8.0 SUMMARY AND CONCLUSIONS

The Load Line 3 Phase II RI Report presents a detailed analysis of the environmental data collected during the Phase I and II RI field efforts. The following sections present an overview of the major findings of the nature and extent of contamination, modeling of contaminant fate and transport, and human health and ERAs. A revised site-specific conceptual model (CSM) is presented to integrate results of the evaluations presented in this report. The CSM denotes, based on available data, where source areas occur, the mechanisms for contaminant migration from source areas to receptor media (e.g., streams and groundwater), and exit pathways from the AOC. The conclusions of the Phase II RI are presented by media, with an emphasis on the degree of contamination and the potential risks to human receptors.

8.1 SUMMARY

8.1.1 Contaminant Nature and Extent

The Phase II RI evaluated the nature and extent of contamination in surface soil from 0 to 0.3 m (0 to 1 ft) bgs, subsurface soil from 0.3 to 1 m (1 to 3 ft) bgs, sediment, surface water, groundwater, storm and sanitary sewers, and selected buildings and structures.

8.1.1.1 Data aggregates/exposure units and data reduction

Surface and subsurface soil, sediments, and surface water were further divided into spatial aggregates based on AOC operational history, proximity of sampling stations to source areas, drainage patterns, and viability of aquatic habitat. These aggregates form the basis for EUs evaluated in the human health and ecological risk evaluations (Chapters 6.0 and 7.0, respectively). Surface soil and subsurface soil were divided into seven aggregates based on the criteria above. The aggregates demarcate areas believed to be impacted by different process-related activities, as well as areas believed to be relatively non-contaminated.

Sediment and surface water were grouped based on drainage patterns (e.g., upstream versus downstream) and to focus on the receptor exposure points for the human health and ecological risk evaluations. Sediments collected from intermittent, primarily dry drainage conveyances were addressed as surface soil media in the nature and extent evaluation and risk evaluations. Surface water samples were collected from non-viable ecological habitat and addressed as a separate miscellaneous surface water aggregate. Groundwater was evaluated on an AOC-wide basis. Storm and sanitary sewer systems, and samples from buildings and structures, were also considered separately in the nature and extent evaluation; these samples were not subjected to risk evaluations, as they are not representative of the exposure scenarios (e.g., recreational, NGB, or residential) evaluated in this RI.

Summary statistics for data within each aggregate were calculated for the purposes of identifying SRCs. SRCs were identified by screening data against frequency of detection criteria, essential human nutrient criteria, and RVAAP facility-wide background values for inorganics. The nature and extent evaluation focused on only those constituents identified as site-related.

8.1.1.2 Surface soil

A total of 131 primary surface soil samples from the 0- to 0.3-m (0- to 1-ft) depth were collected for the purpose of determining nature and extent of surface soil contamination across Load Line 3. Within the production area of the load line, sampling locations were biased to the building perimeters and drainage conveyances where contaminants most likely would have accumulated over time. Random grid sampling was applied in non-production areas (Perimeter Area Aggregate).

Explosive and propellant compounds occur in surface soil at Load Line 3, with the highest concentrations observed in immediate proximity of source areas. Pervasive inorganic SRCs in surface soil include barium, cadmium, chromium, copper, lead, thallium, and zinc. SVOCs detected in surface soil were primarily PAHs, which were observed frequently, although at generally low concentrations. Few VOCs were detected in surface soil samples from Load Line 3 and concentrations were generally low. PCBs appeared widespread as compared to the other melt-pour load lines at RVAAP. Some pesticides were detected sporadically.

Explosives Handling Areas Aggregate

This EU contained the highest concentrations and most extensive SRCs within Load Line 3. Explosives within this aggregate are widespread in extent, with the highest concentrations near the major production and processing buildings. The highest detected concentration of 2,4,6-TNT (390,000 mg/kg) was identified near Building EB-10 and far exceeded any other detected concentration within the load line. Numerous inorganic SRCs were identified in this aggregate; aluminum, arsenic, barium, cadmium, chromium, cobalt, copper, lead, manganese, nickel, and zinc were most pervasive. SVOCs were detected frequently, with the highest concentrations clustered near Buildings EA-6, EB-4, and EB-10. VOCs were generally limited to toluene and acetone, all with low detected concentrations. PCBs were detected in a number of samples with the highest concentrations (up to 1,100 mg/kg) clustered in the vicinity of Building EB-4. Low concentrations of pesticides were detected throughout the aggregate.

Preparation and Receiving Areas Aggregate

Contaminants in surface soils within this aggregate generally consisted of low levels of explosives, propellants, inorganics, and PCBs. Explosives and propellants were detected in the surface soils immediate to Building EB-803. Explosive compounds were all less than 1 mg/kg. Nitrocellulose was present at a concentration of 29.9 mg/kg in the single sample analyzed. Pervasive inorganic SRCs include arsenic, barium, chromium, cobalt, copper, lead, manganese, nickel, vanadium, and zinc. Although their distribution is widely variable, the highest overall concentrations of inorganics appear to be clustered on the west side of Building EB-803. Low concentrations of PAHs were detected; most observed detections were clustered near Buildings EB-3 and EB-803. PCBs were widely detected at relatively low concentrations with the peak values being identified along the west side of Building EB-803. Four VOCs were detected at low concentrations associated with Building EB-3. Low concentrations of pesticides were detected.

Packaging and Shipping Areas Aggregate

Contaminants in surface soil in this aggregate were limited to primarily explosives and inorganics. Explosives concentrations were generally low, with a single peak concentration of 2,4,6-TNT (820 mg/kg) being associated with Building EB-11. Nitroguanidine was detected at low concentrations. Pervasive inorganic SRCs include barium, cadmium, chromium, copper, lead, manganese, mercury, nickel, thallium, and zinc with peak concentrations being identified west of Building EB-11. SVOCs (primarily PAHs) were detected as a single occurrence with all detected concentrations being less than 1 mg/kg. PCB-1254 was consistently detected, with the highest concentration (91 mg/kg) being reported near Building EB-11. VOCs and pesticides were not detected.

Change Houses Aggregate

Contaminants in surface soil in this EU were limited to primarily inorganics and PCBs. No explosives compounds greater than 1 mg/kg were detected during field analyses. Inorganic SRCs were widely detected within the surface soils of this aggregate, with the majority of constituents being detected at concentrations up to 2 times background values where established. Peak concentrations were associated with Building EB-8A. PCB-1254 was identified in four of six samples analyzed with reported concentrations being confined to Buildings EB-8 and EB-8A. SVOCs, VOCs, and pesticides were not analyzed within this aggregate based on established DQOs (SAIC 2001).

Perimeter Area Aggregate

Some surface soil locations in this EU contained elevated levels of inorganic SRCs and lower levels of explosives, SVOCs, pesticides, and PCBs. Inorganic SRCs exceeding background concentrations were widely distributed with peak concentrations of several metals being detected in the area of Building EA-21. In general, low concentrations of explosive and propellant compounds were found associated with Buildings EA-21 and EA-5. SVOCs, specifically PAHs, were found associated with Building EA-21. The VOCs toluene and acetone were identified at a single location near Building EA-21 at concentrations less than 1 mg/kg. Low levels of several pesticides were identified near Building EA-21. PCB-1254 was reported at 110 mg/kg at this location as well.

DLA Storage Tanks Aggregate

No explosives compounds greater than 1 mg/kg were detected during field analyses. Surface soils within this aggregate contain primarily elevated levels of inorganic SRCs. The most pervasive compounds were antimony and cadmium. Typically, elevated concentrations of inorganic SRCs were reported in the southernmost DLA storage tank farm, specifically, just south of the southernmost storage tank along the railroad track. Several SVOCs, primarily PAHs, were identified at a single location; however, all concentrations were less than 1 mg/kg. VOCs, pesticides, and PCBs were not detected in the surface soils of the DLA Storage Tanks Aggregate.

West Ditches Aggregate

Surface soil in this EU contained elevated levels of explosives, inorganics, SVOCs, and PCBs and, to a lesser extent, several pesticide compounds. 2,4,6-TNT was identified as the most pervasive explosive compound reported at a peak concentration of 110 mg/kg, located at the western tip of the central ditch, just south of Building EB-8. In general, the associate explosive and propellant compounds identified were reported at much lower concentrations, typically less than 1 mg/kg. Cadmium, lead, mercury, and zinc were the most pervasive inorganic SRCs, with widespread, above background, detections throughout the aggregate. SVOCs were found to be widespread, with elevated concentrations of several PAHs reported in the areas of the confluence of the two southernmost West Ditches, north of Building EB-22. PCBs were reported at numerous locations with a peak concentration of 34 mg/kg associated with the central West Ditch, north of Building EB-8. Several pesticides were identified at low concentrations. VOCs were not characterized within the West Ditches Aggregate, as defined by the established DQOs (SAIC 2001).

8.1.1.3 Subsurface soil

A total of 27 primary soil samples from 0.3- to 0.9-m (1- to 3-ft) depths were collected based on field analyses of explosives to determine the nature and extent of subsurface soil contamination and to assess vertical migration. Based on Phase II RI data, contamination in subsurface soil within Load Line 3 is generally confined to explosive compounds and inorganics representing the primary SRCs. Metals detected at concentrations exceeding background criteria include barium, beryllium, cadmium, lead, and zinc. The highest concentrations of metals above background occur in the vicinity of Building EB-3 in the Preparation and Receiving Areas Aggregate, Buildings EB-4 and EA-6 in the Explosives Handling Areas Aggregate, and Building EA-21 in the Perimeter Areas Aggregate.

Explosives Handling Areas Aggregate

Subsurface soils in this aggregate contain primarily explosive and inorganic constituents. 2,4,6-TNT, being the most pervasive explosive compound, was identified in nearly all subsurface samples collected. The peak concentration of 270 mg/kg was reported near Building EA-6, with other elevated concentrations being reported in the same area and immediate to Building EB-4. Several concentrations in these areas were notably higher than those in the corresponding surface soil samples. Due to the adsorptive properties of the explosive compounds, the inconsistencies may be attributed to localized reworking of the surface soils.

PCBs were reported near Buildings EA-6 and EB-4, with the concentrations identified near Building EB-4 exceeding those reported in the corresponding surface sample. SVOCs, VOCs, and pesticides were not characterized in subsurface soils based on established DQOs (SAIC 2001).

Preparation and Receiving Areas Aggregate

Concentrations of explosive compounds greater than 1 mg/kg were not detected during field analyses of subsurface soils. Inorganic SRCs consisting of arsenic, cadmium, lead, and zinc were identified, with peak concentrations exceeding background immediate to Building EB-3. All detected concentrations were, however, relatively low for those with background values, with all detects being less than 2 times background. SVOCs, VOCs, pesticides, and PCBs were not characterized in the subsurface soils based on established DQOs (SAIC 2001).

Perimeter Area Aggregate

Some subsurface soil locations within the Perimeter Area Aggregate contain elevated concentrations of explosives and inorganic SRCs. 2,4,6-DNT was reported at 500 mg/kg near Building EA-5, along the railroad track. The corresponding surface soil sample exhibited a concentration of 0.83 mg/kg. Associate explosive constituents were reported as single occurrences with low concentrations near Building EA-6. Arsenic, barium, beryllium, cadmium, chromium, copper, lead, and zinc were identified at concentrations above background near Building EA-21. Arsenic and beryllium concentrations exceeded those reported for the corresponding surface soil samples. Inorganic SRCs were not reported above background in the area of Building EA-5. SVOCs, VOCs, pesticides, and PCBs were not characterized within the subsurface soils of this aggregate based on established DQOs (SAIC 2001).

8.1.1.4 Sediment and surface water

Cobb's Pond Tributary Aggregate

Explosive compounds were detected in the most downgradient sediment sample, although at low concentrations. Inorganic SRCs were identified in all sediment samples collected. The primary accumulation area for inorganics is near the confluence of the central west ditch located north of Building EB-8 and the Cobb's Pond Tributary. The reported value for copper at this location was 8 times background. One PCB compound was detected at a concentration of less than 1 mg/kg. The Phase I RI reported generally low concentrations of pesticides and SVOCs in the sediment sample collected. Analysis of SVOCs, pesticides, and VOCs was not performed during the Phase II RI based on established DQOs.

Impacts identified within the surface waters of the Cobb's Pond Tributary were limited to low concentrations of inorganic SRCs. With the exception of arsenic, peak concentrations of most constituents were detected in concert with the primary accumulation areas for elevated inorganic constituents in sediment. An isolated occurrence of 2-butanone was identified at the most downgradient location of the tributary. As the detected concentration was relatively low and a single occurrence, this detect appears to be an isolated outlier. No SVOCs, pesticides, or PCBs were identified at detectable concentrations in the surface waters of the Cobb's Pond Tributary.

Miscellaneous Surface Water Aggregate

Several explosive constituents were identified at one miscellaneous water station with all reported concentrations being less than 1 mg/L. Antimony and barium were also identified at low concentrations. Neither SVOCs, VOCs, pesticides, nor PCBs were identified at detectable levels in the Miscellaneous Surface Water Aggregate. The analytical results obtained from the sediment sample collected from this station were considered as surface soil for the nature and extent discussion and were included in the Explosives Handling Areas Aggregate.

8.1.1.5 Groundwater

Groundwater at Load Line 3 contained elevated concentrations of several explosive compounds in the area west of Building EB-4. Low concentrations of cobalt and manganese and several VOCs were identified throughout the aggregate. One SVOC, [bis(2-ethylhexyl)phthalate], and two pesticide compounds (heptachlor epoxide and beta-BHC) were reported as isolated occurrences. All organic constituents and cobalt were present at concentrations less than 1 mg/L. PCBs were not detected.

8.1.1.6 Storm and sanitary sewer system

Accumulation of explosives in sediment within the storm and sanitary sewer system of Load Line 3 appears limited to elevated concentrations (68 mg/kg) of 2,4,6-TNT. Several accessory explosive compounds were reported; however, concentrations were typically less than 1 mg/kg. All explosive compounds detected in the water samples were reported at concentrations less than 1 mg/L. Sediment collected from several manholes contained inorganic SRCs at concentrations between 1 (arsenic) and 143 (lead) times RVAAP background values for sediment. Other notable detections were chromium, copper, and barium at concentrations 25, 54, and 16 times RVAAP sediment background values, respectively. The peak metals concentrations were located in storm inlets that drain the areas near Building EB-803. Elevated inorganics were also present in the sediments from storm inlets that drain the areas near Buildings EB-11 and EB-10.

Water samples contained lead, nickel, and silver as inorganic SRCs, for which no background values have been established. All concentrations were isolated detects at concentrations less than 0.01 mg/L.

PCB-1254 was identified in all sediment samples collected with the peak concentration (15 mg/kg) being detected in the storm inlet west of Building EB-4. PCBs were not detected in the storm/sanitary sewer system waters. SVOCs, VOCs, and pesticides were absent in sediment and water within the storm and sanitary sewer system of Load Line 3.

8.1.1.7 Buildings and structures

Soil beneath building sub-floors exhibited generally low concentrations of explosives, several inorganic constituents, and PCB-1254.

Explosive compounds were detected in the sediments collected from washout annexes and sedimentation basins with elevated concentrations being associated primarily with the washout basins at Building EB-4 and, to a lesser extent, the sedimentation basin at Building EA-6. Detectable levels of inorganic constituents, in particular, cadmium, chromium, copper, lead, and zinc, were also identified. Relatively low concentrations of several SVOCs, primarily PAHs, and VOCs were identified in the washout annexes of Buildings EB-4 and EB-4A.

Water samples collected from the washout basins reflected detectable concentrations of metals and explosives corresponding to those observed at high concentrations in sediment.

Floor sweep samples were comprised of a high percentage of iron. Cadmium, chromium, lead, nickel, and zinc were present at elevated concentrations in all three buildings. Cyanide and As^{+3} were detected in the samples collected from all three buildings, although concentrations were low and relatively consistent. The highest levels of explosives were observed in Building EB-4. Low, estimated concentrations of a number of SVOCs and pesticides were detected in all of the floor sweep samples. Trace levels of acetone, benzene, and toluene were also detected in the samples collected from Buildings EB-10 and EB-3. Notably, PCB-1254 was detected in all three floor sweep samples with the highest values observed in Building EB-10. Cadmium and/or lead were detected in TCLP extracts with concentrations exceeding the TCLP criteria for hazardous waste determination at Buildings EB-10 and EB-3; however, no constituent exceeded their respective criteria for characteristically hazardous wastes.

8.1.2 Contaminant Fate and Transport

Contaminant fate and transport modeling performed as part of the Phase II RI included leachate modeling (SESOIL) at the source area within Load Line 3 demonstrating the highest levels of process-related contaminants (Building EB-4A). Groundwater modeling (AT123D) was conducted from this source to selected receptors or exit points from the AOC. The receptor and exit points selected for groundwater transport modeling consists of the tributary to Cobb's Pond (the tributary is the nearest presumed groundwater baseflow discharge point) and the RVAAP facility boundary. Groundwater transport modeling was conducted to evaluate the potential for off-site migration of any identified CMCOPCs.

SESOIL Modeling

One metal (selenium) and eight organic compounds (1,3-DNB; 2,4-DNT; 2,6-DNT; 4-nitrotoluene; nitrobenzene; 1,3,5-TNT; 2,4,6-TNT; and RDX) were identified as initial CMCOPCs based on source loading predicted by the leachability analysis near the source (Building EA-4A) and were selected for SESOIL modeling. The SESOIL modeling results indicate that RDX may leach from surface soil to groundwater with concentrations beneath the source area exceeding its groundwater MCL or RBC. The predicted time for peak groundwater concentration for RDX was 12 years, which based on site history, may have already occurred. RDX was identified in groundwater at a concentration lower than the predicted value. The leaching model is conservative and migration of these constituents may be attenuated because of moderate to high retardation factors for these constituents.

AT123D Modeling

Modeling of contaminant transport in shallow groundwater was conducted for four CMCOPCs from the Building EB-4A source area to two endpoints. One of these four CMCOPCs was identified from SESOIL modeling results, and the remaining three (manganese, beta-BHC, and heptachlor epoxide) were identified based on observed groundwater concentrations (that exceeded their respective MCL or RBC). The first endpoint evaluated was the Cobb's Pond Tributary at the closest point to the source area; the tributary is presumed to be a discharge area for shallow groundwater based on potentiometric data. The second endpoint modeled was the RVAAP facility boundary at its closest point downgradient of the source area.

AT123D modeling results indicate that migration of RDX to the Cobb's Pond Tributary endpoint may occur with concentrations at the endpoint above its RBC. Modeling results indicate no migration of manganese, beta-BHC, or heptachlor epoxide to the Cobb's Pond Tributary and no migration of any of the CMCOPCs to the RVAAP boundary endpoints at concentrations exceeding MCLs or RBCs. Concentrations of RDX at the Cobb's Pond Tributary receptor point are predicted to reach a peak concentration of 0.375 mg/L (Chapter 5.0, Table 5-3). The predicted peak concentration for RDX at the RVAAP boundary point is 0.0000262 mg/L.

8.1.3 Human Health Risk Evaluation

A SHHRA was conducted to identify COCs and RGOs for contaminated media at the RVAAP Load Line 3 for three potential future use scenarios: National Guard use, recreational use, and residential use. Results have been presented for all scenarios and exposure pathways. The following steps were used to generate conclusions regarding human health risks and hazards associated with contaminated media at Load Line 3:

- identification of COPCs;
- calculation of EPCs for COPCs;
- calculation of screening RGOs at a chemical HI of 0.1 or risk level of 10^{-6} for all identified COPCs;
- identification of COCs by comparing COPC concentrations against screening RGOs; and
- calculation of risk-based RGOs (HI of 1 or risk level of 10^{-5}) to move forward to the FS.

COCs were identified for National Guard receptors (Trainee, Security Guard/Maintenance Worker, and Fire/Dust Suppression Worker), recreational receptors (Hunter/Trapper/Fisher), and residential receptors (Resident Subsistence Farmer Adult and Child). A COC summary is presented in Table 8-1, with results discussed below for each medium. Risk-based RGOs were calculated for all chemicals identified as COCs (see Chapter 6.0) for any medium or receptor (e.g., arsenic is identified as a COC in surface water for the resident farmer only; however, risk-based RGOs are calculated for this metal for all receptors exposed to surface water).

8.1.3.1 Groundwater

One COC (2,4,6-TNT) was identified for the National Guard Trainee exposed via potable use of groundwater; this COC and five additional COCs (manganese, RDX, heptachlor epoxide, beta-BHC, and carbon tetrachloride) were identified for the On-Site Residential Farmer scenarios. For these groundwater COCs, ratios of EPCs to RGOs indicate that estimated cancer risks would be less than 10^{-6} for the National Guard Trainee and between 10^{-6} and 10^{-5} for the residential farmer scenarios. These are hypothetical future scenarios; no receptors are currently using groundwater from the AOC for any purpose.

8.1.3.2 Surface water and sediment

Exposure to surface water and sediment in Cobb's Pond was evaluated for five receptor scenarios: National Guard Fire/Dust Suppression Worker, National Guard Trainee, Hunter/Trapper/Fisher, and Resident Farmer (adult and child). Manganese was the only surface water COC identified for the National Guard Trainee; this COC and arsenic were identified for the On-Site Residential Farmer scenarios also. For the surface water COCs, ratios of EPCs to RGOs indicate that estimated cancer risks would be less than 10^{-6} for the National Guard receptors; estimated cancer risks would be between 10^{-6} and 10^{-5} for the residential farmer scenarios.

Table 8-1. Chemicals Exceeding RGOs (COCs) by Receptor/Medium/Exposure Unit Combination at Load Line 3

COC	Groundwater			Surface Water					Sediment				
	National Guard Trainee	Resident Farmer Adult	Resident Farmer Child	Dust/Fire Control Worker	National Guard Trainee	Hunter/ Trapper/ Fisher	Resident Farmer Adult	Resident Farmer Child	Dust/Fire Control Worker	National Guard Trainee	Hunter/ Trapper/ Fisher	Resident Farmer Adult	Resident Farmer Child
Inorganics													
Aluminum													
Antimony													CP
Arsenic							CP	CP					
Barium													
Cadmium													
Manganese		LL3	LL3		CP		CP	CP					
Thallium													
Organic Explosives													
1,3-Dinitrobenzene													
2,4,6-Trinitrotoluene	LL3	LL3	LL3										
2,4-Dinitrotoluene													
RDX		LL3	LL3										
Organic PCBs													
PCB-1254													CP
PCB-1260													
Organic Pesticides													
4,4'-DDE													
Dieldrin													
Heptachlor													
Heptachlor Epoxide		LL3	LL3										
beta-BHC		LL3											
Organic Semivolatiles													
Benz(*a*)anthracene													
Benzo(*a*)pyrene												CP	CP
Benzo(*b*)fluoranthene													
Dibenz(*a,h*)anthracene													
Indeno(1,2,3-*cd*)pyrene													
Organic Volatiles													
Carbon Tetrachloride		LL3											

Table 8-1. Chemicals Exceeding RGOs (COCs) by Receptor/Medium/Exposure Unit Combination at Load Line 3 (continued)

COC	Shallow Surface Soil					Deep Surface Soil	Subsurface Soil	
	Security Guard/ Maintenance Worker	Dust/Fire Control Worker	Hunter/ Trapper/ Fisher	Resident Farmer Adult	Resident Farmer Child	National Guard Trainee	Resident Farmer Adult	Resident Farmer Child
Inorganics								
Aluminum					CH,EH,PS	CH,EH,PS		
Antimony				DL,WD	DL,EH,PR,PS,WD			
Arsenic	DL,EH,PA,PR,PS, WD			DL,EH,PA,PR,PS, WD	DL,EH,PA,PR,PS,WD	DL,EH,PA,PR,PS,WD	EH,PA,PR	EH,PA,PR
Barium					PS	PS		
Cadmium					PA,PS	PA,PS		PA
Manganese				PS	CH,DL,EH,PA,PR,PS, WD	CH,DL,EH,PA,PR,PS, WD		
Thallium					PR			
Organic Explosives								
1,3-Dinitrobenzene	EH			EH	EH			
2,4,6-Trinitrotoluene	EH,PS,WD	EH,PS	EH	EH,PS,WD	EH,PS,WD	EH,PA,PS	EH,PA	EH,PA
2,4-Dinitrotoluene	EH			EH,PS	EH,PS			
RDX	EH,PA			EH,PA,PR	EH,PA,PR		PA	PA
Organic PCBs								
PCB-1254	CH,EH,PA,PR,PS, WD	EH,PA,PS	EH,PA,PS	CH,EH,PA,PR,PS, WD	CH,EH,PA,PR,PS,WD	CH,EH,PA,PR,PS,WD	EH	EH
PCB-1260	EH			EH,PR	EH			
Organic Pesticides								
4,4'-DDE				PA	PA			
Dieldrin	EH			EH,WD	EH,WD			
Heptachlor				PA	PA			
Heptachlor Epoxide								
beta-BHC								
Organic Semivolatiles								
Benz(*a*)anthracene	EH,WD			EH,PA,WD	EH,WD			
Benzo(*a*)pyrene	EH,PA,PR,PS,WD	WD		EH,PA,PR,PS,WD	EH,PA,PR,PS,WD	EH,WD		
Benzo(*b*)fluoranthene	EH,WD			EH,PA,WD	EH,PA,WD			
Dibenz(*a,h*)anthracene	EH,WD			EH,PA,PR,WD	EH,WD			
Indeno(1,2,3-*cd*)pyrene	EH,WD			EH,WD	EH,WD			
Organic Volatiles								
Carbon Tetrachloride								

Table 8-1. Chemicals Exceeding RGOs (COCs) by Receptor/Medium/Exposure Unit Combination at Load Line 3 (continued)

COCs are shown for each medium/receptor/area of concern combination. Chemicals whose exposure point concentration exceeds its screening risk-based RGO are COCs. Area of concern codes are as follows:

LL3 = Load Line 3.
CH = Change Houses Aggregate
CP = Cobb's Pond Tributary Aggregate.
DL = DLA Tanks Aggregate.
EH = Explosives Handling Areas Aggregate.
PA = Perimeter Area Aggregate.
PR = Preparation and Receiving Areas Aggregate.
PS = Packaging and Shipping Areas Aggregate.
WD = West Ditches Aggregate.

BHC = Benzene hexachloride.
COC = Chemical of concern.
DDE = Dichlorodiphenyldichloroethylene.
PCB = Polychlorinated biphenyl.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.
RGO = Remedial goal option. Screening risk-based RGOs are based on a cancer risk level of 10^{-6} or a hazard level of 0.1 (whichever is smaller) and are shown in Tables Q-10 through Q-15. Screening of Load Line 3 data to determine COCs is shown in Tables Q-16 through Q-21.

Three chemicals were identified as sediment COCs for the Resident Farmer scenario only: antimony, PCB-1254 (child only), and benzo(*a*)pyrene (adult and child). For the sediment COCs, ratios of EPCs to RGOs indicate that estimated cancer risks would be at or slightly above 10^{-6} for the residential farmer scenarios.

8.1.3.3 Soil

Soil was evaluated at seven EUs defined on the basis of Load Line 3 operational history and site characteristics. Three vertical aggregations of the soil column were evaluated depending on the receptor scenario.

- Shallow surface soil from 0 to 0.3 m (0 to 1 ft) bgs, as applied to all receptors, except the National Guard Trainee.

- Deep surface soil from o to 1.3 m (0 to 4 ft) bgs, as applied to only the National Guard Trainee.

- Subsurface soil defined as all soil deeper than 0.3 m (> 1 ft) bgs for the Resident Farmer adult and child only.

Direct contact (ingestion, dermal contact, and inhalation) with surface and subsurface soils was evaluated for six receptors: National Guard Security Guard/Maintenance Worker (shallow surface soil), National Guard Fire/Dust Suppression Worker (shallow surface soil), National Guard Trainee (deep surface soil), Hunter/Trapper/Fisher (shallow surface soil), and Resident Farmer (adult and child) (shallow surface soil and subsurface soil). The following summarizes the resulting COCs in soil at Load Line 3.

Shallow Surface Soil

Twenty-one Load Line 3 COCs were identified for shallow surface soil (Table 8-1). The number of shallow surface soil COCs varied for each receptor, with 2 COCs for the Hunter/Trapper/Fisher; 3 COCs for the Fire/Dust Suppression Worker; 13 COCs for the Security Guard/Maintenance Worker, 17 COCs for the Resident Farmer Adult, and 21 COCs for the Resident Farmer Child. The number of shallow surface soil COCs identified for each EU also varied: 3 for both the DLA Storage Tanks and Change Houses Aggregates, 8 for the Preparation and Receiving Areas Aggregate, 10 for the Packaging and Shipping Areas Aggregate, 11 for both the Perimeter Area and West Ditches Aggregates, and 16 for the Explosives Handling Areas Aggregate.

Ratios of EPCs to RGOs provide an indication of estimated cancer risks. Most COCs have EPCs that would produce cancer risks of less than 10^{-5}; a handful of COCs would produce risks in excess of 10^{-5} for receptors other than the resident farmer.

- PCB-1254 in six of the seven aggregates (all except the DLA Storage Tanks Aggregate; estimated risk for PCB-1254 would exceed 10^{-4} for the Security Guard/Maintenance Worker in the in the Explosives Handling Areas and Packaging and Shipping Areas Aggregates).

- 2,4,6-TNT in the Explosives Handling Areas and Packaging and Shipping Areas Aggregates.

- Benzo(*a*)pyrene in the Explosives Handling Areas and West Ditches Aggregates.

Estimated risks for several COCs would exceed the 10^{-5} risk level for the resident farmer scenarios, including:

- arsenic (>10^{-4} in the Explosives Handling Areas Aggregate);
- 2,4,6-TNT (>10^{-4} in the Explosives Handling Areas Aggregate),
- 2,4-DNT and PCB-1254 (>10^{-4} in the Explosives Handling Areas, Packaging and Shipping Areas, and Perimeter Area Aggregates); and
- benzo(*a*)pyrene, benzo(*b*)fluoranthene, and dibenz(*a,h*)anthracene.

Deep Surface Soil

Eight Load Line 3 COCs were identified for the National Guard Trainee exposed to deep surface soil, including five metals (aluminum, arsenic, barium, cadmium, and manganese), one explosive (2,4,6-TNT), one PCB (PCB-1254), and one PAH [benzo(*a*)pyrene]. The number of deep surface soil COCs identified for each EU varied, ranging from two for the DLA Storage Tanks Aggregate to seven for the Packaging and Shipping Areas Aggregate.

Ratios of EPCs to RGOs indicate that estimated cancer risks would be at or slightly above 10^{-6} for most deep surface soil COCs; two COCs would result in estimated cancer risk to the National Guard Trainee of slightly larger than 10^{-5} at the Explosives Handling Areas Aggregate (2,4,6-TNT and PCB-1254), the Packaging and Shipping Areas Aggregate (PCB-1254), and the Perimeter Area Aggregate (PCB-1254).

Subsurface Soil

Five COCs were identified for the Resident Farmer (adult and child) exposed to subsurface soil at Load Line 3 (arsenic; cadmium; 2,4,6-TNT; RDX; and PCB-1254). The Perimeter Area, Explosives Handling Areas, and Preparation and Receiving Areas Aggregates had several identified COCs each. No COCs were identified for Packaging and Shipping Areas, DLA Storage Tanks, Change Houses, and West Ditches Aggregates.

Ratios of EPCs to RGOs provide an indication of estimated cancer risks. Estimated risks that would be greater than 10^{-5} for the resident farmer include arsenic and PCB-1254 (>10^{-4}) at the Explosives Handling Areas Aggregate; arsenic and 2,4,6-TNT at the Perimeter Area Aggregate; and arsenic at the Preparation and Receiving Areas Aggregate.

8.1.4 Ecological Risk Evaluation

Load Line 3 contains sufficient terrestrial and aquatic (surface water and sediment) habitat to support various types of ecological receptors, such as vegetation, small and large mammals, and birds. Due to the presence of suitable habitat and observed receptors at the site, a SERA was performed in accordance with written guidance from USACE, Louisville District and Ohio EPA, and also utilized Ohio's WQSs. Ecological evaluations were done on soil, sediment, and surface water using ecological screening values primarily. Following the SERA, there was a Level III BERA performed on the preliminary COPECs. The methods followed the Army and Ohio EPA protocols and resulted in COECs. Groundwater was not evaluated considering that direct exposure to receptors would be expected to occur as discharge to surface water features. Soil deeper than 0.3 m (1 ft) was also not evaluated considering that contaminant concentrations in surface soil represent the probable worst-case exposures for most contaminants.

8.1.4.1 Soil

Risks were evaluated for seven EUs for surface soils based on historical use and geographic proximity, as described in Section 4.1.2 and Chapter 7.0. At all EUs, the rationale responsible for identifying the most preliminary COPECs was the maximum detection exceeded the ESV. The rationale responsible for identifying the fewest preliminary COPECs was No ESV, which only identified PCB-1254 at two of the six EUs. The number of preliminary COPECs that were identified by the rationale of the Load Line 3 means > Load Line 1 means per t-tests and the spatial distribution evaluation was generally small, ranging from six metals at the Explosives Handling Areas Aggregate and none at the Preparation and Receiving Areas and Perimeter Area aggregates. All of these preliminary COPECs were further evaluated by calculating screening HQs. BERA activities depended on the following ecological receptors: vegetation, soil invertebrates, cottontail rabbits, shrews, foxes, and hawks.

The Explosives Handling Areas Aggregate contained the most preliminary COPECs for soil (19, including 16 metals, 2 pesticides, and 1 PCB), whereas the West Ditches Aggregate contained the fewest preliminary COPECs for soil (6 metals each). The Preparation and Receiving Areas Aggregate had the second highest number of preliminary COPECs (12, including 9 metals, 1 explosive, 1 PCB, and 1 semivolatile). The Packaging and Shipping Areas Aggregate had nine preliminary COPECs (all metals). A summary of the Load Line 3 soil preliminary COPECs, organized by EUs, and the rationales for why the analytes were preliminary COPECs is presented in Chapter 7.0, Table 7-9. BERA activities reduced the number of COPECs in every location. The Explosives Handling Areas Aggregate had 11 COECs (down from 19 COPECs), the Preparation and Receiving Areas Aggregate showed 9 (down from 12), and the Packaging and Shipping Areas Aggregate had 8 (down from 9). The West Ditches Aggregate remained one of the lowest with five COECs (down from six) and the DLA Storage Tank and Perimeter Area Aggregates exhibited even fewer COECs of four and three, respectively. A summary of Load Line 3 soil COECs is provided in Chapter 7.0, Table 7-12.

8.1.4.2 Sediment and surface water

Sediment

The Cobb's Pond Tributary Aggregate contained 29 preliminary COPECs for sediment (10 metals, 4 pesticides, 1 PCB, 2 explosives, and 12 semivolatiles). Approximately one-half of the preliminary COPECs for sediment were selected by virtue of being PBT compounds (14 out of 29). Only five sediment analytes were identified as preliminary COPECs based solely on having no ESVs, and only three analytes were selected by having a maximum detect exceeding the ESV. All of these preliminary COPECs were further evaluated by calculating screening HQs. A summary of the Load Line 3 sediment preliminary COPECs and the rationales for why the analytes were preliminary COPECs is presented in Chapter 7.0, Table 7-10. BERA activities utilized the following ecological receptors: benthic invertebrates, riparian herbivores (muskrats and mallards), and riparian carnivores (mink and herons). BERA activities reduced the number of COPECs. For example, at Cobb's Pond Tributary Aggregate there are 18 COECs (down from 29 COPECs). A summary of Load Line 3 sediment COECs is provided in Chapter 7.0, Table 7-13.

Surface Water

Three preliminary COPECs (three metals) were identified at the Cobb's Pond Tributary Aggregate. The rationales responsible for identifying the preliminary COPECs included maximum detection exceeding ESV for iron and manganese, and no ESV for potassium. All of these preliminary COPECs were further evaluated by calculating screening HQs. A summary of the Load Line 3 surface water preliminary COPECs and the rationales for why the analytes were preliminary COPECs is presented in Chapter 7.0,

Table 7-11. BERA activities used the following ecological receptors: aquatic life, riparian herbivores (muskrats and mallards), and riparian carnivores (mink and herons). BERA activities further screened the three COPECs to two COECs.

8.2 CONCEPTUAL SITE MODEL

The preliminary Load Line 3 CSM, developed as part of the Phase II RI SAP Addendum, was summarized in Chapter 2.0. A revised CSM is presented in this section that incorporates Phase II RI data and the results of contaminant fate and transport modeling and risk evaluations. Elements of the CSM include

- primary contaminant source areas and release mechanisms,
- contaminant migration pathways and exit points, and
- data gaps and uncertainties.

An illustrated version of the revised CSM is provided in Figure 8-1 to assist in visualizing the concepts discussed below.

8.2.1 Source-Term and Release Mechanisms

Results of the Phase II RI soil sampling indicate that the Explosives Handling Areas Aggregate, particularly areas surrounding Buildings EB-4 and EA-6, contains the greatest numbers and concentrations of contaminants. Metals, explosives, PAHs, and PCBs/pesticides are present in soil in these areas at concentrations greater than background or risk-screening criteria. Other source areas defined by Phase II RI data include the areas surrounding Buildings EB-3 and EB-803 (inorganics and PCBs).

The majority of soil contamination at Load Line 3 is within the surface soil interval less than a depth of 0.3 m (1.0 ft). However, within the limited number of subsurface samples collected, explosives and several inorganic constituents were detected at elevated concentrations, primarily in the vicinity of Buildings EA-21 and EA-5 in the Perimeter Area Aggregate and Building EA-6 in the Explosives Handling Areas Aggregate.

Two primary mechanisms for release of contaminants from the source areas are identified (1) erosional and/or dissolved phase transport of contaminants from soil sources with transport into the storm drain network or drainage ditches, and (2) leaching of constituents to groundwater via infiltration of rainwater through surface and subsurface soils. Evaluation of these release mechanisms was done through sampling of the storm drainage network (ditches and storm sewers) and numerical modeling of soil leaching processes. Discussion of the results of evaluation of data for preferred contaminant migration pathways and exit points is presented below. Airborne dispersion of contaminants was not quantified or modeled. The chemical characteristics of the SRCs present high, annual precipitation levels and heavy vegetation cover at Load Line 3 likely precludes any substantial dispersion of contaminants via this pathway.

8.2.2 Contaminant Migration Pathways and Exit Points

Surface Water Pathways

Migration of contaminants from soil sources via surface water occurs primarily by (1) movement of particle-bound (e.g., clays or colloids) contaminants in surface water runoff, and (2) transport of dissolved constituents in surface water. Surface runoff is directed to drainage ditches and the storm drainage network, most of which drain into the tributary to Cobb's Pond.

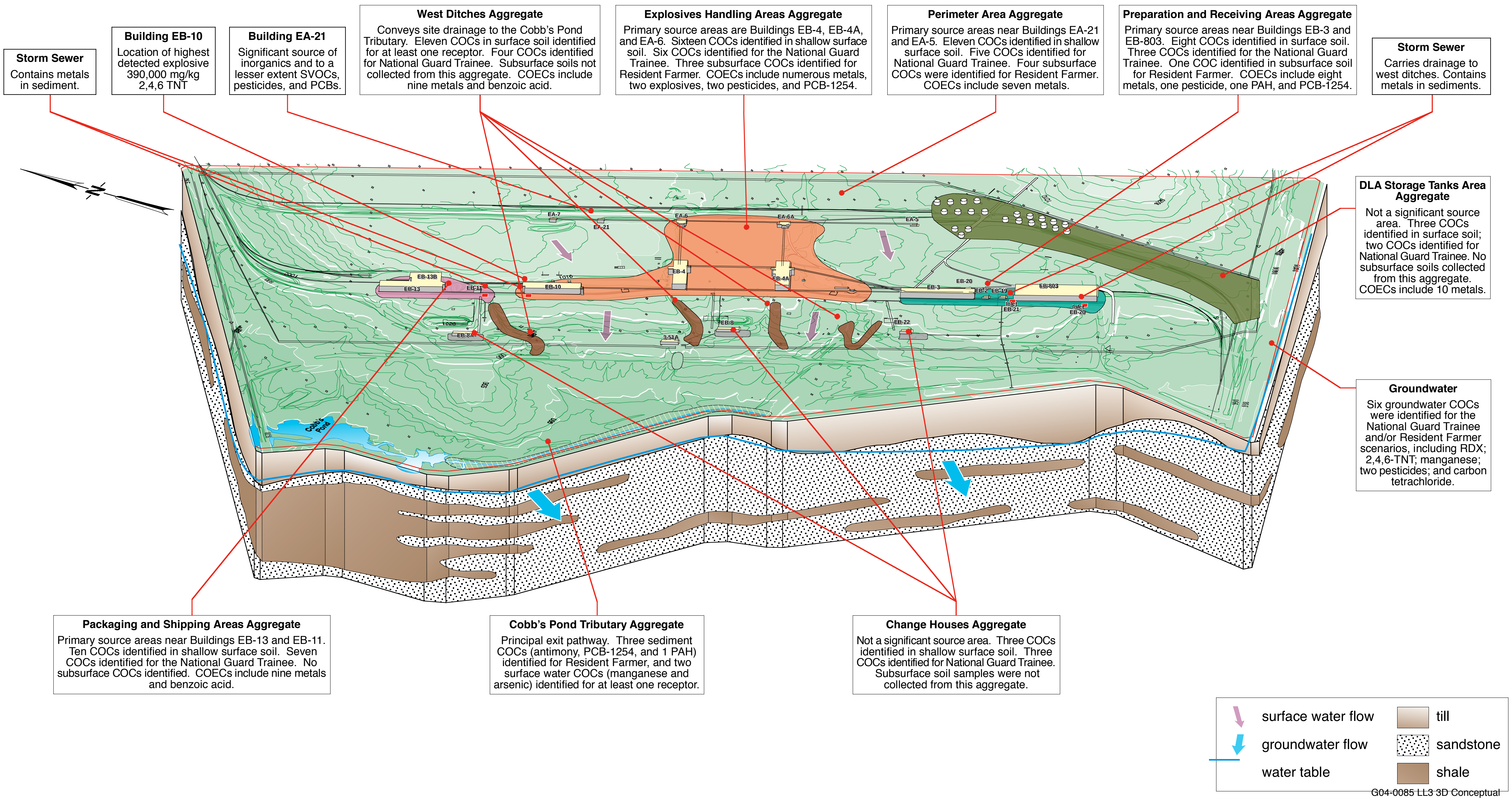

Figure 8-1 Conceptual Site Model for Load Line 3

Upon reaching quiescent portions of surface water conveyances, flow velocities decrease and particle-bound contaminants are expected to settle out as sediment accumulation. Sediment-bound contaminants may be re-mobilized during storm events. Sediment-bound contaminants may also partition to surface water and be transported in dissolved phase. Sampling of the dry sediment from the West Ditches indicates some contaminant accumulation from the Explosives Handling Areas and sedimentation basins through these conveyances into the Cobb's Pond Tributary, which exits the AOC to the northwest. Results of sediment and water sampling from the storm sewer network indicate some accumulation of explosives and inorganics in sediment and only trace concentrations in water. Low levels of PCBs also appear to have accumulated. The sanitary sewer system is a closed system and is not open to receiving substantial surface water runoff.

Substantial contaminant accumulation within the Cobb's Pond Tributary is limited to inorganic constituents identified in isolated areas based on Phase I and II RI data. Inorganic SRCs were detected in tributary sediment and the highest concentrations appear to have accumulated near the confluence of the central west ditch located north of Building EB-8 and the Cobb's Pond Tributary. However, the magnitude of constituents exceeding background is generally low with the exception of copper, lead, and zinc. Partitioning of contaminants from sediment to water is not evident based on available data.

Accumulated explosive compounds were less than 1 mg/kg in tributary sediment and partitioning to water with subsequent dissolved phase transport is not evident. SVOCs, VOCs, pesticides, and PCBs were detected at low concentrations in stream sediments with no significant appearance in the tributary waters.

Leaching and Groundwater Pathways

Theoretical numerical modeling of leaching potential for soil source areas indicates that RDX may be expected to leach from the contaminated surface soil into the groundwater and reach concentrations exceeding groundwater MCLs or RBCs. The low concentrations of RDX, and lack of overall substantial contamination, in groundwater at Load Line 3 suggest that retardation processes (e.g., sorption, degradation, etc.) effectively attenuate contaminants within the vadose zone. Shallow groundwater flow follows stream drainage and topographic patterns with flow to the west toward the AOC and RVAAP boundaries. Modeling results indicate that migration of RDX via shallow groundwater to the Cobb's Pond Tributary may occur at concentrations above RBCs. Concentrations of RDX at the Cobb's Pond Tributary receptor point are predicted to reach a peak concentration of 0.375 mg/L (Chapter 5.0, Table 5-3). The predicted peak concentration for RDX at the RVAAP boundary point is 0.0000262 mg/L. The conservative modeling results may not fully represent retardation and attenuation effects in the subsurface.

Given that a portion of the storm and sanitary sewer system at Load Line 3 is flooded, these utility networks may serve as preferential conduits for shallow groundwater movement. These systems were evaluated to determine if they facilitate transport of contaminants dissolved in groundwater or function as sources of dissolved phase contaminants to groundwater. As noted above, the storm drain network contains some accumulated inorganics and PCBs that appear to be partitioning to water. Concentrations of explosives were detected at maximum concentrations of 68 mg/kg for 2,4,6-TNT. Most contaminant accumulation is within the storm drain inlet basins. Accordingly, the storm drain network may act as a minor source of contaminant flux to groundwater and likely facilitates the movement of shallow groundwater in the vicinity of cracked or broken pipes where inflow or outflow may occur. The sanitary sewer system at Load Line 3 contains some accumulated inorganics and may contribute some level of contaminant flux to groundwater.

8.2.3 Uncertainties

The CSM is developed based on available site characterization and chemical data. Uncertainties are inherent in the CSM where selected data do not exist or are sparse. The uncertainties within the CSM for Load Line 3 include the following.

- Groundwater monitoring wells installed during the Phase II RI targeted the water table interval only. The observed extent and magnitude of contamination in AOC soil and shallow groundwater do not indicate substantial contamination of groundwater within the AOC and conservative modeling results suggest that off-AOC migration of contaminants will not occur. However, groundwater within deeper flow zones was not characterized and conclusions regarding groundwater contaminant transport are representative of only the source areas modeled and hydrostratigraphic intervals that were characterized.

- The exact source(s) of PAHs at Load Line 3 is unknown, although likely they may, in part, be anthropogenic combustion products derived from coal and/or fuel oil-fired power and boiler plant emissions.

- Leachate and transport modeling is limited by uncertainties in the behavior and movement of contaminants in the presence of multiple solutes. In addition, heterogeneity, anisotropy, and spatial distributions of permeable zones (e.g., sand or gravel zones) could not be fully characterized during the field investigation nor addressed in the modeling. Therefore, effects of these features on contaminant transport at Load Line 3 are uncertain and modeling results are considered as conservative representations.

- The exact source(s) of some inorganics (specifically manganese) in surface soils and sediments of Load Line 3 is unknown. Data evaluated in the nature and extent and risk evaluations address all accumulated contamination within the load line, whether from natural or anthropogenic sources. Results of the evaluations may reflect, in part, contributions from sources other than Load Line 3 operations (e.g., slag or pre-RVAAP activities).

- Limited data collected from beneath building floor slabs do not indicate substantial contamination of subfloor soils. However, additional data may be required to further characterize such soils if building floor slabs are removed as part of a future action.

8.3 CONCLUSIONS

The conclusions presented below, by medium, combine the findings of the contaminant nature and extent evaluation, fate and transport modeling, and the human health and ecological risk evaluations. To support remedial alternative selection and evaluation in future CERCLA documents (e.g., FS), RGOs were developed for identified COCs in surface soil, subsurface soil, surface water, sediment, and groundwater at Load Line 3 at an HI or 1 or risk level of 10^{-5}. A summary of the results of the human health RGO comparisons is provided in Chapter 6.0.

8.3.1 Explosives Handling Areas Aggregate

The primary identified source areas in the Explosives Handling Areas Aggregate include Buildings EA-6 and EB-4. Metals, explosives, PAHs, and PCBs represent the most pervasive SRCs in the former production areas. The spatial distribution and concentrations of contaminants were highly variable in the vicinity of these source areas. With respect to vertical distribution, the numbers and concentrations of SRCs in subsurface soil at these source areas are selectively higher relative to surface soil.

Theoretical numerical modeling of leaching potential for soil source areas indicates that at Buildings EB-4 and EB-4A, concentrations of RDX at the groundwater table may exceed RBCs. Migration of RDX from Building EB-4 to the closest groundwater baseflow discharge points is predicted to occur. Migration of constituents is expected to be attenuated, due to moderate to high retardation factors, as well as degradation of organic compounds; these processes are not reflected in the conservative modeling results.

Comparison of concentrations of Load Line 3 COPCs in shallow surface soil to screening RGOs shows that a total of 16 chemicals exceed their respective criteria in at least one receptor scenario (Section 6.5.2.4). Six deep surface soil COCs were identified for the National Guard Trainee. Three subsurface soil COCs were identified for the Resident Farmer Scenario (adult and/or child).

COECs include numerous metals, two explosives, two pesticides, and PCB-1254.

8.3.2 Preparation and Receiving Areas Aggregate

The primary identified source areas in the Preparation and Receiving Areas Aggregate include Buildings EB-3 and EB-803. Metals, PAHs, and PCBs represent the most pervasive SRCs in these areas. The spatial distribution and concentrations of contaminants were highly variable. With respect to vertical distribution, the numbers and concentrations of SRCs in subsurface soil at these source areas deceased substantially relative to surface soil.

Comparison of concentrations of Load Line 3 COPCs in shallow surface soil to screening RGOs shows that a total of eight chemicals exceed the RGOs for at least one exposure scenario (Section 6.5.2.4). Three COCs were identified for deep surface soil for the National Guard Trainee. One COC was identified for the Resident Farmer Scenario in subsurface soil.

COECs include eight metals, one pesticide, one PAH, and PCB-1254.

8.3.3 Packaging and Shipping Areas Aggregate

The primary identified source area in the Packaging and Shipping Areas Aggregate is Building EB-11. Metals are the most pervasive SRCs in this area; low concentrations of PAHs and PCBs were detected sporadically. The spatial distribution and concentrations of contaminants were highly variable. No explosives compounds greater than 1 mg/kg were detected during field analyses. Accordingly, subsurface soil samples were not collected.

Comparison of concentrations of Load Line 3 COPCs in shallow surface soil to screening RGOs shows that a total of 10 chemicals exceed the RGOs for at least one receptor scenario (Section 6.5.2.4). Seven deep surface soil COCs were identified for the National Guard Trainee. No COCs were identified for the Resident Farmer Scenario in subsurface soil. COECs include nine metals and benzoic acid.

8.3.4 Change Houses Aggregate

Surface soil in this EU contains 14 inorganic SRCs with results exceeding RVAAP background values; however, concentrations were typically less than 2 times background values. Low levels of PCBs were also reported. No explosives compounds greater than 1 mg/kg were detected during field analyses. Accordingly, subsurface soil samples were not collected. Maximum levels of SRCs were detected in the vicinity of Buildings EB-8 and EB-8A.

Comparison of concentrations of Load Line 3 COPCs in shallow surface soil to screening RGOs shows that a total of three chemicals exceed the RGOs for at least one receptor scenario. Three deep surface soil COCs were identified for the National Guard Trainee. Subsurface soils were not evaluated, as no samples were collected.

8.3.5 Perimeter Area Aggregate

The primary contaminant source in this aggregate is Building EA-21 and, to a lesser extent, Building EA-5. Elevated concentrations of PCB-1254 were reported near Building EA-5. Elevated explosive and propellant compounds, specifically RDX and nitrocellulose, and inorganics (primarily antimony, barium, chromium, copper, lead, and zinc), were clustered in the vicinity of Building E-21. Lead and zinc concentrations were lower than those observed in surface soil; however, each was reported at concentrations greater than 4 times background. Minor concentrations of several PAH compounds, pesticides, and VOCs were also reported.

Comparison of concentrations of Load Line 3 COPCs in shallow surface soil to screening RGOs shows that a total of 11 chemicals exceed the RGOs for at least one receptor scenario (Section 6.5.2.4). Five deep surface soil COCs were identified for the National Guard Trainee. Four subsurface soil COCs were identified for the Resident Farmer (adult and/or child).

COECs include seven metals.

8.3.6 West Ditches Aggregate

Surface soil in this EU exhibited elevated levels of explosives, inorganics, SVOCs, and PCBs. Generally, elevated explosives, SVOCs, and PCBs were confined to select locations and not widely distributed. Inorganic SRCs consistently exceeded background values by factors of more than 2 times background. Subsurface soil samples were not collected from this aggregate due to the lack of detectable field explosives in surface soil.

Comparison of concentrations of Load Line 3 COPCs in shallow surface soil to screening RGOs shows that a total of 11 chemicals exceed the RGOs for at least one receptor (Section 6.5.2.4). Four COCs were identified for deep surface soil for the National Guard Trainee. Subsurface soil was not collected in this aggregate. COECs include nine metals and benzoic acid.

8.3.7 DLA Storage Tanks Area Aggregate

No explosives compounds greater than 1 mg/kg were detected during field analyses. Surface soils within this aggregate contain primarily elevated levels of inorganic SRCs. The most pervasive compounds were antimony and cadmium, with elevated concentrations of inorganics being reported in the southernmost DLA storage tank farm, specifically, just south of the southernmost storage tank along the railroad track. Several SVOCs, primarily PAHs, were identified at a single location; however, all concentrations were less than 1 mg/kg. VOCs, pesticides, and PCBs were not detected in the surface soils of the DLA Storage Tanks Aggregate.

Comparison of concentrations of Load Line 3 COPCs in shallow surface soil to screening RGOs shows that three chemicals exceed the RGOs for at least one receptor (Section 6.5.2.4). Two COCs were identified in deep surface soil for the National Guard Trainee scenario. Subsurface soils were not collected in this aggregate. COECs include 10 metals.

8.3.8 Sediment and Surface Water

Sediment in the Cobb's Pond Tributary Aggregate

Explosives contamination in sediment of the Cobb's Pond Tributary Aggregate is confined to the most downgradient location and at low concentrations. Inorganic SRCs exceeded background criteria by factors of 2 (nickel) to 8 (copper) times. Trace concentrations of one PCB compound and several pesticides and SVOCs were detected.

Three sediment human health COCs were identified for the Resident Farmer (child): antimony, PCB-1254, and benzo(*a*)pyrene. Benzo(*a*)pyrene was also identified as a COC for the Resident Farmer (adult) (Section 6.5.2.3).

COECs include 10 metals, 2 explosives, 12 PAHs, 3 pesticides, and PCB-1254.

Surface Water in the Cobb's Pond Tributary and Miscellaneous Surface Water Aggregates

Explosives were not detected in water samples collected from any of the three EUs established within the main stream and settling pond. Vanadium and manganese were the only two inorganic SRCs detected consistently in surface water above background criteria; maximum concentrations of manganese occurred within the aggregate upstream of the Load Line 3 Perimeter Road. The pesticide 4,4'-DDT was detected in one water sample from the settling pond; no SVOCs or PCBs were detected. VOCs were only sporadically detected at low concentrations.

Of the identified SRCs in surface water, manganese was identified as a COC for the National Guard Trainee and Resident Farmer (adult and child). Arsenic was also identified as a COC for the adult and child Resident Farmer (Section 6.5.2.2).

8.3.9 Groundwater

Groundwater within the AOC contains elevated concentrations of several explosive compounds and minor contributions of cobalt and manganese; however, inorganic constituent occurrence and distribution above background criteria were sporadic. Low concentrations of VOCs and SVOCs were observed.

The Load Line 3 groundwater aggregate was evaluated to identify COCs. Comparisons of Load Line 3 COCs in groundwater to screening RGOs show that RDX; 2,4,6-TNT; manganese; heptachlor epoxide; beta-BHC; and carbon tetrachloride exceed the RGOs for the National Guard and/or Resident Farmer receptor scenarios (Section 6.5.2.1).

8.3.10 Storm and Sanitary Sewer System

The sanitary sewer sediment does not contain accumulated explosives based on Phase II RI sampling results, although accumulated inorganics and low levels of PCBs are present. Inorganics and PCBs partitioning to water appear limited within the system as evidenced by low to non-detected concentrations of each in the sanitary sewer waters. Low levels of explosives were reported in the waters of the storm sewer, indicating the introduction of explosive compounds through building drains and/or sumps. The sanitary sewer system does not receive large influxes of storm runoff and is largely a closed system, except where pipes may be cracked.

The storm sewer system does contain accumulated sediment, explosives, inorganics, and PCBs based on Phase II RI sampling results. Although water samples were not collected from the storm sewer, during rain events significant flow enters the system. Therefore, the storm drain network may act as a minor source of contaminant flux to groundwater and likely facilitates the movement of shallow groundwater in the vicinity of cracked or broken pipes where inflow or outflow may occur.

8.3.11 Buildings and Structures

Soil beneath building sub-floors exhibited generally low concentrations of explosives, several inorganic constituents, and PCB-1254.

Any future demolition of the Building EB-4 washout basin should consider that sediment in this structure contained elevated levels of metals, explosives, propellants, PCBs, and pesticides. These COCs will require additional evaluation. The associated water sample contained elevated levels of many constituents that were detected at high concentrations in sediment.

Any future demolition of the Building EA-6 sedimentation basin should consider that sediment in this structure contained elevated concentrations of several metals related to historical processes (cadmium, chromium, copper, lead, and zinc).

Floor sweeping samples collected from Buildings EB-4, EB-10, and EB-3 were comprised of a high percentage of iron. Copper, cadmium, chromium, and lead were present at high concentrations, particularly in Buildings G-8 and G-19. Low concentrations of explosives were detected in samples from G-8 and G-19. Low concentrations of PCBs, pesticides, and various PAHs were also detected. Cadmium and/or lead were detected in TCLP extracts with concentrations exceeding the TCLP criteria for hazardous waste determination at Buildings EB-10 and EB-3; however, no constituent exceeded their respective criteria for characteristically hazardous wastes.

8.4 LESSONS LEARNED

A key project quality objective for the Phase II RI at Load Line 3 is to document lessons learned so that future projects may constantly improve data quality and performance. Lessons learned are derived from process improvements that were implemented or corrective measures for nonconformances. The Phase II RIs for Load Lines 2, 3, and 4 were planned and implemented under one mobilization; therefore, the key lessons learned discussed below are applicable to all of the investigations conducted in 2001.

- The Phase II RIs for Load Lines 2, 3, and 4 were integrated under a single SAP, QAPP, and Health and Safety Plan Addendum. Preparation for field efforts, including logbook preparation, sampling, database pre-population, readiness reviews, and personnel training assignments, were conducted under one combined mobilization. Field sampling operations for all three load lines were coordinated under one Field Operations Manager, Site Health and Safety Officer, and Sample Manager and utilized the same sampling teams. Set up and operation of the field laboratory was likewise done once for all three investigations. The integrated effort allowed subcontractors (drilling, test pit excavation, video camera surveys, concrete coring, etc.) to conduct their operations under one mobilization. This integrated effort for multiple sites eliminated redundant start up operations, compressed the field investigation schedules, reduced costs, and improved data quality by utilizing staff familiar with the project DQOs and sampling procedures.

- The Phase II RI efforts for Load Lines 2, 3, and 4 were the first conducted by SAIC at RVAAP to designate a formal IDW Compliance Officer. A single person with waste operations and management experience was designated to coordinate the packaging, labeling, tracking, and disposition of all project IDW. This person reported directly to the Field Operations Manager and

SAIC Project Manager. Implementation of this position resulted in greater efficiencies in IDW management and no compliance issues related to IDW during the course of the project.

- Analytical difficulties were encountered for some floor sweep and other sample types collected within or near buildings and railroad tracks due to the suspected presence of paint chips, creosotes, or other materials. Prior notification to the analytical laboratory is advised when such unusual samples may be collected so that they can adjust extraction or analytical protocols, as needed, to avoid gross contamination or even damage to instrumentation and to improve overall data quality.

- Use of field portable X-ray fluorescence (XRF) analyses for metals was not employed to help guide the placement of sampling locations, although the method may have provided useful information regarding the distribution of inorganic contaminants. Re-evaluation of previous applications of XRF at RVAAP is to be conducted, including implementation of a revised analytical method. Upon completion of the evaluation and testing of the new method(s), the use of field XRF to help guide characterization sampling activities or to conduct remediation verification sampling should be considered.

- Incorporation of undesignated contingency samples into the project planning provides a useful tool and added flexibility to sample additional locations based on field observations. Examples of the application of contingency samples include small sedimentation basins discovered at Load Lines 3 and 4 near explosives preparation buildings and collection of Cr^{+6} at multiple stations at Load Line 2.

- The presence of Ohio EPA and USACE staff on-site during field operations was beneficial in that potential changes to the project work plan due to field conditions could be quickly discussed, resolved, and implemented.

- The availability of on-site facilities for use as a field staging area and to house the field explosives laboratory was extremely beneficial. Having high quality shelter facilities for sample storage, management operations, equipment decontamination, and the field laboratory improved sample quality and project efficiency. The facility provides a central and secure location to store equipment and supplies, as well as to conduct safety meetings and other site-specific training.

- Field operations were temporarily suspended for 5 days beginning September 12, 2001, due to RVAAP security measures in response to the terrorist attacks of September 11, 2001. As a result, field operations were placed in a safe and compliant standby condition, including:

  – Communication of events and planned actions to the appropriate SAIC, USACE, and RVAAP management personnel;

  – Removal of environmental samples that were in refrigerated storage in order to deliver these to analytical laboratories;

  – Inspection and securing of IDW containers to ensure safe and compliant storage;

  – Removal of rental vehicles and rented field equipment; and

  – Sealing of project field records in coolers and securing of the field staging building.

Future SAP Addenda for investigations at RVAAP may include a section containing instructions for unplanned events resulting in the immediate suspension of field operations.