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 2 included sampling of surface and subsurface soils, debris, sediment, surface water, and groundwater. Other investigative activities included excavation of 6 test trenches to depths of 3.3 m (10 ft) to characterize soil stratigraphy, biased floor sweep samples from 3 buildings, sampling beneath building floors, sampling soil and slag along Track DH (Figure 1-5) to evaluate the suitability of the area as a "clean-hard fill" disposal area, a video camera survey of portions of the former sanitary sewer system, and sampling of 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 contamination nature and extent and to help guide the sampling efforts.

In order to organize and track sampling efforts, the Load Line 2 AOC was separated into 37 functional areas in the Phase II RI SAP Addendum based on (1) type of environmental media (e.g., soil, surface water, or groundwater), (2) DQOs, (3) historical operational data, (4) available Phase I RI data, and (5) site characteristics. These functional areas, rationales, 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 174 stations located throughout Load Line 2. Samples were collected from surface and subsurface locations, as well as from test pits (perimeter trenches) and beneath building floor slabs. Although not considered a soil matrix, three floor sweep samples of debris from within primary operations buildings and two railroad track ballast samples were collected and submitted for chemical analysis and 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 and related samples described above that were collected during the Phase II RI field effort. Actual sample depths may not exactly match the planned depth intervals due to refusal on bedrock or float. Departures from the planned sampling efforts due to site conditions (i.e., refusal), additional analyses added during the field effort, and the locations of contingency samples are specifically denoted.

Table 3-1. Load Line 2 Phase II RI Functional Areas and Sample Matrices

Functional Area Number	Description	Principal Suspected Contaminants	Sampling Rationale	Sample Matrix		
				Soil Stations	Sediment/ Surface Water Station	Monitoring Well Boring/ Groundwater Station
1	Building DB-27C – Shipping	Explosives and metals	Identify possible contamination in soil	•	•	
2	Building DB-27 – Cyclic Heating Building No. 2	Explosives and metals	Identify possible contamination in soil and beneath floor slab	•		
3	Building DB-27A– Cyclic Heating Building No. 1	Explosives and metals	Identify possible contamination in soil and beneath floor slab	•		
4	Building DB-27B – Cyclic Heating HVAC Building	Explosives, SVOCs, VOCs, metals, PCBs	Identify possible contamination in soil and beneath floor slab	•		
5	Building DA-7 – Service Building	Explosives and metals	Identify possible contamination in soil	•		
6	Building DA-6 – Explosive Preparation Building	Explosives and metals	Identify possible contamination in soil and beneath floor slab	•		
7	Building DA-28 – Elevator Machine House at Building DA-6	Explosives, SVOCs, VOCs, metals, PCBs	Identify possible contamination in soil	•		
8	Building DA-6A – Explosive Preparation Building	Explosives and metals	Identify possible contamination in soil and beneath floor slab	•		
9	Building DA-28A – Elevator Machine House at Building DA-6A	Explosives, SVOCs, VOCs, metals, PCBs	Identify possible contamination in soil	•		
10	Building DA-21 – Service Building	Explosives and metals	Identify possible contamination in soil	•		
11	Building DA-5 – Service Building	Explosives and metals	Identify possible contamination in soil	•		
12	Building DB-4 Settling Tanks	Explosives, SVOCs, VOCs, metals, PCBs	Identify possible contamination in soil and residual contamination in tanks	•	•	
13	Building DB-4A Settling Tanks	Explosives, SVOCs, VOCs, metals, PCBs	Identify possible contamination in soil and residual contamination in tanks	•	•	
14	Building DB-13A, -13B, and -13C – Packing and Shipping	Explosives and metals	Identify possible contamination in soil	•		
15	Building DB-26 – Radiography Building	Explosives and metals	Identify possible contamination in soil	•		

Table 3-1. Load Line 2 Phase II RI Functional Areas and Sample Matrices (continued)

Functional Area Number	Description	Principal Suspected Contaminants	Sampling Rationale	Sample Matrix		
				Soil Stations	Sediment/ Surface Water Station	Monitoring Well Boring/ Groundwater Station
16	Building DB-29 – Elevator Machine House	Explosives, SVOCs, VOCs, metals, PCBs	Identify possible contamination in soil	•		
17	Building DB-2 – Service Building	Explosives and metals	Identify possible contamination in soil	•		
18	Building DB-9 – Service Building	Explosives and metals	Identify possible contamination in soil	•		
19	Building DB-9A – Service Building	Explosives and metals	Identify possible contamination in soil	•		
20	Building DB-11 – Service Building	Explosives and metals	Identify possible contamination in soil	•		
21	Building DB-19 – Service Building	Explosives and metals	Identify possible contamination in soil	•		
22	Building DB-20 – Service Building	Explosives and metals	Identify possible contamination in soil	•		
23	Building DB-10 – Drilling and Assembly	Explosives, SVOCs, VOCs, metals, PCBs	Identify possible contamination in soil and beneath floor slab	•		
24	Sedimentation Basin	Explosives, SVOCs, VOCs, metals, PCBs	Identify possible contamination in soil and residual contamination in basin	•	•	
25	Building DB-4 – Melt-pour Building	Explosives, SVOCs, VOCs, metals, PCBs	Define extent of contamination in soil outside of the building slabs and obtain soil data from beneath floor slab	•	•	
26	Building DB-4A – Melt-pour Building	Explosives, SVOCs, VOCs, metals, PCBs	Define extent of contamination in soil outside of the building slabs and obtain soil data from beneath floor slab	•	•	
27	Building DB-25 – Carrier Washout Building	Explosives and metals	Define extent of contamination in soil	•		
28	Building DB-3 – Shell Receiving Building	Explosives, metals, SVOCs, VOCs, PCBs	Identify possible contamination in soil	•		

Table 3-1. Load Line 2 Phase II RI Functional Areas and Sample Matrices (continued)

Functional Area Number	Description	Principal Suspected Contaminants	Sampling Rationale	Sample Matrix		
				Soil Stations	Sediment/ Surface Water Station	Monitoring Well Boring/ Groundwater Station
29	Building DC-1 – Powerhouse No. 2	Metals, SVOCs, VOCs, and PCBs	Identify possible contamination in soil and beneath floor slab	•		
30	Building DB-802 – Inert Storage	Explosives and metals	Identify possible contamination in soil	•		
31	Non-Production Area (Random Sampling Grid)	Explosives and metals	Statistically representative characterization of non-production areas (Phase I RI sample data from stations 040, 041, and 042 to be used to represent additional grid points)	•		
NA	Contingency Samples	TBD	To be assigned in the field	•		
32	Test Pits	Geotechnical characterization	To provide a better understanding of the flow regime and to assist in selecting optimal locations for monitoring wells	•		
33	Track DH – Clean-hard Fill Location	Explosives and metals	Characterize suitability of selected areas for disposal of inert demolition debris	•		
34	AOC Ditches, Streams, and Ponds	All; Full suite of analyses	Characterize potential contaminant exit pathways and accumulation points		•	
35	Storm Sewer System	All; Full suite of analyses	Characterize potential contaminant exit pathways and accumulation points		•	
36	Sanitary Sewer System	All; Full suite of analyses	Characterize potential contaminant exit pathways and accumulation points		•	
37	Monitoring Wells	All; Full suite of analyses	Identify possible contamination in groundwater near source areas			•

Table 3-1. Load Line 2 Phase II RI Functional Areas and Sample Matrices (continued)

Functional Area Number	Description	Principal Suspected Contaminants	Sampling Rationale	Sample Matrix		
				Soil Stations	Sediment/ Surface Water Station	Monitoring Well Boring/ Groundwater Station
37 (continued)			Identify possible contamination in groundwater and provide an understanding of the flow regime near existing wells LL2-059 and LL2-060 to the south of the AOC			•
			Identify possible contamination in groundwater and provide an understanding of the flow regime along the northern edge of the production area near Building DB-13 and to evaluate potential off-AOC transport to the north/northwest			•

Full suite = Explosives, Target Analyte List (TAL) metals, cyanide, VOCs, SVOCs, and PCBs/Pesticides.
AOC = Area of Concern.
HVAC = Heating, ventilation, and air conditioning.
NA = Not applicable.
PCB = Polychlorinated biphenyl.
RI = Remedial Investigation.
SVOC = Semivolatile organic compound.
TBD = To be determined.
VOC = Volatile organic compound.

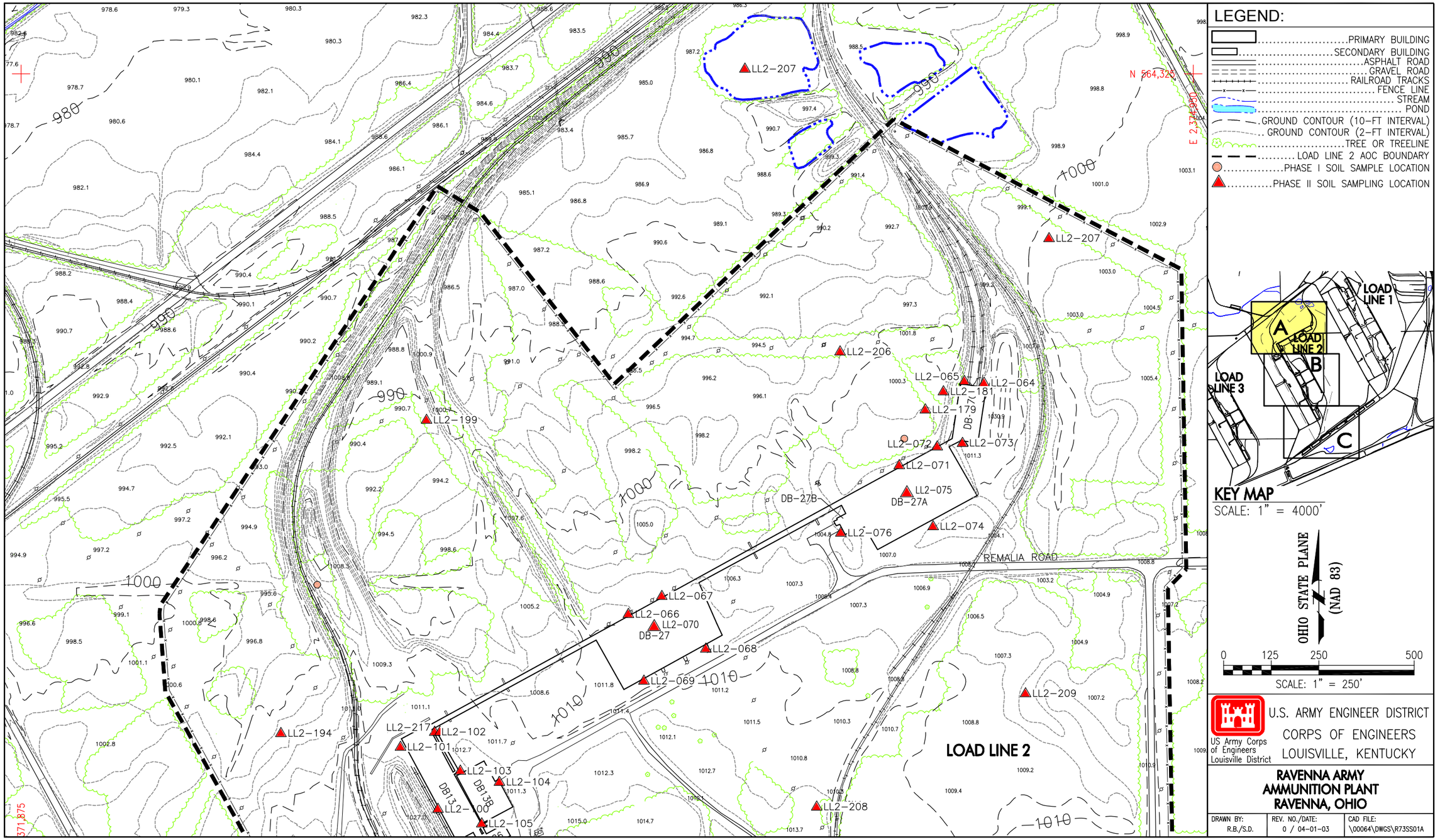


Figure 3-1. Phase II RI Surface and Subsurface Soil Sampling Locations at Load Line 2 - Northern Section

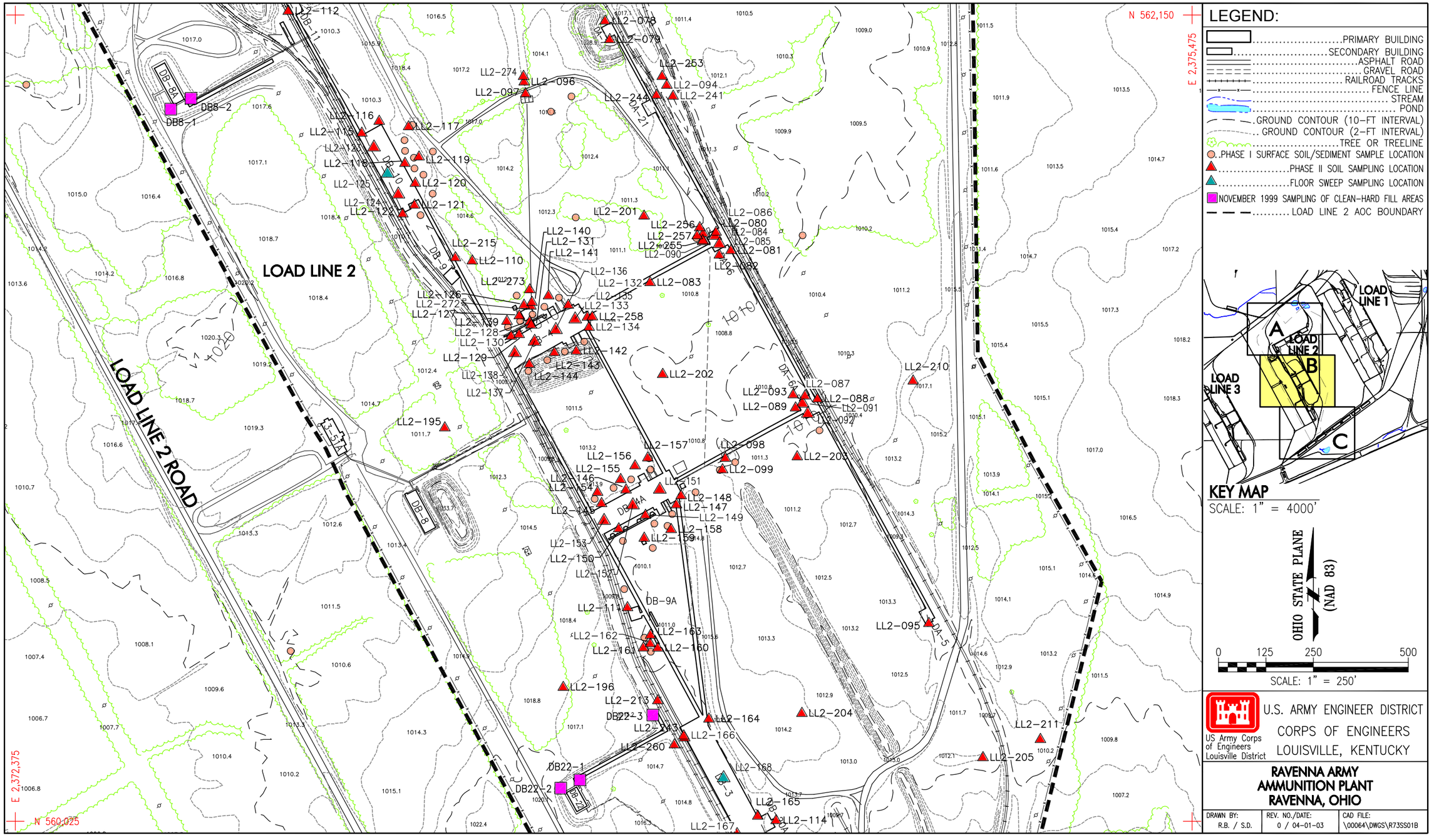


Figure 3-2. Phase II RI Surface and Subsurface Soil Sampling Locations at Load Line 2 - Central Section

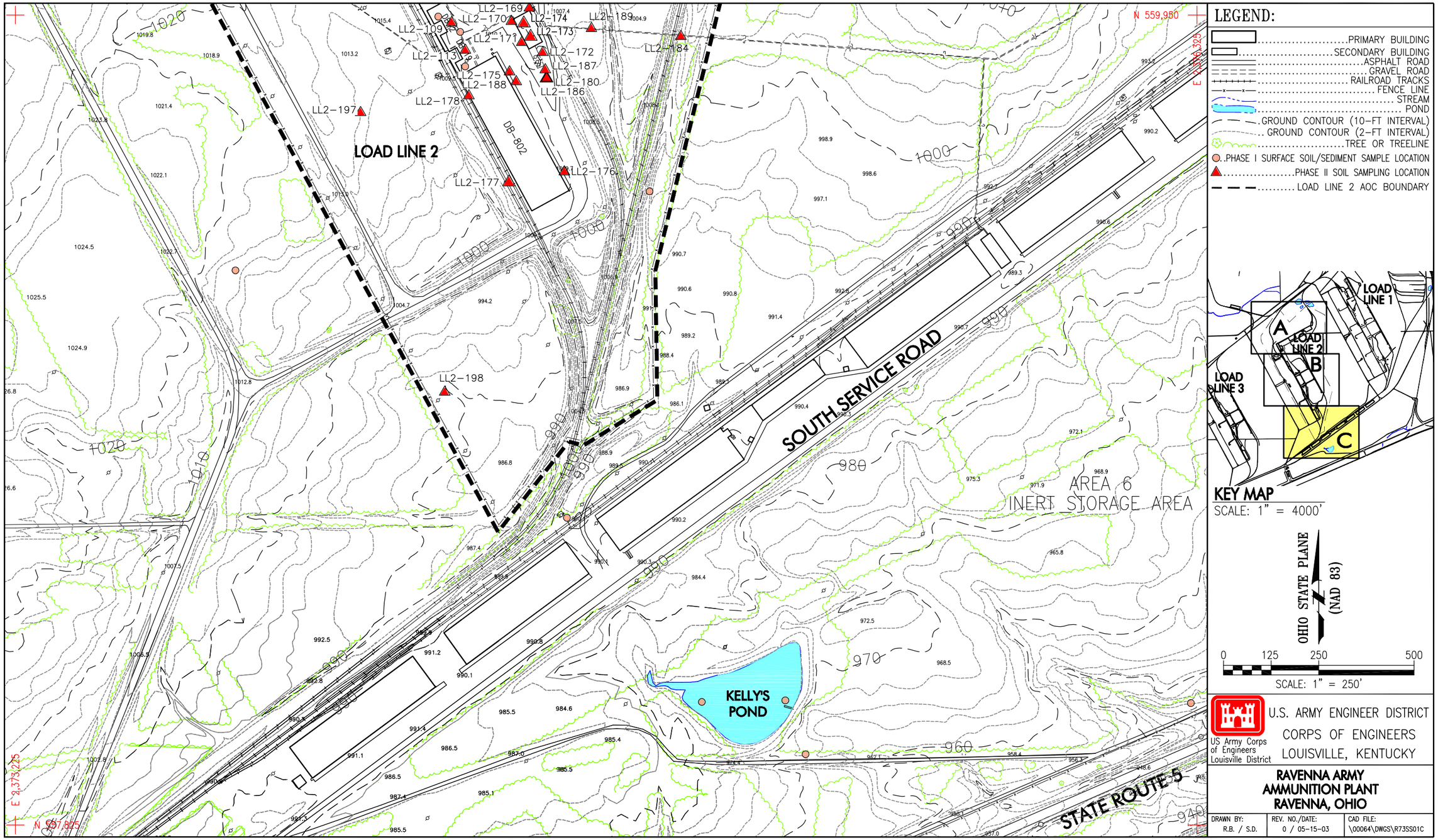
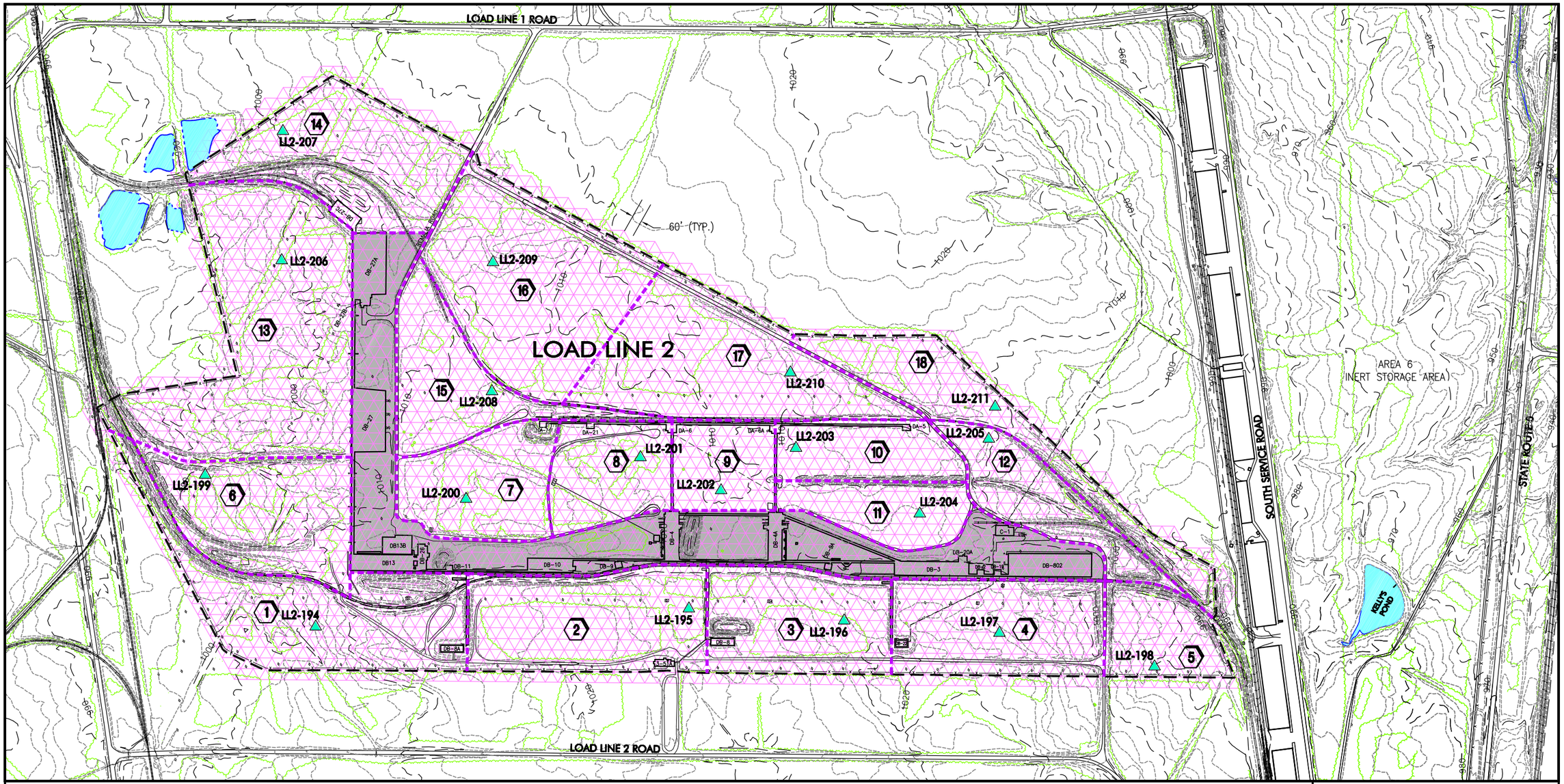


Figure 3-3. Phase II RI Surface and Subsurface Soil Sampling Locations at Load Line 2 - Southern Section



LEGEND:

- PRIMARY BUILDING
- SECONDARY BUILDING
- ASPHALT ROAD
- GRAVEL ROAD
- RAILROAD TRACKS
- FENCE LINE
- STREAM
- POND
- GROUND CONTOUR (10-FT INTERVAL)
- GROUND CONTOUR (2-FT INTERVAL)
- TREE OR TREELINE
- LOAD LINE 2 AOC BOUNDARY
- RANDOM GRID EXPOSURE UNIT BOUNDARY
- RANDOM GRID EXPOSURE UNIT NUMBER
- PRODUCTION AREA, NOT INCLUDED IN RANDOM GRID
- SURFACE SOIL SAMPLE

NOTE:

1.) RANDOM GRID SPACING 60 FT.

OHIO STATE PLANE (NAD 83)

0 250 500 1000

SCALE: 1" = 500'

US Army Corps of Engineers Louisville District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

DRAWN BY:	REV. NO./DATE:	CAD FILE:
R.B. / S.D.	0 / 04-02-03	\00064\DWGS\R73GRID01

Figure 3-4. Phase II RI Random Grid Soil Sampling Locations at Load Line 2

Table 3-2. Soil Sampling List and Rationales, Load Line 2 Phase II RI

Facility/Building No.	Depth (ft)	Station	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
Source Area Characterization						
DB-27C Shipping Building	0 to 1	LL2-064	LL2ss-064-0684-SO	Yes	7/24/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-064	LL2so-064-0685-SO	No		LL2-0685 reassigned to roll-off box IDW sample
	3 to 5	LL2-064	LL2so-064-0686-SO	No		LL2-0686 reassigned to new contingency station LL2-274 (0 to 1 ft)
	0 to 1	LL2-065	LL2ss-065-0687-SO	Yes	7/24/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-065	LL2so-065-0688-SO	No		LL2-0688 reassigned to new contingency station LL2-272 (0 to 1 ft)
	3 to 5	LL2-065	LL2so-065-0689-SO	No		LL2-0689 reassigned to new contingency station LL2-272 (1 to 3 ft)
DB-27 Cyclic Heat Building	0 to 1	LL2-066	LL2ss-066-0690-SO	Yes	7/26/01	Field explosives 1.06 mg/kg
	1 to 3	LL2-066	LL2so-066-0691-SO	Yes	8/1/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	3 to 5	LL2-066	LL2so-066-0692-SO	No		LL2-0692 reassigned to new contingency station LL2-273 (0 to 1 ft)
	0 to 1	LL2-067	LL2ss-067-0693-SO	Yes	7/26/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	0 to 1	LL2-067	LL2ss-067-1182-SO	Yes	7/26/01	Duplicate sample
	0 to 1	LL2-067	LL2ss-067-1207-SO	Yes	7/26/01	Split sample
	1 to 3	LL2-067	LL2so-067-0694-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-067	LL2so-067-0695-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-068	LL2ss-068-0696-SO	Yes	7/26/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-068	LL2so-068-0697-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-068	LL2so-068-0698-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-069	LL2ss-069-0699-SO	Yes	7/26/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-069	LL2so-069-0700-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-069	LL2so-069-0701-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-070	LL2ss-070-0702-SO	Yes	7/25/01	Subfloor, field explosives < 1 mg/kg
DB-27A Cyclic Heat Building	0 to 1	LL2-071	LL2ss-071-0703-SO	Yes	7/25/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-071	LL2so-071-0704-SO	Yes	7/30/01	VOCs, SVOCs, and pesticides were added to this sample due to high organic odor, Field explosives < 1 mg/kg
	3 to 5	LL2-071	LL2so-071-0705-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-072	LL2ss-072-0706-SO	Yes	7/25/01	Field explosives 1.9 mg/kg

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

Facility/Building No.	Depth (ft)	Station	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
	1 to 3	LL2-072	LL2so-072-0707-SO	Yes	7/26/01	Field explosives 1.18 mg/kg
	3 to 5	LL2-072	LL2so-072-0708-SO	Yes	7/29/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	0 to 1	LL2-073	LL2ss-073-0709-SO	Yes	7/24/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-073	LL2so-073-0710-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-073	LL2so-073-0711-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-074	LL2ss-074-0712-SO	Yes	7/24/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-074	LL2so-074-0713-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-074	LL2so-074-0714-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-075	LL2ss-075-0715-SO	Yes	7/25/01	Subfloor, field explosives < 1 mg/kg
DB27B Boiler Plant (HVAC)	0 to 1	LL2-076	LL2ss-076-0716-SO	Yes	7/25/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-076	LL2so-076-0717-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-076	LL2so-076-0718-SO	No		Surface sample < 1 mg/kg field explosives
Subfloor	0 to 1	LL2-077	LL2ss-077-0719-SO	Yes	7/25/01	Subfloor; MS/MSD collected, field explosives < 1 mg/kg
DA-7 Service Building	0 to 1	LL2-078	LL2ss-078-0720-SO	Yes	7/26/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	0 to 1	LL2-078	LL2ss-078-1171-SO	Yes	7/26/01	Duplicate sample
	0 to 1	LL2-078	LL2ss-078-1196-SO	Yes	7/26/01	Split sample
	1 to 3	LL2-078	LL2so-078-0721-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-078	LL2so-078-0722-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-079	LL2ss-079-0723-SO	Yes	7/26/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-079	LL2so-079-0724-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-079	LL2so-079-0725-SO	No		Surface sample < 1 mg/kg field explosives
DA-6 Explosive Preparation	0 to 1	LL2-080	LL2ss-080-0726-SO	Yes	7/25/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	0 to 1	LL2-080	LL2ss-080-1176-SO	Yes	7/25/01	Duplicate
	0 to 1	LL2-080	LL2ss-080-1201-SO	Yes	7/25/01	Split
	1 to 3	LL2-080	LL2so-080-0727-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-080	LL2so-080-0728-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-081	LL2ss-081-0729-SO	Yes	7/25/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-081	LL2so-081-0730-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-081	LL2so-081-0731-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-082	LL2ss-082-0732-SO	Yes	7/25/01	Field explosives 114 mg/kg, refusal at 0.5 ft
	1 to 3	LL2-082	LL2so-082-0733-SO	No		Refusal at 0.5 ft

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

Facility/Building No.	Depth (ft)	Station	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
	3 to 5	LL2-082	LL2so-082-0734-SO	No		
	0 to 1	LL2-083	LL2ss-083-0735-SO	Yes	7/25/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-083	LL2so-083-0736-SO	No		
	3 to 5	LL2-083	LL2so-083-0737-SO	No		
	0 to 1	LL2-084	LL2ss-084-0738-SO	Yes	7/25/01	Subfloor, field explosives < 1 mg/kg
	0 to 1	LL2-085	LL2ss-085-0739-SO	Yes	7/25/01	Subfloor, field explosives < 1 mg/kg
DA-28 Elevator Machine House	0 to 1	LL2-086	LL2ss-086-0740-SO	Yes	7/26/01	Propellants jar collected on 7/28/01 at 1145, field explosives 2,400 mg/kg
	0 to 1	LL2-086	LL2ss-086-1168-SO	Yes	7/26/01	Duplicate
	0 to 1	LL2-086	LL2ss-086-1193-SO	Yes	7/26/01	Split
	1 to 3	LL2-086	LL2so-086-0741-SO	Yes	7/28/01	Field explosives 1,350 mg/kg
	1 to 3	LL2-086	LL2so-086-1186-SO	Yes	7/28/01	Duplicate
	1 to 3	LL2-086	LL2so-086-1211-SO	Yes	7/28/01	Split
	3 to 5	LL2-086	LL2so-086-0742-SO	Yes	7/29/01	Field explosives 67.3 mg/kg
	5 to 7	LL2-086	LL2so-086-1005-SO	Yes	7/30/01	Field explosives 53.2 mg/kg, refusal at 5.8 ft
DA-6A Explosive Preparation	0 to 1	LL2-087	LL2ss-087-0743-SO	Yes	7/26/01	Field explosives 9.6 mg/kg
	0 to 1	LL2-087	LL2ss-087-1177-SO	Yes	7/26/01	Duplicate
	0 to 1	LL2-087	LL2ss-087-1202-SO	Yes	7/26/01	Split
	1 to 3	LL2-087	LL2so-087-0744-SO	Yes	7/29/01	Field explosives 18.9 mg/kg
	3 to 5	LL2-087	LL2so-087-0745-SO	Yes	7/30/01	Field explosives 59.3 mg/kg, refusal at 3.5 ft
	0 to 1	LL2-088	LL2ss-088-0746-SO	Yes	7/26/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-088	LL2so-088-0747-SO	No		
	3 to 5	LL2-088	LL2so-088-0748-SO	No		
	0 to 1	LL2-089	LL2ss-089-0749-SO	Yes	7/26/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-089	LL2so-089-0750-SO	No		
	3 to 5	LL2-089	LL2so-089-0751-SO	No		
	0 to 1	LL2-090	LL2ss-090-0752-SO	Yes	7/26/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-090	LL2so-090-0753-SO	No		
	3 to 5	LL2-090	LL2so-090-0754-SO	No		
	0 to 1	LL2-091	LL2ss-091-0755-SO	Yes	7/26/01	Subfloor, field explosives < 1 mg/kg
	0 to 1	LL2-092	LL2ss-092-0756-SO	Yes	7/26/01	Subfloor, field explosives < 1 mg/kg
DA-28A Elevator Machine House	0 to 1	LL2-093	LL2ss-093-0757-SO	Yes	7/26/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-093	LL2so-093-0758-SO	No		

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

Facility/Building No.	Depth (ft)	Station	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
	3 to 5	LL2-093	LL2so-093-0759-SO	No		
DA-21 Service Building	0 to 1	LL2-094	LL2ss-094-0760-SO	Yes	7/26/01	Propellants jar collected on 7/30/01 at 1320, field explosives 1,980 mg/kg
	1 to 3	LL2-094	LL2so-094-0761-SO	Yes	7/30/01	Field explosives 691 mg/kg, refusal at 1.7 ft
	3 to 5	LL2-094	LL2so-094-0762-SO	No		
DA-5 Service Building	0 to 1	LL2-095	LL2ss-095-0763-SO	Yes	7/26/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-095	LL2so-095-0764-SO	No		
	3 to 5	LL2-095	LL2so-095-0765-SO	No		
Concrete Settling Tanks	0 to 1	LL2-096	LL2ss-096-0766-SO	Yes	7/26/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	0 to 1	LL2-096	LL2ss-096-1169-SO	Yes	7/26/01	Duplicate
	0 to 1	LL2-096	LL2ss-096-1194-SO	Yes	7/26/01	Split
	1 to 3	LL2-096	LL2so-096-0767-SO	No		
	3 to 5	LL2-096	LL2so-096-0768-SO	No		
	0 to 1	LL2-097	LL2ss-097-0769-SO	Yes	7/26/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-097	LL2so-097-0770-SO	No		
	3 to 5	LL2-097	LL2so-097-0771-SO	No		
Wooden Settling Tanks	0 to 1	LL2-098	LL2ss-098-0772-SO	Yes	7/26/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	0 to 1	LL2-098	LL2ss-098-1164-SO	Yes	7/26/01	Duplicate
	0 to 1	LL2-098	LL2ss-098-1189-SO	Yes	7/26/01	Split
	1 to 3	LL2-098	LL2so-098-0773-SO	No		
	3 to 5	LL2-098	LL2so-098-0774-SO	No		
	0 to 1	LL2-099	LL2ss-099-0775-SO	Yes	7/26/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-099	LL2so-099-0776-SO	No		
	3 to 5	LL2-099	LLso2-099-0777-SO	No		
DB-13A, -13B, -13C Packing and Shipping	0 to 1	LL2-100	LL2ss-100-0778-SO	Yes	7/26/01	Field explosives 2.2 mg/kg
	1 to 3	LL2-100	LL2so-100-0779-SO	Yes	7/29/01	No field explosives, refusal at 1.7 ft
	3 to 5	LL2-100	LL2so-100-0780-SO	No		
	0 to 1	LL2-101	LL2ss-101-0781-SO	Yes	7/25/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-101	LL2so-101-0782-SO	No		
	3 to 5	LL2-101	LL2so-101-0783-SO	No		
	0 to 1	LL2-102	LL2ss-102-0784-SO	Yes	7/25/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-102	LL2so-102-0785-SO	No		

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

Facility/Building No.	Depth (ft)	Station	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
	3 to 5	LL2-102	LL2so-102-0786-SO	No		Refusal at 0.5 ft
	0 to 1	LL2-103	LL2ss-103-0787-SO	Yes		Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-103	LL2so-103-0788-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-103	LL2so-103-0789-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-104	LL2ss-104-0790-SO	Yes		Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-104	LL2so-104-0791-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-104	LL2so-104-0792-SO	No		Surface sample < 1 mg/kg field explosives
DB-26 Radiographic Building	0 to 1	LL2-105	LL2ss-105-0793-SO	Yes	7/25/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-105	LL2so-105-0794-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-105	LL2so-105-0795-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-106	LL2ss-106-0796-SO	Yes	7/25/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-106	LL2so-106-0797-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-106	LL2so-106-0798-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-107	LL2ss-107-0799-SO	Yes	7/25/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-107	LL2so-107-0800-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-107	LL2so-107-0801-SO	No		Surface sample < 1 mg/kg field explosives
DB-29 Elevator Machine House	0 to 1	LL2-108	LL2ss-108-0802-SO	Yes	7/27/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-108	LL2so-108-0803-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-108	LL2so-108-0804-SO	No		Surface sample < 1 mg/kg field explosives
DB-2 Service Building	0 to 1	LL2-109	LL2ss-109-0805-SO	Yes	7/27/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-109	LL2so-109-0806-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-109	LL2so-109-0807-SO	No		Surface sample < 1 mg/kg field explosives
DB-9 Service Building	0 to 1	LL2-110	LL2ss-110-0808-SO	Yes	7/28/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-110	LL2so-110-0809-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-110	LL2so-110-0810-SO	No		Surface sample < 1 mg/kg field explosives
DB-9A Service Building	0 to 1	LL2-111	LL2ss-111-0811-SO	Yes	7/28/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-111	LL2so-111-0812-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-111	LL2so-111-0813-SO	No		Surface sample < 1 mg/kg field explosives
DB-11 Service Building	0 to 1	LL2-112	LL2ss-112-0814-SO	Yes	7/27/01	Field explosives 1.41 mg/kg
	1 to 3	LL2-112	LL2so-112-0815-SO	No		Refusal at 1.8 ft
	3 to 5	LL2-112	LL2so-112-0816-SO	No		Refusal at 1.8 ft
DB-19 Service Building	0 to 1	LL2-113	LL2ss-113-0817-SO	Yes	7/27/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-113	LL2so-113-0818-SO	No		Surface sample < 1 mg/kg field explosives

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

Facility/Building No.	Depth (ft)	Station	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
	3 to 5	LL2-113	LL2so-113-0819-SO	No		Surface sample < 1 mg/kg field explosives
DB-20A Service Building	0 to 1	LL2-114	LL2ss-114-0820-SO	Yes	7/28/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-114	LL2so-114-0821-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-114	LL2so-114-0822-SO	No		Surface sample < 1 mg/kg field explosives
DB-10 Drilling and Assembly	0 to 1	LL2-115	LL2ss-115-0823-SO	Yes	7/25/01	Refusal at 0.4 ft bgs, field explosives 4.89 mg/kg
	1 to 3	LL2-115	LL2so-115-0824-SO	No		LL2-0824 reassigned to surface water split sample associated with LL2-1130
	3 to 5	LL2-115	LL2so-115-0825-SO	No		LL2-0825 reassigned to QC source blank of canola oil-based grease used in drilling to grease threads of drill rods
	0 to 1	LL2-116	LL2ss-116-0826-SO	Yes	7/25/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-116	LL2so-116-0827-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-116	LL2so-116-0828-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-117	LL2ss-117-0829-SO	Yes	7/25/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-117	LL2so-117-0830-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-117	LL2so-117-0831-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-118	LL2ss-118-0832-SO	Yes	7/25/01	Field explosives 1.59 mg/kg, refusal at 0.8 ft
	1 to 3	LL2-118	LL2so-118-0833-SO	No		Reassigned to station LL2-184 (0 to 1 ft sample)
	3 to 5	LL2-118	LL2so-118-0834-SO	No		LL2-0834 reassigned to station LL2-243
	0 to 1	LL2-119	LL2ss-119-0835-SO	Yes	7/25/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-119	LL2so-119-0836-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-119	LL2so-119-0837-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-120	LL2ss-120-0838-SO	Yes	7/25/01	Refusal at 0.4 ft bgs, field explosives 2.43 mg/kg
	1 to 3	LL2-120	LL2so-120-0839-SO	No		LL2-0839 reassigned to station LL2-241
	3 to 5	LL2-120	LL2so-120-0840-SO	No		
	0 to 1	LL2-121	LL2ss-121-0841-SO	Yes	7/25/01	Refusal at 0.7 ft bgs, field explosives 1.01 mg/kg
	1 to 3	LL2-121	LL2so-121-0842-SO	No		LL2-0842 reassigned to station LL2-253

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

Facility/Building No.	Depth (ft)	Station	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
	3 to 5	LL2-121	LL2so-121-0843-SO	No		LL2-0843 reassigned to station LL2-255
	0 to 1	LL2-122	LL2ss-122-0844-SO	Yes	7/25/01	Refusal at 0.4 ft bgs, field explosives 5.223 mg/kg
	1 to 3	LL2-122	LL2so-122-0845-SO	No		Sample LL2-0845 reassigned to station LL2-256
	3 to 5	LL2-122	LL2so-122-0846-SO	No		LL2-0846 reassigned to station LL2-257
	0 to 1	LL2-123	LL2ss-123-0847-SO	Yes	7/25/01	Subfloor, field explosives < 1 mg/kg
	0 to 1	LL2-124	LL2ss-124-0848-SO	Yes	7/25/01	Subfloor, field explosives < 1 mg/kg
	0 to 1	LL2-125	LL2fs-125d-0849-FS	Yes	8/20/01	Floor sweep sample; As^{+3}, TCLP also collected, no field explosives
Covered Sedimentation Basin	0 to 1	LL2-126	LL2ss-126-0850-SO	Yes	7/26/02	Field explosives < 1 mg/kg in 0 to 1 ft sample
	0 to 1	LL2-126	LL2ss-126-1166-SO	Yes	7/26/02	Duplicate
	0 to 1	LL2-126	LL2ss-126-1191-SO	Yes	7/26/02	Split
	1 to 3	LL2-126	LL2so-126-0851-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-126	LL2so-126-0852-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-127	LL2ss-127-0853-SO	Yes	7/26/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-127	LL2so-127-0854-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-127	LL2so-127-0855-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-128	LL2ss-128-0856-SO	Yes	7/26/01	Field explosives 17.4 mg/kg
	1 to 3	LL2-128	LL2so-128-0857-SO	Yes	7/28/01	MS/MSD collected, field explosives < 1 mg/kg
	3 to 5	LL2-128	LL2so-128-0858-SO	No		Surface sample < 1 mg/kg field explosives
DB-4 Melt-load Building/SPCC	0 to 1	LL2-129	LL2ss-129-0859-SO	Yes	7/27/01	Adjacent to building, field explosives < 1 mg/kg
	0 to 1	LL2-129	LL2ss-129-1165-SO	Yes	7/27/01	Duplicate
	0 to 1	LL2-129	LL2ss-129-0859-SO	Yes	7/27/01	Split
	1 to 3	LL2-129	LL2so-129-0860-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-129	LL2so-129-0861-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-130	LL2ss-130-0862-SO	Yes	7/27/01	Adjacent to building, field explosives 17.2 mg/kg

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

Facility/Building No.	Depth (ft)	Station	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
	1 to 3	LL2-130	LL2so-130-0863-SO	Yes	7/28/01	Refusal at 2.0 ft bgs, field explosives 24.2 mg/kg
	3 to 5	LL2-130	LL2so-130-0864-SO	No		LL2-0864 reassigned to station LL2-258
	0 to 1	LL2-131	LL2ss-131-0865-SO	Yes	7/26/01	Adjacent to building, field explosives 7.15 mg/kg
	1 to 3	LL2-131	LL2so-131-0866-SO	No		No explaination
	3 to 5	LL2-131	LL2so-131-0867-SO	No		No explaination
	0 to 1	LL2-132	LL2ss-132-0868-SO	Yes	7/26/01	Adjacent to building; propellants collected 7/28/01 at 1331, field explosives 39 mg/kg
	1 to 3	LL2-132	LL2so-132-0869-SO	Yes	7/28/01	Field explosives 5.21 mg/kg
	1 to 3	LL2-132	LL2so-132-1185-SO	Yes	7/28/01	Duplicate
	1 to 3	LL2-132	LL2so-132-1210-SO	Yes	7/28/01	Split
	3 to 5	LL2-132	LL2so-132-0870-SO	Yes	7/29/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	0 to 1	LL2-133	LL2ss-133-0871-SO	Yes	7/28/01	Adjacent to building, field explosives 152 mg/kg
	1 to 3	LL2-133	LL2so-133-0872-SO	Yes	7/29/01	Field explosives 48 mg/kg
	3 to 5	LL2-133	LL2so-133-0873-SO	Yes	7/30/01	Field explosives 1.25 mg/kg, refusal at 3.2 ft
	0 to 1	LL2-134	LL2ss-134-0874-SO	Yes	7/28/01	Adjacent to building, field explosives 5.28 mg/kg
	1 to 3	LL2-134	LL2so-134-0875-SO	Yes	7/29/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	3 to 5	LL2-134	LL2so-134-0876-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-135	LL2ss-135-0877-SO	Yes	7/28/01	Subfloor, field explosives < 1 mg/kg
	0 to 1	LL2-136	LL2ss-136-0878-SO	Yes	7/28/01	Subfloor, field explosives < 1 mg/kg
	0 to 1	LL2-137	LL2ss-137-0879-SO	Yes	7/28/01	Subfloor, field explosives < 1 mg/kg
	0 to 1	LL2-138	LL2fs-138d-0880-FS	Yes	8/20/01	Floor sweep; As+3 and TCLP collected, no field explosives
	0 to 1	LL2-139	LL2ss-139-0881-SO	Yes	7/26/01	Uphill or adjacent to barrier, field explosives < 1 mg/kg
	1 to 3	LL2-139	LL2so-139-0882-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-139	LL2so-139-0883-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-140	LL2ss-140-0884-SO	Yes	7/26/01	Uphill or adjacent to barrier, field explosives < 1 mg/kg

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

Facility/Building No.	Depth (ft)	Station	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
	1 to 3	LL2-140	LL2so-140-0885-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-140	LL2so-140-0886-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-141	LL2ss-141-0887-SO	Yes	7/26/01	MS/MSD; Uphill or adjacent to barrier, field explosives < 1 mg/kg
	0 to 1	LL2-141	LL2ss-141-1172-SO	Yes	7/26/01	Duplicate
	0 to 1	LL2-141	LL2ss-141-1197-SO	Yes	7/26/01	Split
	1 to 3	LL2-141	LL2so-141-0888-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-141	LL2so-141-0889-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-142	LL2ss-142-0890-SO	Yes	7/28/01	Uphill or adjacent to barrier, field explosives < 1 mg/kg
	1 to 3	LL2-142	LL2so-142-0891-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-142	LL2so-142-0892-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-143	LL2ss-143-0893-SO	Yes	7/28/01	Uphill or adjacent to barrier, field explosives < 1 mg/kg
	1 to 3	LL2-143	LL2so-143-0894-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-143	LL2so-143-0895-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-144	LL2ss-144-0896-SO	Yes	7/28/01	Uphill or adjacent to barrier, field explosives < 1 mg/kg
	0 to 1	LL2-144	LL2ss-144-1178-SO	Yes	7/28/01	Duplicate
	0 to 1	LL2-144	LL2ss-144-1203-SO	Yes	7/28/01	Split
	1 to 3	LL2-144	LL2so-144-0897-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-144	LL2so-144-0898-SO	No		Surface sample < 1 mg/kg field explosives
DB-4A Melt-load Building/SPCC	0 to 1	LL2-145	LL2ss-145-0899-SO	Yes	7/27/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-145	LL2so-145-0900-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-145	LL2so-145-0901-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-146	LL2ss-146-0902-SO	Yes	7/27/01	Adjacent to building, field explosives 3.56 mg/kg, refusal at 0.3 ft
	1 to 3	LL2-146	LL2so-146-0903-SO	No		Refusal at 0.3 ft
	3 to 5	LL2-146	LL2so-146-0904-SO	No		Refusal at 0.3 ft
	0 to 1	LL2-147	LL2ss-147-0905-SO	Yes	7/27/01	Adjacent to building, field explosives < 1 mg/kg
	0 to 1	LL2-147	LL2ss-147-1179-SO	Yes	7/27/01	Duplicate

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

Facility/Building No.	Depth (ft)	Station	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
	0 to 1	LL2-147	LL2ss-147-1204-SO	Yes	7/27/01	Split
	1 to 3	LL2-147	LL2so-147-0906-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-147	LL2so-147-0907-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-148	LL2ss-148-0908-SO	Yes	7/27/01	Adjacent to building, field explosives < 1 mg/kg
	1 to 3	LL2-148	LL2so-148-0909-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-148	LL2so-148-0910-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-149	LL2ss-149-0911-SO	Yes	7/27/01	Adjacent to building, field explosives 2.23 mg/kg
	1 to 3	LL2-149	LL2so-149-0912-SO	Yes	7/28/01	Field explosives < 1 mg/kg
	3 to 5	LL2-149	LL2so-149-0913-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-150	LL2ss-150-0914-SO	Yes	7/27/01	Adjacent to building, field explosives 3.54 mg/kg, refusal at 0.5 ft
	1 to 3	LL2-150	LL2so-150-0915-SO	No		Refusal at 0.5 ft
	3 to 5	LL2-150	LL2so-150-0916-SO	No		Refusal at 0.5 ft
	0 to 1	LL2-151	LL2ss-151-0917-SO	Yes	7/27/01	Subfloor, field explosives < 1 mg/kg
	0 to 1	LL2-152	LL2ss-152-0918-SO	Yes	7/27/01	Subfloor, field explosives < 1 mg/kg
	0 to 1	LL2-153	LL2ss-153-0919-SO	Yes	7/27/01	Subfloor, field explosives < 1 mg/kg
	0 to 1	LL2-154	LL2ss-154-0920-SO	Yes	7/27/01	Uphill or adjacent to barrier, field explosives < 1 mg/kg
	1 to 3	LL2-154	LL2so-154-0921-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-154	LL2so-154-0922-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-155	LL2ss-155-0923-SO	Yes	7/27/01	Uphill or adjacent to barrier, field explosives < 1 mg/kg
	1 to 3	LL2-155	LL2so-155-0924-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-155	LL2so-155-0925-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-156	LL2ss-156-0926-SO	Yes	7/27/01	Uphill or adjacent to barrier, field explosives < 1 mg/kg
	1 to 3	LL2-156	LL2so-156-0927-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-156	LL2so-156-0928-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-157	LL2ss-157-0929-SO	Yes	7/27/01	Uphill or adjacent to barrier, field explosives < 1 mg/kg
	1 to 3	LL2-157	LL2so-157-0930-SO	No		Surface sample < 1 mg/kg field explosives

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

Facility/Building No.	Depth (ft)	Station	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
	3 to 5	LL2-157	LL2so-157-0931-SO	No		
	0 to 1	LL2-158	LL2ss-158-0932-SO	Yes	7/27/01	Uphill or adjacent to barrier, field explosives 2.34 mg/kg, refusal at 0.9 ft
	0 to 1	LL2-158	LL2ss-158-1180-SO	Yes	7/27/01	Duplicate
	0 to 1	LL2-158	LL2ss-158-1205-SO	Yes	7/27/01	Split
	1 to 3	LL2-158	LL2so-158-0933-SO	No		Refusal at 0.9 ft
	3 to 5	LL2-158	LL2so-158-0934-SO	No		Refusal at 0.9 ft
	0 to 1	LL2-159	LL2ss-159-0935-SO	Yes	7/27/01	Uphill or adjacent to barrier, no field explosives
	1 to 3	LL2-159	LL2so-159-0936-SO	No		No surface field explosives
	3 to 5	LL2-159	LL2so-159-0937-SO	No		No surface field explosives
DB-25 Washout Building	0 to 1	LL2-160	LL2ss-160-0938-SO	Yes	7/28/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	0 to 1	LL2-160	LL2ss-160-1184-SO	Yes	7/28/01	Duplicate
	0 to 1	LL2-160	LL2ss-160-1209-SO	Yes	7/28/01	Split
	1 to 3	LL2-160	LL2so-160-0939-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-160	LL2so-160-0940-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-161	LL2ss-161-0941-SO	Yes	7/27/01	MS/MSD, field explosives < 1 mg/kg
	1 to 3	LL2-161	LL2so-161-0942-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-161	LL2so-161-0943-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-162	LL2ss-162-0944-SO	Yes	7/28/01	Field explosives 6.63 mg/kg
	1 to 3	LL2-162	LL2so-162-0945-SO	Yes	7/30/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	3 to 5	LL2-162	LL2so-162-0946-SO	No		1- to 3-ft sample < 1 mg/kg field explosives
	0 to 1	LL2-163	LL2ss-163-0947-SO	Yes	7/28/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-163	LL2so-163-0948-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-163	LL2so-163-0949-SO	No		Surface sample < 1 mg/kg field explosives
DB-3 Shell Receiving Building	0 to 1	LL2-164	LL2ss-164-0950-SO	Yes	7/28/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	0 to 1	LL2-164	LL2ss-164-1167-SO	Yes	7/28/01	Duplicate
	0 to 1	LL2-164	LL2ss-164-1192-SO	Yes	7/28/01	Split
	1 to 3	LL2-164	LL2so-164-0951-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-164	LL2so-164-0952-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-165	LL2ss-165-0953-SO	Yes	7/28/01	Refusal at 0.6 ft bgs, field explosives 2.19 mg/kg, refusal at 0.5 ft
	1 to 3	LL2-165	LL2so-165-0954-SO	No		LL2-0954 reassigned to station LL2-260

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

Facility/Building No.	Depth (ft)	Station	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
	3 to 5	LL2-165	LL2so-165-0955-SO	No		LL2-0955 reassigned to station LL2-241
	0 to 1	LL2-166	LL2ss-166-0956-SO	Yes	7/27/01	Field explosives 134 mg/kg
	1 to 3	LL2-166	LL2so-166-0957-SO	Yes	7/29/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	3 to 5	LL2-166	LL2so-166-0958-SO	No		1- to 3-ft sample < 1 mg/kg field explosives
	0 to 1	LL2-167	LL2ss-167-0959-SO	Yes	7/27/01	Field explosives 19.6 mg/kg
	1 to 3	LL2-167	LL2so-167-0960-SO	Yes	7/29/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	3 to 5	LL2-167	LL2so-167-0961-SO	No		1- to 3-ft sample < 1 mg/kg field explosives
Floor sweep	0 to 1	LL2-168	LL2fs-168d-0962-FS	Yes	8/20/01	As^{+3} and TCLP collected, no field explosives
DC-1 Power House 2	0 to 1	LL2-169	LL2ss-169-0963-SO	Yes	7/24/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-169	LL2so-169-0964-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-169	LL2so-169-0965-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-170	LL2ss-170-0966-SO	Yes	7/24/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-170	LL2so-170-0967-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-170	LL2so-170-0968-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-171	LL2ss-171-0969-SO	Yes	7/24/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-171	LL2so-171-0970-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-171	LL2so-171-0971-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-172	LL2ss-172-0972-SO	Yes	7/24/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-172	LL2so-172-0973-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-172	LL2so-172-0974-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-173	LL2ss-173-0975-SO	Yes	7/26/01	Subfloor, field explosives < 1 mg/kg
	0 to 1	LL2-174	LL2ss-174-0976-SO	Yes	7/26/01	Subfloor, field explosives < 1 mg/kg
DB-802 Inert Storage	0 to 1	LL2-175	LL2ss-175-0977-SO	Yes	7/27/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-175	LL2so-175-0978-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-175	LL2so-175-0979-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-176	LL2ss-176-0980-SO	Yes	7/27/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-176	LL2so-176-0981-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-176	LL2so-176-0982-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-177	LL2ss-177-0983-SO	Yes	7/27/01	Field explosives 1.63 mg/kg
	0 to 1	LL2-177	LL2ss-177-1004-SO	Yes	7/27/01	Additional metals sample only
	1 to 3	LL2-177	LL2so-177-0984-SO	Yes	7/29/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	3 to 5	LL2-177	LL2so-177-0985-SO	No		1- to 3-ft sample < 1 mg/kg field explosives
	0 to 1	LL2-178	LL2ss-178-0986-SO	Yes	7/27/01	Field explosives 2.68 mg/kg

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

Facility/Building No.	Depth (ft)	Station	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
	1 to 3	LL2-178	LL2so-178-0987-SO	Yes	7/29/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	3 to 5	LL2-178	LL2so-178-0988-SO	No		1- to 3-ft sample < 1 mg/kg field explosives
Area adjacent to Phase I Location LL2-041	0 to 1	LL2-179	LL2ss-179-0989-SO	Yes	7/25/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-179	LL2so-179-0990-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-179	LL2so-179-0991-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-180	LL2ss-180-0992-SO	Yes	7/25/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-180	LL2so-180-0993-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-180	LL2so-180-0994-SO	No		Surface sample < 1 mg/kg field explosives
	0 to 1	LL2-181	LL2ss-181-0995-SO	Yes	7/25/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-181	LL2so-181-0996-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-181	LL2so-181-0997-SO	No		Surface sample < 1 mg/kg field explosives
Contingency						
	NA	LL2-182	LL2sd-182-0998-SO	No		Reassigned to sediment media (Table 3-3)
	NA	LL2-182	LL2sd-182-1175-SO	No		Reassigned to sediment media (Table 3-3)
	NA	LL2-182	LL2sd-182-1200-SO	No		Reassigned to sediment media (Table 3-3)
	1 to 3	LL2-182	LL2so-182-0999-SO	No		No subsurface sediment
	3 to 5	LL2-182	LL2so-182-1000-SO	No		No subsurface sediment
	NA	LL2-183	LL2sd-183-1001-SO	No		Reassigned to sediment media (Table 3-3)
	NA	LL2-183	LL2sd-183-1002-SO	No		Reassigned to sediment media (Table 3-3)
	3 to 5	LL2-183	LL2so-183-1003-SO	No		No subsurface sediment
Building DA-5 Vicinity	0 to 1	LL2-184	LL2ss-184-0833-SO	Yes	8/13/01	Reassigned from station LL2-118, 1 to 3 ft sample, field explosives < 1 mg/kg
	0 to 1	LL2-184	LL2ss-184-1004-SO	No		Sample LL2-1004 reassigned to station LL2-177
	1 to 3	LL2-184	LL2so-184-1005-SO	No		Sample LL2-1005 reassigned to station LL2-086 (5 to 7 ft)
	3 to 5	LL2-184	LL2so-184-1006-SO	No		Sample LL2-1006 reassigned to surface water duplicate associated with station LL2-053
	NA	LL2-185	LL2sd-185-1007-SO	No		Reassigned to sediment media (Table 3-3)
	1 to 3	LL2-185	LL2so-185-1008-SO	No		No subsurface sediment
	3 to 5	LL2-185	LL2so-185-1009-SO	No		No subsurface sediment
Building DC-1/DB-802 Vicinity	0 to 1	LL2-186	LL2ss-186-1010-SO	Yes	7/28/01	No field explosives

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

Facility/Building No.	Depth (ft)	Station	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
	1 to 3	LL2-186	LL2so-186-1011-SO	No		No subsurface sediment
	3 to 5	LL2-186	LL2so-186-1012-SO	No		No subsurface sediment
Building DC-1/DB-802 Vicinity	0 to 1	LL2-187	LL2ss-187-1013-SO	Yes	7/28/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-187	LL2so-187-1014-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-187	LL2so-187-1015-SO	No		Surface sample < 1 mg/kg field explosives
DB-802 Chromic Acid Tank Pedestals	0 to 0.5	LL2-188	LL2ss-188-1016-SO	Yes	7/27/01	Field explosives 1.95 mg/kg
	0.5 to 1	LL2-188	LL2so-188-1017-SO	Yes	7/28/01	Field explosives only, field explosives 1.3 mg/kg, refusal at 1.0 ft
	3 to 5	LL2-188	LL2so-188-1018-SO	No		Refusal at 1.0 ft
Building DC-1/DB-802 Vicinity	0 to 1	LL2-189	LL2ss-189-1019-SO	Yes	7/28/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	1 to 3	LL2-189	LL2so-189-1020-SO	No		Surface sample < 1 mg/kg field explosives
	3 to 5	LL2-189	LL2so-189-1021-SO	No		Surface sample < 1 mg/kg field explosives
Building DA-21 Vicinity	0 to 1	LL2-241	LL2ss-241-0839-SO	Yes	8/13/01	Field explosives 7.4 mg/kg
Building DA-21 Vicinity	1 to 3	LL2-241	LL2ss-241-0955-SO	Yes	8/21/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
DB-3 – Track Behind Building	0 to 1	LL2-243	LL2ss-243-0834-SO	Yes	8/13/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
Building DA-21 Vicinity	0 to 1	LL2-244	LL2ss-244-0840-SO	Yes	8/13/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
Building DA-21 Vicinity	0 to 1	LL2-253	LL2ss-253-0842-SO	Yes	8/13/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
DA-6 Vicinity	0 to 1	LL2-255	LL2ss-255-0843-SO	Yes	8/13/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
DA-6 Vicinity	0 to 1	LL2-256	LL2ss-256-0845-SO	Yes	8/13/01	Field explosives only, field explosives < 1 mg/kg
DA-6 Vicinity	0 to 1	LL2-257	LL2ss-257-0846-SO	Yes	8/14/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
DB-4 Adjacent to Barrier	0 to 1	LL2-258	LL2ss-258-0864-SO	Yes	8/14/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
DB-3 Vicinity	0 to 1	LL2-260	LL2ss-260-0954-SO	Yes	8/13/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
Covered Sedimentation Basin	0 to 1	LL2-272	LL2so-272-0688-SO	Yes	8/25/02	North side of basin, field explosives 19.8 mg/kg
Covered Sedimentation Basin	1 to 3	LL2-272	LL2so-272-0689-SO	Yes	8/26/02	North side of basin, field explosives < 1 mg/kg
Covered Sedimentation Basin	0 to 1	LL2-273	LL2so-273-0692-SO	Yes	8/26/02	North side of basin, field explosives < 1 mg/kg
North of Settling Basin	0 to 1	LL2-274	LL2so-274-0686-SO	Yes	8/25/02	20 ft north of Station LL2-096, field explosives < 1 mg/kg

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

Facility/Building No.	Depth (ft)	Station	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
Random Grid in Non-Production Areas						
	0 to 1	LL2-194	LL2ss-194-1034-SO	Yes	7/31/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	0 to 1	LL2-195	LL2ss-195-1035-SO	Yes	7/31/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	0 to 1	LL2-196	LL2ss-196-1036-SO	Yes	7/31/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	0 to 1	LL2-197	LL2ss-197-1037-SO	Yes	7/31/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	0 to 1	LL2-198	LL2ss-198-1038-SO	Yes	7/31/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	0 to 1	LL2-199	LL2ss-199-1039-SO	Yes	7/31/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	0 to 1	LL2-200	LL2ss-200-1040-SO	Yes	7/31/01	MS/MSD, field explosives < 1 mg/kg
	0 to 1	LL2-201	LL2ss-201-1041-SO	Yes	7/31/01	Field explosives < 1 mg/kg
	0 to 1	LL2-201	LL2ss-201-1181-SO	Yes	7/31/01	Duplicate
	0 to 1	LL2-201	LL2ss-201-1206-SO	Yes	7/31/01	Split
	0 to 1	LL2-202	LL2ss-202-1042-SO	Yes	7/31/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	0 to 1	LL2-203	LL2ss-203-1043-SO	Yes	7/31/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	0 to 1	LL2-204	LL2ss-204-1044-SO	Yes	7/31/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	0 to 1	LL2-205	LL2ss-205-1045-SO	Yes	7/30/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	0 to 1	LL2-206	LL2ss-206-1046-SO	Yes	7/30/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	0 to 1	LL2-207	LL2ss-207-1047-SO	Yes	7/30/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	0 to 1	LL2-208	LL2ss-208-1048-SO	Yes	7/30/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	0 to 1	LL2-209	LL2ss-209-1049-SO	Yes	7/30/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	0 to 1	LL2-210	LL2ss-210-1050-SO	Yes	7/30/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
	0 to 1	LL2-211	LL2ss-211-1051-SO	Yes	7/31/01	Field explosives < 1 mg/kg in 0 to 1 ft sample
RR Track DH	0 to 0	LL2-212	LL2ss-212b-1157-SO	No		Station LL2-212 re-assigned to dry ditch west of DB-802
	0 to 1	LL2-213	LL2ss-213-1053-SO	Yes	7/27/01	Surface beneath ballast, field explosives < 1 mg/kg
	0 to 0	LL2-214	LL2ss-214b-1158-SO	Yes	7/27/01	Ballast sample
	0 to 1	LL2-214	LL2ss-214-1054-SO	Yes	7/27/01	Surface beneath ballast, field explosives < 1 mg/kg
	0 to 1	LL2-214	LL2ss-214-1183-SO	Yes	7/27/01	Duplicate, surface beneath ballast, field explosives < 1 mg/kg
	0 to 1	LL2-214	LL2ss-214-1208-SO	Yes	7/27/01	Split, surface beneath ballast
	0 to 1	LL2-215	LL2ss-215-1055-SO	Yes	7/27/01	Surface beneath ballast, field explosives < 1 mg/kg

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

Facility/Building No.	Depth (ft)	Station	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
	0 to 0	LL2-216	LL2ss-216b-1159-SO	Yes	7/27/01	Ballast sample
	0 to 1	LL2-216	LL2ss-216-1056-SO	Yes	7/27/01	Surface beneath ballast, field explosives < 1 mg/kg
	0 to 1	LL2-217	LL2ss-217-1057-SO	Yes	7/27/01	Surface beneath ballast, field explosives < 1 mg/kg
Perimeter Trenches Geotechnical Samples						
		LL2-218	LL2tr-218-1058-SO	No		Not selected for analysis
		LL2-218	LL2tr-218-1059-SO	No		Not selected for analysis
		LL2-218	LL2tr-218-1060-SO	No		Not selected for analysis
		LL2-219	LL2tr-219-1061-SO	No		Not selected for analysis
		LL2-219	LL2tr-219-1062-SO	No		Not selected for analysis
		LL2-219	LL2tr-219-1063-SO	No		Not selected for analysis
	1 to 1.5	LL2-220	LL2tr-220-1064-SO	Yes	8/20/01	MC, GS, AL, USCS, SG, pH
	2 to 2.5	LL2-220	LL2tr-220-1065-SO	Yes	8/20/01	MC, GS, AL, USCS, SG, pH
	4 to 4.5	LL2-220	LL2tr-220-1066-SO	Yes	8/20/01	MC, GS, AL, USCS, SG, pH
		LL2-221	LL2tr-221-1067-SO	No		Not selected for analysis
		LL2-221	LL2tr-221-1068-SO	No		Not selected for analysis
		LL2-221	LL2tr-221-1069-SO	No		Not selected for analysis
		LL2-222	LL2tr-222-1070-SO	No		Not selected for analysis
		LL2-222	LL2tr-222-1071-SO	No		Not selected for analysis
		LL2-222	LL2tr-222-1072-SO	No		Not selected for analysis
	7.3 to 7.6	LL2-223	LL2tr-223-1073-SO	Yes	8/20/01	MC, GS, AL, USCS, SG, pH
	2.8 to 3.2	LL2-223	LL2tr-223-1074-SO	Yes	8/20/01	MC, GS, AL, USCS, SG, pH
	9	LL2-223	LL2tr-223-1075-SO	Yes	8/20/01	MC, GS, AL, USCS, SG, pH

AL = Atterberg limits.
As^{+3} = Trivalent arsenic.
bgs = Below ground surface.
Cr^{+6} = Hexavalent chromium.
GS = Grain size.
HVAC = Heating, ventilation, and air conditioning.
ID = Identification.
MC = Moisture content.
MS/MSD = Matrix spike/matrix spike duplicate.
pH = Soil pH.
QC = Quality control.
SG = Specific gravity.
TCLP = Toxicity Characteristic Leaching Procedure.
USCS = Universal Soil Classification System.

Rationale

Data from soil samples collected during the Phase II RI at Load Line 2 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 soil

As presented in Table 3-2, soil sampling locations were categorized by geographic location and sample type. The categories include: (1) source area characterization, including buildings and structures; (2) contingency samples; and (3) random grid samples in non-production areas. The rationales for collecting these categories of samples were based on the CSM, as presented in Chapter 2.0, and are summarized below. When developing EUs for evaluation of contaminant nature and extent and risks to human and ecological receptors (Section 4.1), these samples were assigned to specific EUs based on geographic location and rationale for collection.

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 30). 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 sampling around potential sources was biased to locations most likely to exhibit contamination (e.g., around doors and edges of floor slabs and low lying areas). Along railroad beds, soil samples were collected from the soil interval immediately beneath the ballast layer; they are addressed as surface soil samples in the nature and extent and risk evaluations although the overlying ballast layer was up to 0.6 m (2 ft) thick in areas.

In addition to planned biased samples activities, source area characterization incorporated the use of color spectrophotometry, or colorimetry, to analyze for TNT and RDX in a field laboratory (see Section 3.7.1). The rationale for employing the field analytical methods was to identify the presence of explosive compounds at a specific sample location on a “real-time” basis to help determine lateral and vertical characterization of explosives compounds. Figure 3-5 illustrates the application of explosives field analysis in guiding sampling Phase II RI sampling efforts. At stations where these compounds were identified at concentrations greater than 1 mg/kg in the surface soil interval, data were evaluated to determine if additional samples were required at a location to determine the horizontal extent of contamination. All samples that had field TNT or RDX concentrations greater than 1 mg/kg were submitted to a fixed-based off-site laboratory for confirmatory analyses. In addition, 15% of the samples having no detected TNT or RDX using the field methods were submitted to off-site laboratory analyses for QA purposes.

A total of 149 surface soil samples was collected around potential source areas. Additionally, samples were collected from beneath building floors to evaluate any contaminant releases through cracks in floor slabs or leaking drains. A total of 17 soil samples was collected from beneath building floor slabs.

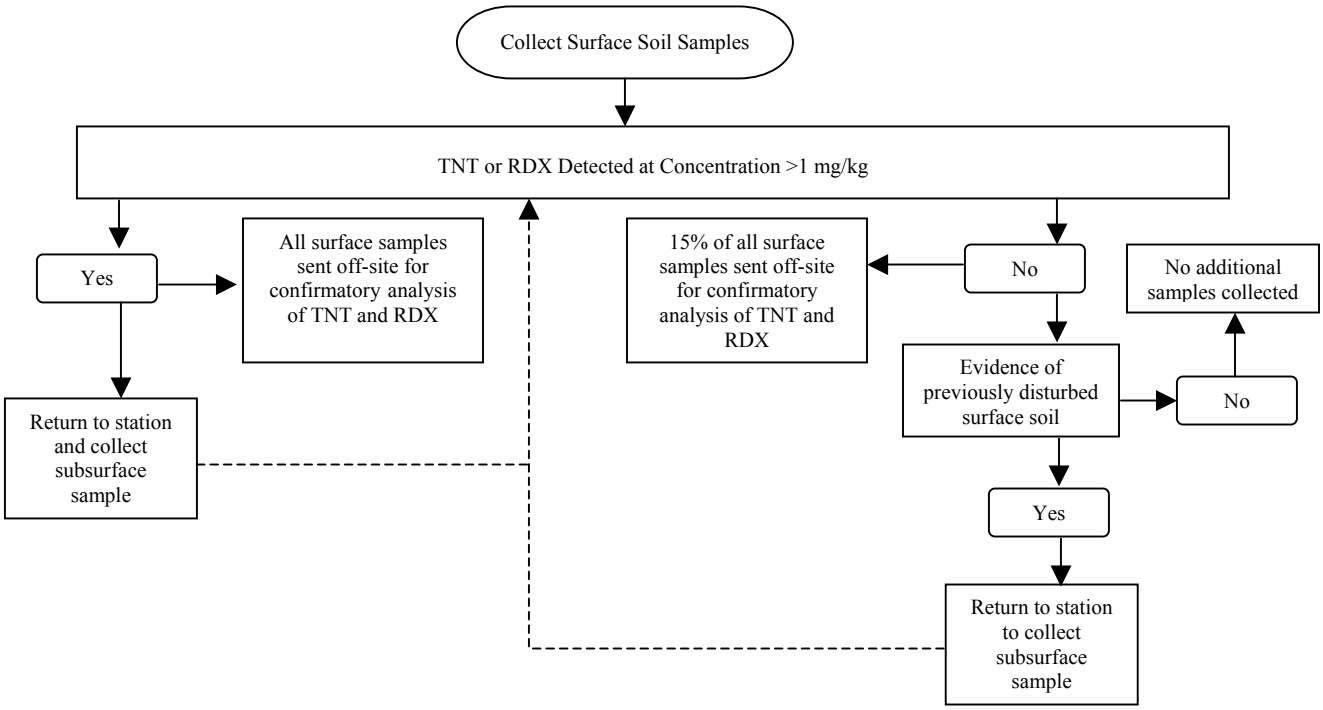


Figure 3-5. Field Explosives Analysis Screening Rationale

Contingency Samples

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. Such field observations included potential evidence of contamination (e.g., stained soil) or specific data needs (e.g., Cr^{+6} characterization near Building DB-802 and former steam lines). Contingency samples were assigned to their appropriate data aggregates during development of EUs in Chapter 4.0.

Random Grid Samples 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 31)], a statistically based random sampling method was employed (Gilbert 1987). Non-production areas were divided into 18 EUs, each encompassing of a few acres (Figure 3-4). 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. One surface soil sample was collected within each EU. 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 a specific node within each EU at which a sample would be collected.

Subsurface Soil

Subsurface soil sampling strategy was based on the use of field analyses for TNT and RDX denoted above (Figure 3-5). 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 31 subsurface soil samples. A total of 26 subsurface soil samples (including contingencies) was ultimately collected based on field TNT or RDX above 1 mg/kg, including 20 samples from the 0.3- to 0.9-m (1- to 3-ft) bgs intervals; 5 samples from the 0.9- to 1.6-m (3- to 5-ft) bgs intervals; and 1 sample from the 1.6- to 2.2-m (5- to 7-ft) bgs intervals. Subsurface soil sample target depths were not attained for many Load Line 2 subsurface soil samples due to refusal of hand auger borings on bedrock or float.

3.1.1.2 Test pits

To provide a better understanding of subsurface stratigraphy and factors affecting shallow groundwater flow, test pits were excavated at six locations around the outer perimeter of the AOC where the vadose zone was presumed to be uncontaminated (Figure 3-6). Stratigraphic and geotechnical data were collected from the test pits that would not ordinarily be obtained through conventional soil borings or direct-push sampling techniques. Characterization of the unconsolidated zone was accomplished through visual examination of subsurface materials and collection of geotechnical samples representing different depth intervals. Disturbed samples for geotechnical analyses were collected at test pit 3 (LL2-220) and test pit 6 (LL2-223). A sequence of three samples was collected at each test pit to provide a vertical profile of geotechnical characteristics and to characterize different soil types encountered in the pits. Samples for chemical analyses were not planned or collected (Table 3-2).

Depth (bgs) to bedrock at the six Load Line 2 test pits is as follows:

Test Pit 1 (LL2-218): 6.1 ft,
Test Pit 2 (LL2-219): 2.4 ft,
Test Pit 3 (LL2-220): 5 ft,
Test Pit 4 (LL2-221): 4.5 ft,
Test Pit 5 (LL2-222): 4.9 ft, and
Test Pit 6 (LL2-223): > 10 ft (total depth drilled was 10 ft, bedrock was not encountered at this location).

3.1.1.3 Floor sweep samples

To provide data for future building demolition activities, floor sweep samples were collected from three buildings (DB-10, DB-3, and DB-4). The samples were collected from random areas within the buildings and analyzed for chemical constituents including As^{+3}, in order to determine if residual explosives dust, lead or PCB-based paint chips, or other contaminants were present that could affect demolition activities or waste management planning. In addition to chemical analyses, these samples were submitted for Toxicity Characteristic Leaching Procedure (TCLP) analyses to determine if any of the materials might exhibit hazardous characteristics.

3.1.1.4 Geotechnical samples

Soil samples for geotechnical analyses were collected from 27 stations (Table 3-2). One undisturbed Shelby tube sample was collected from monitoring well boring LL2 mw-268 (see Figure 3-6) from just

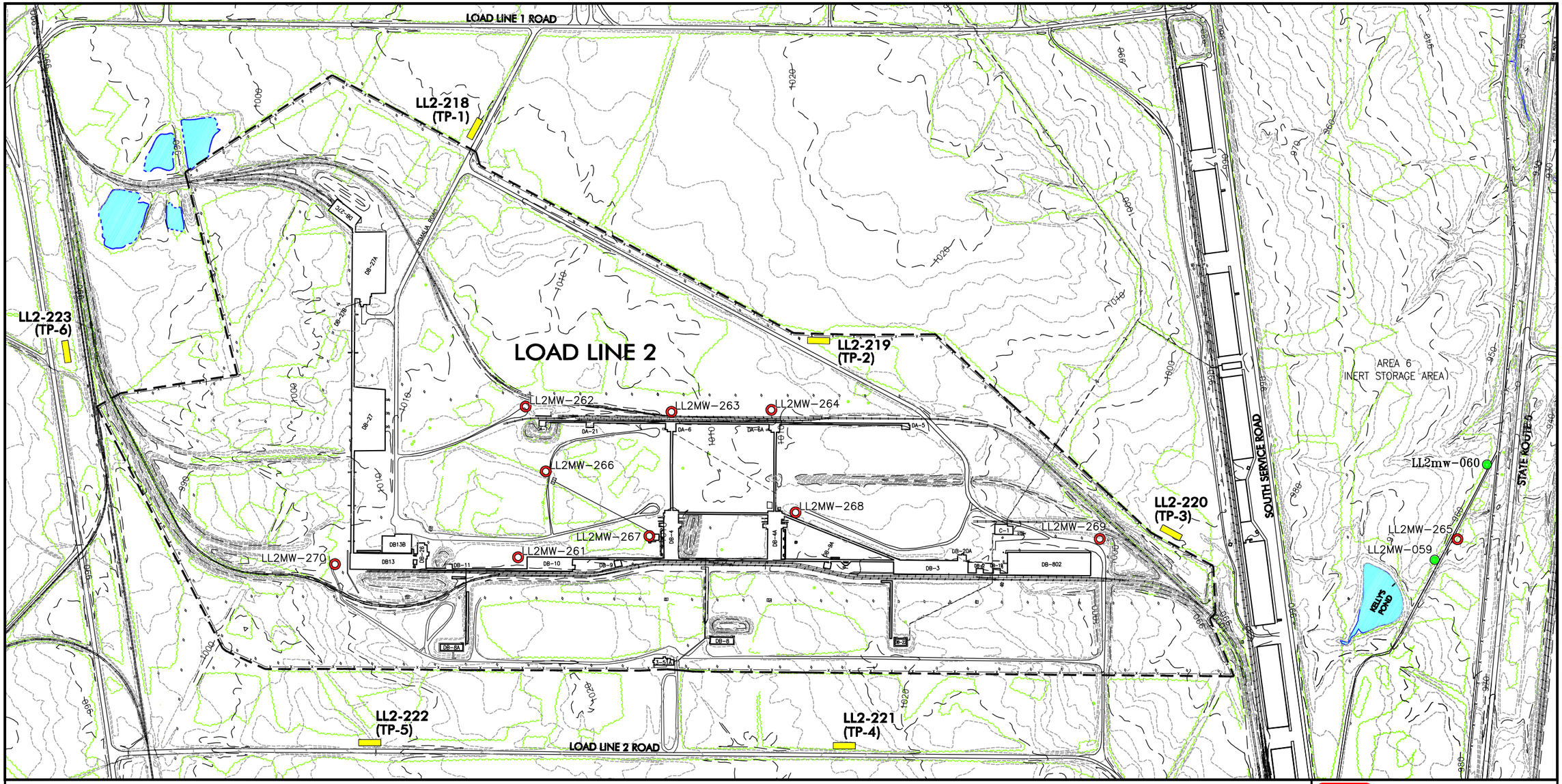


Figure 3-6. Phase II RI Monitoring Well and Test Pit Locations at Load Line 2

above the unconsolidated zone/bedrock contact. Twenty disturbed surface soil geotechnical samples were collected from hand auger borings. Six representative samples were collected from test pits (see Section 3.1.1.2). Analysis of each sample was performed to determine specific geotechnical properties necessary to evaluate media-specific fate and transport mechanisms and potential remedial alternatives.

3.1.2 Surface and Subsurface Soil Field Sampling Methods

3.1.2.1 Surface soil and dry sediment

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). 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 the auger bucket. The remaining soil 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, 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 to 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 about 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 samples for explosive and propellant compounds analyses were placed into appropriate containers. A portion of the sample was extracted from the sample container for field colorimetric analysis of TNT and RDX. Samples for analyses of other contaminants (e.g., inorganics, SVOCs, VOCs, etc.) were collected from a boring placed in the approximate center of the triangle formed by the three sub-samples.

For samples collected beneath building floor slabs, coring of the concrete floor slabs was required. Locations selected for coring targeted observed cracks in the floor slab or adjacent to drains through which contaminants could potentially migrate. Discrete samples were collected from the first 0.3-m (1-ft) interval beneath the floor slab using a bucket auger as described above.

Field descriptions and classifications for the soil samples were 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, with the following exception. Headspace gases were not screened in the field for organic vapors. Organic vapor measurements were made in the breathing zone during sampling and the results 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 P. Hand auger borings were backfilled to the ground surface with dry bentonite chips following collection of all necessary surface and subsurface soil samples.

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.

For composite sampling stations where refusal occurred in the center boring, the subsurface samples were collected by deepening one of three equilateral sub-sampling points.

Soil from the subsurface interval was placed into a stainless steel bowl, homogenized, and representative aliquots were placed into the appropriate sample containers. All VOC 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 were 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, with the following exception. Headspace gases were not screened in the field for organic vapors. 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 P. Hand auger borings were backfilled to the ground surface with dry bentonite chips.

3.1.2.3 Test pits

Test pits were excavated using a track-mounted excavator with a 61-cm (24-in.) bucket to depths ranging from 0.9 to 3.3 m (3 to 10 ft). Excavation was terminated at either the maximum depth capability of the excavator or upon encountering bedrock. The water table was not encountered in any of the test pits excavated at Load Line 2.

Soil extracted from the test pits was logged using conventional geologic and geotechnical methods, including visual Unified Soil Classification System (USCS) classification and standard Munsell soil color charts (Munsell 1988). Sample sequences were collected, as described in Sect. 3.1.1.2. Headspace gases were not screened in the field for organic vapors. 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 17 stations located within drainage conveyances, stream channels, and ponds (Table 3-3; Figure 3-7). These samples were collected to evaluate contaminant migration from surface soil sources via erosional processes and accumulation within these features. The analytical results for sediment samples collected from surface drainage features were used to quantify

Table 3-3. Sediment Sampling List and Rationales, Load Line 2 Phase II RI

Facility/Building No.	Depth (ft)	Station	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
Associated with Buildings						
Covered Sedimentation Basin	0 to 0.5	LL2-226	LL2sd-226-1082-SD	Yes	7/30/01	Field explosives < 1 mg/kg
DB-4 Melt-pour Building - North Washout Annex	0 to 0.5	LL2-227	LL2sd-227-1084-SD	Yes	7/30/01	Field explosives 31.5 mg/kg
DB-4 Melt-pour Building - South Washout Annex	0 to 0.5	LL2-228	LL2sd-228-1086-SD	Yes	7/30/01	Additional sample volume for VOC analysis was collected 8/26/01 at 1140, field explosives 20.5 mg/kg
DB-4A Melt-pour Building - North Washout Annex	0 to 0.5	LL2-229	LL2sd-229-1088-SD	Yes	7/30/01	Field explosives 45.7 mg/kg
DB-4A Melt-pour Building - South Washout Annex	0 to 0.5	LL2-230	LL2sd-230-1090-SD	Yes	7/30/01	MS/MSD requested for explosives, field explosives 44.4 mg/kg
Northeast Water Basin	0 to 0.5	LL2-231	LL2sd-231-1092-SD	Yes	7/29/01	Field explosives 3.4 mg/kg RDX
Northeast Water Basin	0 to 0.5	LL2-232	LL2sd-232-1094-SD	Yes	7/29/01	Field explosives 11.05 mg/kg
Northeast Pond (largest)	0 to 0.5	LL2-271	LL2sd-271-1076-SD	Yes	7/31/01	Field explosives < 1 mg/kg
Storm Sewers and Surface Drainages						
Fence at State Route 5	0 to 0.5	LL2-182	LL2sd-182-0998-SD	Yes	7/31/01	Field explosives < 1 mg/kg
	0 to 0.5	LL2-182	LL2sd-182-1175-SD	Yes	7/31/01	Duplicate
	0 to 0.5	LL2-182	LL2sd-182-1200-SD	Yes	7/31/01	Split
Culvert Inlet: South of Building DB-802	0 to 0.5	LL2-183	LL2sd-183-1001-SD	Yes	7/27/01	Field explosives < 1 mg/kg
	0.5 to 1.0	LL2-183	LL2sd-183-1002-SD	Yes	7/27/01	Field explosives < 1 mg/kg
Culvert Outlet: South of Building DB-802	0 to 0.5	LL2-185	LL2sd-185-1007-SD	Yes	7/27/01	Field explosives < 1 mg/kg
DB-802	0 to 1	LL2-212	LL2ss-212-1052-SO	Yes	7/27/02	Ditch west of building - saturated sediment, field explosives < 1 mg/kg
Outfall; Track 25 at Station 69+00	0 to 0.5	LL2-233	LL2sd-233-1096-SD	Yes	7/27/01	GS, TOC, field explosives < 1 mg/kg
Outfall; Track 45 at Station 72+50	0 to 0.5	LL2-234	LL2sd-234-1097-SD	Yes	7/27/01	Field explosives 0.746 mg/kg
Resample Phase I Station LL2-046	0 to 0.5	LL2-046	LL2sd-046-1098-SD	Yes	7/29/01	Field explosives < 1 mg/kg
Resample Phase I Station LL2-050	0 to 0.5	LL2-050	LL2sd-050-1099-SD	Yes	7/27/01	Field explosives 1.72 mg/kg
Storm Sewer Inlet DB2	0 to 0.5	LL2-235	LL2sd-235-1100-SD	No		Inlet filled with rock and debris, no sediment. Reassigned to Inlet C4
Storm Sewer Inlet C4	0 to 0.5	LL2-235	LL2sd-235-1100-SD	Yes	7/29/01	MS/MSD, Sample for Cr^{+6} analysis collected 8/26/01 at 1115, field explosives < 1 mg/kg
Storm Sewer Inlet DB6	0 to 0.5	LL2-236	LL2sd-236-1101-SD	Yes	7/28/01	Field explosives < 1 mg/kg
Storm Sewer Inlet DB8	0 to 0.5	LL2-237	LL2sd-237-1102-SD	Yes	7/28/01	Field explosives < 1 mg/kg

Table 3-3. Sediment Sampling List and Rationales, Load Line 2 Phase II RI (continued)

Facility/Building No.	Depth (ft)	Station	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
Storm Sewer Inlet B1	0 to 0.5	LL2-238	LL2sd-238-1103-SD	Yes	7/29/01	Field explosives 4.59 mg/kg
MH B1	0 to 0.5	LL2-239	LL2sd-239-1104-SD	Yes	8/6/01	Field explosives < 1 mg/kg
MH B2	0 to 0.5	LL2-240	LL2sd-240-1106-SD	Yes	8/6/01	Field explosives < 1 mg/kg
MH B3	0 to 0.5	LL2-241	LL2sd-241-1108-SD	No		There was no sediment at MH B3. Station LL2-241 was reassigned as soil station at DA-21
Storm Sewer Inlet DB11	0 to 0.5	LL2-242	LL2sd-242-1110-SD	Yes	7/28/01	Field explosives 13.6 mg/kg
Storm Sewer Inlet DB12	0 to 0.5	LL2-243	LL2sd-243-1111-SD	No		There was no sediment at Inlet DB12. Station LL2-243 reassigned to soil contingency at DB-3 along track. Sample ID LL21111 reassigned to surface water station LL2-239
Storm Sewer Inlet DB15	0 to 0.5	LL2-244	LL2sd-244-1112-SD	No		There was no sediment at Inlet DB15. Reassigned as a soil station at Building DA-21
Begin Open Ditch	0 to 0.5	LL2-245	LL2sd-245-1113-SD	Yes	7/30/01	TOC, GS, field explosives < 1 mg/kg
Storm Sewer Inlet DA12	0 to 0.5	LL2-246	LL2sd-246-1115-SD	Yes	7/29/01	Field explosives < 1 mg/kg
Storm Sewer Inlet DA18	0 to 0.5	LL2-247	LL2sd-247-1116-SD	Yes	7/28/01	Field explosives < 1 mg/kg
OF near Storm Sewer Inlet DA21	0 to 0.5	LL2-248	LL2sd-248-1117-SD	Yes	7/29/01	Field explosives < 1 mg/kg
Storm Sewer Inlet where Open Ditch Flows Beneath Track DA	0 to 0.5	LL2-249	LL2sd-249-1118-SD	Yes	7/30/01	GS, TOC, field explosives < 1 mg/kg
	0 to 0.5	LL2-249	LL2sd-249-1170-SD	Yes	7/30/01	Duplicate, MS/MSD
	0 to 0.5	LL2-249	LL2sd-249-1195-SD	Yes	7/30/01	Split
Resample Phase I Station LL2-048	0 to 0.5	LL2-048	LL2sd-048-1120-SD	Yes	7/27/01	Cr^{+6}, field explosives < 1 mg/kg
Inlet DB20	0 to 0.5	LL2-250	LL2sd-250-1121-SD	Yes	7/28/01	Field explosives 1.72 mg/kg
	0 to 0.5	LL2-250	LL2sd-250-1174-SD	Yes	7/28/01	Duplicate
	0 to 0.5	LL2-250	LL2sd-250-1199-SD	Yes	7/28/01	Split
Inlet DB21	0 to 0.5	LL2-251	LL2sd-251-1122-SD	Yes	7/28/01	Field explosives < 1 mg/kg
Resample Phase I Station LL2-049	0 to 0.5	LL2-049	LL2sd-049-1123-SD	Yes	7/27/01	Cr^{+6}, field explosives < 1 mg/kg
	0 to 0.5	LL2-049	LL2sd-049-1173-SD	Yes	7/27/01	Duplicate
	0 to 0.5	LL2-049	LL2sd-049-1198-SD	Yes	7/27/01	Split
Inlet Upgradient of Phase I Station LL2-049	0 to 0.5	LL2-252	LL2sd-252-1125-SD	Yes	7/30/01	GS, TOC, field explosives < 1 mg/kg

Table 3-3. Sediment Sampling List and Rationales, Load Line 2 Phase II RI (continued)

Facility/Building No.	Depth (ft)	Station	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
Resample Phase I Station LL2-052 (Kelly's Pond)	0 to 0.5	LL2-052	LL2sd-052-1127-SD	Yes	7/30/01	Field explosives < 1 mg/kg
Resample Phase I Station LL2-053 (Kelly's Pond)	0 to 0.5	LL2-053	LL2sd-053-1129-SD	Yes	7/30/01	GS, TOC, field explosives < 1 mg/kg
Resample Phase I Station LL2-054	0 to 0.5	LL2-054	LL2sd-054-1131-SD	Yes	7/30/01	GS, TOC, field explosives < 1 mg/kg
Resample Phase I Station LL2-055	0 to 0.5	LL2-055	LL2sd-055-1133-SD	Yes	7/31/01	GS, TOC, field explosives < 1 mg/kg
Sanitary Sewer						
MH 302	0 to 0.5	LL2-253	LL2sd-253-1135-SD	No		There was no sediment at MH 302. Reassigned as a soil sample at DA-21
MH 303	0 to 0.5	LL2-254	LL2sd-254-1136-SD	No		There was no sediment at MH 303. Sample LL2-254 was reassigned as surface water from MH 304 along side of road between DB-4 and DB-10
MH 305	0 to 0.5	LL2-255	LL2sd-255-1137-SD	No		There was no sediment at MH 305. Sample was not collected. Reassigned as a soil station at DA-6
MH 306	0 to 0.5	LL2-256	LL2sd-256-1138-SD	No		There was no sediment at MH 306. Sample was not collected. Reassigned as a soil station at DA-6
MH 307	0 to 0.5	LL2-257	LL2sd-257-1139-SD	No		There was no sediment at MH 307. Sample was not collected. Reassigned as a soil station at DA-6
MH 310	0 to 0.5	LL2-258	LL2sd-258-1140-SD	No		There was no sediment at MH 310. Sample was not collected. Reassigned as a soil station at DB-4
Ejector Station 2	0 to 0.5	LL2-259	LL2sd-259-1141-SD	Yes	7/31/2001	Field explosives < 1 mg/kg
MH 337	0 to 0.5	LL2-260	LL2sd-260-1143-SD	No		There was no sediment at MH 337. Sample was not collected. Reassigned as a soil station northeast of DB-3

Cr^{+6} = Hexavalent chromium.
GS = Grain size.
ID = Identification.
MC = Moisture content.
MH = Manhole.
MS/MSD = Matrix spike/matrix spike duplicate.
RI = Remedial Investigation.
TOC = Total organic carbon.
VOC = Volatile organic compound.

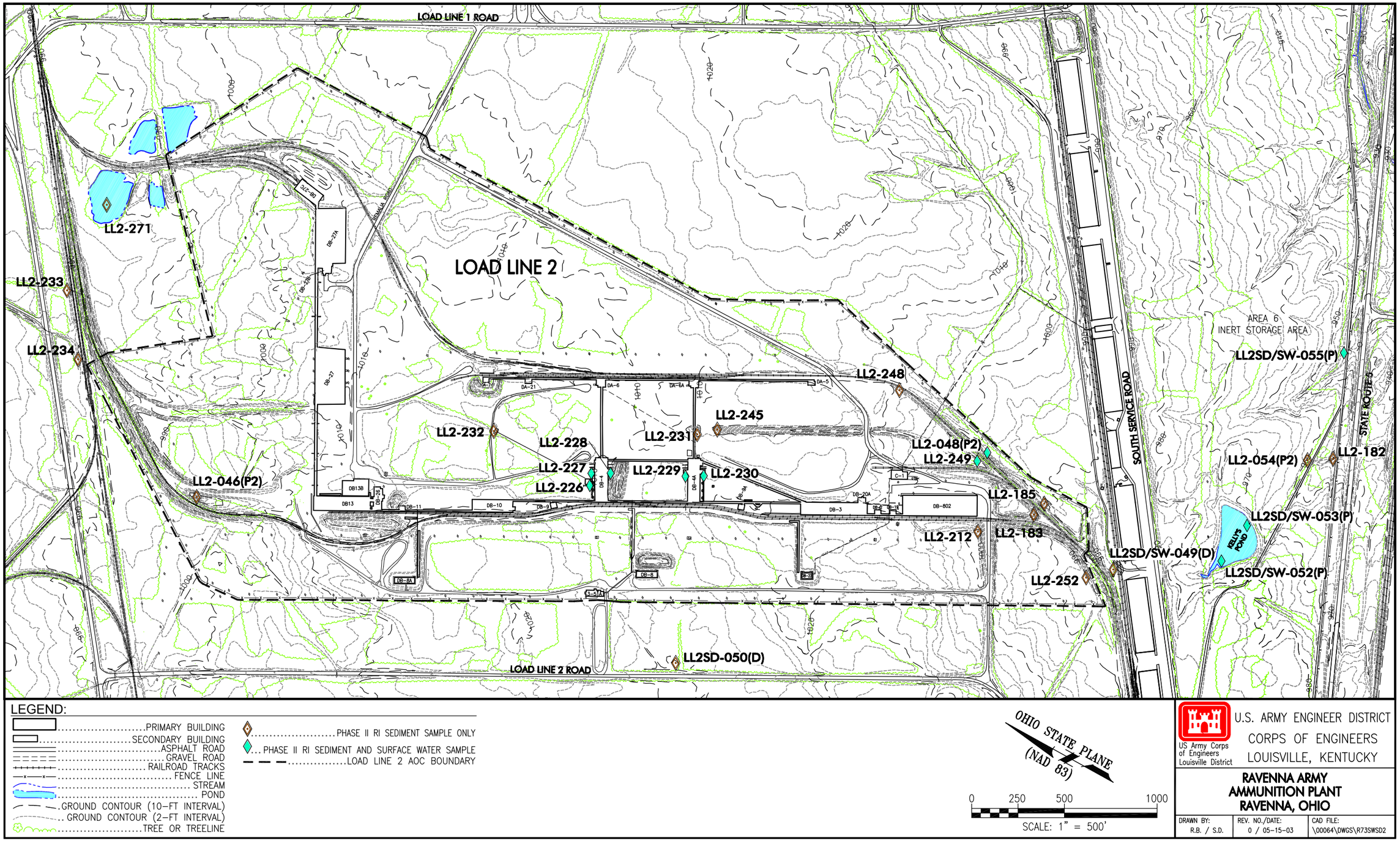


Figure 3-7. Phase II RI Sediment and Surface Water Sampling Locations at Load Line 2

risks to human and ecological receptors that may be exposed to sediment (see Chapters 6.0 and 7.0).Sediment samples from drainage conveyances that are predominantly dry, except during storm events, were addressed as soil in the development of EUs and the risk evaluations. Samples collected from perennial streams and ponds were addressed as true sub-aqueous sediment in the nature and extent and risk evaluations.

Seven samples of accumulated sediments and sludges were also collected from sedimentation basins, settling tanks, and washout sumps to help characterize residual contaminants in buildings and structures for the purposes of demolition and waste management planning. These samples were considered separately in the evaluation of contaminant nature and extent and were not evaluated with respect to risk.

Accumulated sediments were also collected from 13 points within the storm and sanitary sewer networks (inlets and manhole locations); these are discussed separately in Section 3.5.

Table 3-3 details the various types of sediment samples collected for the Phase II RI. Departures from the planned sampling efforts due to site conditions (i.e., lack of sufficient sample material) and the addition of contingency samples are specifically denoted. In addition to chemical analyses, seven sediment samples from various locations were submitted for geotechnical analyses [grain size and total organic carbon (TOC)] to help qualitatively evaluate contaminant sorption and natural attenuation characteristics.

3.2.2 Sediment Field Sampling Methods

Sediment samples from dry drainage conveyances and low-lying areas were collected using the hand bucket auger method, as described for surface soil samples noted 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, where the sampling station 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. For perennial streams and pond sampling locations where the depth of water exceeded about 30 cm (1.0 ft), a clamshell sampler was used to obtain sediment. For samples collected using both trowels and the clamshell sampler, 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.

For sediment samples from within structures and building (e.g., settling basins and sumps), a trowel or clamshell sampler was employed depending on the presence and depth of accumulated water within the structures. As a safety precaution, samples from washout annexes inside the melt-pour buildings were collected by UXO avoidance personnel. UXO avoidance personnel were trained by SAIC field staff on proper collection techniques prior to sampling. Upon collection and visual examination of samples by UXO avoidance personnel, the samples were transferred to on-site SAIC field staff for sample packaging and shipping.

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. Headspace gases were not screened in the field for organic vapors. Organic vapor measurements made in the breathing zone during sampling were recorded in the field logbooks.

3.3 SURFACE WATER CHARACTERIZATION

3.3.1 Rationales

Surface water represents the primary contaminant transport pathway off of the AOC, either as dissolved phase or adsorbed to particulates/sediment that are mobilized by flow. Surface water data obtained were used to evaluate ambient water quality entering the AOC, as well as to assess potential impacts from other potential source areas. Load line drainage patterns are primarily to the south to Kelly's Pond, which, in turn, discharges off of RVAAP to the south. In the northeast section of the AOC, drainage is toward the north to several small ponds and wetlands, which then discharge to Sand Creek.

Perennial streams and ponds were the focal areas of the surface water sampling during the Phase II RI; these samples are addressed as viable ecological habitat in the nature and extent and risk evaluations. Re-sampling of surface water at five Phase I RI stations was planned (Table 3-4). These Phase I RI stations were chosen for sampling because they are located within water bodies that exit the load line. Only three of the planned locations (stations LL2-052, LL2-053, and LL2-055) had sufficient water to sample (Figure 3-7). One additional surface water sampling location was added (Phase I RI station LL2-048).

In addition, surface water samples were collected at a few locations within the load line at locations where potential contaminants would be expected to leach or erode from source areas into drainage ditches. These samples are addressed as miscellaneous water samples from nonviable ecological habitats in the nature and extent and risk evaluations. Three water samples from ditches inside the production area were planned; sufficient water to sample was only found at station LL2-249 (Figure 3-7).

Sedimentation basins and washout basins were also focal points for water sampling. Accumulated water within these structures 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 dispositions under any future demolition or remedial action. A total of seven water samples was collected from sedimentation and washout basins (Table 3-4; Figure 3-7).

Water samples were also planned from the locations within the storm and sanitary sewer systems; these are discussed in Section 3.5.

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 also in an attempt to minimize the effects of sediment turbidity on surface water quality. In flowing streams, sample collection was initiated at the sampling point furthest downstream in the channel, and then proceeded to upstream sampling locations, to minimize the effects of sediment turbidity.

As a safety precaution, water samples from washout annexes inside the melt-pour buildings were collected by UXO avoidance personnel. UXO avoidance personnel were trained by SAIC field staff on proper collection techniques prior to sampling. Upon collection of samples by UXO avoidance personnel, the samples were transferred to on-site SAIC field staff for sample packaging and shipping.

Table 3-4. Surface Water Sampling List and Rationales, Load Line 2 Phase II RI

Facility/Building No.	Station	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
Associated with Buildings					
Covered Sedimentation Basin	LL2-226	LL2sw-226-1083-SW	Yes	7/29/01	Associated trip blank = LL2-1219
	LL2-226	LL2sw-226-1188-SW	Yes	7/29/01	Duplicate, associated trip blank = LL2-1219
	LL2-226	LL2sw-226-1213-SW	Yes	7/29/01	Split, associated trip blank = LL2-1219
DB-4 Melt-pour Building North Washout Annex	LL2-227	LL2sw-227-1085-SW	Yes	7/30/01	Associated trip blank = LL2-1219
DB-4 Melt-pour Building South Washout Annex	LL2-228	LL2sw-228-1087-SW	Yes	7/30/01	
DB-4A Melt-pour Building North Washout Annex	LL2-229	LL2sw-229-1089-SW	Yes	7/30/01	Associated trip blank = LL2-1221
DB-4A Melt-pour Building South Washout Annex	LL2-230	LL2sw-230–1091-SW	Yes	7/30/01	MS/MSD
Northeast Water Basin	LL2-231	LL2sw-231-1093-SW	No		Station LL2-231 was dry
	LL2-232	LL2sw-232-1095-SW	No		Station LL2-232 was dry. Sample LL2-1095 was reassigned to contingency LL2-184 (0 to 1 ft)
Manhole (MH) 304	LL2-254	LL2sw-254-1105-SW	Yes	8/1/01	Surface water collected from MH 304
Storm Sewers and Surface Drainages					
Manhole (MH) B1	LL2-239	LL2sw-239-1111-SW	Yes	8/6/01	
Manhole (MH) B2	LL2-240	LL2sw-240–1107-SW	Yes	8/1/01	
Manhole (MH) B3	LL2-241	LL2sw-241-1109-SW	No		MH B3 was dry
Beginning of Central Open Ditch	LL2-245	LL2sw-245-1114-SW	No		The ditch at this location was dry
Inlet where Open Ditch Flows Beneath Track DA	LL2-249	LL2sw-249-1119-SW	Yes	7/30/01	
Resample Phase I Station LL2-049	LL2-049	LL2sw-049-1124-SW	No		Drainage was dry. Reassigned to contingency LL2-048
Drainage Northeast of LL2-049	LL2-048	LL2sw-048-1124-SW	Yes	7/27/01	Reassigned from LL2-049 which was dry
Inlet Upgradient of Phase I Station LL2-049	LL2-252	LL2sw-252-1126-SW	No		This inlet was dry
Resample Phase I Station LL2-052 (Kelly's Pond)	LL2-052	LL2sw-052-1128-SW	Yes	7/30/01	An additional metals bottle and a bottle for Cr+6 were collected at a later date than the remainder of the sample

Table 3-4. Surface Water Sampling List and Rationales, Load Line 2 Phase II RI (continued)

Facility/Building No.	Station	Sample ID	Sample Collected (Yes/No)	Date Sampled	Comments/Rationales
Re-sample Phase I Station LL2-053 (Kelly's Pond)	LL2-053	LL2sw-053-1130-SW	Yes	7/30/01	Associated trip blank = LL2-1220. An additional metals sample and a sample for Cr^{+6} were collected at a later date than the remainder of sample
	LL2-053	LL2sw-053-1006-SW	Yes	8/9/01	Duplicate, analyzed for Cr^{+6} only
	LL2-053	LL2sw-053-0824-SW	Yes	8/9/01	Split, analyzed for Cr^{+6} only
Re-sample Phase I Station LL2-054	LL2-054	LL2sw-054-1132-SW	No		This station was dry
Re-sample Phase I Station LL2-055	LL2-055	LL2sw-055-1134-SW	Yes	7/30/01	Associated trip blank = LL2-1221. An additional metals sample and a sample for Cr^{+6} were collected at a later date than the remainder of the sample
Sanitary Sewer					
Ejector Station 2	LL2-259	LL2sw-259-1142-SW	Yes	7/31/01	Associated trip blank = LL2-1222
Manhole (MH) 337	LL2-260	LL2sw-260–1144-SW	No		MH 337 was dry

Cr^{+6} = Hexavalent chromium.
MS/MSD = Matrix spike/matrix spike duplicate.

Field measurements were taken during sampling, including pH, conductivity, dissolved oxygen content, and temperature (with the exception of samples from washout annexes). These measurements were performed in accordance with procedures contained in Section 4.3.3 of the Facility-wide SAP (USACE 2001a), as referenced by the Phase II RI SAP Addendum (USACE 2001b). 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 2 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.

Limited hydrogeologic and analytical data exist for groundwater at Load Line 2; therefore, 10 new monitoring wells were installed during the Phase II RI. Two monitoring wells (LL2mw-059 and LL2mw-060) were installed as part of the Phase I RI activities and were re-sampled during the Phase II RI. Figure 3-6 illustrates monitoring well locations. Nine of the monitoring wells were installed adjacent to former process buildings and settling basins (in presumed downgradient locations based on topography and stream drainage) to maximize the potential to identify contaminated groundwater resulting from leaching at known and suspected source areas. Well LL2mw-269 was moved from its planned location near DB-3 to a location about 100 ft southeast and downgradient of Building DB-802. The decision to move well LL2mw-269 was made on the basis of additional historical information obtained prior to the field effort that indicated the use of Cr^{+6} in Building DB-802.

The two existing Phase I RI monitoring wells were located south and downgradient of Kelly's Pond, a presumed recharge point to groundwater. One additional Phase II RI well was also installed south of Kelly's Pond to provide additional coverage in this area and to evaluate whether contaminated groundwater was migrating toward the facility boundary. Table 3-5 provides details for groundwater sampling during the Phase II RI.

3.4.2 Monitoring Well Installation Methods

Monitoring well installation was conducted in accordance with Section 4.3.2 of the Facility-wide SAP (USACE 2001a), as referenced by the Phase II RI SAP Addendum (USACE 2001b). Monitoring wells were installed using hollow-stem auger and air rotary 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 unconsolidated materials. Soil samples were collected continuously from the surface to bedrock refusal or planned borehole termination using a split-barrel sampler. Soil sampling was conducted during well drilling for description of soil stratigraphy in accordance with the USCS using standard Munsell Soil Color Charts (Munsell 1988). Geotechnical samples only were collected from monitoring well borings in the unconsolidated zone.

Table 3-5. Groundwater Sampling List and Rationales, Load Line 2 Phase II RI

Station	Sample ID	Sample Collected (Yes/No)	Date Sampled	Associated Trip Blank	Shelby Tube Sample ID	Comments/Rationales
LL2-261	LL2mw-261-1145-GW	Yes	09/10/01	LL21216		
LL2-262	LL2mw-262-1146-GW	Yes	09/07/01	LL21215		
LL2-263	LL2mw-263-1147-GW	Yes	09/07/01	LL21215		
LL2-264	LL2mw-264-1148-GW	Yes	09/10/01	LL21215		
LL2-265	LL2mw-265-1149-GW	Yes	09/19/01	LL21223		
LL2-265	LL2mw-265-1187-GW	Yes	09/19/01	LL21223		Duplicate
LL2-265	LL2mw-265-1212-GW	Yes	09/19/01	LL21223		Split
LL2-266	LL2mw-266-1150-GW	Yes	09/11/01	LL21216		
LL2-267	LL2mw-267-1151-GW	Yes	09/10/01	LL21215		
LL2-268	LL2mw-268-1152-GW	Yes	09/07/01	LL21215		
LL2-268		Yes	07/30/01		LL2mw-268-1160-SO	MC, GS, AL, USCS, SG
LL2-269	LL2mw-269-1153-GW	Yes	09/20/01	LL21223		
LL2-270	LL2mw-270–1154-GW	Yes	09/07/01	LL21215		
LL2-059	LL2mw-059-1155-GW	Yes	09/20/01	LL21223		
LL2-060	LL2mw-060–1156-GW	Yes	09/19/01	LL21223		

AL = Atterberg limits.
GS = Grain size.
ID = Identification.
MC = Moisture content.
RI = Remedial Investigation.
SG = Specific gravity.
USCS = Universal Soil Classification System.

Bedrock was encountered between 0.56 and 6.1 m (0.7 and 18.6 ft) bgs in all borings within Load Line 2. The bedrock interval was cored to the approximate target monitoring depth using NQ wireline coring equipment. Coring was performed without the addition of potable water; however, small quantities of deionized water were used on a few occasions (<10 gal) to loosen plugged core bits. Rock cores were logged, placed in wooden core boxes, and photographed in accordance with DM1110-1-4, *Engineering and Design Geotechnical Manual for Surface and Subsurface Investigations* (USACE 1983), as referenced in the Facility-Wide SAP (USACE 2001a). A borehole log, including stratigraphic information, was entered in 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 (OVA). Samples for headspace readings were not collected. In addition, the breathing zone was continuously monitored for evidence of organic chemicals. All readings were recorded in the project logbooks.

Upon reaching the approximate target depth for each boring, drilling operations were halted for approximately 1 hr to determine the amount of groundwater recharge. The objective for this step was to ensure that at least one-half of the screened interval for each well was below the water table. If sufficient groundwater recovery occurred, the field crew proceeded with reaming of the borehole to the proper diameter and construction of the monitoring well. If a sufficient water column was not present, the boring was advanced further.

Following advancement of each borehole to the appropriate depth, monitoring wells were constructed from pre-cleaned 5.0-cm (2.0-in.) diameter, 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. A small quantity of 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 0.6 m (2 ft) bgs. A protective steel surface casing with locking cover, mortar collar, and cement pad was then constructed. A minimum of three, or four as required by site conditions, steel posts were installed around each well and were painted and labeled. Table 3-6 presents a summary of monitoring well construction details.

Table 3-6. Summary of Load Line 2 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 in Screened Interval
LL2-059[a]	19.5	964.33	966.67	10.0	9.14 to 19.14	Sandstone
LL2-060[a]	18.3	958.93	961.57	10.5	8.08 to 17.94	Sandstone
LL2-261	22.5	1,008.97	1,011.40	7.63	9.8 to 19.8	Sandstone w/shale interbeds
LL2-262	21.2	1,010.62	1,012.62	7.2	10.6 to 20.6	Sandstone w/shale interbeds
LL2-263	22.2	1,008.97	1,011.47	8.5	10.8 to 20.8	Sandstone w/shale interbeds
LL2-264	20.5	1,009.51	1,011.88	8.6	9.75 to 19.75	Sandstone w/shale interbeds
LL2-265	22.5	958.74	961.24	10.5	11.82 to 21.82	Sandstone
LL2-266	20.5	1,013.67	1,016.28	8.6	9.8 to 19.8	Sandstone w/shale interbeds
LL2-267	20.5	1,012.36	1,014.81	12.2	9.8 to 19.8	Sandstone w/shale interbeds
LL2-268	28.8	1,014.53	1,017.28	15.0	17.29 to 27.29	Sandstone w/shale interbeds
LL2-269	28.0	1,008.4	1,011.62	21.3	17.1 to 27.1	Shale
LL2-270	20.5	1,007.72	1,010.18	9.2	9.8 to 19.8	Sandstone

[a] Phase I Remedial Investigation (RI) monitoring well, the filter pack above the screened interval extends above the top of rock at these two wells.
amsl = Above mean sea level.
bgs = Below ground surface.
TOC = Top of casing.

3.4.3 Well Development Methods

At least 48 hrs after completion, each monitoring well was developed so that representative groundwater samples could be collected. Well development was accomplished by purging at least 5 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). Turbidity was not measured; however, well development continued until the water was visually clear or the maximum development time (48 hr) had expired and a minimum of 5 times the casing and filter pack volume had been removed, 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 C.

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 (USACE 2001a). 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-through 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 using the bailer.

All groundwater samples were analyzed for explosives, propellants, TAL metals (filtered only), cyanide, VOCs, SVOCs, and pesticides/PCBs. Additionally, laboratory analyses for hexavalent chromium were conducted on groundwater samples from four wells (LL2-059, LL2-060, LL2-265, and LL2-269). Groundwater samples analyzed for dissolved metals were filtered during sample collection using either a disposable, in-line barrel filter or a disposable filter using negative pressure pump, both with 0.45-µm pores. The results of groundwater sampling at Load Line 2 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 all monitoring wells to determine the hydraulic conductivity of the geologic materials surrounding each well screen. 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. 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 to the pretest static water level over time. The rising-head test was 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 from 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 pretest 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

To determine the hydraulic gradient and flow directions across Load Line 2, as well as throughout RVAAP, a complete round of water level measurements was obtained from all accessible monitoring wells at the 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. Potentiometric data for Load Line 2 and the RVAAP facility are 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 and storm sewer systems at Load Line 2 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 and storm sewer systems for the presence of residual contaminants and to provide data for the evaluation of remedial alternatives, if any, sediment and water samples were collected at selected access points (manholes/inlets) where sufficient quantities of these media had accumulated. To assess the presence of accumulated explosives, integrity of the pipe, and their potential of releasing contaminants to the environment, a color video survey was attempted of the existing sewer systems at Load Line 2. Of the approximately 26,500 ft of sewer lines at Load Line 2, approximately 1,500 ft, or 6%, was actually surveyed. Results of the sewer system inspection are contained in Section 4.7.1.

3.5.2 Sewer Line Sediment and Water Sampling

One of eight planned sediment samples was collected from the sanitary sewer at station LL2-259 (Ejector Station 2; Figure 3-8). Planned samples at remaining sanitary sewer locations were not collected because an insufficient volume of sediment for sample collection was present (Table 3-3). Co-located samples of water that had accumulated in the sanitary sewer line were collected as planned from Ejector Station 2 (LL2-259). One additional co-located water sample was planned but could not be collected due to insufficient water present (Table 3-4). One additional water sample was collected at station LL2-254 (manhole 304).

Twelve of 16 planned sediment samples were collected from the storm sewer system (manholes and inlets). Samples could not be collected from the remaining storm sewer sampling stations because they were either infilled with debris or lacked sufficient sediment. Three of four planned water samples were collected from the storm sewer system.

Sampling of water from the sewer systems was performed prior to sediment sampling to ensure that the water was free from excess turbidity using a disposable bailer. The bailer was lowered into the ejector station 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.

Where the depth of the inlet allowed, collection of sediment samples from storm sewer inlets was conducted using a decontaminated stainless steel spoon or scoop. Collection of sediment samples from deep inlets and sewer system 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 has been obtained to fill sample containers.

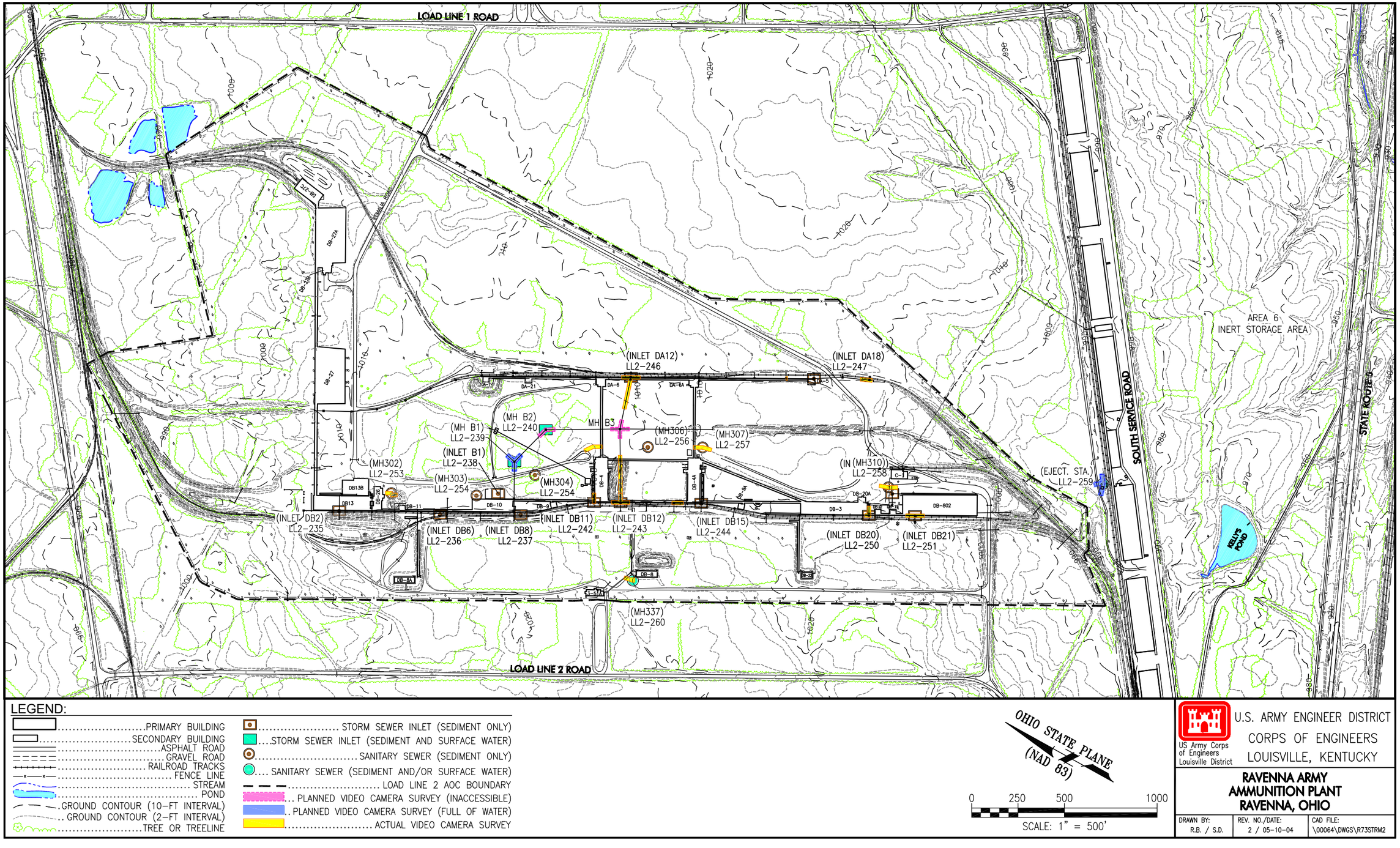


Figure 3-8. Phase II RI Storm and Sewer Sampling and Video Survey Locations at Load Line 2

For both methods of sediment sampling, aliquots for VOC analyses were collected directly from the sampling device from the first material obtained. A volume of sediment was placed into a stainless steel bowl, 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. No headspace samples were collected for organic vapor monitoring.

3.5.3 Video Camera Survey

The video camera survey was biased to the portions of the system located near production areas of the load lines. The camera survey 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 surveys were recorded on videotape and the video camera survey inspection log is contained in Appendix N.

Table 3-7 presents the planned video camera survey along with a summary of the actual direction and footages videotaped. Several of the planned entry points were obstructed with debris (leaves, sticks, and sediment). No attempts were made to survey flooded lines as placement of the track camera in the pipes caused sediment to be re-suspended, which prevented video observation. Section 4.7.1 discusses the results for the video camera survey at Load Line 2.

3.6 TOPOGRAPHIC SURVEY

A topographic survey was performed by a surveying subcontractor at the conclusion of the Phase II 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 0.03 m (0.1 ft), and all elevations to the nearest 0.003 m (0.01 ft). Sample locations inside of buildings were not surveyed. Field activities included the following:

- Surveying soil, sediment, and surface water sampling locations.
- Establishing final locations, ground surface elevations, and top-of-casing elevations for all new monitoring wells.

3.7 ANALYTICAL PROGRAM OVERVIEW

All analytical procedures and data verification/evaluation processes were completed in accordance with applicable professional standards, EPA requirements, government regulations and guidelines, Louisville District analytical QA guidelines, and specific project goals and requirements, as defined in the Phase II RI SAP Addendum.

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

Manhole	Planned Direction/Footage	Actual Direction/Footage
Load Line 2 Storm Sewer		
DB-2	N/50, E/50, S/50	Replaced with Inlet C4
MH-B1	N/50, W/50, E/50	Full of Water
MH-B2	NW/50, S/50	Inaccessible
MH-B3	N/50, W/50, E/50, S/50	Inaccessible
DB-11	E/50	E/50
DB-12	N/50, E/50, S/50	N/50, E/50, S/50
DB-12		E/254 (towards MHB3)
DB-14		N/11, S/50
DB-15	N/50, E/50, S/50	Replaced with DB-14
DB-20	N/50, E/50, S/50	N/22, S/11, E/50
DB-21	N/50, S/50	N/50, S/50
DA-12	N/50, W/50, S/50	N/50, W/50, S/50
DA-12		W/173 (towards MHB3)
DA-17		S/8, N/0
DA-18	N/50, S/50	Replaced with DA-17
DA-20		N/50, S/15
C4		W/8, S/9
Load Line 2 Sanitary Sewer		
MH-302	W/50, N/50, S/50	N/32, S/32
MH-305	NW/50, S/50	N/50, S/50
MH-307	N/50, S/50	N/50, S/50
MH-310	W/50, N/50, E/50, S/50	N/50, S/50
MH-337	W/50, N/50, E/50	S/0, W/15, N/50
Ejector Station	W/50, N/50, E/50	Full of Water

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. Figure 3-5 illustrates the application of field analyses of explosives during the Phase II RI.

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 to 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 and comparison of the field screening and laboratory results for field TNT and RDX is presented in Section 4.11.

3.7.2 Geotechnical Analyses

The geotechnical sampling and analysis program conducted during the Phase II RI for Load Line 2 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 TOC by chemical analysis. The results of the geotechnical evaluation for soils and sediment samples are discussed in Chapter 4.0 and included in entirety in Appendix K.

In addition to disturbed samples, Shelby tubes were used to collect one undisturbed sample from monitoring well boring LL2mw-268. 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 involved the collection and analysis of surface soil, subsurface soil, sediment, surface water, groundwater, and miscellaneous solid materials (ballast and floor sweep debris). Field screening for organic vapors in the breathing zone was conducted at each sampling location using an OVA, with exception of floor sweep samples. Independent QA analyses were conducted by an analytical laboratory under contract with USACE, Louisville District.

Samples collected during the investigation were analyzed by Severn Trent Laboratories (STL), North Canton, Ohio, a USACE CX-certified laboratory. QA samples were collected of soil, sediment, surface water, and groundwater and 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 (USACE 2001a) and the Phase II RI SAP Addendum (USACE 2001b). Prepared in accordance with USACE and EPA guidance, the Facility-wide SAP (USACE 2001a) and associated addenda outline the organization, objectives, intended data uses, and QA/QC activities to achieve the desired DQOs and to 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 (USACE 2001a) 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 requirements.

The types of QA/QC samples for this project included field blanks, trip blanks, QA field duplicates, laboratory method blanks, laboratory control samples (LCSs), laboratory duplicates, matrix spike/matrix spike duplicate (MS/MSD) 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. Evaluation of these QA/QC samples and their contribution to documenting the project data quality is provided in the Data Quality Assessment (DQA) Report in Appendix H.

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 USACE, Louisville District and RVAAP.

Table 3-8. Summary of QA/QC Samples, Load Line 2 Phase II RI

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.
RI = Remedial Investigation.

Analytical data reports from STL have been forwarded to the USACE, Louisville District independent 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 2 Phase II RI Quality Assurance Project Plan (QAPP) Addendum, the 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 entry. 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 Louisville USACE. 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 stay away from 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. Where 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 downhole magnetomer readings at 0.6-m (2-ft) intervals. The OE technician remained on-site as drilling was performed to visually examine drill cuttings for any unusual materials indicative of potential OE.

OE technicians also provided sampling support for washout basins (sediment and water) located within the melt-pour buildings, as described in Sections 3.2.2 and 3.3.2.

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