01	NA	NC	2.0E+01	NA	NC
Antimony	3.9E+00	1.7E+04	2.3E-04	2.0E+00	NA	NC	2.8E+00	NA	NC
Arsenic	1.9E+00	2.9E+01	6.6E-02	1.6E+00	3.6E+00	4.5E-01	1.4E+00	3.6E+00	3.9E-01
Barium	9.5E+00	4.3E+02	2.2E-02	4.8E+00	NA	NC	7.0E+00	NA	NC

Table B.15–43
Risk from Potential Lethal Effects for Terrestrial Receptors from Average Exposure Concentrations of ECPCs in Food and Surface Soil
Site 15
Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

ANALYTE	*Short–tailed shrew*			*Rufous–sided towhee*			*American woodcock*		
	PDE	RTV	HQ	PDE	RTV	HQ	PDE	RTV	HQ
Cadmium	4.7E–01	3.0E+01	1.6E–02	2.1E+00	NA	NC	3.1E–01	NA	NC
Chromium	6.4E–02	4.0E+01	1.6E–03	3.6E–02	2.5E+01	1.4E–03	4.6E–02	2.5E+01	1.8E–03
Cobalt	2.0E–01	1.8E+01	1.1E–02	1.1E–01	NA	NC	1.5E–01	NA	NC
Copper	1.3E–01	1.9E+02	7.2E–04	3.3E–01	NA	NC	9.3E–02	NA	NC
Cyanide	7.8E–03	1.7E+00	4.6E–03	3.2E–02	1.1E+00	2.9E–02	5.1E–03	1.1E+00	4.6E–03
Lead	3.3E+01	6.0E+01	5.6E–01	1.8E+01	7.5E+01	2.4E–01	2.4E+01	7.5E+01	3.3E–01
Manganese	8.9E–01	4.5E+01	2.0E–02	4.8E–01	NA	NC	6.6E–01	NA	NC
Nickel	9.3E–01	1.3E+01	7.2E–02	4.7E–01	1.0E+02	4.7E–03	6.9E–01	1.0E+02	6.9E–03
Vanadium	1.1E+00	6.0E+00	1.8E–01	5.4E–01	1.9E+01	2.8E–02	7.9E–01	1.9E+01	4.1E–02
Zinc	3.6E–01	3.9E+02	9.3E–04	3.8E–01	NA	NC	2.6E–01	NA	NC
SUMMARY HAZARD INDEX			1.1E+00			7.6E–01			7.7E–01

PDE = Potential Dietary Exposure (mg/kgBW/day) RTV = Reference Toxicity Value (mg/kgBW/day) HQ = Hazard Quotient (calculated by dividing PDE by RTV)

Table B.15–43
Risk from Potential Sublethal Effects for Terrestrial Receptors from Average Exposure Concentrations of ECPCs in Food and Surface Soil
Site 15
Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

ANALYTE	Short–tailed shrew			Rufous–sided towhee			American woodcock		
	PDE	RTV	HQ	PDE	RTV	HQ	PDE	RTV	HQ
Acenaphthene	3.6E–02	1.0E+01	3.6E–03	2.3E–02	NA	NC	2.6E–02	NA	NC
Anthracene	1.1E–01	1.0E+01	1.1E–02	6.9E–02	NA	NC	7.9E–02	NA	NC
Benzo (a) anthracene	6.7E–01	1.0E+01	6.7E–02	4.3E–01	NA	NC	4.9E–01	NA	NC
Benzo (a) pyrene	6.5E–01	1.0E+01	6.5E–02	4.2E–01	NA	NC	4.7E–01	NA	NC
Benzo (b) fluoranthene	9.5E–01	1.0E+01	9.5E–02	6.1E–01	NA	NC	6.9E–01	NA	NC
Benzo (g,h,i) perylene	2.8E–01	1.0E+01	2.8E–02	1.8E–01	NA	NC	2.0E–01	NA	NC
Benzo (k) fluoranthene	3.4E–01	1.0E+01	3.4E–02	2.1E–01	NA	NC	2.4E–01	NA	NC
Butylbenzylphthalate	8.9E–03	4.9E+03	1.8E–06	6.9E–03	NA	NC	6.4E–03	NA	NC
Carbazole	7.2E–02	NA	NC	6.3E–02	NA	NC	5.2E–02	NA	NC
Chrysene	7.9E–01	1.0E+01	7.9E–02	5.1E–01	NA	NC	5.7E–01	NA	NC
Dibenz (a,h) anthracene	1.1E–01	1.0E+01	1.1E–02	7.1E–02	NA	NC	8.0E–02	NA	NC
Dibenzofuran	1.8E–02	NA	NC	1.4E–02	NA	NC	1.3E–02	NA	NC
Di–n–butylphthalate	4.6E–02	1.3E+02	3.7E–04	3.6E–02	NA	NC	3.3E–02	NA	NC
bis(2–Ethylhexyl) phthalate	1.0E–02	3.5E+01	3.0E–04	8.2E–03	NA	NC	7.6E–03	NA	NC
Fluoranthene	1.2E+00	1.0E+01	1.2E–01	7.8E–01	NA	NC	8.9E–01	NA	NC
Fluorene	2.0E–02	1.0E+01	2.0E–03	1.3E–02	NA	NC	1.4E–02	NA	NC
Indeno (1,2,3–cd) pyrene	3.2E–01	1.0E+01	3.2E–02	2.0E–01	NA	NC	2.3E–01	NA	NC
2–Methylnaphthalene	1.3E–02	1.0E+01	1.3E–03	8.1E–03	NA	NC	9.1E–03	NA	NC
Naphthalene	3.0E–02	3.6E+01	8.3E–04	1.9E–02	NA	NC	2.1E–02	NA	NC
Phenanthrene	5.3E–01	1.0E+01	5.3E–02	3.4E–01	NA	NC	3.9E–01	NA	NC
Pyrene	9.3E–01	1.0E+01	9.3E–02	5.9E–01	NA	NC	6.7E–01	NA	NC
HMX	9.1E–02	9.0E+01	1.0E–03	5.3E–01	NA	NC	5.7E–02	NA	NC
3–Nitrotoluene	2.2E–02	3.4E+01	6.4E–04	4.3E–02	NA	NC	1.5E–02	NA	NC
4–Nitrotoluene	2.3E–02	3.4E+01	6.8E–04	4.6E–02	NA	NC	1.6E–02	NA	NC
4,4'–DDE	2.6E–04	2.0E–01	1.3E–03	1.3E–04	3.9E–01	3.4E–04	1.9E–04	3.9E–01	4.8E–04
4,4'–DDT	8.5E–04	2.0E–01	4.2E–03	4.6E–04	1.4E–01	3.3E–03	6.2E–04	1.4E–01	4.4E–03
Dieldrin	2.3E–04	6.5E–01	3.5E–04	1.2E–04	NA	NC	1.7E–04	NA	NC
Endosulfan II	1.3E–03	2.6E–01	5.0E–03	6.7E–04	NA	NC	9.6E–04	NA	NC
Aluminum	2.8E+01	4.3E+02	6.5E–02	1.6E+01	NA	NC	2.0E+01	NA	NC
Antimony	3.9E+00	NA	NC	2.1E+00	NA	NC	2.9E+00	NA	NC
Arsenic	1.9E+00	5.8E–01	3.3E+00	1.6E+00	1.0E+00	1.6E+00	1.4E+00	1.0E+00	1.4E+00
Barium	9.6E+00	2.0E+02	4.8E–02	4.8E+00	NA	NC	7.0E+00	NA	NC

Table B.15-43
Risk from Potential Sublethal Effects for Terrestrial Receptors from Average Exposure Concentrations of ECPCs in Food and Surface Soil
Site 15
Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

ANALYTE	*Short-tailed shrew*			*Rufous-sided towhee*			*American woodcock*		
	PDE	RTV	HQ	PDE	RTV	HQ	PDE	RTV	HQ
Cadmium	4.8E-01	2.2E+01	2.2E-02	2.1E+00	1.0E+01	2.1E-01	3.1E-01	1.0E+01	3.1E-02
Chromium	6.4E-02	1.4E+03	4.5E-05	3.6E-02	2.0E+02	1.8E-04	4.6E-02	2.0E+02	2.3E-04
Cobalt	2.0E-01	4.2E+00	4.8E-02	1.1E-01	NA	NC	1.5E-01	NA	NC
Copper	1.3E-01	1.0E+02	1.3E-03	3.3E-01	NA	NC	9.3E-02	NA	NC
Cyanide	7.8E-03	1.2E+01	6.5E-04	3.2E-02	1.1E+01	2.9E-03	5.1E-03	1.1E+01	4.6E-04
Lead	3.4E+01	2.5E+00	1.4E+01	1.8E+01	1.3E+02	1.5E-01	2.5E+01	1.3E+02	2.0E-01
Manganese	9.2E-01	1.0E+02	9.2E-03	4.9E-01	NA	NC	6.7E-01	NA	NC
Nickel	9.3E-01	5.0E+01	1.9E-02	4.7E-01	NA	NC	6.8E-01	NA	NC
Vanadium	1.1E+00	8.4E+00	1.3E-01	5.4E-01	1.1E+01	4.9E-02	7.9E-01	1.1E+01	7.2E-02
Zinc	3.6E-01	2.0E+02	1.8E-03	3.8E-01	NA	NC	2.6E-01	NA	NC
SUMMARY HAZARD INDEX			1.8E+01			2.1E+00			1.7E+00

PDE = Potential Dietary Exposure (mg/kgBW/day) RTV = Reference Toxicity Value (mg/kgBW/day) HQ = Hazard Quotient (calculated by dividing PDE by RTV)

Table B.15–44
Risk from Lethal Effects for Semi–Aquatic Receptors from Maximum Exposure Concentrations of ECPCs in Food, Surface Water, and Sediment
Site 15

Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

CHEMICAL	*Florida water rat*			*Raccoon*			*Great blue heron*		
	PDE	RTV	HQ	PDE	RTV	HQ	PDE	RTV	HQ
2–Butanone	2.9E–05	5.5E+02	5.4E–08	8.8E–08	5.5E+02	1.6E–10	2.2E–05	NA	NC
Anthracene	9.0E–04	3.4E+03	2.6E–07	2.7E–06	3.4E+03	7.9E–10	6.6E–04	NA	NC
Benzo (a) anthracene	1.0E–02	1.2E+02	8.3E–05	3.0E–05	1.2E+02	2.5E–07	7.3E–03	NA	NC
Benzo (a) pyrene	1.3E–02	1.2E+02	1.1E–04	3.9E–05	1.2E+02	3.3E–07	9.6E–03	NA	NC
Benzo (b) fluoranthene	1.6E–02	1.2E+02	1.4E–04	4.9E–05	1.2E+02	4.1E–07	1.2E–02	NA	NC
Benzo (g,h,i) perylene	5.7E–03	1.2E+02	4.8E–05	1.7E–05	1.2E+02	1.4E–07	4.2E–03	NA	NC
Benzo (k) fluoranthene	6.1E–03	1.2E+02	5.0E–05	1.8E–05	1.2E+02	1.5E–07	4.4E–03	NA	NC
Carbazole	9.5E–05	1.0E+02	9.5E–07	2.8E–07	1.0E+02	2.8E–09	7.0E–05	NA	NC
Chrysene	1.2E–02	1.2E+02	1.0E–04	3.6E–05	1.2E+02	3.0E–07	8.8E–03	NA	NC
Dibenz (a,h) anthracene	1.8E–03	1.2E+02	1.5E–05	5.4E–06	1.2E+02	4.5E–08	1.3E–03	NA	NC
Di–n–butylphthalate	5.1E–03	1.1E+00	4.6E–03	1.5E–05	1.1E+00	1.4E–05	3.7E–03	NA	NC
Fluoranthene	1.6E–02	4.0E+02	4.1E–05	4.9E–05	4.0E+02	1.2E–07	1.2E–02	NA	NC
Indeno (1,2,3–cd) pyrene	7.0E–03	1.2E+02	5.9E–05	2.1E–05	1.2E+02	1.7E–07	5.2E–03	NA	NC
Phenanthrene	5.1E–03	1.4E+02	3.6E–05	1.5E–05	1.4E+02	1.1E–07	3.7E–03	NA	NC
Pyrene	1.5E–02	1.6E+02	9.3E–05	4.4E–05	1.6E+02	2.8E–07	1.1E–02	NA	NC
3–Nitrotoluene	5.5E–04	3.5E+01	1.6E–05	5.5E–07	3.5E+01	1.6E–08	7.5E–05	NA	NC
4–Nitrotoluene	6.6E–02	3.5E+01	1.9E–03	1.9E–04	3.5E+01	5.3E–06	4.5E–02	NA	NC
TETRYL	2.1E–03	9.0E+01	2.3E–05	2.1E–06	9.0E+01	2.3E–08	2.8E–04	8.0E+00	3.5E–05
1,3,5–Trinitrobenzene	7.5E–04	9.0E+01	8.4E–06	7.5E–07	9.0E+01	8.4E–09	1.0E–04	8.0E+00	1.3E–05
4,4'–DDD	1.5E–03	1.7E+01	8.8E–05	1.5E–05	1.2E+01	1.3E–06	1.4E–02	1.2E+02	1.1E–04
4,4'–DDE	1.2E–03	1.4E+02	8.2E–06	1.1E–05	1.4E+02	8.1E–08	1.0E–02	1.2E+02	8.6E–05
4,4'–DDT	1.1E–03	1.7E+01	6.5E–05	1.1E–05	1.2E+01	9.2E–07	1.0E–02	1.2E+02	8.4E–05
Dieldrin	1.9E–04	8.0E+00	2.4E–05	1.9E–06	1.3E+01	1.5E–07	1.7E–03	6.0E–01	2.9E–03
Aluminum	5.5E+00	7.4E+02	7.5E–03	1.3E–02	7.4E+02	1.7E–05	3.2E+00	NA	NC
Arsenic	1.4E–03	2.9E+01	4.7E–05	1.4E–06	2.9E+01	4.7E–08	1.8E–04	3.6E+00	5.1E–05
Barium	1.5E–02	4.3E+02	3.6E–05	2.1E–05	4.3E+02	4.9E–08	4.9E–03	NA	NC
Chromium	4.4E–03	4.0E+01	1.1E–04	1.0E–05	4.0E+01	2.6E–07	2.5E–03	2.5E+01	1.0E–04
Copper	1.2E–03	1.9E+02	6.6E–06	1.2E–06	1.9E+02	6.6E–09	1.7E–04	NA	NC
Iron	5.6E–01	NA	NC	1.2E–03	NA	NC	2.8E–01	NA	NC
Lead	4.9E+00	6.0E+01	8.1E–02	4.1E–03	6.0E+01	6.9E–05	1.0E+00	7.5E+01	1.4E–02
Vanadium	4.3E–03	6.0E+00	7.2E–04	1.2E–05	6.0E+00	2.0E–06	2.9E–03	1.9E+01	1.5E–04
SUMMARY HAZARD INDEX			9.7E–02			1.1E–04			1.7E–02

PDE = Potential Dietary Exposure (mg/kgBW–day). RTV = Reference Toxicity Value (mg/kgBW–day) HQ = Hazard Quotient (calculated by dividing PDE by RTV)

AL15MAX wk1

07–Oct–97

Table B.15–44
Risk from Sublethal Effects for Semi–Aquatic Receptors from Maximum Exposure Concentrations of ECPCs in Food, Surface Water, and Sediment
Site 15

Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

CHEMICAL	*Florida water rat*			*Raccoon*			*Great blue heron*		
	PDE	RTV	HQ	PDE	RTV	HQ	PDE	RTV	HQ
2–Butanone	2.9E–05	1.7E+02	1.7E–07	8.8E–08	1.7E+02	5.1E–10	2.2E–05	NA	NC
Anthracene	9.0E–04	1.0E+01	9.0E–05	2.7E–06	1.0E+01	2.7E–07	6.6E–04	NA	NC
Benzo (a) anthracene	1.0E–02	1.0E+01	1.0E–03	3.0E–05	1.0E+01	3.0E–06	7.3E–03	NA	NC
Benzo (a) pyrene	1.3E–02	1.0E+01	1.3E–03	3.9E–05	1.0E+01	3.9E–06	9.6E–03	NA	NC
Benzo (b) fluoranthene	1.6E–02	1.0E+01	1.6E–03	4.9E–05	1.0E+01	4.9E–06	1.2E–02	NA	NC
Benzo (g,h,i) perylene	5.7E–03	1.0E+01	5.7E–04	1.7E–05	1.0E+01	1.7E–06	4.2E–03	NA	NC
Benzo (k) fluoranthene	6.1E–03	1.0E+01	6.1E–04	1.8E–05	1.0E+01	1.8E–06	4.4E–03	NA	NC
Carbazole	9.5E–05	NA	NC	2.8E–07	NA	NC	7.0E–05	NA	NC
Chrysene	1.2E–02	1.0E+01	1.2E–03	3.6E–05	1.0E+01	3.6E–06	8.8E–03	NA	NC
Dibenz (a,h) anthracene	1.8E–03	1.0E+01	1.8E–04	5.4E–06	1.0E+01	5.4E–07	1.3E–03	NA	NC
Di–n–butylphthalate	5.1E–03	1.3E+02	4.1E–05	1.5E–05	1.3E+02	1.2E–07	3.7E–03	NA	NC
Fluoranthene	1.6E–02	1.0E+01	1.6E–03	4.9E–05	1.0E+01	4.9E–06	1.2E–02	NA	NC
Indeno (1,2,3–cd) pyrene	7.0E–03	1.0E+01	7.0E–04	2.1E–05	1.0E+01	2.1E–06	5.2E–03	NA	NC
Phenanthrene	5.1E–03	1.0E+01	5.1E–04	1.5E–05	1.0E+01	1.5E–06	3.7E–03	NA	NC
Pyrene	1.5E–02	1.0E+01	1.5E–03	4.4E–05	1.0E+01	4.4E–06	1.1E–02	NA	NC
3–Nitrotoluene	5.5E–04	3.4E+01	1.6E–05	5.5E–07	2.0E+01	2.8E–08	7.5E–05	NA	NC
4–Nitrotoluene	6.6E–02	3.4E+01	1.9E–03	1.9E–04	2.0E+01	9.3E–06	4.5E–02	NA	NC
TETRYL	2.1E–03	1.5E+00	1.4E–03	2.1E–06	1.5E+00	1.4E–06	2.8E–04	NA	NC
1,3,5–Trinitrobenzene	7.5E–04	1.5E+00	5.0E–04	7.5E–07	1.5E+00	5.0E–07	1.0E–04	NA	NC
4,4'–DDD	1.5E–03	2.0E–01	7.6E–03	1.5E–05	3.5E+03	4.2E–09	1.4E–02	1.4E–01	9.7E–02
4,4'–DDE	1.2E–03	2.0E–01	5.8E–03	1.1E–05	3.5E+03	3.2E–09	1.0E–02	3.9E–01	2.6E–02
4,4'–DDT	1.1E–03	2.0E–01	5.6E–03	1.1E–05	3.5E+03	3.1E–09	1.0E–02	1.4E–01	7.1E–02
Dieldrin	1.9E–04	6.5E–01	3.0E–04	1.9E–06	5.0E–02	3.8E–05	1.7E–03	NA	NC
Aluminum	5.5E+00	4.3E+02	1.3E–02	1.3E–02	4.3E+02	3.0E–05	3.2E+00	NA	NC
Arsenic	1.4E–03	5.8E–01	2.4E–03	1.4E–06	5.8E–01	2.4E–06	1.8E–04	1.0E+00	1.8E–04
Barium	1.5E–02	2.0E+02	7.8E–05	2.1E–05	2.0E+02	1.1E–07	4.9E–03	NA	NC
Chromium	4.4E–03	1.4E+03	3.2E–06	1.0E–05	1.4E+03	7.3E–09	2.5E–03	2.0E+02	1.3E–05
Copper	1.2E–03	1.0E+02	1.2E–05	1.2E–06	1.0E+02	1.2E–08	1.7E–04	NA	NC
Iron	5.6E–01	NA	NC	1.2E–03	NA	NC	2.8E–01	NA	NC
Lead	4.9E+00	2.5E+00	2.0E+00	4.1E–03	2.5E+00	1.7E–03	1.0E+00	1.3E+02	8.1E–03
Vanadium	4.3E–03	8.4E+00	5.1E–04	1.2E–05	8.4E+00	1.4E–06	2.9E–03	1.1E+01	2.7E–04
SUMMARY HAZARD INDEX			2.0E+00			1.8E–03			2.0E–01

PDE = Potential Dietary Exposure (mg/kgBW–day). RTV = Reference Toxicity Value (mg/kgBW–day) HQ = Hazard Quotient (calculated by dividing PDE by RTV)

Table B.15–45
Risk from Sublethal Effects for Semi–Aquatic Receptors from Average Exposure Concentrations of ECPCs in Food, Surface Water, and Sediment
Site 15

Remedial Investigation, Operable Unit 5, Sites 14 and 15
Naval Air Station Cecil Field, Jacksonville, Florida

CHEMICAL	*Florida water rat*			*Raccoon*			*Great blue heron*		
	PDE	RTV	HQ	PDE	RTV	HQ	PDE	RTV	HQ
2–Butanone	1.8E–05	1.7E+02	1.0E–07	5.4E–08	1.7E+02	3.1E–10	1.3E–05	NA	NC
Anthracene	4.3E–04	1.0E+01	4.3E–05	1.3E–06	1.0E+01	1.3E–07	3.1E–04	NA	NC
Benzo (a) anthracene	1.8E–03	1.0E+01	1.8E–04	5.4E–06	1.0E+01	5.4E–07	1.3E–03	NA	NC
Benzo (a) pyrene	2.3E–03	1.0E+01	2.3E–04	6.8E–06	1.0E+01	6.8E–07	1.7E–03	NA	NC
Benzo (b) fluoranthene	2.9E–03	1.0E+01	2.9E–04	8.8E–06	1.0E+01	8.8E–07	2.2E–03	NA	NC
Benzo (g,h,i) perylene	9.8E–04	1.0E+01	9.8E–05	2.9E–06	1.0E+01	2.9E–07	7.2E–04	NA	NC
Benzo (k) fluoranthene	1.2E–03	1.0E+01	1.2E–04	3.5E–06	1.0E+01	3.5E–07	8.6E–04	NA	NC
Carbazole	9.5E–05	NA	NC	2.8E–07	NA	NC	7.0E–05	NA	NC
Chrysene	2.1E–03	1.0E+01	2.1E–04	6.3E–06	1.0E+01	6.3E–07	1.6E–03	NA	NC
Dibenz (a,h) anthracene	4.9E–04	1.0E+01	4.9E–05	1.5E–06	1.0E+01	1.5E–07	3.6E–04	NA	NC
Di–n–butylphthalate	3.1E–03	1.3E+02	2.5E–05	9.3E–06	1.3E+02	7.4E–08	2.3E–03	NA	NC
Fluoranthene	2.9E–03	1.0E+01	2.9E–04	8.8E–06	1.0E+01	8.8E–07	2.2E–03	NA	NC
Indeno (1,2,3–cd) pyrene	1.3E–03	1.0E+01	1.3E–04	3.8E–06	1.0E+01	3.8E–07	9.2E–04	NA	NC
Phenanthrene	9.3E–04	1.0E+01	9.3E–05	2.8E–06	1.0E+01	2.8E–07	6.8E–04	NA	NC
Pyrene	2.6E–03	1.0E+01	2.6E–04	7.8E–06	1.0E+01	7.8E–07	1.9E–03	NA	NC
3–Nitrotoluene	2.1E–04	3.4E+01	6.3E–06	2.1E–07	2.0E+01	1.1E–08	2.9E–05	NA	NC
4–Nitrotoluene	2.3E–02	3.4E+01	6.6E–04	6.4E–05	2.0E+01	3.2E–06	1.5E–02	NA	NC
TETRYL	1.4E–03	1.5E+00	9.3E–04	1.4E–06	1.5E+00	9.3E–07	1.9E–04	NA	NC
1,3,5–Trinitrobenzene	2.7E–04	1.5E+00	1.8E–04	2.7E–07	1.5E+00	1.8E–07	3.6E–05	NA	NC
4,4'–DDD	7.8E–04	2.0E–01	3.9E–03	7.6E–06	3.5E+03	2.2E–09	6.9E–03	1.4E–01	4.9E–02
4,4'–DDE	6.5E–04	2.0E–01	3.3E–03	6.4E–06	3.5E+03	1.8E–09	5.8E–03	3.9E–01	1.5E–02
4,4'–DDT	6.3E–04	2.0E–01	3.1E–03	6.1E–06	3.5E+03	1.7E–09	5.6E–03	1.4E–01	4.0E–02
Dieldrin	1.9E–04	6.5E–01	3.0E–04	1.9E–06	5.0E–02	3.8E–05	1.7E–03	NA	NC
Aluminum	3.7E+00	4.3E+02	8.8E–03	8.6E–03	4.3E+02	2.0E–05	2.1E+00	NA	NC
Arsenic	8.0E–04	5.8E–01	1.4E–03	7.9E–07	5.8E–01	1.4E–06	1.1E–04	1.0E+00	1.1E–04
Barium	1.2E–02	2.0E+02	6.2E–05	1.7E–05	2.0E+02	8.4E–08	3.9E–03	NA	NC
Chromium	2.9E–03	1.4E+03	2.1E–06	6.8E–06	1.4E+03	4.9E–09	1.7E–03	2.0E+02	8.4E–06
Copper	1.2E–03	1.0E+02	1.2E–05	1.2E–06	1.0E+02	1.2E–08	1.7E–04	NA	NC
Iron	3.6E–01	NA	NC	7.9E–04	NA	NC	1.8E–01	NA	NC
Lead	1.5E+00	2.5E+00	5.9E–01	1.2E–03	2.5E+00	5.0E–04	3.0E–01	1.3E+02	2.4E–03
Vanadium	3.3E–03	8.4E+00	3.9E–04	9.1E–06	8.4E+00	1.1E–06	2.2E–03	1.1E+01	2.0E–04
SUMMARY HAZARD INDEX			6.1E–01			5.7E–04			1.1E–01

PDE = Potential Dietary Exposure (mg/kgBW–day). RTV = Reference Toxicity Value (mg/kgBW–day) HQ = Hazard Quotient (calculated by dividing PDE by RTV)

APPENDIX C

APPENDIX C

REGRESSION ANALYSIS

Aluminum
Site 15
Simple Linear Regressions

Statistical Analysis of Surface Soil Toxicological and Chemical Data

Aluminum in Surface Soil versus Lettuce Seed Germination

	Aluminum Surface Soil (mg/kg) (x)	Lettuce Seed Germination (%) (y)
CF15SS15	5570	98
CF15SS18	316	98
CF15SS20	844	56
CF15SS26	1410	97
CF15SS46	3540	93
CF15SS48	333	94
CF15SS6	1250	95
CF15SS7	415	92

Regression Output:

Constant		87.47002
Std Err of Y Est		14.79997
R Squared		0.051693
No of Observations		8
Degrees of Freedom		6
X Coefficient(s)	0.001699	
Std Err of Coef.	0.002971	

Aluminum in Surface Soil versus14–Day Earthworm Survival

	Aluminum Surface Soil (mg/kg) (x)	14–Day Earthworm Survival (%) (y)
CF15SS15	5570	17
CF15SS18	316	100
CF15SS20	844	100
CF15SS26	1410	20
CF15SS46	3540	17
CF15SS48	333	100
CF15SS6	1250	33
CF15SS7	415	100

Regression Output:

Constant		89 64096
Std Err of Y Est		29.98918
R Squared		0.565562
No. of Observations		8
Degrees of Freedom		6
X Coefficient(s)	−0 01682	
Std Err of Coef.	0.00602	

Aluminum in Surface Soil versus 30–Day Earthworm Survival

	Aluminum Surface Soil (mg/kg) (x)	30–Day Earthworm Survival (%) (y)
CF15SS15	5570	0
CF15SS18	316	100
CF15SS20	844	97
CF15SS26	1410	0
CF15SS46	3540	0
CF15SS48	333	100
CF15SS6	1250	0
CF15SS7	415	100

Regression Output:

Constant		83.4186
Std Err of Y Est		40.85131
R Squared		0.49193
No of Observations		8
Degrees of Freedom		6
X Coefficient(s)	−0.01977	
Std Err of Coef.	0.0082	

Aluminum in Surface Soil versus Earthworm Growth

	Aluminum Surface Soil (mg/kg) (x)	Earthworm Growth (grams) (y)
CF15SS18	316	0.27
CF15SS20	844	0.133
CF15SS48	333	0 356
CF15SS7	415	0.334

Regression Output:

Constant		0.444874
Std Err of Y Est		0.05588
R Squared		0.793339
No. of Observations		4
Degrees of Freedom		2
X Coefficient(s)	−0.00036	
Std Err of Coef.	0.00013	

Arsenic
Site 15
Simple Linear Regressions

Statistical Analysis of Surface Soil Toxicological and Chemical Data

Arsenic in Surface Soil versus Lettuce Seed Germination

	Arsenic Surface Soil (mg/kg) (x)	Lettuce Seed Germination (%) (y)
CF15SS15	96.5	98
CF15SS18	1.1	98
CF15SS20	1.5	56
CF15SS26	25.2	97
CF15SS46	47.4	93
CF15SS6	4.2	95
CF15SS7	2.6	92

Regression Output:

Constant		86.19978
Std Err of Y Est		15.5761
R Squared		0.115098
No. of Observations		7
Degrees of Freedom		5
X Coefficient(s)	0.143426	
Std Err of Coef.	0.177851	

Arsenic in Surface Soil versus14–Day Earthworm Survival

	Arsenic Surface Soil (mg/kg) (x)	14–Day Earthworm Survival (%) (y)
CF15SS15	96.5	17
CF15SS18	1.1	100
CF15SS20	1.5	100
CF15SS26	25.2	20
CF15SS46	47 4	17
CF15SS6	4 2	33
CF15SS7	2.6	100

Regression Output:

Constant		76.09621
Std Err of Y Est		33.35561
R Squared		0.478703
No. of Observations		7
Degrees of Freedom		5
X Coefficient(s)	–0.8161	
Std Err of Coef.	0.380861	

Arsenic in Surface Soil versus 30–Day Earthworm Survival

	Arsenic Surface Soil (mg/kg) (x)	30–Day Earthworm Survival (%) (y)
CF15SS15	96.5	0
CF15SS18	1.1	100
CF15SS20	1.5	97
CF15SS26	25.2	0
CF15SS46	47.4	0
CF15SS6	4.2	0
CF15SS7	2 6	100

Regression Output:

Constant		65.8934
Std Err of Y Est		45.41589
R Squared		0.386412
No of Observations		7
Degrees of Freedom		5
X Coefficient(s)	–0.92019	
Std Err of Coef.	0.518568	

Arsenic in Surface Soil versus Earthworm Growth

	Arsenic Surface Soil (mg/kg) (x)	Earthworm Growth (grams) (y)
CF15SS18	1.1	0.27
CF15SS20	1 5	0.133
CF15SS7	2.6	0.334

Regression Output:

Constant		0.120072
Std Err of Y Est		0.121463
R Squared		0.300412
No. of Observations		3
Degrees of Freedom		1
X Coefficient(s)	0.072459	
Std Err of Coef.	0.110574	

Iron
Site 15
Simple Linear Regressions

Statistical Analysis of Surface Soil Toxicological and Chemical Data

Iron in Surface Soil versus Lettuce Seed Germination

	Iron Surface Soil (mg/kg) (x)	Lettuce Seed Germination (%) (y)
CF15SS15	665	98
CF15SS18	100	98
CF15SS20	198	56
CF15SS26	417	97
CF15SS46	436	93
CF15SS48	89.4	94
CF15SS6	115	95
CF15SS7	721	92

Regression Output:

Constant		86.65515
Std Err of Y Est		14.89975
R Squared		0.038863
No. of Observations		8
Degrees of Freedom		6
X Coefficient(s)	0.010855	
Std Err of Coef.	0.022039	

Iron in Surface Soil versus14-Day Earthworm Survival

	Iron Surface Soil (mg/kg) (x)	14-Day Earthworm Survival (%) (y)
CF15SS15	665	17
CF15SS18	100	100
CF15SS20	198	100
CF15SS26	417	20
CF15SS46	436	17
CF15SS48	89 4	100
CF15SS6	115	33
CF15SS7	721	100

Regression Output:

Constant		79.7613
Std Err of Y Est		42.88066
R Squared		0.111777
No of Observations		8
Degrees of Freedom		6
X Coefficient(s)	-0.05511	
Std Err of Coef.	0.063427	

Iron in Surface Soil versus 30-Day Earthworm Survival

	Iron Surface Soil (mg/kg) (x)	30-Day Earthworm Survival (%) (y)
CF15SS15	665	0
CF15SS18	100	100
CF15SS20	198	97
CF15SS26	417	0
CF15SS46	436	0
CF15SS48	89.4	100
CF15SS6	115	0
CF15SS7	721	100

Regression Output:

Constant		68.96508
Std Err of Y Est		55 15431
R Squared		0.073873
No. of Observations		8
Degrees of Freedom		6
X Coefficient(s)	-0.05644	
Std Err of Coef	0.081581	

Iron in Surface Soil versus Earthworm Growth

	Iron Surface Soil (mg/kg) (x)	Earthworm Growth (grams) (y)
CF15SS18	100	0.27
CF15SS20	198	0.133
CF15SS48	89.4	0.356
CF15SS7	721	0.334

Regression Output:

Constant		0.24953
Std Err of Y Est		0.11883
R Squared		0.065448
No. of Observations		4
Degrees of Freedom		2
X Coefficient(s)	0.000086	
Std Err of Coef.	0.000229	

Lead
Site 15
Simple Linear Regressions

Statistical Analysis of Surface Soil Toxicological and Chemical Data

Lead in Surface Soil versus Lettuce Seed Germination

	Lead Surface Soil (mg/kg) (x)	Lettuce Seed Germination (%) (y)
CF15SS15	7510	98
CF15SS18	41.1	98
CF15SS20	278	56
CF15SS26	3490	97
CF15SS46	4430	93
CF15SS48	0.97	94
CF15SS6	1340	95
CF15SS7	205	92

Regression Output:

Constant		86.71369
Std Err of Y Est		14.34475
R Squared		0.109133
No. of Observations		8
Degrees of Freedom		6
X Coefficient(s)	0.001694	
Std Err of Coef.	0.001975	

Lead in Surface Soil versus14-Day Earthworm Survival

	Lead Surface Soil (mg/kg) (x)	14-Day Earthworm Survival (%) (y)
CF15SS15	7510	17
CF15SS18	41.1	100
CF15SS20	278	100
CF15SS26	3490	20
CF15SS46	4430	17
CF15SS48	0.97	100
CF15SS6	1340	33
CF15SS7	205	100

Regression Output:

Constant		88.89001
Std Err of Y Est		24.37849
R Squared		0.712914
No. of Observations		8
Degrees of Freedom		6
X Coefficient(s)	-0.01296	
Std Err of Coef.	0.003357	

Lead in Surface Soil versus 30-Day Earthworm Survival

	Lead Surface Soil (mg/kg) (x)	30-Day Earthworm Survival (%) (y)
CF15SS15	7510	0
CF15SS18	41.1	100
CF15SS20	278	97
CF15SS26	3490	0
CF15SS46	4430	0
CF15SS48	0.97	100
CF15SS6	1340	0
CF15SS7	205	100

Regression Output:

Constant		82.69357
Std Err of Y Est		35.04771
R Squared		0.626035
No. of Observations		8
Degrees of Freedom		6
X Coefficient(s)	-0.0153	
Std Err of Coef.	0.004826	

Lead in Surface Soil versus Earthworm Growth

	Lead Surface Soil (mg/kg) (x)	Earthworm Growth (grams) (y)
CF15SS18	41.1	0.27
CF15SS20	278	0.133
CF15SS48	0.97	0.356
CF15SS7	205	0.334

Regression Output:

Constant		0.340275
Std Err of Y Est		0.091221
R Squared		0.449267
No. of Observations		4
Degrees of Freedom		2
X Coefficient(s)	-0.00051	
Std Err of Coef.	0.0004	

Manganese
Site 15
Simple Linear Regressions

Statistical Analysis of Surface Soil Toxicological and Chemical Data

Manganese in Surface Soil versus Lettuce Seed Germination

	Manganese Surface Soil (mg/kg) (x)	Lettuce Seed Germination (%) (y)
CF15SS15	2	98
CF15SS18	5.6	98
CF15SS20	3.3	56
CF15SS26	1.2	97
CF15SS46	1 7	93
CF15SS48	0.86	94
CF15SS6	1	95
CF15SS7	30 9	92

Regression Output:

Constant		90 25736
Std Err of Y Est		15.19635
R Squared		0.000217
No. of Observations		8
Degrees of Freedom		6
X Coefficient(s)	0.020213	
Std Err of Coef.	0 560088	

Manganese in Surface Soil versus14–Day Earthworm Survival

	Manganese Surface Soil (mg/kg) (x)	14–Day Earthworm Survival (%) (y)
CF15SS15	2	17
CF15SS18	5.6	100
CF15SS20	3.3	100
CF15SS26	1.2	20
CF15SS46	1.7	17
CF15SS48	0.86	100
CF15SS6	1	33
CF15SS7	30.9	100

Regression Output:

Constant		50.18958
Std Err of Y Est		40.70101
R Squared		0.19978
No. of Observations		8
Degrees of Freedom		6
X Coefficient(s)	1.835984	
Std Err of Coef.	1.500106	

Manganese in Surface Soil versus 30–Day Earthworm Survival

	Manganese Surface Soil (mg/kg) (x)	30–Day Earthworm Survival (%) (y)
CF15SS15	2	0
CF15SS18	5 6	100
CF15SS20	3.3	97
CF15SS26	1 2	0
CF15SS46	1.7	0
CF15SS48	0.86	100
CF15SS6	1	0
CF15SS7	30.9	100

Regression Output:

Constant		35.82461
Std Err of Y Est		50.93918
R Squared		0.210021
No. of Observations		8
Degrees of Freedom		6
X Coefficient(s)	2.3712	
Std Err of Coef.	1.877451	

Manganese in Surface Soil versus Earthworm Growth

	Manganese Surface Soil (mg/kg) (x)	Earthworm Growth (grams) (y)
CF15SS18	5.6	0.27
CF15SS20	3.3	0.133
CF15SS48	0.86	0.356
CF15SS7	30.9	0.334

Regression Output:

Constant		0.247732
Std Err of Y Est		0.115185
R Squared		0.121897
No. of Observations		4
Degrees of Freedom		2
X Coefficient(s)	0 00251	
Std Err of Coef.	0.004764	

Total Organic Carbon
Site 15
Simple Linear Regressions

Statistical Analysis of Surface Soil Toxicological and Chemical Data

TOC in Surface Soil versus Lettuce Seed Germination

	TOC Surface Soil (mg/kg) (x)	Lettuce Seed Germination (%) (y)
CF15SS15	46000	98
CF15SS18	9200	98
CF15SS20	10000	56
CF15SS26	20000	97
CF15SS46	46000	93
CF15SS48	2700	94
CF15SS6	13000	95
CF15SS7	8300	92

Regression Output.

Constant		86.46083
Std Err of Y Est		14.7331
R Squared		0.060243
No. of Observations		8
Degrees of Freedom		6
X Coefficient(s)	0.000202	
Std Err of Coef.	0.000325	

TOC in Surface Soil versus14–Day Earthworm Survival

	TOC Surface Soil (mg/kg) (x)	14–Day Earthworm Survival (%) (y)
CF15SS15	46000	17
CF15SS18	9200	100
CF15SS20	10000	100
CF15SS26	20000	20
CF15SS46	46000	17
CF15SS48	2700	100
CF15SS6	13000	33
CF15SS7	8300	100

Regression Output:

Constant		99.04049
Std Err of Y Est		27.33508
R Squared		0.639056
No. of Observations		8
Degrees of Freedom		6
X Coefficient(s)	−0.00197	
Std Err of Coef.	0.000604	

TOC in Surface Soil versus 30–Day Earthworm Survival

	TOC Surface Soil (mg/kg) (x)	30–Day Earthworm Survival (%) (y)
CF15SS15	46000	0
CF15SS18	9200	100
CF15SS20	10000	97
CF15SS26	20000	0
CF15SS46	46000	0
CF15SS48	2700	100
CF15SS6	13000	0
CF15SS7	8300	100

Regression Output:

Constant		94.19428
Std Err of Y Est		38.47738
R Squared		0.549264
No. of Observations		8
Degrees of Freedom		6
X Coefficient(s)	−0.0023	
Std Err of Coef.	0.00085	

TOC in Surface Soil versus Earthworm Growth

	TOC Surface Soil (mg/kg) (x)	Earthworm Growth (grams) (y)
CF15SS18	9200	0.27
CF15SS20	10000	0.133
CF15SS48	2700	0.356
CF15SS7	8300	0.334

Regression Output:

Constant		0.435422
Std Err of Y Est		0.086836
R Squared		0.500942
No. of Observations		4
Degrees of Freedom		2
X Coefficient(s)	−2.1E−05	
Std Err of Coef.	0.000015	

Total PAHs
Site 15
Simple Linear Regressions

Statistical Analysis of Surface Soil Toxicological and Chemical Data

Total PAHs in Surface Soil versus Lettuce Seed Germination

	Total PAHs Surface Soil (ug/kg) (x)	Lettuce Seed Germination (%) (y)
CF15SS15	80	98
CF15SS18	22993	98
CF15SS20	1147600	56
CF15SS26	316	97
CF15SS46	556	93
CF15SS48	471	94
CF15SS6	674	95
CF15SS7	2830200	92

Regression Output:

Constant		92.74306
Std Err of Y Est		14.2701
R Squared		0.118381
No. of Observations		8
Degrees of Freedom		6
X Coefficient(s)	−4.7E−06	
Std Err of Coef.	5.3E−06	

Total PAHs in Surface Soil versus14−Day Earthworm Survival

	Total PAHs Surface Soil (ug/kg) (x)	14−Day Earthworm Survival (%) (y)
CF15SS15	80	17
CF15SS18	22993	100
CF15SS20	1147600	100
CF15SS26	316	20
CF15SS46	556	17
CF15SS48	471	100
CF15SS6	674	33
CF15SS7	2830200	100

Regression Output:

Constant		50.18488
Std Err of Y Est		38.89623
R Squared		0.269174
No. of Observations		8
Degrees of Freedom		6
X Coefficient(s)	0.000021	
Std Err of Coef.	0.000014	

Total PAHs in Surface Soil versus 30−Day Earthworm Survival

	Total PAHs Surface Soil (ug/kg) (x)	30−Day Earthworm Survival (%) (y)
CF15SS15	80	0
CF15SS18	22993	100
CF15SS20	1147600	97
CF15SS26	316	0
CF15SS46	556	0
CF15SS48	471	100
CF15SS6	674	0
CF15SS7	2830200	100

Regression Output:

Constant		36.0965
Std Err of Y Est		48.91041
R Squared		0.271694
No. of Observations		8
Degrees of Freedom		6
X Coefficient(s)	0.000027	
Std Err of Coef.	0.000018	

Total PAHs in Surface Soil versus Earthworm Growth

	Total PAHs Surface Soil (ug/kg) (x)	Earthworm Growth (grams) (y)
CF15SS18	22993	0.27
CF15SS20	1147600	0.133
CF15SS48	471	0.356
CF15SS7	2830200	0.334

Regression Output:

Constant		0.271193
Std Err of Y Est		0.122874
R Squared		0.000745
No. of Observations		4
Degrees of Freedom		2
X Coefficient(s)	2.1E−09	
Std Err of Coef.	5.3E−08	

Aluminum, Lead, and TOC
Site 15
Multiple Linear Regressions

Location	Al	Pb	TOC	Let ger %
CF15SS15	5570	7510	46000	98
CF15SS18	316	41.1	9200	98
CF15SS20	844	278	10000	56
CF15SS26	1410	3490	20000	97
CF15SS46	3540	4430	46000	93
CF15SS48	333	0.97	2700	94
CF15SS6	1250	1340	13000	95
CF15SS7	415	205	8300	92

Regression Output:

Constant		89.21536	
Std Err of Y Est		16.36925	
R Squared		0.226619	
No. of Observations		8	
Degrees of Freedom		4	
X Coefficient(s)	−0.00988	0.008001	0.000039
Std Err of Coef.	0.01453	0.008632	0.001156

Location	Al	Pb	TOC	Worm %Sur.
CF15SS15	5570	7510	46000	17
CF15SS18	316	41.1	9200	100
CF15SS20	844	278	10000	100
CF15SS26	1410	3490	20000	20
CF15SS46	3540	4430	46000	17
CF15SS48	333	0 97	2700	100
CF15SS6	1250	1340	13000	33
CF15SS7	415	205	8300	100

Regression Output:

Constant		90.88662	
Std Err of Y Est		24.73033	
R Squared		0.803045	
No. of Observations		8	
Degrees of Freedom		4	
X Coefficient(s)	0.029451	−0.02378	−0.00149
Std Err of Coef.	0.021952	0.013042	0.001746

Location	Al	Pb	TOC	Worm %Sur
CF15SS15	5570	7510	46000	0
CF15SS18	316	41.1	9200	100
CF15SS20	844	278	10000	97
CF15SS26	1410	3490	20000	0
CF15SS46	3540	4430	46000	0
CF15SS48	333	0 97	2700	100
CF15SS6	1250	1340	13000	0
CF15SS7	415	205	8300	100

Regression Output:

Constant		83.79488	
Std Err of Y Est		38.13514	
R Squared		0.704831	
No. of Observations		8	
Degrees of Freedom		4	
X Coefficient(s)	0.034932	−0.0292	−0.00159
Std Err of Coef	0.033851	0.020111	0.002692

Location	Al	Pb	TOC	Worm Grow
CF15SS18	316	41.1	9200	0.27
CF15SS20	844	278	10000	0.133
CF15SS48	333	0.97	2700	0.356
CF15SS7	415	205	8300	0.334

APPENDIX D

APPENDIX D

TOXICITY TEST RESULTS

HUMAN HEALTH TOXICITY PROFILES

Acetone. Acetone is found both naturally in the environment, resulting from the breakdown of fat in the body, and is also used as a solvent in manufacturing plastics, fibers, drugs, and other pharmaceuticals. Workers, occupationally exposed to acetone, complained of respiratory tract and eye irritation. At higher doses, workers reported headaches, feelings of light-headedness and confusion. The USEPA toxicity value for acetone is based on changes in liver weight and kidney toxicity observed in rats. Information on the carcinogenicity of acetone is inadequate to classify it as carcinogenic.

References:

Agency for Toxic Substances and Disease Registry (ATSDR). 1993. "Toxicological Profile for Acetone." Agency for Toxic Substances and Disease Registry, U.S. Public Health Service (February).

Integrated Risk Information System (IRIS). 1993. United States Environmental Protection Agency.

Aluminum. Aluminum occurs naturally in the soil and makes up approximately 8 percent of the earth's crust. Higher soil concentrations are associated with industries that burn coal and aluminum mining and smelting. Human exposures to aluminum may occur through ingestion of foods grown in soil that contains aluminum and use of antacids, antiperspirants, and other drug store items. Aluminum in antiperspirants can cause skin rashes in some people. Factory workers who inhale large amounts of aluminum dust may develop lung problems. Aluminum has caused lower birth weights in some animals. Studies have shown that aluminum accumulates in the brains of people with Alzheimer's disease. However, any causal link between aluminum exposure and this disease is yet to be demonstrated. Both human epidemiological studies and animal experiments strongly suggest that aluminum is not a carcinogen.

Reference:

ATSDR. 1989. "Toxicological Profile for Aluminum." Agency for Toxic Substances and Disease Registry, U.S. Public Health Service (October).

Antimony. Antimony enters the environment during the mining and processing of its ores and other related compounds. Small amounts of antimony are also released into the environment by incinerators and coal-burning power plants. Antimony will strongly adhere to soil that contains iron, manganese, or aluminum. Antimony was used for medicinal purposes to treat people infected with parasites. However, chronic exposure can cause eye, skin, and lung irritation, as well as heart problems, vomiting and diarrhea. The oral RfD, based on an oral drinking water study in rats, showed changes in glucose and cholesterol metabolism. Antimony has not been evaluated by the USEPA for evidence of human carcinogenic potential.

References:

ATSDR. 1991. "Toxicological Profile for Antimony." Agency for Toxic Substances and Disease Registry, U.S. Public Health Service (February).

IRIS. 1993. United States Environmental Protection Agency.

Arsenic. Arsenic has been used in pesticide formulations and has industrial uses in tanneries, as well as the glass and wine making industries. Toxicity depends on its chemical form. Arsenic is an irritant of the skin, mucous membranes, and gastrointestinal tract. Symptoms of acute toxicity include vomiting, diarrhea, convulsions, and a severe drop in blood pressure. Subchronic effects include hyperpigmentation, sensory-motor polyneuropathy, persistent headache, and lethargy. Chronic oral exposure has caused skin lesions, peripheral vascular disease, and peripheral neuropathy. The USEPA has classified arsenic in Group A, human carcinogen, based on increased incidence of lung cancer in occupational studies.

Reference:

ATSDR. 1992. "Toxicological Profile for Arsenic." Agency for Toxic Substances and Disease Registry, U.S. Public Health Service (February).

Benzo(a)anthracene. Benzo(a)anthracene is a member of the polycyclic aromatic hydrocarbons (PAH) class of compounds that contain two or more aromatic rings. PAHs are ubiquitous in nature and are also manmade. Benzo(a)anthracene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material. It is also a product of pyrolysis in tobacco smoke.

Benzo(a)anthracene has produced skin tumors in laboratory animals after dermal application. Benzo(a)anthracene produced mutations in bacteria and in mammalian cells, and transformed mammalian cells in culture. Although there are no human data that specifically link exposure to benzo(a)anthracene to human cancers, benzo(a)anthracene is a component of mixtures that have been associated with human cancer. As such, benzo(a)anthracene has been classified by USEPA as a B2, probable human carcinogen.

Reference:

Massachusetts Department of Environmental Protection (MADEP). 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6." Policy #WSC/ORS-142-92. Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, Massachusetts (September).

Benzo(a)pyrene. Benzo(a)pyrene is a member of the polycyclic aromatic hydrocarbons (PAH) class of compounds that contain two or more aromatic rings. They are ubiquitous in nature and are also manmade. Benzo(a)pyrene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material. Human data demonstrating a causal relationship linking benzo(a)pyrene to carcinogenicity are lacking. However, multiple animal studies

pyrene elicits its carcinogenic potential is well understood. Benzo(a)pyrene has produced positive results in numerous genotoxicity assays. Benzo(a)pyrene has been classified by the USEPA as a B2, probable human carcinogen.

References:

ATSDR. 1989. "Toxicological Profile for Polycyclic Aromatic Hydrocarbons." Agency for Toxic Substances and Disease Registry, U.S. Public Health Service (October).

Clayton, George D. and Florence E. Clayton, editors. 1981. *Patty's Industrial Hygiene and Toxicology*. 3rd Revised Edition. New York: John Wiley & Sons.

IRIS. 1993. United States Environmental Protection Agency.

Benzo(b)fluoranthene. Benzo(b)fluoranthene is a member of the polycyclic aromatic hydrocarbons (PAH) class of compounds that contain two or more aromatic rings. PAHs are ubiquitous in nature and are also manmade. Benzo(b)fluoranthene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material.

Although there are no human data that specifically link exposure to benzo(b)fluoranthene to human cancers, benzo(b)fluoranthene is a component of mixtures that have been associated with human cancer. These include coal tar, soots, coke oven emissions, and cigarette smoke. Benzo(b)fluoranthene produced tumors in mice after lung implantation, intraperitoneal, or subcutaneous injection, and skin painting. Benzo(b)fluoranthene has produced positive results in several genotoxicity assays. It has been classified as a B2, probable human carcinogen, by the USEPA.

Reference:

MADEP. 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6." Policy #WSC/ORS-142-92. Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, Massachusetts (September).

Benzo(k)fluoranthene. Benzo(k)fluoranthene is a member of the polycyclic aromatic hydrocarbons (PAH) class of compounds that contain two or more aromatic rings. PAHs are ubiquitous in nature and are also manmade. Benzo(k)fluoranthene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material.

Although there are no human data that specifically link exposure to benzo(k)fluoranthene to human cancers, benzo(k)fluoranthene is a component of mixtures that have been associated with human cancer. These include coal tar, soots, coke oven emissions, and cigarette smoke. Benzo(k)fluoranthene produced tumors after lung implantation in mice and when administered with a promoting agent in skin-painting studies. Benzo(k)fluoranthene is mutagenic in bacteria. Benzo(k)fluoranthene has been classified by USEPA as a B2, probable human carcinogen.

Reference:

MADEP. 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6." Policy #WSC/ORS-142-92. Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, Massachusetts (September).

Benzo(g,h,i)perylene. Benzo(g,h,i)perylene is a member of the polycyclic aromatic hydrocarbons (PAH) class of compounds that contain two or more aromatic rings. PAHs are ubiquitous in nature and are also manmade. They occur naturally in coal tar, crude oil, and are formed from incomplete combustion of organic material.

There are no available data regarding human exposures. There are inadequate animal data from lung implant, skin-painting and subcutaneous injection bioassays. The USEPA has determined that benzo(g,h,i)perylene is not classifiable as to human carcinogenicity and has assigned it to class D.

Reference:

MADEP. 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6." Policy #WSC/ORS-142-92. Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, Massachusetts (September).

Beryllium. Beryllium is a trace element that is obtained by extraction from mineral ores. Most beryllium is contributed to the environment by the burning of fossil fuels that contain beryllium ore. Beryllium is generally incorporated into alloy metals that are used in jet engine parts and electrical components. Pure beryllium metal is used in parts for aircraft brakes, nuclear weapons, nuclear reactors, and precision instruments.

Available data on beryllium suggest that it is most toxic to the lungs. Acute inhalation exposures to high concentrations of beryllium in the air can cause chemical pneumonitis, the symptoms of which include cough, shortness of breath, and fatigue. These symptoms can persist and even worsen after exposure to beryllium has been discontinued. Inhalation exposures to low concentrations of beryllium can produce chronic beryllium disease, which results in inhibited breathing efficiency. Inhalation of beryllium has been shown to produce lung cancer in animals, and an increased incidence of lung cancer has been demonstrated in workers who are exposed to beryllium in the air. Therefore, beryllium has been classified by the USEPA as a B2, probable human carcinogen.

Reference:

ATSDR. 1991. "Toxicological Profile for Beryllium." Agency for Toxic Substances and Disease Registry, U.S. Public Health Service (February).

***Bis*(2-ethylhexyl)phthalate (DEHP)**. DEHP is used industrially as a plasticizer for resins and is found in many plastic materials as it makes them more flexible. It is also used in manufacturing organic pump fluids in electrical capacitors. Acute exposure to DEHP has produced eye and mucous membrane irritation, nausea, and diarrhea. Chronic exposure of laboratory animals to DEHP indicate that the target organs are the liver, causing morphological and biochemical changes, as well as the testes, producing damage to the seminiferous tubules. DEHP has

produced developmental and reproductive effects in laboratory animals, including spina bifida and reduced fertility. DEHP has been shown to cause a dose-related increase in liver tumors in mice and rats. Thus, the USEPA has designated DEHP as a B2, probable human carcinogen.

Reference:

ATSDR. 1991. "Toxicological Profile for Di(2-ethylhexyl)phthalate." Agency for Toxic Substances and Disease Registry, U.S. Public Health Service (October).

Carbazole. Carbazole is a dibenzopyrole compound that is formed from the incomplete combustion of nitrogen-containing organic matter, such as tobacco in cigarettes. Carbazole is also contained in crude oil and coal tars. Carbazole is used for making dyes, photographic plates, and in reagents.

Data on the adverse effects of carbazole exposure are limited. No data were available concerning human exposure. In animals, the oral LD_{50} has been reported as ranging from 500 to 5000 milligrams per kilogram (mg/kg), depending on the animal species tested. However, subcutaneous injections of 10 milligram (mg) carbazole for 1 year did not produce any adverse effects in mice. In a carcinogenicity bioassay with mice, chronic oral administration of carbazole in the diet produced both hepatocellular carcinomas and forestomach papillomas in males and females. Limited *in vitro* genotoxicity data indicate that carbazole is not mutagenic, suggesting that a reactive metabolite is responsible for the carcinogenic effects. Based on these data, carbazole has been ranked a group B2, probable human carcinogen.

Reference:

International Agency for Research on Cancer. 1983. IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans. Polynuclear Aromatic Compounds, Part 1, Chemical, Environmental and Experimental Data, Volume 32. World Health Organization, France.

Chrysene. Chrysene is one of the polycyclic aromatic hydrocarbons (PAH) compounds that are formed during the combustion of organic material. Although there are no human data that specifically link exposure to chrysene to human cancers, chrysene is a component of mixtures that have been associated with human cancer. These include coal tar, soots, coke oven emissions and cigarette smoke. Chrysene produced chromosomal abnormalities in hamsters and mouse germ cells after gavage exposure, positive responses in bacterial gene mutation assays, and transformed mammalian cells exposed in culture. Due to its similarities with benzo(a)pyrene and other carcinogenic PAHs, chrysene has been classified as a B2, probable human carcinogen.

Reference:

MADEP. 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6." Policy #WSC/ORS-142-92. Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, Massachusetts (September).

Dichlorodiphenyldichloroethane (DDD), Dichlorodiphenyldichloroethene (DDE), Dichlorodiphenyltrichloroethane (DDT). DDT was one of the most highly used insecticides and is now ubiquitous in the environment. It was used extensively in World War II to control lice (applied directly to human skin), and later used as an agricultural insecticide and as a public health tool to control insects that spread typhus and malaria. DDD and DDE were contained as impurities in DDT and are also primary metabolites of DDT and share similar toxicological properties. DDT, DDD, and DDE are highly persistent in the environment, and thus tend to bioconcentrate in the food chain. This, combined with its toxicological properties, has been attributed to the decline in population of several predatory bird species.

DDT is absorbed to a minor extent via inhalation and dermal routes, and to a large extent by the oral route. Exposure to humans is likely greatest through ingestion of mucous that was contaminated with DDT that had been inhaled. DDT is absorbed into the lymphatic system and distributed to fats throughout the body. In both humans and animals, DDT acts as a central nervous system stimulant by interfering with the movement of ions within neurons. DDT acts as an estrogenic compound in animals, and this has been attributed to numerous adverse reproductive effects observed in animals exposed to DDT. DDT also causes liver hypertrophy, hepatocyte degeneration, and induces the enzyme cytochrome P450, which can affect the metabolism of other xenobiotics. There is no conclusive evidence of DDT-induced carcinogenicity in humans. However, DDT has produced liver tumors in laboratory animals. DDD, DDE, and DDT have, therefore, been placed in U.S. Environmental Protection Agency's weight of evidence group B2, probable human carcinogen.

Reference:

ATSDR. 1992. "Toxicological Profile for DDD, DDE, and DDT." Agency for Toxic Substances and Disease Registry, U.S. Public Health Service (October).

Dibenzo(a,h)anthracene. Dibenzo(a,h)anthracene is one of the polycyclic aromatic hydrocarbons (PAH) compounds which are formed during the combustion of organic material. This compound is found in tobacco smoke, food, and industrial emissions. Although there are no human data that specifically link exposure to dibenzo(a,h)anthracene to human cancers, dibenzo(a,h)anthracene is a component of mixtures that have been associated with human cancer. These include coal tar, soots, coke oven emissions and cigarette smoke. Dibenzo(a,h)anthracene is metabolized similarly to benzo(a)pyrene, and has produced skin tumors in laboratory animals following dermal exposure. Dibenzo(a,h)anthracene has also been shown to be mutagenic, producing DNA damage in human cell cultures. Due to its similarities with benzo(a)pyrene and other carcinogenic PAHs, dibenzo(a,h)anthracene has been classified as a B2, probable human carcinogen.

Reference:

MADEP. 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6." Policy #WSC/ORS-142-92. Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, Massachusetts (September).

Fluoranthene. Fluoranthene is one of the polycyclic aromatic hydrocarbons (PAH) compounds which are formed during the combustion of organic material. Although there are no human data that specifically link exposure to chrysene to human cancers, fluoranthene is a component of mixtures that have been associated with human cancer. It is a constituent of coal tar and petroleum-derived asphalt. No data regarding human exposure are available, and animal data suggest that fluoranthene is not carcinogenic. Fluoranthene has been classified by USEPA as a D carcinogen.

Reference:

ATSDR. 1989. "Toxicological Profile for Polycyclic Aromatic Hydrocarbons." Agency for Toxic Substances and Disease Registry, U.S. Public Health Service (October).

Indeno(1,2,3-cd)pyrene. Indeno(1,2,3-c,d)pyrene is one of the polycyclic aromatic hydrocarbons (PAH) compounds that are formed during the combustion of organic material and is a component of cigarette smoke and smoke stack emissions. No carcinogenicity data specifically for indeno(1,2,3-c,d)pyrene are available in humans, however, toxic effects are attributable to mixtures of PAHs. Animal studies indicate that indeno(1,2,3-c,d)pyrene can induce skin tumors in mice, and may have some immunosuppressive effects. In mammalian cell cultures, indeno(1,2-,3-c,d)pyrene was found to be genotoxic. It has been classified by the USEPA as a B2 carcinogen.

Reference:

MADEP. 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6." Policy #WSC/ORS-142-92. Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, Massachusetts (September).

Iron. Iron is a metal that is required for a variety of physiological functions such as heme biosynthesis, oxidative phosphorylation and mixed-function oxidase-mediated metabolic reactions. Only divalent forms of iron are absorbed. As absorption occurs, divalent iron is biochemically converted to trivalent iron, the biologically active form. Under normal conditions, absorbed dietary iron is complexed to hemoglobin and transported to the liver for storage until needed for physiological reactions. The balance of iron is regulated only by the amount of dietary intake and the degree of intestinal absorption. Intestinal absorption tends to be low (2 - 15 percent) except during periods of increased iron need when absorption efficiency increases dramatically.

Acute iron toxicity has been well characterized following the accidental ingestion of iron-containing preparations by children. Shortly after ingestion, the corrosive effects of iron cause vomiting and diarrhea, often bloody. Later signs include shock, metabolic acidosis, seizures, liver and/or kidney failure, coma, and death. Chronic iron overload manifests as disturbances in liver

function, diabetes mellitus, and endocrine and cardiovascular effects. Inhalation of iron containing dust or fumes in occupational settings may result in deposition of iron particles in the lungs leading to interstitial fibrosis. Autopsies of hematite miners noted an increase in lung cancer. However, the etiology of the lung cancer may be related to factors other than iron exposure such as cigarette, silica or PAH exposures.

References:

Aisen, P., Cohen, G., and J.O. Kang. 1990. "Iron Toxicosis." *Int. Rev. Exp. Pathol* 31:1-46.

Goyer, R.A. 1991. "Toxic Effects of Metals." In *Casarett and Doull's Toxicology: The Basic Science of Poisons*. 3rd ed. Eds. C.D. Klaassen, M.O. Amdur and J. Doull. New York: Macmillan Publishing Co.

Lead. Lead is used as a component in storage batteries and was widely used in gasoline and paints. It is the most ubiquitous toxic metal in the environment. The most serious effects of chronic exposure are encephalopathy, renal damage, and changes in the hematopoietic system, which is the most sensitive indicator of lead exposure. Peripheral nerve dysfunction is observed in adults at blood lead levels of 30 to 50 micrograms per liter ($\mu g/\ell$)-blood. The nervous systems of children are reported to be affected at levels of 15 micrograms per liter ($\mu g/\ell$)-blood (Benignus and others, 1981). Chronic lead exposure by workers through inhalation has resulted in statistically significant increases in tumors. Oral exposures of lead salts in animals has been shown to increase tumor formation.

References:

Amdur, Mary O., John Doull, and Curtis D. Klaassen. 1991. *Toxicology: The Basic Science of Poisons*. 4th ed. New York: Pergamon Press, Inc.

Benignus, V.A., D.A. Otto, K.E. Muller, and K.J. Seiple. 1981. "Effects of Age and Body Lead Burden on CNS Function in Young Children, II:EEG Spectra." *Electroencephalograph. Clin. Neurophysiol*, 52:240-248.

Manganese. Manganese is a naturally occurring substance found in many types of rock. It does not generally occur in the environment as the pure metal, rather, it is found combined with other chemicals such as sulfur, oxygen, and chlorine. Manganese is mixed with iron to make various types of steel. Manganese is a component of some ceramics, pesticides, fertilizers, and in nutritional supplements. In small doses manganese is beneficial to human health. Manganese miners and steel workers exposed to elevated concentrations of manganese have evidenced mental and emotional disturbances, and slow and clumsy body movements. Target organs of manganese are the lung and central nervous system. When inhaled, manganese dust can also cause lung irritation. USEPA has classified manganese as a Class D, not classifiable as to human carcinogenicity.

Reference:

ATSDR. 1991. "Toxicological Profile for Manganese." Agency for Toxic Substances and Disease Registry, U.S. Public Health Service (February).

Phenanthrene. Phenanthrene is a member of the polycyclic aromatic hydrocarbons (PAH) class of compounds which contain two or more aromatic rings. PAHs are ubiquitous in nature and are also manmade. Phenanthrene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material.

Phenanthrene has been shown to be a skin photosensitizer in humans. Intraperitoneally injection in rats produced liver effects. Although limited evidence exists that phenanthrene is a mutagen, the majority of tests have proved negative. Equivocal evidence exists for cancer after dermal application of phenanthrene in rats. Ingestion of 200 milligrams of phenanthrene produced no tumors in rats after 2 months.

Reference:

MADEP. 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6." Policy #WSC/ORS-142-92. Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, Massachusetts (September).

Pyrene. Pyrene is a member of the polycyclic aromatic hydrocarbons (PAH) class of compounds which contain two or more aromatic rings. They are ubiquitous in nature and are also manmade. It occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material. Pyrene is reported to be a skin irritant to humans. Rats administered pyrene exhibited blood chemistry changes, as well as liver and kidney damage. Pyrene was shown to be inactive as an initiating agent and thus has been classified as a D carcinogen.

Reference:

ATSDR. 1989. "Toxicological Profile for Polycyclic Aromatic Hydrocarbons." Agency for Toxic Substances and Disease Registry, U.S. Public Health Service (October).

Thallium. Thallium is a naturally occurring soft metal that is a minor constituent in a variety of ores and is obtained as a by-product of the refining of iron, cadmium, and zinc. It is used as a catalyst, in certain alloys, jewelry, thermometers, semiconductors, dyes and pigments, and optical lenses. It has been used medically as a depilatory agent. Additionally, it is used as a rodenticide and insecticide. Thallium is efficiently absorbed from the gastrointestinal tract. Excretion occurs primarily through urine and feces. Following absorption, distribution occurs to kidney tissue to a large extent, with lesser distribution to thyroid, intestines, testes, pancreas, skin, bone, and spleen.

Thallium is one of the more toxic metals. Acute toxicity results in gastrointestinal irritation, shock, ascending paralysis, seizures, and psychic disturbances. Signs of subacute or chronic thallium poisoning include hair loss, nail

dystrophy, cataracts, peripheral muscular weakness and atrophy, chorea, peripheral neuropathy, and kidney damage. Loss of vision have been related to industrial thallium exposures. No information is available which addresses the carcinogenic potential of thallium.

References:

Goyer, R.A. 1991. "Toxic Effects of Metals." In *Casarett and Doull's Toxicology: The Basic Science of Poisons*. 3rd ed. Eds. C.D. Klaassen, M.O. Amdur, and J. Doull. New York: Macmillan Publishing Co.

Tweig, M. 1990. "Thallium." In *Poisoning and Drug Overdose*. Ed. K.R. Olson. Connecticut: Appleton & Lange.

Tetryl. Tetryl is a commercial name for tinitrophenylmethylnitramine (CAS number 479458). This chemical is also known as n-methyl-n2,4,6-te tranitroaniline. It is an explosive that is used as a detonating agent for less sensitive high explosives. There is no carcinogenicity data available for tetryl. Animal studies with rabbits indicate that tetryl can cause histopathological effects in the liver, kidney, and spleen.

Vanadium. Vanadium is widely, but sparsely, distributed in the earth's crust and in the environment. It is invaluable as an alloying agent with steel; ferrovanadium alloys are used in high-stress applications such as bearings, jet engines, and cutting tools. Human and animal studies indicate that vanadium is readily absorbed from the lungs and poorly absorbed from the gastrointestinal tract. It distributes primarily to the bone and kidney. Vanadium is a respiratory irritant. Inhalation of vanadium dusts in both animals and occupationally-exposed workers induces mild to moderate respiratory irritation. The effects are reversible and subside when exposure is discontinued. No studies were located regarding cancer in humans or animals following inhalation, oral, or dermal exposures. However, vanadium has been found to induce DNA damage in human cell cultures, suggesting that vanadium may have the potential to be genotoxic to humans.

Reference:

ATSDR. 1990. "Toxicological Profile for Vanadium." Agency for Toxic Substances and Disease Registry, U.S. Public Health Service (October).

Zinc. The most common use of zinc is as a protective coating for other metals. Zinc is emitted into the air during mining, refining, manufacturing, and combustion of zinc-containing materials. Zinc is an essential trace element and is found in many foods. Zinc compounds are of relatively low toxicity via ingestion, however, ingestion may result in gastrointestinal distress and diarrhea. Metal fume fever results from occupational inhalation of fumes of zinc oxide whose symptoms include chills, fever, and profuse sweating. There is no evidence that zinc is a carcinogen.

Reference:

Amdur, Mary O., John Doull, and Curtis D. Klaassen. 1991. *Toxicology: The Basic Science of Poisons*. 4th ed. New York: Pergamon Press, Inc.