3.0 STUDY AREA INVESTIGATION

This chapter presents information on sampling locations and the rationale for samples collected during the field effort, and provides a synopsis of the sampling methods employed during the investigation. Specific notation is made where site conditions required a departure from planned activities in the Phase II RI SAP Addendum (USACE 2001b). Information regarding standard field decontamination procedures, sample container types, preservation techniques, sample labeling, chain-of-custody, and packaging and shipping requirements implemented during the field investigation may be found in the Facility-wide SAP (USACE 2001a) and the Phase II RI SAP Addendum (USACE 2001b).

The scope of the Phase II RI field effort at Load Line 3 included sampling of surface and subsurface soils, debris, sediment, surface water, and groundwater. Other investigative activities included excavating test trenches to characterize soil stratigraphy, collecting biased floor sweep samples from three buildings, sampling beneath building floors, performing a video camera survey of portions of the former sanitary sewer system, and sampling surface water and sediment from the former sanitary sewer system. In addition, analyses for TNT and RDX using a colorimetric method were performed in a field-based laboratory to provide an indication of explosives contamination nature and extent and to help guide the sampling efforts.

In order to organize and track the field sampling efforts, the Load Line 3 AOC was separated into 33 functional areas based on: (1) type of environmental media (i.e., soil, surface water, groundwater, etc.), (2) DQOs, (3) historical operational data, (4) available Phase I RI data, and (5) site characteristics. The rationale and approach for sampling within each functional area were based on the project DQOs, as discussed in Section 1.3.4.

Functional areas 1 through 26 include former operational facilities and physical plant structures. Functional area 29 includes the DLA storage tanks. Functional areas 27, 28, and 30 address soils in non-production areas and surface water and sediment downstream of the AOC. Functional areas 31 and 32 are the storm and sanitary sewer systems, functional area 33 is groundwater. These functional areas and a summary of the environmental matrices that were sampled within each are listed in Table 3-1.

3.1 SOIL AND VADOSE ZONE CHARACTERIZATION

Soil samples for chemical analyses were collected from a total of 152 stations located throughout Load Line 3. Samples were collected from surface and subsurface locations, as well as from test pits (perimeter trenches), beneath building floors, and floor sweep samples from several buildings. Although not considered a soil matrix, the floor sweep samples collected and submitted for chemical analysis are addressed in this section. Figures 3-1 through 3-4 illustrate the locations for surface soil and subsurface soil sampling. Table 3-2 provides a detailed listing of the soil samples collected during the Phase II RI field effort.

Table 3-1. Load Line 3 Phase II RI Functional Areas and Sample Matrices

Functional Area Number	Description	Principal Suspected Contaminants	Sampling Rationale	Sample Matrix		
				Soil Stations	Sediment/ Surface Water Stations	Monitoring Well Boring/ Groundwater Stations
1	Building EA-7 – Service building	Explosives and metals	Identify possible contamination in soil	•		
2	Building EA-21 – Service building	Explosives and metals	Identify possible contamination in soil	•		
3	Building EA-5 – Service building	Explosives and metals	Identify possible contamination in soil	•		
4	Building EA-6 – Explosive preparation building	Explosives and metals	Identify possible contamination in soil and beneath floor slab	•		
5	Building EA-28 – Elevator machine house at Building EA-6	Explosives, SVOCs, VOCs, metals, and PCBs	Identify possible contamination in soil	•		
6	Building EA-6A – Explosive preparation building	Explosives and metals	Identify possible contamination in soil and beneath floor slab	•		
7	Building EA-28A – Elevator machine house at Building EA-6	Explosives, SVOCs, VOCs, metals, and PCBs	Identify possible contamination in soil	•		
8	Building EB-13A, -13B, and -13C – Packing and shipping	Explosives, propellants, and metals	Identify possible contamination in soil	•		
9	Building EB-11 – Service building	Explosives and metals	Identify possible contamination in soil	•		
10	Building EB-9 – Service building	Explosives and metals	Identify possible contamination in soil	•		
11	Building EB-9A – Service building	Explosives and metals	Identify possible contamination in soil	•		
12	Building EB-2 – Service building	Explosives and metals	Identify possible contamination in soil	•		
13	Building EB-19 – Service building	Explosives and metals	Identify possible contamination in soil	•		
14	Building EB-20 – Service building	Explosives and metals	Identify possible contamination in soil	•		
15	Building EB-10A – Radiography Building	Explosives and metals	Identify possible contamination in soil	•		

Table 3-1. Load Line 3 Phase II RI Functional Areas and Sample Matrices (continued)

Functional Area Number	Description	Principal Suspected Contaminants	Sampling Rationale	Sample Matrix: Soil Stations	Sample Matrix: Sediment/ Surface Water Stations	Sample Matrix: Monitoring Well Boring/ Groundwater Stations
16	Building EB-10 – Drilling and Assembly	Explosives, SVOCs, VOCs, metals, and PCBs	Identify possible contamination in soil and beneath building floor slab	•		
17	Settling Tanks	Explosives, SVOCs, VOCs, metals, and PCBs	Identify possible contamination in soil and residual contamination in tanks	•	•	
18	Building EB-4 – Melt-pour Building	Explosives, SVOCs, VOCs, metals, and PCBs	Define the extent of contamination in soil outside of the building slabs and obtain the soil data from beneath the floor slab	•	•	
19	Building EB-4A – Melt-pour Building	Explosives, SVOCs, VOCs, metals, and PCBs	Define the extent of contamination in soil outside of the building slabs and obtain the soil data from beneath the floor slab	•	•	
20	Northeast Water Basin	Explosives and metals	Identify possible residual contamination within the tank		•	
21	Building EB-25 – Carrier Washout Building	Explosives and metals	Identify possible contamination in soil	•		
22	Building EB-3 – Shell Receiving Building	Explosives, SVOCs, VOCs, metals, and PCBs	Identify possible contamination in soil	•		
23	Building EB-803 – Inert Storage	Explosives and metals	Identify possible contamination in soil	•		
24	Building EB-8 – Change House	Explosives and metals	Characterize suitability of selected areas for disposal of inert demolition debris	•		
25	Building EB-8A – Change House	Explosives and metals	Characterize suitability of selected areas for disposal of inert demolition debris	•		
26	Building EB-22 – Change House	Explosives and metals	Characterize suitability of selected areas for disposal of inert demolition debris	•		

Table 3-1. Load Line 3 Phase II RI Functional Areas and Sample Matrices (continued)

Functional Area Number	Description	Principal Suspected Contaminants	Sampling Rationale	Sample Matrix: Soil Stations	Sample Matrix: Sediment/ Surface Water Stations	Sample Matrix: Monitoring Well Boring/ Groundwater Stations
27	Non-Production Area (Random Sampling Grid)	Explosives and metals	Statistically representative characterization of non-production areas (Phase I RI sample data from stations 038, 039, and 049 to be used to represent additional grid points)	•		
NA	Contingency Samples	TBD	To be assigned in the field	•		
28	Test Pits	Geotechnical	To provide a better understanding of the flow regime and assist in selecting optimal locations for monitoring wells	•		
29	DLA Storage Tanks	Metals	Identify possible contamination in soil	•		
30	AOC Ditches, Streams, and Ponds	All; Full suite to be performed	Characterize potential contaminant exit pathways and accumulation points		•	
31	Storm Sewer System	All; Full suite to be performed	Characterize potential contaminant exit pathways and accumulation points		•	
32	Sanitary Sewer System	All; Full suite to be performed	Characterize potential contaminant exit pathways and accumulation points		•	
33	Additional Monitoring Wells	All; Full suite to be performed	Identify possible contamination in groundwater near source areas			•
			Identify possible contamination in groundwater and potential off-AOC transport of contamination to the south			•
			Identify possible contamination in groundwater, better understand the flow regime in the northern part of the AOC and evaluate potential off-AOC transport of contamination to the north			•

AOC = Area of Concern.
DLA = Defense Logistics Agency.
PCB = Polychlorinated biphenyl.
RI = Remedial Investigation.
SVOC = Semivolatile organic compound.
TBD = To be determined.
VOC = Volatile organic compound.

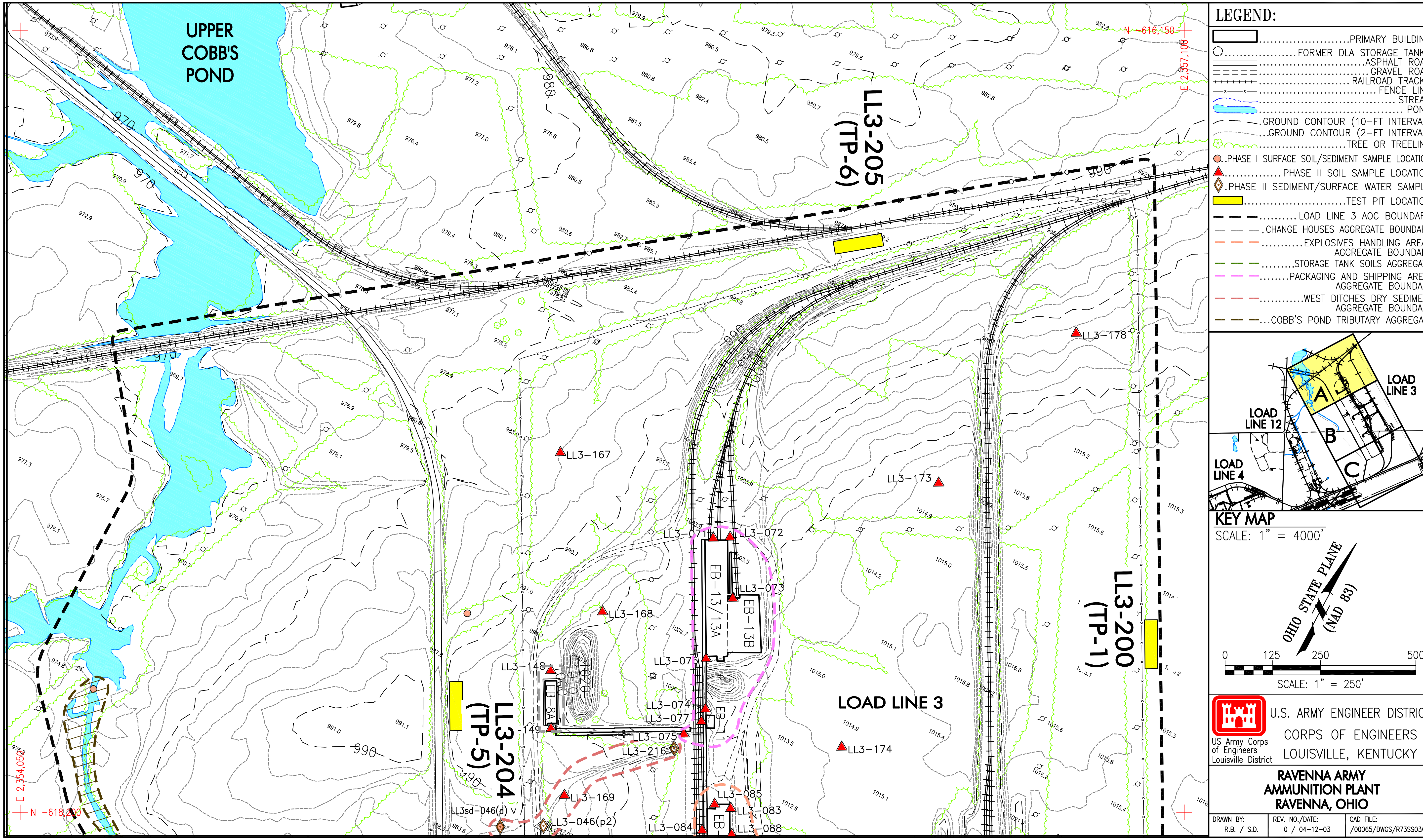

Figure 3-1. Phase II RI Surface and Subsurface Soil Sampling Locations at Load Line 3 - Northern Section

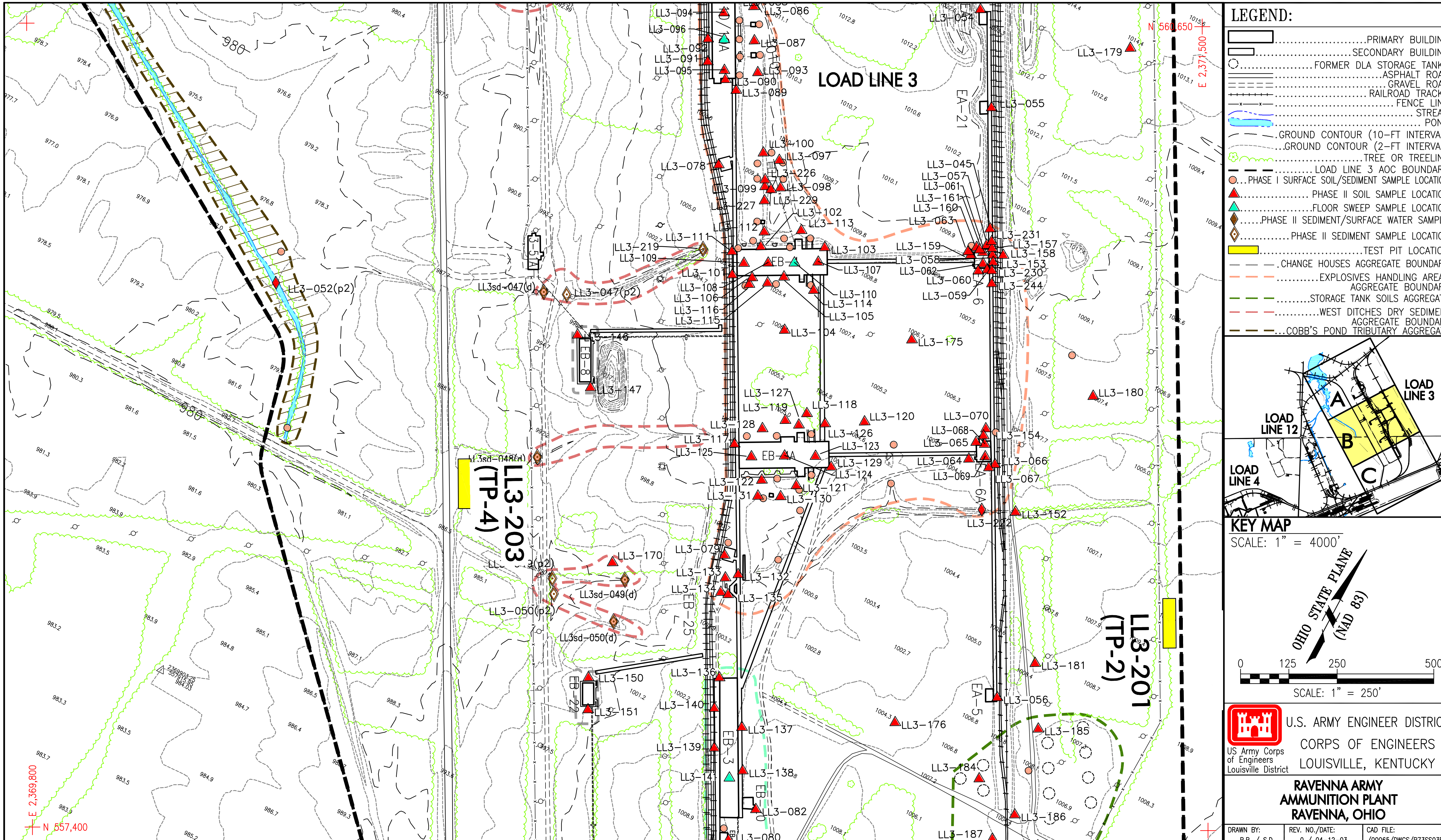

Figure 3-2. Phase II RI Surface and Subsurface Soil Sampling Locations at Load Line 3 - Central Section

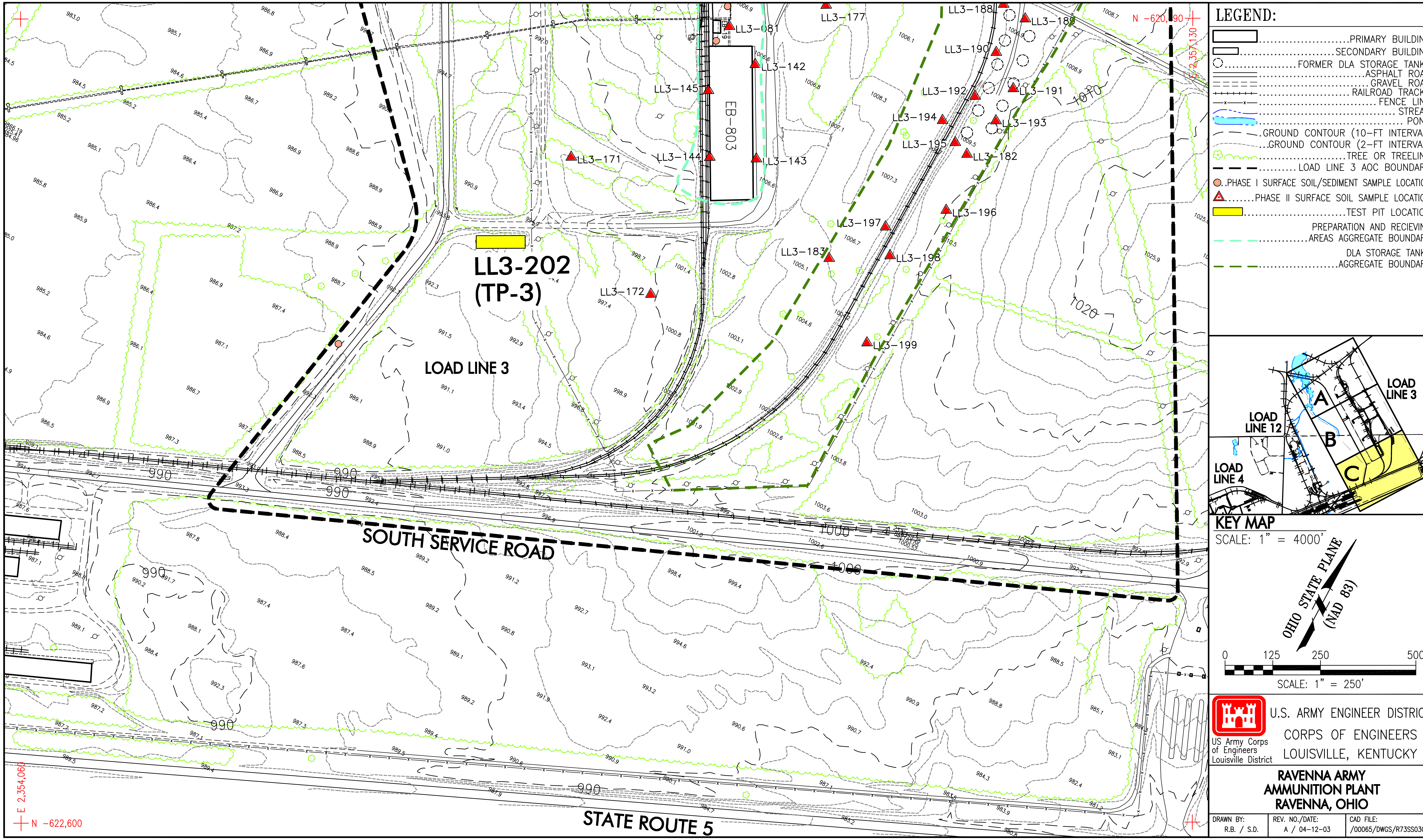

Figure 3-3. Phase II RI Surface and Subsurface Soil Sampling Locations at Load Line 3 - Southern Section

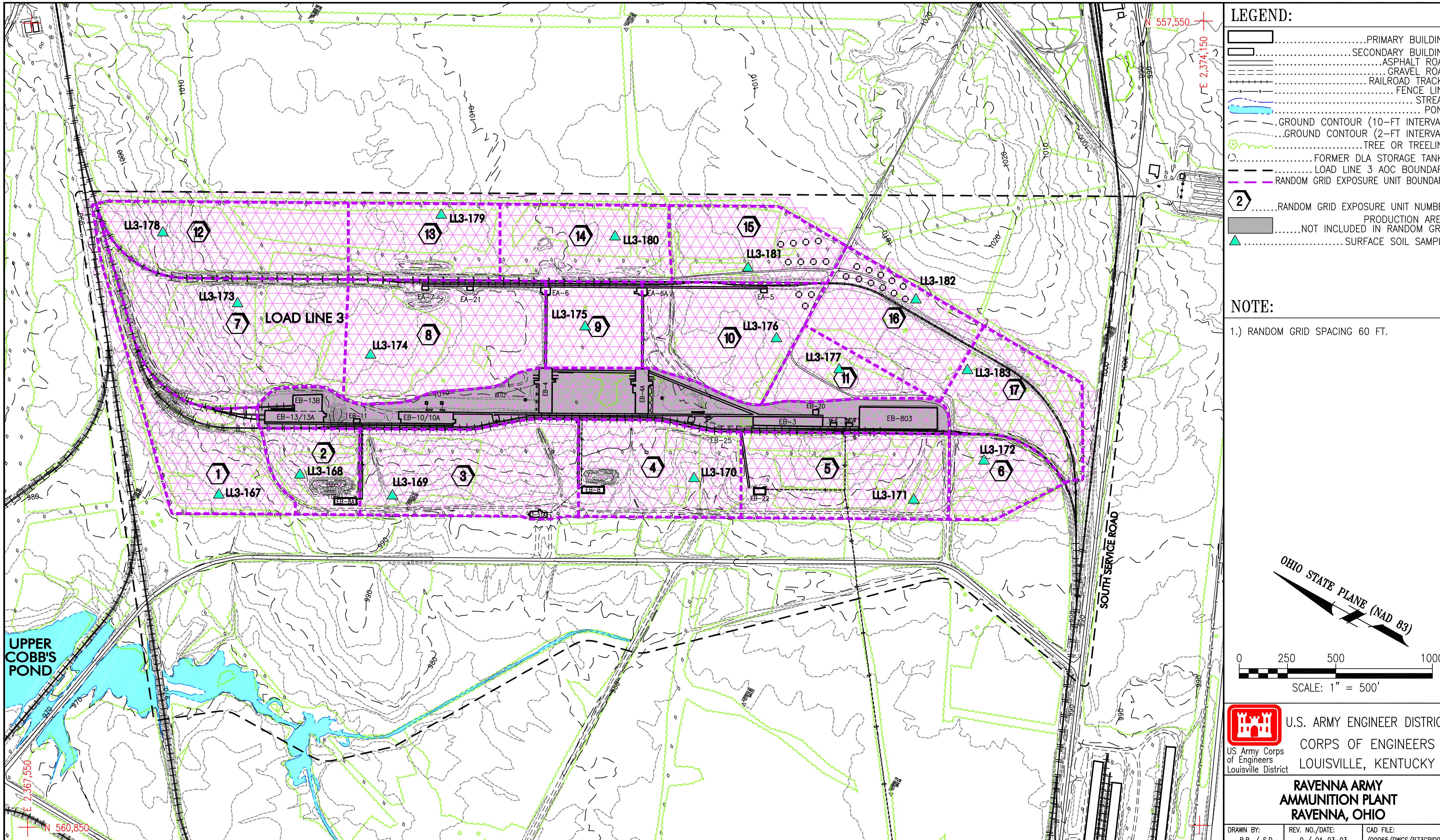

Figure 3-4. Phase II RI Random Grid Soil Sampling Locations at Load Line 3

Table 3-2. Soil Sample list and Rationales, Load Line 3 Phase II RI

Facility/ Building No.	Depth (ft)	Station ID	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
Source Area Characterization						
EA-7 Service Building	0 to 1	LL3-054	LL3ss-054-0684-SO	Yes	8/10/01	Field analysis of TNT/RDX < 1 mg/kg, refusal at 0.8 ft
	1 to 3	LL3-054	LL3so-054-0685-SO	No		Sample LL3-0685 reassigned to IDW characterization for Load Line 3
	3 to 5	LL3-054	LL3so-054-0686-SO	No		Sample LL3-0686 reassigned to contingency station LL3-244, 0 to 1 ft
EA-21 Service Building	0 to 1	LL3-055	LL3ss-055-0687-SO	Yes	8/10/01	Field analysis of TNT = 8.4 mg/kg
	1 to 3	LL3-055	LL3so-055-0688-SO	Yes	8/12/01	Field analysis of TNT = 6.6 mg/kg
	3 to 5	LL3-055	LL3so-055-0689-SO	No		Sample LL3-0689 reassigned to contingency station LL3-245, 0 to 1 ft, refusal at 2.0 ft
EA-5 Service Building	0 to 1	LL3-056	LL3ss-056-0690-SO	Yes	8/10/01	Field analysis of TNT = 3.6 mg/kg
	1 to 3	LL3-056	LL3so-056-0691-SO	Yes	8/12/01	Field analysis of TNT = 200.9 mg/kg, refusal at 1.5 ft
	3 to 5	LL3-056	LL3so-056-0692-SO	No		Refusal at 1.5 ft
EA-6 Explosive Preparation Building	0 to 1	LL3-057	LL3ss-057-0693-SO	Yes	7/31/01	MC and pH. Field analysis of TNT = 29.2 mg/kg
	0 to 1	LL3-057	LL3ss-057-1121-SO	Yes	7/31/01	Duplicate
	0 to 1	LL3-057	LL3ss-057-1143-SO	Yes	7/31/01	Split
	1 to 3	LL3-057	LL3so-057-0694-SO	Yes	8/7/01	Field analysis of TNT/RDX < 1 mg/kg, collect 1 to 3 ft, no refusal
	3 to 5	LL3-057	LL3so-057-0695-SO	No		Field explosives < 1 mg/kg in 1- to 3-ft sample
	0 to 1	LL3-058	LL3ss-058-0696-SO	Yes	7/31/01	Field analysis of TNT = 38 mg/kg
	1 to 3	LL3-058	LL3so-058-0697-SO	Yes	8/7/01	Field analysis of TNT = 29.9 mg/kg, refusal at 3 ft
	3 to 5	LL3-058	LL3so-058-0698-SO	No		Refusal at 3.0 ft
	0 to 1	LL3-059	LL3ss-059-0699-SO	Yes	7/31/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-059	LL3ss-059-0700-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-059	LL3so-059-0701-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-060	LL3ss-060-0702-SO	Yes	7/31/01	MC and pH. Field analysis of TNT = 5.51 mg/kg, RDX < 1 mg/kg
	1 to 3	LL3-060	LL3so-060-0703-SO	Yes	8/7/01	Field analysis of TNT/RDX < 1 mg/kg

Table 3-2. Soil Sample list and Rationales, Load Line 3 Phase II RI (continued)

Facility/ Building No.	Depth (ft)	Station ID	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
	3 to 5	LL3-060	LL3so-060-0704-SO	No		Field explosives < 1 mg/kg in 1- to 3-ft sample
	0 to 1	LL3-061	LL3ss-061-0705-SO	Yes	7/31/01	Sub-floor, field analysis of TNT/RDX < 1 mg/kg
	0 to 1	LL3-062	LL3ss-062-0706-SO	Yes	7/31/01	Sub-floor, field analysis of TNT/RDX < 1 mg/kg
EA-28 Elevator Machine House	0 to 1	LL3-063	LL3ss-063-0707-SO	Yes	7/31/01	Propellants jar collected on 8/7/01 at 1550. Field analysis of TNT = 4,211 mg/kg
	1 to 3	LL3-063	LL3so-063-0708-SO	Yes	8/7/01	Field analysis of TNT/95.8 mg/kg, refusal at 2.0 ft
	3 to 5	LL3-063	LL3so-063-0709-SO	No		Refusal at 2.0 ft
EA-6A Explosive Preparation Building	0 to 1	LL3-064	LL3ss-064-0710-SO	Yes	7/31/01	MC and pH. Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-064	LL3so-064-0711-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-064	LL3so-064-0712-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-065	LL3ss-065-0713-SO	Yes	8/7/01	MC and pH. Field analysis of TNT = 2.3 mg/kg
	0 to 1	LL3-065	LL3ss-065-1129-SO	Yes	8/7/01	Duplicate
	0 to 1	LL3-065	LL3ss-065-1151-SO	Yes	8/7/01	Split
	1 to 3	LL3-065	LL3so-065-0714-SO	Yes	8/12/01	Field analysis of TNT/RDX < 1 mg/kg, refusal at 1.6 ft
	3 to 5	LL3-065	LL3so-065-0715-SO	No		Refusal at 1.6 ft
	0 to 1	LL3-066	LL3ss-066-0716-SO	Yes	8/8/01	Field analysis of TNT = 2.3 mg/kg
	1 to 3	LL3-066	LL3so-066-0717-SO	Yes	8/12/01	Field analysis of TNT/RDX < 1 mg/kg, refusal at 1.9 ft
	3 to 5	LL3-066	LL3so-066-0718-SO	No		Refusal at 1.9 ft
	0 to 1	LL3-067	LL3ss-067-0719-SO	Yes	7/31/01	Field analysis of TNT = 1.35 mg/kg, RDX < 1 mg/kg
	1 to 3	LL3-067	LL3so-067-0720-SO	Yes	8/8/01	Field analysis of TNT = 1.5mg/kg, Refusal at 2.5 ft
	3 to 5	LL3-067	LL3so-067-0721-SO	No		Refusal at 2.5 ft
	0 to 1	LL3-068	LL3ss-068-0722-SO	Yes	7/31/01	Sub-floor, field analysis of TNT/RDX < 1 mg/kg
	0 to 1	LL3-069	LL3ss-069-0723-SO	Yes	7/31/01	Sub-floor, field analysis of TNT < 1 mg/kg, RDX 8.9 mg/kg

Table 3-2. Soil Sample list and Rationales, Load Line 3 Phase II RI (continued)

Facility/ Building No.	Depth (ft)	Station ID	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
EA-28A Elevator Machine House	0 to 1	LL3-070	LL3ss-070-0724-SO	Yes	8/8/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-070	LL3so-070-0725-SO	No		
	3 to 5	LL3-070	LL3so-070-0726-SO	No		
EB-13/13A, Packing and Shipping	0 to 1	LL3-071	LL3ss-071-0727-SO	Yes	8/8/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-071	LL3so-071-0728-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-071	LL3so-071-0729-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-072	LL3ss-072-0730-SO	Yes	8/9/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-072	LL3so-072-0731-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-072	LL3so-072-0732-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-073	LL3ss-073-0733-SO	Yes	8/9/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-073	LL3so-073-0734-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-073	LL3so-073-0735-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-074	LL3ss-074-0736-SO	Yes	8/9/01	Field analysis of TNT/RDX < 1 mg/kg
	0 to 1	LL3-074	LL3ss-074-1124-SO	Yes	8/9/01	Duplicate
	0 to 1	LL3-074	LL3ss-074-1146-SO	Yes	8/9/01	Split
	1 to 3	LL3-074	LL3so-074-0737-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-074	LL3so-074-0738-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-075	LL3ss-075-0739-SO	Yes	8/9/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-075	LL3so-075-0740-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-075	LL3so-075-0741-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-076	LL3ss-076-0742-SO	Yes	8/9/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-076	LL3so-076-0743-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-076	LL3so-076-0744-SO	No		Field Explosives < 1 mg/kg in surface sample
EB-11 Service Building	0 to 1	LL3-077	LL3ss-077-0745-SO	Yes	8/10/01	Field analysis of TNT = 848 mg/kg, refusal at 1.5 ft
	0 to 1	LL3-077	LL3ss-077-1131-SO	Yes	8/10/01	Duplicate
	0 to 1	LL3-077	LL3ss-077-1156-SO	Yes	8/10/01	Split
	1 to 3	LL3-077	LL3so-077-0746-SO	No		Refusal at 1.5 ft
	3 to 5	LL3-077	LL3so-077-0747-SO	No		Refusal at 1.5 ft
EB-9 Service Building	0 to 1	LL3-078	LL3ss-078-0748-SO	Yes	8/11/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-078	LL3so-078-0749-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-078	LL3so-078-0750-SO	No		Field Explosives < 1 mg/kg in surface sample
EB-9A Service Building	0 to 1	LL3-079	LL3ss-079-0751-SO	Yes	8/10/01	Field analysis of TNT/RDX < 1 mg/kg

Table 3-2. Soil Sample list and Rationales, Load Line 3 Phase II RI (continued)

Facility/ Building No.	Depth (ft)	Station ID	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
	1 to 3	LL3-079	LL3so-079-0752-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-079	LL3so-079-0753-SO	No		
EB-2 Service Building	0 to 1	LL3-080	LL3ss-080-0754-SO	Yes	8/10/01	Field analysis of TNT = 1.1 mg/kg
	1 to 3	LL3-080	LL3so-080-0755-SO	Yes	8/12/01	Field analysis of TNT/RDX < 1 mg/kg
	3 to 5	LL3-080	LL3so-080-0756-SO	No		Field explosives < 1 mg/kg in 1- to 3-ft sample
EB-19 Service Building	0 to 1	LL3-081	LL3ss-081-0757-SO	Yes	8/9/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-081	LL3so-081-0758-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-081	LL3so-081-0759-SO	No		Field Explosives < 1 mg/kg in surface sample
EB-20 Service Building	0 to 1	LL3-082	LL3ss-082-0760-SO	Yes	8/10/01	Field analysis of TNT/RDX < 1 mg/kg
	0 to 1	LL3-082	LL3ss-082-1126-SO	Yes	8/10/01	Duplicate
	0 to 1	LL3-082	LL3ss-082-1148-SO	Yes	8/10/01	Split
	1 to 3	LL3-082	LL3so-082-0761-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-082	LL3so-082-0762-SO	No		Field Explosives < 1 mg/kg in surface sample
EB-10A Radiography Building	0 to 1	LL3-083	LL3ss-083-0763-SO	Yes	8/6/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-083	LL3so-083-0764-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-083	LL3so-083-0765-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-084	LL3ss-084-0766-SO	Yes	8/11/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-084	LL3so-084-0767-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-084	LL3so-084-0768-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-085	LL3ss-085-0769-SO	Yes	8/6/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-085	LL3so-085-0770-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-085	LL3so-085-0771-SO	No		Field Explosives < 1 mg/kg in surface sample
EB-10 Drilling and Assembly	0 to 1	LL3-086	LL3ss-086-0772-SO	Yes	8/6/01	MC and pH. Field analysis of TNT/RDX < 1 mg/kg
EB-10 Drilling and Assembly	1 to 3	LL3-086	LL3so-086-0773-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-086	LL3so-086-0774-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-087	LL3ss-087-0775-SO	Yes	8/6/01	MC and pH. Field analysis of TNT/RDX < 1 mg/kg
	0 to 1	LL3-087	LL3ss-087-1135-SO	Yes		Duplicate
	0 to 1	LL3-087	LL3ss-087-1157-SO	Yes		Split
	1 to 3	LL3-087	LL3so-087-0776-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-087	LL3so-087-0777-SO	No		Field Explosives < 1 mg/kg in surface sample

Table 3-2. Soil Sample list and Rationales, Load Line 3 Phase II RI (continued)

Facility/ Building No.	Depth (ft)	Station ID	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
	0 to 1	LL3-088	LL3ss-088-0778-SO	Yes	8/6/01	MC, pH, GS, AL, SG, USCS, Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-088	LL3so-088-0779-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-088	LL3so-088-0780-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-089	LL3ss-089-0781-SO	Yes	8/6/01	MC, pH, GS, AL, SG, USCS. Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-089	LL3so-089-0782-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-089	LL3so-089-0783-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-090	LL3ss-090-0784-SO	Yes	8/1/01	Field analysis of TNT = 1.86 mg/kg
	0 to 1	LL3-090	LL3ss-090-1127-SO	Yes		Duplicate
	0 to 1	LL3-090	LL3ss-090-1149-SO	Yes		Split
	1 to 3	LL3-090	LL3so-090-0785-SO	Yes	8/7/01	Field analysis of TNT = 2.5 mg/kg; refusal at 2.0 ft
	3 to 5	LL3-090	LL3so-090-0786-SO	No		Refusal at 2.0 ft
	0 to 1	LL3-091	LL3ss-091-0787-SO	Yes	8/11/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-091	LL3so-091-0788-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-091	LL3so-091-0789-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-092	LL3ss-092-0790-SO	Yes	8/7/01	Field analysis of TNT = 2.4 mg/kg, refusal at 0.6 ft
	1 to 3	LL3-092	LL3so-092-0791-SO	No		Refusal at 0.6 ft
	3 to 5	LL3-092	LL3so-092-0792-SO	No		Refusal at 0.6 ft
	0 to 1	LL3-093	LL3ss-093-0793-SO	Yes	8/6/01	MC and pH. Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-093	LL3so-093-0794-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-093	LL3so-093-0795-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-094	LL3ss-094-0796-SO	Yes	8/1/02	Sub-floor, field analysis of TNT/RDX < 1 mg/kg, refusal at 1.2 ft
	0 to 1	LL3-095	LL3ss-095-0797-SO	Yes	8/1/01	Sub-floor, field analysis of TNT/RDX < 1 mg/kg
	0 to 1	LL3-096	LL3fs-096-0798-FS	Yes	8/20/01	Floor sweep
	0 to 1	LL3-097	LL3ss-097-0799-SO	Yes	8/7/01	Settling tank, field analysis of TNT/RDX < 1 mg/kg, refusal at 0.8 ft
	0 to 1	LL3-097	LL3ss-097-1119-SO	Yes	8/7/01	Duplicate
	0 to 1	LL3-097	LL3ss-097-1141-SO	Yes	8/7/01	Split

Table 3-2. Soil Sample list and Rationales, Load Line 3 Phase II RI (continued)

Facility/ Building No.	Depth (ft)	Station ID	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
	1 to 3	LL3-097	LL3so-097-0800-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-097	LL3so-097-0801-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-098	LL3ss-098-0802-SO	Yes	8/7/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-098	LL3so-098-803-SO	No		Field Explosives < 1 mg/kg in surface sample
EB-10 Drilling and Assembly	3 to 5	LL3-098	LL3so-098-0804-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-099	LL3ss-099-0805-SO	Yes	8/7/01	Propellants jar collected on 8/12/01 at 1305. Field analysis of TNT = 1.59 mg/kg
	1 to 3	LL3-099	LL3so-099-0806-SO	No		No explanation
	3 to 5	LL3-099	LL3so-099-0807-SO	No		No explanation
	0 to 1	LL3-100	LL3ss-100-0808-SO	Yes	8/7/01	Field analysis of TNT/RDX < 1 mg/kg, refusal at 0.8 ft
	1 to 3	LL3-100	LL3so-100-0809-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-100	LL3so-100-0810-SO	No		Field Explosives < 1 mg/kg in surface sample
EB-4 Melt-load Building	0 to 1	LL3-101	LL3ss-101-0811-SO	Yes	8/11/01	Adjacent to building. Propellants jar collected 8/12/01 at 1625. Field analysis of TNT = 14.6 mg/kg
	1 to 3	LL3-101	LL3so-101-0812-SO	Yes	8/12/01	Field analysis of TNT = 14.2 mg/kg, refusal at 2.0 ft
	3 to 5	LL3-101	LL3so-101-0813-SO	No		Refusal at 2.0 ft
	0 to 1	LL3-102	LL3ss-102-0814-SO	Yes	8/7/01	Adjacent to building. MC and pH. Field analysis of TNT = 1.3 mg/kg
	1 to 3	LL3-102	LL3so-102-0815-SO	Yes	8/9/01	Field analysis of TNT = 1.46 mg/kg, refusal at 1.5 ft
	3 to 5	LL3-102	LL3so-102-0816-SO	No		Refusal at 1.5 ft
	0 to 1	LL3-103	LL3ss-103-0817-SO	Yes	8/7/01	Adjacent to building. MC, pH, GS, AL, SG, USCS. Field analysis of TNT = 4.7 mg/kg, refusal at 0.9 ft
	1 to 3	LL3-103	LL3so-103-0818-SO	No		Refusal at 0.9 ft
	3 to 5	LL3-103	LL3so-103-0819-SO	No		Refusal at 0.9 ft
	0 to 1	LL3-104	LL3ss-104-0820-SO	Yes	8/8/01	Adjacent to building. Field analysis of TNT = 3.4 mg/kg, refusal at 0.7 ft
	1 to 3	LL3-104	LL3so-104-0821-SO	No		Refusal at 0.7 ft
	3 to 5	LL3-104	LL3so-104-0822-SO	No		Refusal at 0.7 ft

Table 3-2. Soil Sample list and Rationales, Load Line 3 Phase II RI (continued)

Facility/ Building No.	Depth (ft)	Station ID	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
	0 to 1	LL3-105	LL3ss-105-0823-SO	Yes	8/8/01	Adjacent to building. MC and pH. Field analysis of TNT = 6.3 mg/kg, refusal at 1.0 ft
	1 to 3	LL3-105	LL3so-105-0824-SO	No		Refusal at 1.0 ft
	3 to 5	LL3-105	LL3so-105-0825-SO	No		Refusal at 1.0 ft
	0 to 1	LL3-106	LL3ss-106-0826-SO	Yes	8/8/01	Adjacent to building. MC and pH. Field analysis of TNT = 3.9 mg/kg, refusal at 0.8 ft
	1 to 3	LL3-106	LL3so-106-0827-SO	Yes	8/11/01	Field analysis of TNT = 1.7 mg/kg, refusal at 1.6 ft
	3 to 5	LL3-106	LL3so-106-0828-SO	No		Refusal at 1.6 ft
	0 to 1	LL3-107	LL3ss-107-0829-SO	Yes	8/7/01	Sub-floor, field analysis of TNT/RDX < 1 mg/kg
	0 to 1	LL3-108	LL3ss-108-0830-SO	Yes	8/7/01	Sub-floor, field analysis of TNT/RDX < 1 mg/kg
	0 to 1	LL3-109	LL3ss-109-0831-SO	Yes	8/8/01	Sub-floor, field analysis of TNT/RDX < 1 mg/kg
	0 to 1	LL3-110	LL3fs-110-0832-FS	Yes	8/20/01	Floor sweep
EB-4 Melt-load Building	0 to 1	LL3-111	LL3ss-111-0833-SO	Yes	8/8/01	Uphill or adjacent to barrier. Field analysis of TNT = 2.4 mg/kg. Propellants jar collected on 8/11/01 at 0845
	1 to 3	LL3-111	LL3so-111-0834-SO	Yes	8/11/01	Field analysis of TNT = 1.3 mg/kg
	1 to 3	LL3-111	LL3so-111-1137-SO	Yes	8/11/01	Duplicate
	1 to 3	LL3-111	LL3so-111-1159-SO	Yes	8/11/01	Split
	3 to 5	LL3-111	LL3so-111-0835-SO	No		No explanation given
	0 to 1	LL3-112	LL3ss-112-0836-SO	Yes	8/7/01	Uphill or adjacent to barrier. Field analysis of TNT/RDX < 1 mg/kg, refusal at 0.8 ft
	0 to 1	LL3-112	LL3ss-112-1128-SO	Yes	8/7/01	Duplicate
	0 to 1	LL3-112	LL3ss-112-1150-SO	Yes	8/7/01	Split
	1 to 3	LL3-112	LL3so-112-0837-SO	No		Refusal at 0.8 ft
	3 to 5	LL3-112	LL3so-112-0838-SO	No		Refusal at 0.8 ft
	0 to 1	LL3-113	LL3ss-113-0839-SO	Yes	8/7/01	Uphill or adjacent to barrier. Field analysis of TNT/RDX < 1 mg/kg, refusal at 0.7 ft
	1 to 3	LL3-113	LL3so-113-0840-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-113	LL3so-113-0841-SO	No		Field Explosives < 1 mg/kg in surface sample

Table 3-2. Soil Sample list and Rationales, Load Line 3 Phase II RI (continued)

Facility/ Building No.	Depth (ft)	Station ID	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
	0 to 1	LL3-114	LL3ss-114-0842-SO	Yes	8/8/01	Uphill or adjacent to barrier. MC and pH. Geotechnical sample ID LL30842 was recorded in COC as collected from station LL3-113; sample log shows this sample collected at LL3-114. Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-114	LL3so-114-0843-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-114	LL3so-114-0844-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-115	LL3ss-115-0845-SO	Yes	8/8/01	Uphill or adjacent to barrier. Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-115	LL3so-115-0846-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-115	LL3so-115-0847-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-116	LL3ss-116-0848-SO	Yes	8/8/01	Uphill or adjacent to barrier. Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-116	LL3so-116-0849-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-116	LL3so-116-0850-SO	No		Field Explosives < 1 mg/kg in surface sample
EB-4A Melt-load Building	0 to 1	LL3-117	LL3ss-117-0851-SO	Yes	8/6/01	Field analysis of TNT/RDX > 1 mg/kg
	1 to 3	LL3-117	LL3so-117-0852-SO	Yes	8/8/01	Field analysis of TNT/RDX < 1 mg/kg
	3 to 5	LL3-117	LL3so-117-0853-SO	No		Field explosives < 1 mg/kg in 1- to 3-ft sample
EB-4A Melt-load Building	0 to 1	LL3-118	LL3ss-118-0854-SO	Yes	8/7/01	Adjacent to building. Field analysis of TNT = 2.2 mg/kg
	1 to 3	LL3-118	LL3so-118-0855-SO	Yes	8/12/01	Field analysis of TNT/RDX < 1 mg/kg
	3 to 5	LL3-118	LL3so-118-0856-SO	No		Field explosives < 1 mg/kg in 1- to 3-ft sample
	0 to 1	LL3-119	LL3ss-119-0857-SO	Yes	8/7/01	Adjacent to building. Propellants jar collected on 8/12/01 at 1445. MC and pH. Field analysis of TNT = 11.7 mg/kg
	1 to 3	LL3-119	LL3so-119-0858-SO	Yes	8/12/01	Field analysis of TNT/RDX < 1 mg/kg, refusal at 1.3 ft
	3 to 5	LL3-119	LL3so-119-0859-SO	No		Field explosives < 1 mg/kg in 1- to 3-ft sample
	0 to 1	LL3-120	LL3ss-120-0860-SO	Yes	8/6/01	Adjacent to building. Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-120	LL3so-120-0861-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-120	LL3so-120-0862-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-121	LL3ss-121-0863-SO	Yes	8/6/01	Adjacent to building. MC and pH. Field analysis of TNT/RDX < 1 mg/kg

Table 3-2. Soil Sample list and Rationales, Load Line 3 Phase II RI (continued)

Facility/ Building No.	Depth (ft)	Station ID	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
	1 to 3	LL3-121	LL3so-121-0864-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-121	LL3so-121-0865-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-122	LL3ss-122-0866-SO	Yes	8/1/01	Adjacent to building. MC and pH. Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-122	LL3so-122-0867-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-122	LL3so-122-0868-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-123	LL3ss-123-0869-SO	Yes	8/1/01	Sub-floor, field analysis of TNT = 1.31 mg/kg
	0 to 1	LL3-124	LL3ss-124-0870-SO	Yes	8/1/01	Sub-floor, field analysis of TNT/RDX < 1 mg/kg
	0 to 1	LL3-125	LL3ss-125-0871-SO	Yes	8/1/01	Sub-floor, field analysis of TNT/RDX < 1 mg/kg
	0 to 1	LL3-126	LL3ss-126-0872-SO	Yes	8/7/01	Uphill or adjacent to barrier. Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-126	LL3so-126-0873-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-126	LL3so-126-0874-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-127	LL3ss-127-0875-SO	Yes	8/7/01	Uphill or adjacent to barrier. Field analysis of TNT/RDX < 1 mg/kg
	0 to 1	LL3-127	LL3ss-127-1123-SO	Yes	8/7/01	Duplicate
	0 to 1	LL3-127	LL3ss-127-1145-SO	Yes	8/7/01	Split
	1 to 3	LL3-127	LL3so-127-0876-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-127	LL3so-127-0877-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-128	LL3ss-128-0878-SO	Yes	8/7/01	Uphill or adjacent to barrier. MC and pH. Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-128	LL3so-128-0879-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-128	LL3so-128-0880-SO	No		Field Explosives < 1 mg/kg in surface sample
EB-4A Melt-load Building	0 to 1	LL3-129	LL3ss-129-0881-SO	Yes	8/6/01	Uphill or adjacent to barrier. MC, pH, GS, AL, SG, USCS. Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-129	LL3so-129-0882-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-129	LL3so-129-0883-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-130	LL3ss-130-0884-SO	Yes	8/6/01	Uphill or adjacent to barrier. Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-130	LL3so-130-0885-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-130	LL3so-130-0886-SO	No		Field Explosives < 1 mg/kg in surface sample

Table 3-2. Soil Sample list and Rationales, Load Line 3 Phase II RI (continued)

Facility/ Building No.	Depth (ft)	Station ID	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
	0 to 1	LL3-131	LL3ss-131-0887-SO	Yes	8/6/01	Uphill or adjacent to barrier. Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-131	LL3so-131-0888-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-131	LL3so-131-0889-SO	No		Field Explosives < 1 mg/kg in surface sample
EB-25 Carrier Wash Building	0 to 1	LL3-132	LL3ss-132-0890-SO	Yes	8/10/01	Field analysis of TNT 1.8 mg/kg/RDX 1 mg/kg
	1 to 3	LL3-132	LL3so-132-0891-SO	Yes	8/12/01	Field analysis of TNT/RDX < 1 mg/kg
	3 to 5	LL3-132	LL3so-132-0892-SO	No		Field explosives < 1 mg/kg in 1- to 3-ft sample
	0 to 1	LL3-133	LL3ss-133-0893-SO	Yes	8/10/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-133	LL3so-133-0894-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-133	LL3so-133-0895-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-134	LL3ss-134-0896-SO	Yes	8/1/01	Resampled for metals and PCBs on 8/10/01 at 1430. Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-134	LL3so-134-0897-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-134	LL3so-134-0898-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-135	LL3ss-135-0899-SO	Yes	8/10/01	Field analysis of TNT 1.2 mg/kg/RDX > 1 mg/kg
	1 to 3	LL3-135	LL3so-135-0900-SO	Yes	8/12/01	Field analysis of TNT/RDX < 1 mg/kg, refusal at 1.3 ft
	3 to 5	LL3-135	LL3so-135-0901-SO	No		Field explosives < 1 mg/kg in 1- to 3-ft sample
EB-3 Shell Receiving Building	0 to 1	LL3-136	LL3ss-136-0902-SO	Yes	8/10/01	Field analysis of TNT = 3.6 mg/kg
	1 to 3	LL3-136	LL3so-136-0903-SO	Yes	8/12/01	Field analysis of TNT/RDX < 1 mg/kg
	3 to 5	LL3-136	LL3so-136-0904-SO	No		Field explosives < 1 mg/kg in 1- to 3-ft sample
	0 to 1	LL3-137	LL3ss-137-0905-SO	Yes	8/10/01	Propellants jar collected on 8/12/01 at 1350. Field analysis of TNT = 5.5 mg/kg
	1 to 3	LL3-137	LL3so-137-0906-SO	Yes	8/12/01	Field analysis of TNT/RDX < 1 mg/kg
	3 to 5	LL3-137	LL3so-137-0907-SO	No		Field explosives < 1 mg/kg in 1- to 3-ft sample
	0 to 1	LL3-138	LL3ss-138-0908-SO	Yes	8/10/01	Field analysis of TNT/RDX < 1 mg/kg, refusal at 0.6 ft
	1 to 3	LL3-138	LL3so-138-0909-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-138	LL3so-138-0910-SO	No		Field Explosives < 1 mg/kg in surface sample
EB-3 Shell Receiving Building	0 to 1	LL3-139	LL3ss-139-0911-SO	Yes	8/11/01	Field analysis of TNT/RDX < 1 mg/kg
	0 to 1	LL3-139	LL3ss-139-1133-SO	Yes	8/11/01	Duplicate
	0 to 1	LL3-139	LL3ss-139-0911-SO	Yes	8/11/01	Field analysis of TNT/RDX < 1 mg/kg

Table 3-2. Soil Sample list and Rationales, Load Line 3 Phase II RI (continued)

Facility/ Building No.	Depth (ft)	Station ID	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
	1 to 3	LL3-139	LL3so-139-0912-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-139	LL3so-139-0913-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-140	LL3ss-140-0914-SO	Yes	8/11/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-140	LL3so-140-0915-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-140	LL3so-140-0916-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-141	LL3fs-141-0917-FS	Yes	8/20/01	Floor sweep
EB-803 Inert Storage	0 to 1	LL3-142	LL3ss-142-0918-SO	Yes	8/9/01	Field analysis of TNT = 1.34 mg/kg, refusal at 0.5 ft
	0 to 1	LL3-142	LL3ss-142-1120-SO	Yes	8/9/01	Duplicate
	0 to 1	LL3-142	LL3ss-142-1142-SO	Yes	8/9/01	Split
	1 to 3	LL3-142	LL3so-142-0919-SO	No		Refusal at 0.5 ft
	3 to 5	LL3-142	LL3so-142-0920-SO	No		Refusal at 0.5 ft
	0 to 1	LL3-143	LL3ss-143-0921-SO	Yes	8/9/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-143	LL3so-143-0922-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-143	LL3so-143-0923-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-144	LL3ss-144-0924-SO	Yes	8/9/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-144	LL3so-144-0925-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-144	LL3so-144-0926-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-145	LL3ss-145-0927-SO	Yes	8/9/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-145	LL3so-145-0928-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-145	LL3so-145-0929-SO	No		Field Explosives < 1 mg/kg in surface sample
EB-8 Change House	0 to 1	LL3-146	LL3ss-146-0930-SO	Yes	8/8/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-146	LL3so-146-0931-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-146	LL3so-146-0932-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-147	LL3ss-147-0933-SO	Yes	8/8/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-147	LL3so-147-0934-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-147	LL3so-147-0935-SO	No		Field Explosives < 1 mg/kg in surface sample
EB-8A Change House	0 to 1	LL3-148	LL3ss-148-0936-SO	Yes	8/9/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-148	LL3so-148-0937-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-148	LL3so-148-0938-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-149	LL3ss-149-0939-SO	Yes	8/9/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-149	LL3so-149-0940-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-149	LL3so-149-0941-SO	No		Field Explosives < 1 mg/kg in surface sample
EB-22 Change House	0 to 1	LL3-150	LL3ss-150-0942-SO	Yes	8/8/01	Field analysis of TNT/RDX < 1 mg/kg

Table 3-2. Soil Sample list and Rationales, Load Line 3 Phase II RI (continued)

Facility/ Building No.	Depth (ft)	Station ID	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
	1 to 3	LL3-150	LL3so-150-0943-SO	No		Field Explosives < 1 mg/kg in surface sample
EB-22 Change House	3 to 5	LL3-150	LL3so-150-0944-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-151	LL3ss-151-0945-SO	Yes	8/8/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-151	LL3so-151-0946-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-151	LL3so-151-0947-SO	No		Field Explosives < 1 mg/kg in surface sample
Contingency						
Culvert at Building EA-6A	0 to 1	LL3-152	LL3ss-152-0948-SO	Yes	8/13/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-152	LL3so-152-0949-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-152	LL3so-152-0950-SO	No		Field Explosives < 1 mg/kg in surface sample
Building EA-6 Vicinity	0 to 1	LL3-153	LL3ss-153-0951-SO	Yes	8/13/01	Field analysis of TNT = 181.6 mg/kg
	0 to 1	LL3-153	LL3ss-153-1134-SO	Yes	8/13/01	Duplicate
	0 to 1	LL3-153	LL3ss-153-1153-SO	Yes	8/13/01	Split
	1 to 3	LL3-153	LL3so-153-0952-SO	Yes	8/20/01	Field analysis of TNT = 49.1 mg/kg, refusal at 3.0 ft
	3 to 5	LL3-153	LL3so-153-0953-SO	No		Refusal at 3.0 ft
Building EA-6A Vicinity	0 to 1	LL3-154	LL3ss-154-0954-SO	Yes	8/13/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-154	LL3so-154-0955-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-154	LL3so-154-0956-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-155	LL3ss-155-0957-SO	No		Contingency station LL3-155 reassigned to sediment primary and duplicate samples
	1 to 3	LL3-155	LL3so-155-0958-SO	No		No subsurface sediment
	3 to 5	LL3-155	LL3so-155-0959-SO	No		No subsurface sediment
	0 to 1	LL3-156	LL3ss-156-0960-SO	No		Reassigned as sediment contingency
	1 to 3	LL3-156	LL3so-156-0961-SO	No		No subsurface sediment
	3 to 5	LL3-156	LL3so-156-0962-SO	No		No subsurface sediment
Building EA-6 Vicinity	0 to 1	LL3-157	LL3ss-157-0963-SO	Yes	8/13/01	Field analysis of TNT = 1,563 mg/kg
	1 to 3	LL3-157	LL3so-157-0964-SO	Yes	8/20/01	Field analysis of TNT = 195 mg/kg, refusal at 2.8 ft
	3 to 5	LL3-157	LL3so-157-0965-SO	No		Refusal at 2.8 ft
Building EA-6 Vicinity	0 to 1	LL3-158	LL3ss-158-0966-SO	Yes	8/13/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-158	LL3so-158-0967-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-158	LL3so-158-0968-SO	No		Field Explosives < 1 mg/kg in surface sample
Building EA-6 Vicinity	0 to 1	LL3-159	LL3ss-159-0969-SO	Yes	8/13/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-159	LL3so-159-0970-SO	No		Field Explosives < 1 mg/kg in surface sample

Table 3-2. Soil Sample list and Rationales, Load Line 3 Phase II RI (continued)

Facility/ Building No.	Depth (ft)	Station ID	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
	3 to 5	LL3-159	LL3so-159-0971-SO	No		Field Explosives < 1 mg/kg in surface sample
Building EA-6 Vicinity	0 to 1	LL3-160	LL3ss-160-0972-SO	Yes	8/13/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-160	LL3so-160-0973-SO	No		Field Explosives < 1 mg/kg in surface sample
Building EA-6 Vicinity	3 to 5	LL3-160	LL3so-160-0974-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-161	LL3ss-161-0975-SO	Yes	8/13/01	Field analysis of TNT/RDX < 1 mg/kg
	1 to 3	LL3-161	LL3so-161-0976-SO	No		Field Explosives < 1 mg/kg in surface sample
	3 to 5	LL3-161	LL3so-161-0977-SO	No		Field Explosives < 1 mg/kg in surface sample
	0 to 1	LL3-162	LL3ss-162-0978-SO	No		Contingency station LL3-162 reassigned to sediment
	1 to 3	LL3-162	LL3so-162-0979-SO	No		No subsurface sediment
	3 to 5	LL3-162	LL3so-162-0980-SO	No		No subsurface sediment
	0 to 1	LL3-163	LL3ss-163-0981-SO	No		Contingency station LL3-163 reassigned to sediment
	1 to 3	LL3-163	LL3so-163-0982-SO	No		No subsurface sediment
	3 to 5	LL3-163	LL3so-163-0983-SO	No		No subsurface sediment
Near Station LL3-099 at Sediment Basin	0 to 1	LL3-226	LL3ss-226-1092-SO	Yes	8/24/01	Field analysis of TNT = 1.1 mg/kg
	1 to 3	LL3-226	LL3so-226-1097-SO	Yes	8/25/01	Field analysis of TNT = 5.8 mg/kg
Near Station LL3-099 at Sediment Basin	0 to 1	LL3-227	LL3ss-227-1093-SO	Yes	8/24/01	Field analysis of TNT = 58.9 mg/kg
Near Station LL3-099 at Sediment Basin	0 to 1	LL3-229	LL3ss-229-1096-SO	Yes	8/24/01	Field analysis of TNT/RDX < 1 mg/kg
South of Station LL3-153	0 to 1	LL3-230	LL3ss-230-1098-SO	Yes	8/24/01	Field analysis of TNT = 146.1 mg/kg
	1 to 3	LL3-230	LL3so-230-1085-SO	Yes	8/25/01	Field analysis of TNT = 1.3 mg/kg
North of Station LL3-157	0 to 1	LL3-231	LL3ss-231-1099-SO	Yes	8/24/01	Field analysis of TNT = 1,748 mg/kg
	1 to 3	LL3-231	LL3so-231-1100-SO	Yes	8/25/01	Field analysis of TNT = 241.1 mg/kg
Building EA-6 Vicinity	0 to 1	LL3-244	LL3ss-244-0686-SO	Yes	8/25/03	Field analysis of TNT/RDX < 1 mg/kg
Building EA-6 Vicinity	0 to 1	LL3-245	LL3ss-245-0689-SO	Yes	8/25/03	Field analysis of TNT/RDX < 1 mg/kg
Random Grid in Non-Production Areas						
	0 to 1	LL3-167	LL3ss-167-0993-SO	Yes	8/11/01	Field analysis of TNT/RDX < 1 mg/kg
	0 to 1	LL3-168	LL3ss-168-0994-SO	Yes	8/10/01	Field analysis of TNT/RDX < 1 mg/kg
	0 to 1	LL3-169	LL3ss-169-0995-SO	Yes	8/10/01	Field analysis of TNT/RDX < 1 mg/kg
	0 to 1	LL3-170	LL3ss-170-0996-SO	Yes	8/10/01	Field analysis of TNT/RDX < 1 mg/kg
	0 to 1	LL3-171	LL3ss-171-0997-SO	Yes	8/10/01	Field analysis of TNT/RDX < 1 mg/kg

Table 3-2. Soil Sample list and Rationales, Load Line 3 Phase II RI (continued)

Facility/ Building No.	Depth (ft)	Station ID	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
	0 to 1	LL3-172	LL3ss-172-0998-SO	Yes	8/10/01	Field analysis of TNT/RDX < 1 mg/kg
	0 to 1	LL3-173	LL3ss-173-0999-SO	Yes	8/10/01	Field analysis of TNT/RDX < 1 mg/kg
	0 to 1	LL3-173	LL3ss-173-1132-SO	Yes	8/10/01	Duplicate
	0 to 1	LL3-173	LL3ss-173-1155-SO	Yes	8/10/01	Split
	0 to 1	LL3-174	LL3ss-174-1000-SO	Yes	8/11/01	
	0 to 1	LL3-175	LL3ss-175-1001-SO	Yes	8/9/01	
	0 to 1	LL3-176	LL3ss-176-1002-SO	Yes	8/10/01	
	0 to 1	LL3-177	LL3ss-177-1003-SO	Yes	8/10/01	
	0 to 1	LL3-178	LL3ss-178-1004-SO	Yes	8/10/01	
	0 to 1	LL3-179	LL3ss-179-1005-SO	Yes	8/10/01	
	0 to 1	LL3-180	LL3ss-180-1006-SO	Yes	8/10/01	
	0 to 1	LL3-181	LL3ss-181-1007-SO	Yes	8/10/01	
	0 to 1	LL3-182	LL3ss-182-1008-SO	Yes	8/10/01	
	0 to 1	LL3-183	LL3ss-183-1009-SO	Yes	8/10/01	
DLA Storage Tanks						
	0 to 1	LL3-184	LL3ss-184-1010-SO	Yes	8/10/01	
	0 to 1	LL3-185	LL3ss-185-1011-SO	Yes	8/10/01	
	0 to 1	LL3-186	LL3ss-186-1012-SO	Yes	8/10/01	
	0 to 1	LL3-187	LL3ss-187-1013-SO	Yes	8/10/01	
	0 to 1	LL3-188	LL3ss-188-1014-SO	Yes	8/10/01	
	0 to 1	LL3-189	LL3ss-189-1015-SO	Yes	8/10/01	
	0 to 1	LL3-189	LL3ss-189-1136-SO	Yes	8/10/01	Duplicate
	0 to 1	LL3-189	LL3ss-189-1158-SO	Yes	8/10/01	Split
	0 to 1	LL3-190	LL3ss-190-1016-SO	Yes	8/11/01	
	0 to 1	LL3-191	LL3ss-191-1017-SO	Yes	8/11/01	
	0 to 1	LL3-192	LL3ss-192-1018-SO	Yes	8/11/01	
	0 to 1	LL3-193	LL3ss-193-1019-SO	Yes	8/11/01	
	0 to 1	LL3-194	LL3ss-194-1020-SO	Yes	8/11/01	
	0 to 1	LL3-195	LL3ss-195-1021-SO	Yes	8/11/01	
	0 to 1	LL3-196	LL3ss-196-1022-SO	Yes	8/11/01	
	0 to 1	LL3-197	LL3ss-197-1023-SO	Yes	8/11/01	
	0 to 1	LL3-198	LL3ss-198-1024-SO	Yes	8/11/01	
	0 to 1	LL3-199	LL3ss-199-1025-SO	Yes	8/11/01	

Table 3-2. Soil Sample list and Rationales, Load Line 3 Phase II RI (continued)

Facility/ Building No.	Depth (ft)	Station ID	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
Perimeter Trenches (Test Pits)						
		LL3-200	LL3so-200-1026-SO	No		Sample not selected for analysis
		LL3-200	LL3so-200-1027-SO	No		Sample not selected for analysis
		LL3-200	LL3so-200-1028-SO	No		Sample not selected for analysis
		LL3-201	LL3so-201-1029-SO	No		Sample not selected for analysis
		LL3-201	LL3so-201-1030-SO	No		Sample not selected for analysis
		LL3-201	LL3so-201-1031-SO	No		Sample not selected for analysis
		LL3-202	LL3so-202-1032-SO	No		Sample not selected for analysis
		LL3-202	LL3so-202-1033-SO	No		Sample not selected for analysis
		LL3-202	LL3so-202-1034-SO	No		Sample not selected for analysis
	1.8 to 2.4	LL3-203	LL3so-203-1035-SO	Yes	8/21/01	MC, pH, GS, AL, SG, USCS
	3.5	LL3-203	LL3so-203-1036-SO	Yes	8/21/01	MC, pH, GS, AL, SG, USCS
		LL3-203	LL3so-203-1037-SO	No		Sample not selected for analysis
		LL3-204	LL3so-204-1038-SO	No		Sample not selected for analysis
		LL3-204	LL3so-204-1039-SO	No		Sample not selected for analysis
		LL3-204	LL3so-204-1040-SO	No		Sample not selected for analysis
		LL3-205	LL3so-205-1041-SO	No		Sample not selected for analysis
	11.4	LL3-205	LL3so-205-1042-SO	Yes	8/21/01	MC, pH, GS, AL, SG, USCS
	3.2 to 4.0	LL3-205	LL3so-205-1043-SO	Yes	8/21/01	MC, pH, GS, AL, SG, USCS

AL = Atterberg limits.
COC = Chemical of concern.
DLA = Defense Logistics Agency.
GS = Grain size (sieve method).
ID = Identification.
IDW = Investigation-derived waste.
MC = Moisture content.
PCB = Polychlorinated biphenyl.
pH = Soil pH.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.
RI = Remedial Investigation.
SG = Specific gravity.
TNT = Trinitrotoluene.
USCS = Unified Soil Classification System.

3.1.1 Rationale

Data from soil samples collected during the Phase II RI at Load Line 3 were obtained to identify areas contaminated as a result of historical site operations and to determine the vertical and horizontal extent of identified contamination. Soil sampling data were also obtained to evaluate the potential for contaminant migration via leaching or erosional processes from surface soil sources to receptor media, such as sediment and surface water, using numerical models and qualitative methods (see Chapter 5.0). The results of the soil sample analyses were also used to quantify risks to human and ecological receptors that may be exposed to soil (see Chapters 6.0 and 7.0).

3.1.1.1 Surface and subsurface soils

As presented in Table 3-2, soil sampling locations have been categorized by geographic location and/or sample type. The categories include: (1) source area characterization, (2) contingency, (3) random grid in non-production areas, (4) DLA storage tanks, and (5) perimeter trenches. The ensuing discussion of surface and subsurface soil sampling rationales will follow in a similar manner. As surface soil samples were not collected from the perimeter trenches (test pits), they will not be discussed here, but rather in Section 3.1.1.2 below.

Source Area Characterization

Surface and subsurface soil samples were collected primarily at former operations and support areas that were thought to represent potential source areas for contamination (Functional areas 1 through 26, and 29). Sampling locations were selected on the basis of operational records, the project DQOs, and the analytical results from previous sampling events (Phase I RI) to characterize contaminant nature and extent. Soil samples were also collected from beneath building floors to evaluate any contaminant releases through cracks in floor slabs or leaking drains.

The subsurface sampling strategy was driven in part based on the use of color spectrophotometry, or colorimetry, to analyze for TNT and RDX in a field laboratory. The rationale for employing the field analytical methods was to identify the presence of explosives compounds at a specific sample location on a “real-time” basis. As explosive compounds typically have high adsorption factors, initial field-testing focused on the surface soils only. At stations where TNT and RDX were identified in the surface soil interval at concentrations greater than 1 mg/kg, field teams would return to the station to collect supplementary subsurface soil samples. Due to the absorption factors of explosives compounds and given that most releases at RVAAP were to the ground surface, the absence of TNT or RDX above 1 mg/kg in the surface interval was presumed to indicate that explosives were not present in the subsurface (unless evidence existed that soil had been disturbed), and further subsurface sampling was not conducted. The following flow chart (Figure 3-5) presents the rationale and decision-making tree based on the results of the explosives field testing.

In order to establish the horizontal extent of explosives contamination, the field analytical data were constantly evaluated as work progressed to determine if additional samples were required at a specific location. Section 3.6.1 outlines the methodology for the field colorimetric analyses.

A total of 87 surface and 22 subsurface soil samples was collected from areas associated with the source area characterization functional areas 1 through 26, and 29. In addition, 12 sub-floor samples were collected from beneath building floors.

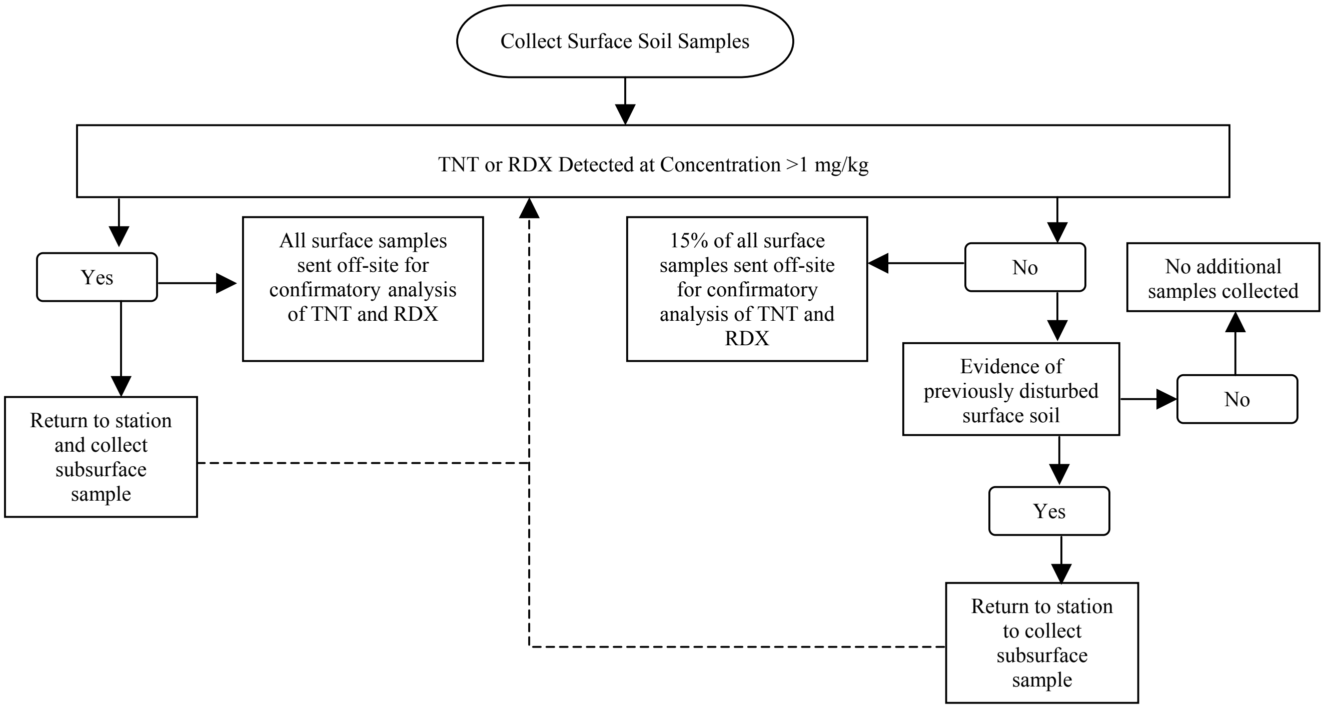

Figure 3-5. Field Explosives Analysis Screening Rationale

Contingency

Fifteen contingency sample locations were identified during the Phase II sampling activities. Contingency samples were collected based on specific field conditions and observations made during the field effort. A total of 15 surface soil and 5 sub-surface soil contingency samples was collected.

Random Grid in Non-Production Areas

To effectively characterize large areas outside of the immediate production complex of the AOC with a high degree of confidence [e.g., non-production areas (functional area 27)], a statistically based random sampling method was employed (Gilbert 1987). Non-production areas were further divided into 17 EUs, each encompassing a few acres (Figure 3-3). EUs were employed to account for potential future residential land use in that a typical residential property owner would not be expected to purchase and use land tracts of more than a few acres. For each EU, a triangular sampling grid having a grid spacing of 18.3 m (60 ft) was superimposed. The grid spacing selected was sufficient to locate a hypothetical elliptical contamination "hotspot" having dimensions of 30.5 m (100 ft) by 15.2 m (50 ft), with a confidence factor of 95%. Each node (or line intersection) on the grid was assigned a numerical value. A random number generator was employed to identify the node at which a sample would be collected. A total of 17 surface soil samples was collected in the non-production areas. There were no sub-surface soils collected from the non-production areas.

Subsurface Soil

Subsurface soil sampling strategy was based on the use of field analyses for TNT and RDX discussed previously. At stations where TNT and RDX were identified in the surface soil interval 0 to 0.3 m (0 to 1 ft) at concentrations greater than 1 mg/kg, field teams would return to the station to collect a sample from the 0.3- to 0.9-m (1- to 3-ft) subsurface interval. This process was repeated for subsequent subsurface intervals based on results of the field explosives analyses. Due to the high adsorption factors for explosive compounds and given that most releases at RVAAP were to the ground surface, the absence of TNT or RDX above 1 mg/kg in the surface interval was presumed to indicate that explosives were not present in the subsurface (unless evidence existed that soil had been disturbed). Thus, if field analyses indicated a lack of detectable explosives in the surface soil interval, subsurface samples were not collected.

Following the decision process above, the option to collect subsurface soil samples at any designated surface soil location was incorporated into the sampling planning process. During scoping of the Phase II RI, provisions were made for approximately 28 subsurface soil samples. A total of 25 subsurface soil samples (including contingencies) were ultimately collected from the 0.3- to 0.9-m (1- to 3-ft) bgs interval based on field TNT or RDX above 1 mg/kg; no samples were collected from the 0.9- to 1.6-m (3- to 5-ft) bgs interval due to the absence of detectable TNT or RDX in the field laboratory. Target depths were not attained for many Load Line 3 subsurface soil samples due to refusal of hand auger borings on bedrock or float.

DLA Storage Tanks

The former DLA storage tanks were used to store various chemicals throughout the Load Line 3 history. To evaluate the current status of surface soils in the area of the former DLA storage tanks, biased surface soil samples were collected from 16 stations. Specific sample locations were based on field observations and site conditions encountered. There were no sub-surface samples collected from the DLA storage tank area.

Tables 3-1 and 3-2 describe the rationale for the final placement of all individual soil sampling locations within the Load Line 3 functional areas based on the project DQOs and field analyses of samples. Specific analysis for each sample is discussed in Appendix H, and all analytical results are discussed in detail in Chapter 4.0.

3.1.1.2 Test pits

To provide a better understanding of the flow regime and to assist in selecting optimal locations for monitoring wells, test pits were excavated at six locations around the outer perimeter of the AOC where the vadose zone was presumed to be uncontaminated. In addition, stratigraphic and geotechnical data were collected from the test pits that would not ordinarily be obtained through conventional soil borings or direct-push sampling. Characterization of the unconsolidated zone stratigraphy was accomplished through collecting a total of four grab samples from two test pits (TP-4 and TP-6). Representative samples (two) from each pit were collected and submitted for analysis of moisture content, grain size, Atterberg limits, United Soil Classification System (USCS) classification, specific gravity, and pH. Table 3-2 presents a comprehensive overview of the geotechnical samples collected and analysis performed. Samples for chemical analyses were not planned or collected.

Depth (bgs) to bedrock at the six Load Line 3 test pits is as follows:

Test Pit 1 (LL3-200): 12.6 ft (no refusal),
Test Pit 2 (LL3-201): 10.9 ft (bedrock),
Test Pit 3 (LL3-202): 4.4 ft (bedrock),
Test Pit 4 (LL3-203): 4.0 ft (bedrock),
Test Pit 5 (LL3-204): 8.0 ft (bedrock), and
Test Pit 6 (LL3-205): 11.4 ft (no refusal).

3.1.1.3 Floor sweep samples

In support of future building demolition activities, floor sweep samples were collected from three buildings (EB-10, EB-4, and EB-3). The samples were collected from random areas within the building in order to determine if residual explosives dust and/or lead-based paint chips were still present. A total of three dust samples was collected, one from each building, and submitted for analysis by the Toxicity Characteristic Leaching Procedure (TCLP). The analysis will determine if the material exhibits characteristically hazardous properties.

3.1.1.4 Geotechnical samples

Geotechnical analysis was performed on samples collected from 38 stations including monitoring well boring locations (5 locations), surface soil (20 locations), sediment (9 locations), and test pits (4 locations) (Table 3-2). Analysis of each sample was selected to determine specific geotechnical properties necessary to evaluate media-specific fate and transport mechanisms and potential remedial alternatives.

A total of five Shelby tubes or undisturbed soil samples was submitted from the monitoring well locations (one Shelby tube from each of five monitoring well borings). The samples were collected from the interval most representative of the unconsolidated material at each monitoring well boring location. Shelby tube samples were submitted for a comprehensive suite of parameters (Table 3-2) to evaluate site hydrogeologic characteristics and to obtain data for potential future evaluation of natural attenuation.

Grab or disturbed samples were collected to characterize the unconsolidated zone stratigraphy at the remaining sample locations. Table 3-2 provides a comprehensive list of all soil samples collected, along with the geotechnical analysis performed on each sample.

3.1.2 Surface and Subsurface Soil Field Sampling Methods

3.1.2.1 Surface soil and dry sediments

A decontaminated stainless steel bucket hand auger was used to collect surface soil samples at each station. The target depth interval for surface soil samples was 0 to 0.3 m (0 to 1 ft). For samples collected beneath the building floors, coring of the concrete floor slabs was required. The samples were then collected from the first 0.3-m (1-ft) interval beneath the floor slab, as described for surface samples. Where explosives and propellant analyses were not specified, a single boring was hand augered at the approved locations. Soil for VOC analyses was placed directly into sample jars from either the auger bucket or directly from the borehole. The remaining soil in the bucket auger was placed into a stainless steel bowl and homogenized. Samples for inorganic constituents (metals and cyanide), SVOCs, and other non-volatile constituents were collected from the homogenized soil mixture.

Where analyses for explosives and propellant compounds were specified (Appendix H), composite samples were collected. Because of the physical characteristics of these explosives and propellant compounds (e.g., flakes, particles, and pellets) and the nature of process operations, the distribution of these types of compounds can be erratic and highly variable. Composite sampling has been shown to reduce statistical sampling error in surface soil at sites with a history of explosives contamination in surface soil (Jenkins et al. 1996) and to increase the likelihood of capturing detectable levels of explosive compounds over a given area. Composite sampling data are considered acceptable by EPA for use in risk assessment where concentrations are expected to vary spatially (EPA 1989a). To collect composite samples for surface soil and dry sediment, three borings were hand augered in an equilateral triangle pattern measuring approximately 0.9 m (3 ft) on a side. Equal portions of soil from the three sub-samples were placed into a large, decontaminated stainless steel bowl, homogenized, and the samples for explosive and propellant compounds analyses placed into sample containers. A portion of the sample was extracted from the sample container for field colorimetric analysis of TNT and RDX. As required by field method results or for confirmation purposes, the remaining portion was submitted to the fixed-base laboratory for additional analysis. Samples for analyses of other contaminants (e.g., inorganics, SVOCs,

VOCs, etc.) were collected, as described for discrete samples above, from a boring placed in the approximate center of the triangle formed by the three sub-samples.

Field descriptions and classifications for the soils encountered were performed in accordance with the USCS using the standard Munsell® Soil Color Charts (Munsell 1988) color system and the results were recorded in the project logbooks in accordance with Section 4.4.2.3 of the Facility-wide SAP, as specified in the Phase II RI SAP Addendum. Organic vapor measurements were made in the breathing zone during sampling and the results recorded in the field logbooks.

Following the collection of each sample, excess soil was designated as IDW and placed in lined, labeled 55-gal drums that were sealed after use and staged at the designated Field Staging Area within Load Line 3. IDW practices for all media are discussed in Appendix Q. Hand auger borings were backfilled to the ground surface with dry bentonite chips.

3.1.2.2 Subsurface soil sampling methods

To collect subsurface samples for chemical analyses, a decontaminated auger bucket was used to deepen the surface soil boring over the required depth interval. At locations where composite sampling was performed for explosive and propellant compound analysis, the subsurface sample was obtained by deepening the surface soil boring located in the center of the equilateral triangle.

Soil from the subsurface interval was placed into a stainless steel bowl, homogenized, and representative aliquots were placed into the appropriate sample containers. All volatile organic compound samples were collected as discrete aliquots from the middle of the interval without homogenization. As with surface soil samples, a portion of the sample designated for explosives and propellant compound analyses was extracted from the sample container for field colorimetric analysis of TNT and RDX. As required by field method results or for confirmation purposes, the remaining portion was submitted to the fixed-base laboratory for additional analysis.

Field descriptions and classification of the soils was performed in accordance with the USCS using the standard Munsell® Soil Color Charts (Munsell 1988) color system, and the results recorded in the project logbooks in accordance with Section 4.4.2.3 of the Facility-wide SAP as specified in the Phase II RI SAP Addendum. Organic vapor measurements were made in the breathing zone during sampling and at the top of the boring and recorded in the field logbooks.

Following collections of the sample, excess soil was designated as IDW and placed in lined, labeled 55-gal drums that were sealed after use and staged at the designated Field Staging Area within the load line. IDW practices for all media are discussed in Appendix Q. Hand auger borings were backfilled to the ground surface with dry bentonite chips.

3.1.3 Floor Sweep Sample Collection Methods

Floor sweep samples were collected by broom-sweeping the floor of each building and gathering accumulated dust and soil particles. The collected material was then poured into the necessary sample containers. The sweep area varied within each building, depending on the amount of accumulated material identified.

3.1.4 Test Pits

Test pit locations are shown on Figure 3-6. The test pits were excavated using a track-mounted excavator with a 61-cm (24-in.) bucket to depths ranging from 1.22 to 3.84 m (4.0 to 12.6 ft). Each excavation was terminated at either the maximum capability of the excavator or upon encountering the water table.

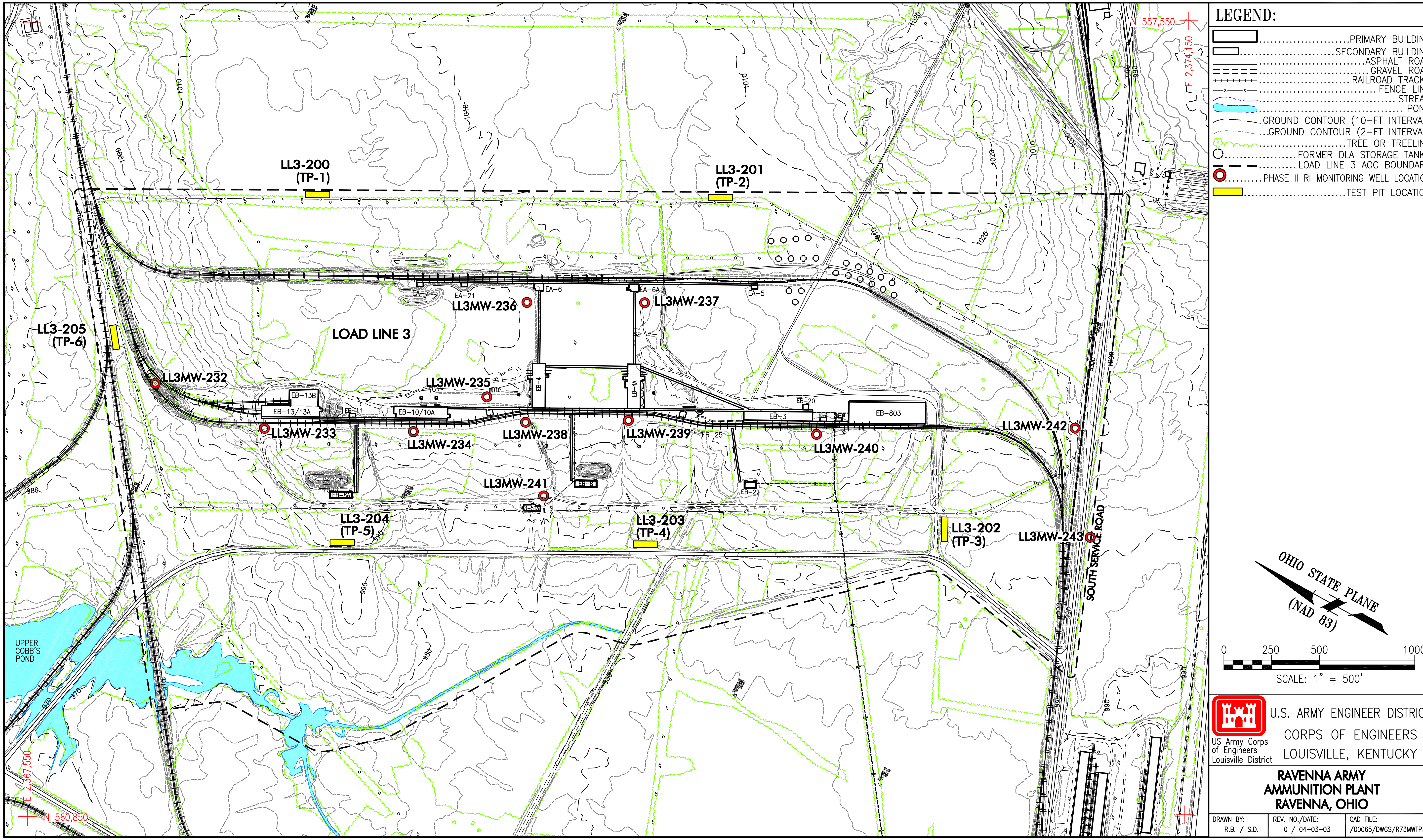

Figure 3-6. Phase II RI Monitoring Well and Test Pit Locations at Load Line 3

Soil extracted from the test pits was logged in accordance with the USCS using the standard Munsell® Soil Color Charts (Munsell 1988) color system. Disturbed samples for geotechnical analyses were collected from two test pits to provide a vertical profile of geotechnical characteristics and to characterize different soil types encountered in the pit. Samples for chemical analyses were not planned or collected. Organic vapor measurements were made in the breathing zone during sampling and at the top of the boring and recorded in the field logbooks.

3.2 SEDIMENT CHARACTERIZATION

3.2.1 Rationale

Sediment samples were collected from a total of 29 stations at Load Line 3 (Table 3-3; Figures 3-7 and 3-8). Data from sediment samples collected within Load Line 3 were obtained to identify areas of contaminant accumulation and to evaluate potential contaminant migration via erosional processes from surface soil sources. Samples were collected from within the principal downstream drainage channels to evaluate potential off-AOC contaminant migration and accumulation within these stream reaches.

The analytical results for sediment samples collected from surface drainage features were used to quantify risks to human and ecological receptors that may be exposed to sediment (see Chapters 6.0 and 7.0). All inorganic sediment samples were collected from the uppermost 15 cm (0.5 ft) interval below any loose material or vegetative matter. A synopsis of sediment sampling activities for chemical analyses is provided below. Departures from the planned sampling efforts due to site conditions (i.e., refusal) and the addition of contingency samples are specifically denoted. Table 3-4 presents a summary of sediment samples collected during the Phase II RI field effort, including the sampling rationale for each location.

The sediment sampling strategy consisted of collecting samples from sedimentation and washout basins within the production area, from ditches and inlets to the storm sewer system inside the production area, from sanitary sewer manholes, and from AOC outfalls or exit points. In addition, several contingency samples were collected based on specific field conditions and observations. Several planned sampling locations did not contain sufficient sediment for sampling or were inaccessible. Table 3-3 presents a summary of sediment samples collected during the Phase II RI field activities, including sampling rationale for each sample locations. Figures 3-7 and 3-8 illustrate the location of all sediment sampling stations.

3.2.2 Sediment Field Sampling Methods

Dry sediment samples from ditch lines and low lying areas were collected using the hand bucket auger method, as described for surface soil samples in Section 3.1.2.1. Sub-aqueous sediments were collected with a decontaminated stainless steel trowel or scoop using the methods described in Section 4.5.2.1.2 of the Facility-wide SAP (USACE 2001a), as referenced by the Phase II RI SAP Addendum (USACE 2001b), given that sampling stations had less than about 30 cm (1.0 ft) of water. The trowel was used to manually obtain sediment material to a depth of 15.24 cm (0.5 ft) bgs. Extracted material was placed into a stainless steel bowl. At sample locations where VOC samples were to be collected, the VOC containers were immediately filled with the first materials obtained. Sample containers for the remaining nonvolatile analytes were then filled. Loose material and debris samples were also collected from the top of the sediment layer using the stainless steel trowel/scoop method.

Field description of the sediment samples was performed and the results recorded in the project logbooks in accordance with Section 4.4.2.3 of the Facility-wide SAP (USACE 2001a), as specified in the Phase II RI SAP Addendum. Organic vapor measurements made in the breathing zone during sampling were recorded in the field logbooks.

Table 3-3. Phase II RI Sediment Sampling Rationale for Load Line 3

Facility/Building No.	Depth (ft)	Station	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/ Rationales
Associated with Buildings						
Settling Tank	0 to 0.5	LL3-208	LL3sd-208-1050-SD	Yes	8/6/01	
EB-4 Melt-load Building North Washout Annex	0 to 0.5	LL3-209	LL3sd-209-1051-SD	No		No sediment
EB-4 Melt-load Building South Washout Annex	0 to 0.5	LL3-210	LL3sd-210-1053-SD	Yes	8/6/01	
	0 to 0.5	LL3-210	LL3sd-210-1122-SD	Yes	8/6/01	Duplicate
	0 to 0.5	LL3-210	LL3sd-210-1144-SD	Yes	8/6/01	Split
EB-4A Melt-load Building North Washout Annex	0 to 0.5	LL3-211	LL3sd-211-1055-SD	Yes	8/6/01	
EB-4A Melt-load Building South Washout Annex	0 to 0.5	LL3-212	LL3sd-212-1057-SD	Yes	8/6/01	
EB-4A Melt-Load Building Northeast Water Basin	0 to 0.5	LL3-213	LL3sd-213-1059-SD	No		No sediment
	0 to 0.5	LL3-214	LL3sd-214-1061-SD	No		No sediment
Storm Water Ditches/Sewer						
IN EB-4	0 to 0.5	LL3-215	LL3sd-215-1063-SD	Yes	8/7/01	
Outfall west of IN EB-4	0 to 0.5	LL3-216	LL3sd-216-1064-SD	Yes	8/7/01	
IN EH 7	0 to 0.5	LL3-217	LL3sd-217-1066-SD	Yes	8/7/01	
IN EH 13	0 to 0.5	LL3-218	LL3sd-218-1067-SD	Yes	8/7/01	
Outfall west of IN EB-11	0 to 0.5	LL3-219	LL3sd-219-1068-SD	Yes	8/7/01	GS
Outfall west of IN EH 16A	0 to 0.5	LL3-220	LL3sd-220-1075-SD	Yes	8/7/01	
Outfall west of Building EB-2	0 to 0.5	LL3-221	LL3sd-221-1081-SD	Yes	8/7/01	
IN EH 21	0 to 0.5	LL3-223	LL3sd-223-1088-SD	Yes	8/8/01	
IN EB 20	0 to 0.5	LL3-224	LL3sd-224-1089-SD	Yes	8/7/01	
	0 to 0.5	LL3-224	LL3sd-224-1130-SD	Yes	8/7/01	Duplicate
	0 to 0.5	LL3-224	LL3sd-224-1152-SD	Yes	8/7/01	Split
Resample Phase I LL3-046	0 to 0.5	LL3-046	LL3sd-046-1065-SD	Yes	8/8/01	
Resample Phase I LL3-047	0 to 0.5	LL3-047	LL3sd-047-1069-SD	Yes	8/8/01	GS
Resample Phase I LL3-052	0 to 0.5	LL3-052	LL3sd-052-1071-SD	Yes	8/8/01	GS
Resample Phase I LL3-053	0 to 0.5	LL3-053	LL3sd-053-1073-SD	Yes	8/8/01	GS
Resample Phase I LL3-048	0 to 0.5	LL3-048	LL3sd-048-1077-SD	Yes	8/8/01	GS
Resample Phase I LL3-051	0 to 0.5	LL3-051	LL3sd-051-1079-SD	Yes	8/8/01	GS
Resample Phase I LL3-049	0 to 0.5	LL3-049	LL3sd-049-1082-SD	Yes	8/8/01	GS
Resample Phase I LL3-050	0 to 0.5	LL3-050	LL3sd-050-1084-SD	Yes	8/8/01	GS
Sanitary Sewer						
MH 413	0 to 0.5	LL3-225	LL3sd-225-1090-SD	No		No sediment
MH 404	0 to 0.5	LL3-226	LL3sd-226-1092-SD	No		No sediment. Station reassigned as additional soil contingency
MH 407	0 to 0.5	LL3-227	LL3sd-227-1093-SD	No		No sediment. Station reassigned as additional soil contingency
MH 408	0 to 0.5	LL3-228	LL3sd-228-1094-SD	Yes	8/9/01	

Table 3-3. Phase II RI Sediment Sampling Rationale for Load Line 3 (continued)

Facility/Building No.	Depth (ft)	Station	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/ Rationales
MH 419	0 to 0.5	LL3-229	LL3sd-229-1096-SD	No		No sediment. Station reassigned as additional soil contingency
MH 424	0 to 0.5	LL3-230	LL3sd-230-1098-SD	No		No sediment. Station reassigned as additional soil contingency
MH 427	0 to 0.5	LL3-231	LL3sd-231-1099-SD	No		No sediment. Station reassigned as additional soil contingency
Contingency Samples						
Building EA-6 Settling Basin	0 to 0.5	LL3-155	LL3sd-155-0957-SD	Yes	8/9/01	
	0 to 0.5	LL3-155	LL3sd-155-1125-SD	Yes	8/9/01	Duplicate
	0 to 0.5	LL3-155	LL3sd-155-1147-SD	Yes	8/9/01	Split
Drainage north of LL3 to Cobb's Pond	0 to 1	LL3-156	LL3sd-156-0960-SD	Yes	8/8/01	
Drainage in Building EB-8 Vicinity	0 to 0.5	LL3-162	LL3sd-162-0978-SD	Yes	8/13/01	
Drainage in Building EB-8 Vicinity	0 to 0.5	LL3-163	LL3sd-163-0981-SD	Yes	8/13/01	

GS = Grain size (sieve method).
ID = Identification.
IN = Inlet.
MH = Manhole.
RI = Remedial Investigation.

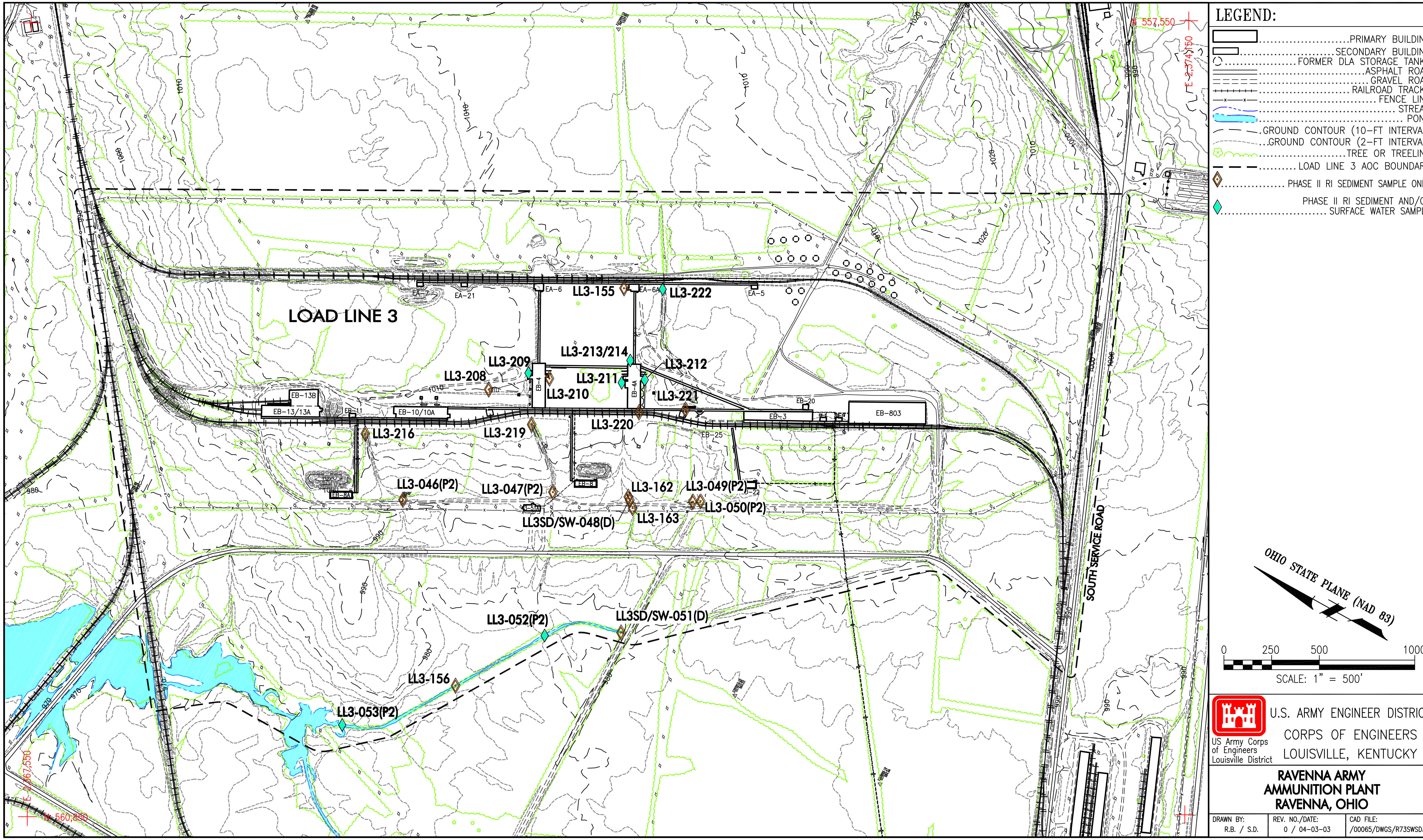

Figure 3-7. Phase II RI Sediment and Surface Water Sampling Locations at Load Line 3

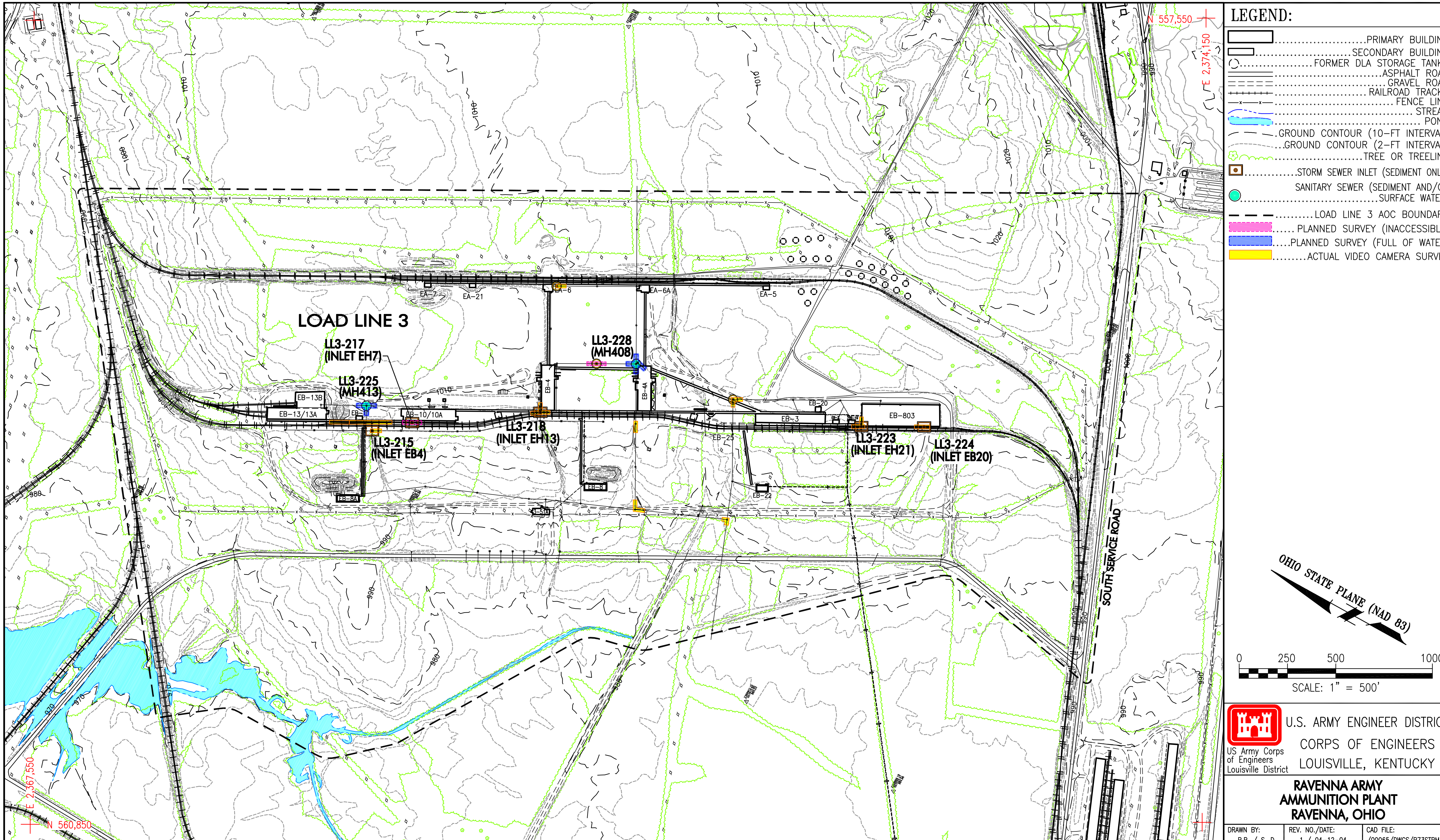

Figure 3-8. Phase II RI Storm and Sanitary Sewer Sampling and Video Survey Locations at Load Line 3

Table 3-4. Phase II RI Surface Water Sampling Rationale for Load Line 3

Facility/Building No.	Station	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/ Rationales
Associated with Buildings					
EB-4 Melt-load Building North Washout Annex	LL3-209	LL3sw-209-1052-SW	Yes	8/6/01	Sedimentation and washout basin within the production area
	LL3-209	LL3sw-209-1139-SW	Yes	8/6/01	Duplicate
	LL3-209	LL3sw-209-1161-SW	Yes	8/6/01	Split
EB-4 Melt-load Building South Washout Annex	LL3-210	LL3sw-210–1054-SW	No		Sedimentation and washout basin within the production area. Location dry
EB-4A Melt-load Building North Washout Annex	LL3-211	LL3sw-211-1056-SW	Yes	8/6/01	Sedimentation and washout basin within the production area
EB-4A Melt-load Building South Washout Annex	LL3-212	LL3sw-212-1058-SW	Yes	8/6/01	Sedimentation and washout basin within the production area
EB-4A Melt-load Building Northeast Water Basin	LL3-213	LL3sw-213-1060-SW	Yes	8/7/01	Sedimentation and washout basin within the production area
	LL3-214	LL3sw-214-1062-SW	Yes	8/9/01	Sedimentation and washout basin within the production area
Storm Water Ditches/Sewer					
Phase I Station LL3-047 (Kelly's Pond)	LL3-047	LL3sw-047-1070-SW	No		Drainage that exits Load Line 3 location dry
Phase I Station LL3-052	LL3-052	LL3sw-052-1072-SW	Yes	8/9/01	Drainage that exits Load Line 3
Phase I Station LL3-053	LL3-053	LL3sw-053-1074-SW	Yes	8/8/01	Drainage that exits Load Line 3. Station sampled for full analytical suite due to abundant water and to get a full QA/QC suite of samples
	LL3-053	LL3sw-053-1140-SW	Yes	8/8/01	Drainage that exits Load Line 3. Station sampled for full analytical suite due to abundant water and to get a full QA/QC suite of samples
	LL3-053	LL3sw-053-1162-SW	Yes	8/8/01	Drainage that exits Load Line 3. Station sampled for full analytical suite due to abundant water and to get a full QA/QC suite of samples
Phase I Station LL3-048	LL3-048	LL3sw-048-1078-SW	No		Drainage that exits Load Line 3. Location dry
Phase I Station LL3-051	LL3-051	LL3sw-051-1080-SW	No		Drainage that exits Load Line 3. Location dry
Phase I Station LL3-049	LL3-049	LL3sw-049-1083-SW	No		Drainage that exits Load Line 3. Location dry

Table 3-4. Phase II RI Surface Water Sampling Rationale for Load Line 3 (continued)

Facility/Building No.	Station	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/ Rationales
Phase I Station LL3-050	LL3-050	LL3sw-050–1085-SW	No		Drainage that exits Load Line 3. Location dry. Reassigned to soil station LL3-230, 1- to 3-ft sample
Outfall west of IN EH 16A	LL3-220	LL3sw-220–1076-SW	No		AOC outfall exit point Location dry
Outfall south of Building EA-6A	LL3-222	LL3sw-222-1087-SW	Yes	8/7/01	AOC outfall exit point Location dry
Sanitary Sewer					
MH 413	LL3-225	LL3sw-225-1091-SW	Yes	8/9/01	
MH 408	LL3-228	LL3sw-228-1095-SW	Yes	8/9/01	
MH 419	LL3-229	LL3sw-229-1097-SW	No		Location dry. Reassigned as soil contingency station
MH 427	LL3-231	LL3sw-231-1100-SW	No		Location dry. Reassigned as soil contingency station

AOC = Area of Concern.
IN = Inlet.
ID = Identification.
MH = Manhole.
QA = Quality assurance.
QC = Quality control.
RI = Remedial Investigation.

3.3 SURFACE WATER CHARACTERIZATION

3.3.1 Rationale

Surface water represents the primary contaminant transport pathway off of the AOC, either as dissolved phase or adsorbed to particulates that are mobilized by flow. Surface water data obtained were used to evaluate ambient water quality entering the AOC, as well as to assess impacts from other potential source areas. Load Line 3 drainage is toward the north and west, ultimately arriving at a tributary flowing along the western edge of the AOC that drains into Upper Cobb's Pond.

Surface water tributaries and impoundments were the focal areas of the surface water sampling program during the Phase II RI. In addition, surface water sampling within the load line was conducted at locations where potential contaminants would be expected to leach or erode from source areas into drainage ditches. Specifically, in the vicinity of operations buildings and settling basins where surface water could migrate toward the AOC exit points.

Sedimentation basins, washout basins, and the storm and sanitary sewer systems were also focal points for water sampling. Accumulated water within basins may potentially contain residual contamination. Discharge or leakage from these basins represents potential secondary sources of contamination to surface water or groundwater. Additionally, residual water within these basins required characterization for the purpose of disposition under any future remedial action.

A total of 13 surface water samples was collected from the areas described above during the Phase II RI field sampling effort. All surface water sampling locations are illustrated on Figures 3-7 and 3-8 and a summary of surface water samples collected, including sampling rationale, is presented in Table 3-4.

3.3.2 Surface Water Field Sampling Methods

All surface water samples were collected directly into sample containers, as referenced in the Phase II RI SAP Addendum. Filtered samples were not collected. The sample container was submerged, with the cap in place, into the surface water. Then the container was slowly and continuously filled using the cap to regulate the rate of sample entry into the container. Surface water samples were collected prior to sediment samples at co-located sites in order to minimize the potential for elevated turbidity in the surface water samples. In flowing streams, sample collection was initiated at the sampling point furthest downstream in the channel, then proceeding to upstream sampling locations, to minimize the effects of sediment turbidity.

Field measurements were recorded during surface water sampling for the following parameters: pH, conductivity, dissolved oxygen content, and temperature. Each parameter was measured in accordance with procedures contained in Section 4.3.3 of the Facility-wide SAP, as referenced by the Phase II RI SAP Addendum. All field measurements were recorded in the sampling logbooks.

3.4 GROUNDWATER CHARACTERIZATION

3.4.1 Rationale

The rationale for the installation and sampling of groundwater monitoring wells during the Phase II RI at Load Line 3 was to identify whether contaminants were present in groundwater at the AOC, determine the directions of groundwater flow and potential contaminant transport, quantify groundwater flow rates to the extent possible, and determine if any contamination was potentially migrating off of the AOC.

No monitoring wells were installed under the Phase I RI; therefore, 12 new monitoring wells were installed as part of the Phase II RI to monitor shallow groundwater at Load Line 3. Table 3-5 provides the rationale for placing wells in the selected locations and Figure 3-6 illustrates the monitoring well locations.

The monitoring well network was developed to maximize the potential to identify contaminated groundwater resulting from leaching at known and suspected source areas (i.e., former process and demilitarization buildings and settling basins). Nine of the 12 monitoring wells were located adjacent to known or suspected source areas within the Load Line 3 boundary. Two wells were installed along the southern boundary of the load line to monitor the potential off-AOC migration of contamination. One well was located along the northern AOC boundary to provide an understanding of the flow regime within the AOC and to evaluate the potential off-AOC migration in the area.

3.4.2 Monitoring Well Installation Methods

All monitoring well installation activities were conducted according to the Facility-wide SAP and the Load Line 3 Phase II RI SAP Addendum. Monitoring wells were installed using hollow-stem auger drilling methods under the direct supervision of a qualified geologist. A 16.5-cm (4.25-in.) inside diameter, hollow-stem auger was used to advance the borehole through the unconsolidated and the softer consolidated shale material. Soil samples were collected continuously from the ground surface to bedrock refusal or planned borehole termination using a standard split-spoon sampler. Soil sampling was

Table 3-5. Phase II RI Groundwater Sampling Rationale for Load Line 3

Station ID	Sample ID	Sampled Collected (Yes/No)	Date Sampled	Associated Trip Blank	Shelby Tube Sample ID	Comments/Rationales Geotech Analyses
LL3-232	LL3mw-232-1101-GW	Yes	9/11/01	LL31170		
LL3-232		Yes	8/13/01		LL3mw-232-1113-SO	MC, GS, AL, USCS, SG
LL3-233*	LL3mw-233-1102-GW	Yes	2/25/02	LL31173		
LL3-234	LL3mw-234-1103-GW	Yes	9/11/01	LL31170		
LL3-234		Yes	8/12/01		LL3mw-234-1114-SO	MC, GS, AL, USCS, SG
LL3-235*	LL3mw-235-1104-GW	Yes	1/22/02	LL31172		
LL3-236	LL3mw-236-1105-GW	Yes	9/18/01	LL31167		
LL3-236		Yes	8/7/01		LL3mw-236-1115-SO	MC, GS, AL, USCS, SG
LL3-237	LL3mw-237-1106-GW	Yes	9/19/01	LL31167		
LL3-238	LL3mw-238-1107-GW	Yes	9/18/01	LL31167		
LL3-239	LL3mw-239-1108-GW	Yes	9/18/01	LL31167		
LL3-239		Yes	8/11/01		LL3mw-239-1116-SO	MC, GS, AL, USCS, SG
LL3-240	LL3mw-240–1109-GW	Yes	9/18/01	LL31167		
LL3-241	LL3mw-241-1110-GW	Yes	9/21/01	LL31168		
LL3-242	LL3mw-242-1111-GW	Yes	9/20/01	LL31168		
LL3-243	LL3mw-243-1112-GW	Yes	9/10/01	LL31170		
LL3-243		Yes	8/11/01		LL3mw-243-1118-SO	MC, GS, AL, USCS, SG
LL3-243	LL3mw-243-1138-GW	Yes	9/10/01	LL31170		Duplicate
LL3-243	LL3mw-243-1160-GW	Yes	9/10/01	LL31170		Split

* = Well sampled by bailer due to very slow recovery. Well bailed dry allowed to recover. No field parameters collected.
AL = Atterberg limits.
GS = Grain size (sieve method).
ID = Identification.
MC = Moisture content.
RI = Remedial Investigation.
SG = Specific gravity.
USCS = Unified Soil Classification System.

conducted during well drilling for description of soil stratigraphy and geotechnical analyses only. All soils and rock were described in accordance with the USCS using the standard Munsell® Soil Color Charts (Munsell 1988) color system.

Bedrock was encountered between 1.5 and 16.9 ft bgs within Load Line 3. Where bedrock was encountered, borehole advancement continued through the use of an NQ wireline core barrel. All rock cores were described and placed in properly labeled wooden core boxes in accordance with DM1110-1-4, *Engineering and Design Geotechnical Manual for Surface and Subsurface Investigations* (USACE 1983). A borehole log, including stratigraphic information, was entered into the project logbooks for each monitoring well boring. The monitoring well boring logs are provided in Appendix C.

Organic vapors were monitored from soil and rock cuttings at each borehole using a hand-held organic vapor analyzer. In addition, the breathing zone was continuously monitored for evidence of organic chemicals. All readings were recorded in the project logbooks.

Each soil boring was advanced to depths necessary to accommodate a sufficiently saturated well screen, capable of supplying a representative groundwater sample. Depth to groundwater was determined by allowing each corehole to sit undisturbed for an indeterminate period while the groundwater equilibrated. Based on the results, if a sufficient water column was not present, the corehole would be further advanced.

Following advancement of each borehole to the appropriate depth, monitoring wells were constructed from pre-cleaned 5.0-cm (2.0-in.) I.D. schedule 40 polyvinyl chloride (PVC) pipe. Well screens were commercially fabricated with slot widths of 0.125 cm (0.005 in.) or 0.025 cm (0.01 in.). The monitoring wells were constructed using 3-m (10-ft) screens. The well casing and screen were assembled and lowered into the open borehole. Following placement of the well casing and screen, a pre-washed filter pack, consisting of Global Supply No. 5 clean silica sand, was tremied in place from the bottom of the borehole to approximately 0.6 m (2 ft) above the top of the well screen in each well. A 0.6-m (2-ft) to 0.9-m (3-ft) bentonite pellet annular seal was then poured into the borehole on top of the filter pack. Potable water was added to hydrate the bentonite seal prior to grouting.

For monitoring well completion, a grout mixture consisting of Type I Portland cement and 5% bentonite was then tremied from the top of the annular seal to approximately 2 ft bgs. A protective steel surface casing with locking cover, and construction of a mortar collar and cement pad, was then installed. Four steel posts were installed around each well and were painted and labeled. Table 3-6 presents a summary of monitoring well construction details. Construction diagrams for all newly installed monitoring wells are provided in Appendix C.

Table 3-6. Summary of Load Line 3 Phase I and Phase II RI Monitoring Well Construction Data

Well ID	Total Depth (ft bgs)	Ground Elevation (ft amsl)	TOC Elevation (ft amsl)	Depth to Bedrock (ft below TOC)	Screened Interval (ft below TOC)	Stratigraphy of Screened Interval
LL3-232	37.00	998.59	1,000.41	41.72	26.80 to 36.80	Sandstone w/interbedded shales
LL3-233	30.13	1,002.47	1,004.36	34.69	20.13 to 30.13	Sandstone w/interbedded shales
LL3-234	20.40	1,004.47	1,006.56	24.79	9.80 to 19.80	Sandstone w/interbedded shales
LL3-235	20.32	1,008.05	1,009.94	24.89	10.14 to 20.14	Sandstone w/interbedded shales
LL3-236	23.95	1,008.94	1,011.17	28.73	13.77 to 23.77	Sandstone w/interbedded shales
LL3-237	22.91	1,003.57	1,005.57	27.6	12.73 to 22.73	Sandstone w/interbedded shales
LL3-238	20.07	1,004.75	1,006.91	25.61	10.50 to 20.52	Sandstone w/interbedded shales
LL3-239	35.03	1,001.7	1,003.50	39.36	24.85 to 34.85	Sandstone w/interbedded shales
LL3-240	34.60	1,005.6	1,007.52	38.92	24.42 to 34.42	Sandstone w/interbedded shales
LL3-241	22.89	992.41	994.65	27.89	12.71 to 22.71	Sandstone w/interbedded shales
LL3-242	20.30	997.39	999.32	24.4	9.80 to 19.80	Sandstone w/interbedded shales
LL3-243	24.40	989.36	991.16	28.3	13.80 to 23.80	Sandstone w/interbedded shales

amsl = Above mean sea level.
bgs = Below ground surface.
ID = Identification.
RI = Remedial Investigation.
TOC = Top of casing.

3.4.3 Well Development Methods

At least 48 hr after well completion, each monitoring well was developed so that representative groundwater samples could be collected. Well development was accomplished by purging at least five well volumes of groundwater, using a submersible pump or a bailer, until the development water was visually clear and sediment thickness in the well was less than 3.0 cm (0.1 ft), or the maximum well development time (48 hr) had expired, as specified in the SAP Addendum for Load Lines 2, 3, and 4. Well development records were included in the project logbooks and are provided in Appendix E.

3.4.4 Groundwater Field Sampling Methods

Following development of the new wells, groundwater samples were collected. The procedure for sampling groundwater is described in Sections 4.3.4 and 4.3.5 of the Facility-Wide SAP. Before sampling, the monitoring wells were purged until readings of pH, conductivity, dissolved oxygen, and water temperature reached equilibrium. Groundwater samples were collected using a bladder pump following low-flow sampling procedures where there was sufficient water. General groundwater quality indicator parameters (pH, specific conductance, dissolved oxygen, temperature, and turbidity) were monitored during the sampling procedure using a flow-thru cell. If insufficient water was present in the well to allow for low flow sampling techniques, the well was purged dry using a dedicated disposable bailer, allowed to recover, then sampled. Two wells at Load Line 3 (LL3-233 and LL3-235) had very slow recovery and were sampled 3 to 4 months after the initial groundwater sampling event. Sampling of these wells took place during a wetter season when the site groundwater level had increased to a level sufficient to collect representative groundwater samples. Because of the extremely slow recharge of these wells, no field parameters were collected during sampling.

All groundwater samples were analyzed for explosives, propellants, TAL metals (filtered only), cyanide, VOCs, SVOCs, and pesticides/PCBs. Groundwater samples analyzed for dissolved metals were filtered during sample collection using either a disposable, in-line barrel filter or a disposable filter using a negative pressure pump, both with 0.45-µm pores. The results of groundwater sampling at Load Line 3 are discussed in detail in Section 4.6. The analytical data are presented in Appendix I.

3.4.5 In-Situ Permeability Testing

Slug tests were performed at monitoring wells to determine the hydraulic conductivity of the geologic materials surrounding each well screen. Slug test were performed in all Load Line 3 wells except LL3mw-233, which had too slow of a recharge rate to effectively conduct the tests, even under wet season conditions. Slug tests followed the provisions of the Phase II RI SAP Addendum. These analyses calculate horizontal hydraulic conductivities in the screened interval of each well. Rising head slug test were conducted in all wells tested. Corresponding falling-head tests were conducted for comparison purposes in wells that had a minimum water column of 5 ft. Falling head tests were performed by inserting a PVC cylinder into the well and monitoring the return (drop) of the potentiometric surface and the pre-test static water level over time. The rising-head test were performed by reversing the process above (e.g., the slug was removed and the rise in water level was monitored). The tests were performed after each well had fully recovered form groundwater sampling. The slug employed for all tests was designed to displace 0.3 m (1 ft) of water.

Pressure transducers and data loggers were used for automated data collection during slug tests. Water level measurements were recorded using a pre-programmed logarithmic time interval. Water levels were monitored for a period of 6 hrs or until the well re-equilibrated to 90% of the pre-test water level. The data were evaluated using AqteSolve™ software and hydraulic conductivity values were derived using the updated Bouwer and Rice method (Bouwer 1989, Butler 1998). Compensation for water levels within the screened interval is included in this evaluation method. The results of the slug tests are presented in Appendix F and are discussed in Chapter 2.0.

3.4.6 Groundwater Level Measurements

In order to determine the hydraulic gradient and flow direction in the area, a complete round of water level measurements were obtained from all accessible monitoring wells at the RVAAP facility during the Phase II RI field effort (August 2001). Water level measurements were obtained over a 2-day period and reflected base flow conditions. Measurements were obtained using an electric water level indicator and measured to the nearest .01 ft. An additional round of water levels was obtained from Load Line 3 in November 2001. Potentiometric maps for Load Line 3 and the entire RVAAP facility are presented and discussed in Chapter 2.0.

3.5 SEWER LINE SAMPLING AND VIDEO CAMERA SURVEY

3.5.1 Rationale

Migration of contaminants to surface water (by flushing during storm events) or groundwater (through leaking or breached sewer pipe) from the sanitary sewer system at Load Line 3 may represent an un-quantified source release mechanism. Investigations of storm and sanitary lines at other army ammunition plant load lines have shown that sewer lines are commonly contaminated with bulk explosives, particularly at load lines that were heavily used. Frequently, camera surveys of such lines reveal cracks or other breaches in the pipe. To characterize the sanitary sewer system for the presence of residual contaminants and to provide data for the evaluation of remedial alternatives, if any, sediment and water samples were collected from the utility system at selected access points (manholes/inlets) where sufficient quantities of these media had accumulated. To assess the integrity of the pipe and its potential of releasing contaminants to the environment, a color video survey was attempted of the existing system at Load Line 3. Results of the sewer system inspection are contained in Section 4.7.1.

3.5.2 Sediment and Water Sampling

One of the seven planned sediment samples was collected from sanitary sewer manhole 408 (Table 3-5; Figure 3-8). The remaining six planned samples at manholes 413, 404, 407, 419, 424, and 427 were not collected due to an insufficient volume of sediment present in the manholes. Co-located samples of water that had accumulated in the sanitary sewer line were collected as planned from two of the four sanitary sewer manholes (413 and 408).

Nine of nine planned sediment samples were collected from the storm sewer system (manholes and inlets). Samples could not be collected form the remaining storm sewer sampling stations because they were either infilled with debris or lacked sufficient sediment. One of two planned water samples were collected from the storm sewer system.

Sampling of water in the sanitary and storm sewer manholes was performed prior to sediment sampling to ensure that the water was free from excess turbidity. Where sufficient water volume was present, samples were retrieved using a disposable bailer. The bailer was lowered into the sewer manhole from the surface using a nylon rope and retrieved as many times as necessary to provide the required sample volume. Sample containers for VOC analyses were collected first. Samples for metals analyses were not filtered.

Collection of sediment samples from sewer line manholes was performed using an Eckmann sampler. The Eckmann sampler is a clamshell device with spring-activated doors that are deployed using a cable or extension rod. The decontaminated sampler was lowered to the sediment interface and the doors actuated to entrap sediment. The sampler was then raised to the surface and the sediment emptied into a decontaminated stainless steel bowl. This process was repeated until sufficient sediment volume had been obtained to fill sample containers. Samples for VOC analyses were collected directly from the sampler from the first material obtained. The volume of sediment placed in the stainless steel bowl was homogenized using a decontaminated stainless steel spoon or scoop and samples for nonvolatile constituent analyses were obtained. During sample collection, all samples were field screened for VOCs using a hand-held photoionization detector.

3.5.3 Video Camera Survey

The camera survey of storm and sanitary sewers was performed using a motorized camera assembly with fiber-optic cable. The camera assembly was capable of maneuvering in pipes as small as 10 cm (4 in.) in diameter and was capable of imaging the entire periphery of a pipes ranging from 20 cm (8 in.) to 76 cm (30 in.) in diameter.

The camera was maneuvered through the pipeline at a uniformly slow rate and the operator provided voice narrative to point out important features and the direction and speed of camera travel. Besides the video and voice record, a written inspection log was completed, which denoted locations of reference points and entry points, obstructions, and cracks or other structural deficiencies. The sewer system surveys were recorded on videotape and the video camera survey inspection log is contained in Appendix N.

Portions of the sanitary sewer system were found to be flooded and several of the planned entry points were obstructed with debris (leaves, sticks, and sediment). No attempts were made to survey flooded lines as movement of the track camera in the pipes causes sediment to be resuspended, which prevents video observation. The survey was biased to the portions of the system located near production areas of the load lines. Table 3-7 presents the planned video camera survey along with a summary of the actual direction and footages videotaped. Approximately 1,100 ft of storm and sanitary sewers were surveyed; this represents 5% of the total footage at Load Line 3 as estimated from engineering plans. Section 4.7.1 discusses the results for the video camera survey at Load Line 3.

Table 3-7. Storm and Sanitary Sewer Line Video Camera Survey Summary

Manhole	Planned Direction/Footage	Actual Direction/Footage
Load Line 3 Storm Sewer		
EB-4	N/50, S/50	N/9, S/50
EH-7	N/50, E/50, S/50	Inaccessible
EH-13	N/50, W/50, E/50, S/50	N/50, S/50, E/50, W12
EH-21	N/50, E/50, S/50	N/50, S/8, E/50
EB-20	N/50, E/50	N/50, E/28
EH4		To EH3/ 103
EH5		Towards EH4/118, towards EH6/103
Load Line 3 Sanitary Sewer		
MH-404	W/50, N/50, E/50, S/50	W/50, E/50, N/0, S/0
MH-407	N/50, S/50	Inaccessible
MH-408	W/50, N/50, E/50, S/50	Full of Water
MH-413	W/50, N/50, S/50	Full of Water
MH-419	N/50, E/50, S/50	N/0, S/50, E/50
MH-424	W/50, S/50	W/40, S/50
MH-427	W/50, N/50, E/50	W/28, N/27, E/0
MH-409		W/46, E/14

3.6 TOPOGRAPHIC SURVEY

A topographic survey was performed by a surveying subcontractor at the conclusion of the RI field investigation. All plane and vertical surveys were conducted under the supervision of an Ohio-registered land surveyor. Final coordinates were converted to a state plane coordinate system and both North

American Datum 1927 and 1983 coordinates reported. All horizontal locations were surveyed to the nearest 0.1 ft, and all elevations to the nearest 0.01 ft. Field activities included the following:

- Performing as-built surveys of new monitoring wells;
- Surveying soil, sediment, and surface water sampling locations;
- Establishing final locations, ground surface elevations, and top-of-casing elevations for all new monitoring wells; and
- All analytical procedures and data verification/evaluation processes.

3.7 ANALYTICAL PROGRAM OVERVIEW

3.7.1 Field Analysis for Explosives Compounds

All surface soil and sediment samples were field analyzed with colorimetric methods for TNT and RDX. The purpose of the analysis was to define the extent of surface soil contamination with respect to these explosive compounds. Field colorimetry was also used as a screening method to reduce the number of samples that required fixed-base laboratory analysis for explosives.

The colorimetric data are considered as bulk values for TNT and RDX, as discussed below (e.g., other explosives compounds may also be present and inflate the apparent TNT concentration). The methods may be used as a screening tool and help map contaminant nature and extent. However, the method cannot be used in human health risk or ecological risk assessments (ERAs) because the quantitative risk calculations require that each compound must be evaluated individually.

The procedure for measuring TNT concentrations in soils involves a liquid extraction of the explosives from the soil matrix with acetone and the formation of a color complex with sodium sulfite and potassium hydroxide. Absorbance is measured at a wavelength of 540 nm. For RDX, all nitrate must be removed from the extract, and then glacial acetic acid and zinc powder are added. A color-producing agent is added to the sample, and absorbance is measured at 507 nm. In both methods, percent absorbance is correlated to concentration.

A full discussion of the field screening and laboratory results for TNT and RDX is presented in Section 4.11 of this report.

3.7.2 Geotechnical Analyses

The geotechnical sampling and analysis program conducted during the Phase II RI for Load Line 3 involved the collection and analysis of surface soil, subsurface soil, and sediment. Samples collected during the investigation were analyzed by S&ME of Knoxville, Tennessee, a USACE Center of Excellence (CX)-certified laboratory. Soil samples collected using the bucket hand auger method are classified as disturbed samples. Soil samples collected directly from the bucket of the track hoe used to excavate test pits are also classified as disturbed samples. Geotechnical analysis of samples collected using these methods was limited to grain size distribution, Atterberg limits, moisture content, USCS classification, pH analysis, and specific gravity. Each soil sample collected was visually classified in the field according to the USCS. Disturbed sediment samples (e.g., collected using manual methods) were also visually classified in the field and submitted for grain size distribution and total organic carbon

(TOC) by chemical analysis. The results of the geotechnical evaluation for soils and sediment samples are discussed in Chapter 4.0 and included in its entirety in Appendix K.

In addition to disturbed samples, Shelby tubes were used to collect five undisturbed samples from monitoring well locations. Each undisturbed sample was collected from the interval most representative of the overburden material at that location. Geotechnical analytical parameters for undisturbed samples included moisture content, grain size distribution, USCS classification, Atterberg limits, and specific gravity.

3.7.3 Laboratory Analyses

The chemical sampling and analysis program conducted during the Phase II RI for Load Line 3 involved the collection and analysis of surface soil, subsurface soil, sediment, surface water, groundwater, and floor sweep samples. All QA split samples were analyzed by an independent QA analytical laboratory under contract with the Louisville District.

Samples collected during the investigation were analyzed by Severn Trent Laboratories (STL), North Canton, Ohio, a USACE CX-certified laboratory. QC samples collected in association with primary soil, sediment, surface water, and groundwater samples were analyzed by USACE's contracted QA laboratory, GP Environmental, Inc., located in Gaithersburg, Maryland. Laboratories supporting this work have statements of qualifications including organizational structures, QA manuals, and standard operating procedures, which can be made available upon request.

Samples were collected and analyzed according to the Facility-wide SAP and the Phase II RI SAP Addendum. Prepared in accordance with USACE and EPA guidance, the Facility-wide SAP and associated addenda outline the organization, objectives, intended data uses, and QA/QC activities to achieve the desired DQOs and maintain the defensibility of the data. Project DQOs were established in accordance with EPA Region V guidance. Requirements for sample collection, handling, analysis criteria, target analytes, laboratory criteria, and data validation criteria for the Phase II RI are consistent with EPA requirements for National Priorities List sites. DQOs for this project included analytical precision, accuracy, representativeness, completeness, comparability, and sensitivity for the measurement data. Appendix H presents an assessment of those objectives as they apply to the analytical program.

Strict adherence to the requirements set forth in the Facility-wide SAP and project addenda was required of the analytical laboratory so that conditions adverse to quality would not arise. The laboratory was required to perform all analyses in compliance with EPA SW-846 (EPA 1990a), Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Analytical Protocols. SW-846 chemical analytical procedures were followed for the analyses of metals, VOCs, SVOCs, pesticides, PCBs, explosives, propellants, and cyanide. Laboratories were required to comply with all methods as written; recommendations were considered as requirements.

The types of QA/QC samples for this project included field blanks, trip blanks, QC field duplicates, laboratory method blanks, laboratory control samples (LCSs), laboratory duplicates, matrix spike/matrix spike duplicate samples, and QC field split samples (submitted to the independent USACE contracted laboratory). Field blanks, consisting of potable water used in the decontamination process, equipment rinsate blanks, and trip blanks were submitted for analysis, along with field duplicate samples, to provide a means to assess the quality of the data resulting from the field sampling program. Table 3-8 presents a summary of QA/QC samples utilized during the Phase II RI environmental sampling program. Evaluation of these QC measures and of their contribution to documenting the project data quality is provided in Appendix H, Data Quality Assessment Report.

Table 3-8. Summary of QA/QC Samples

Sample Type	Rationale
Field Blank	Analyzed to determine procedural contamination at the site that may contribute to sample contamination
Trip Blank	Analyzed to assess the potential for contamination of samples due to contaminant interference during sample shipment and storage
Field Duplicate	Analyzed to determine sample heterogeneity and sampling methodology reproducibility
Equipment Rinsate	Analyzed to assess the adequacy of the equipment decontamination processes for soil and groundwater
Laboratory Method Blanks	Analyzed to determine the accuracy and precision of the analytical method as implemented by the laboratory
Laboratory Duplicate Samples	Analyzed to assist in determining the analytical reproducibility and precision of the analysis for the samples of interest and to provide information about the effect of the sample matrix on the measurement methodology
Matrix Spike/Matrix Spike Duplicate	
QC Split	Analyzed to provide independent verification of the accuracy and precision of the principal analytical laboratory

QA = Quality assurance.
QC = Quality control.

SAIC is the custodian of the project file and will maintain the contents of the file for this investigation, including all relevant records, reports, logs, field notebooks, pictures, subcontractor reports, correspondence, and chain-of-custody forms. These files will remain in a secure area under the custody of the SAIC project manager until they are transferred to the USACE, Louisville District and RVAAP. Analytical data reports from STL have been forwarded to the USACE, Louisville District laboratory data validation contractor (Lee A. Knuppel and Associates) for validation review and QA comparison. STL will retain all original raw data information (both hard copy and electronic) in a secure area under the custody of the laboratory project manager.

3.7.4 Data Review, Validation, and Quality Assessment

Samples were properly packaged for shipment and dispatched to STL for analysis. A separate signed custody record with sample numbers and locations listed was enclosed with each shipment. When transferring the possession of samples, the individuals who relinquished and received the samples signed, dated, and noted the time on the record. All shipments were in compliance with applicable U. S. Department of Transportation regulations for environmental samples.

Data were produced, reviewed, and reported by the laboratory in accordance with specifications outlined in the Load Line 3 Phase II RI Quality Assurance Project Plan (QAPP) Addendum, the USACE, Louisville District analytical QA guidelines, and the laboratory's QA manual. Laboratory reports included documentation verifying analytical holding time compliance.

STL performed in-house analytical data reduction under the direction of the laboratory project manager and QA officer. These individuals were responsible for assessing data quality and informing SAIC and USACE of any data that are considered "unacceptable" or required caution on the part of the data user in terms of its reliability. Data were reduced, reviewed, and reported as described in the laboratory QA manual and standard operating procedures. Data reduction, review, and reporting by the laboratory were conducted as follows:

- Raw data produced by the analyst were turned over to the respective area supervisor.

- The area supervisor reviewed the data for attainment of QC criteria, as outlined in the established methods, and for overall reasonableness.

- Upon acceptance of the raw data by the area supervisor, a report was generated and sent to the laboratory project manager.

- The laboratory project manager completed a thorough review of all reports.

- The laboratory project manager generated the final reports.

Data were then delivered to SAIC for data verification. Lee A. Knuppel and Associates performed independent full data validation on 10% of the total analytical reserves for USACE. Copies of all data packages were forwarded to them for evaluation and preparation of QA documents.

STL prepared and retained full analytical and QC documentation for the project in both hard (paper) copy and electronic storage media (e.g., magnetic tape) as directed by the analytical methodologies employed. STL provided the following information to SAIC in each analytical data package submitted:

- cover sheets listing the samples included in the report and narrative comments describing problems encountered in analysis;

- tabulated results of inorganic and organic compounds identified and quantified; and

- analytical results for QC sample spikes, sample duplicates, initial and continuing calibration verifications of standards and blanks, method blanks, and LCS information.

A systematic process for data verification was performed by SAIC to ensure that the precision and accuracy of the analytical data were adequate for their intended use. This verification also attempted to minimize the potential of using false positive or false negative results in the decision-making process (i.e., to ensure accurate identification of detected versus non-detected compounds). This approach was consistent with the DQOs for the project and with the analytical methods, and was appropriate for determining contaminants of concern and calculating risk. Samples were identified thorough implementation of "definitive" analytical methods. "Definitive Data" were reported consistent with the deliverables identified in the project SAP. These Definitive Data were then verified through the review process outlined in the SAP and are presented in Appendix I.

Independent data validation was performed by Lee A. Knuppel and Associates under a separate task with the USACE, Louisville District. This review constituted comprehensive validation of 10% of the primary dataset, comprehensive validation of the QA split sample dataset, and a comparison of primary sample, field duplicate sample, and field QA split sample information.

3.8 ORDNANCE AND EXPLOSIVE AVOIDANCE AND FIELD RECONNAISSANCE

OE avoidance subcontractor support staff were present during all field operations, except groundwater sampling. The OE team leader led an initial safety briefing on OE to train all field personnel to recognize and avoid propellants and OE. Daily tailgate safety briefings included reminders regarding OE avoidance. Site visitors were briefed on OE avoidance prior to allowing access into the AOC.

Prior to beginning sampling activities, access routes into areas from which samples were to be collected were assessed for potential OE using visual surveys and hand-held magnetometers. The OE team leader, USACE technical representative, and SAIC technical manager located each proposed sampling station, monitoring well, and test trench within the AOC using a steel pin flag with the sample station identification number. The pin flag was placed at a point approved by the OE technician.

An OE technician remained with the sampling crews as work progressed. At stations where subsurface soil samples were to be collected from 0.3 to 0.9 m (1 to 3 ft) bgs, a magnetometer was lowered into the borehole to screen for subsurface magnetic anomalies at the top of the subsurface interval. If circumstances dictated that the borehole be deepened beyond 3 ft bgs, a magnetometer reading was taken at the top of each subsequent 2-ft interval prior to augering.

For monitoring well borings, OE technicians screened the locations by hand augering to a minimum depth of at least 0.9 m (3 ft) or 0.6 m (2 ft) below original undisturbed soil, whichever was more, and performing downhold magnetomer readings at 0.6-m (2-ft) intervals. The OE technician remained on-site as drilling was performed to visually example drill cuttings for any unusual materials indicative of potential OE.

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