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U.S. DEPARTMENT OF ENERGY
LOS ALAMOS AREA OFFICE
Office of Environment and Projects

FAX Number: (505) 665-4872 (Unclassified), Voice Confirm Number (505) 667-4661

DATE: 1/31/97 # PAGES TO FOLLOW: 20

TO: Kim Hill FAX NO. 827 1544

FROM: Bonnie Koch

REMARKS:

Fenton Hill

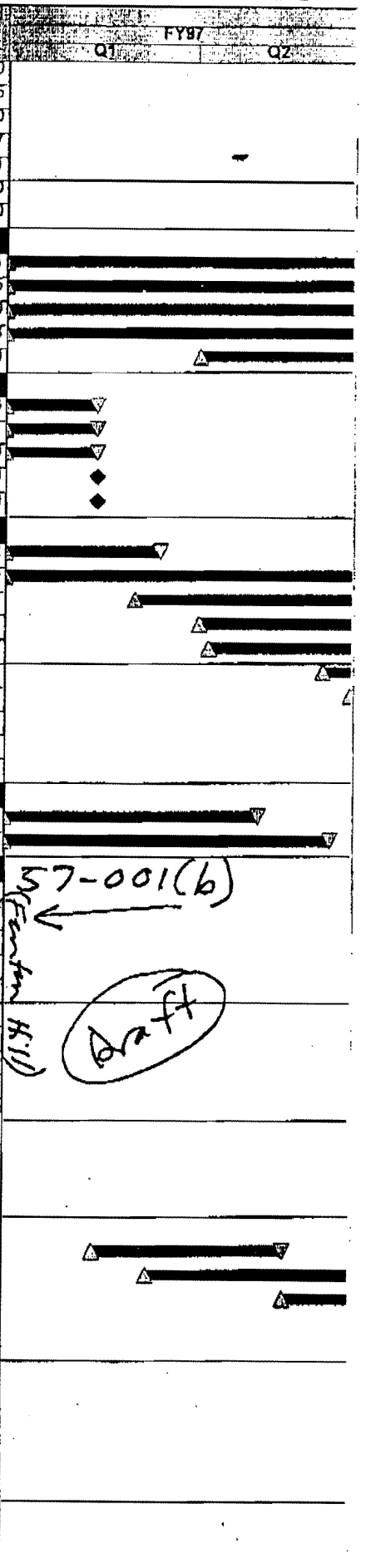
1) Baseline Schedule (may change just slightly)

2) map showing grill

3) relevant chapter from RFI Report for 57-001(b)

3703

Activity ID	Activity Description	Early start	Early Finish	Budgeted cost
A504566604	TA54: MDA G AIR SAM LAND/DOE DRAFT CMPLT RFI		30APR97	0
A504566606	TA54: MDA G AIR SAM LAND/DOE RVW/COMMNT/APRV	01MAY97	29MAY97	7,335
A504566608	TA54: MDA G AIR SAM AA DRFT REPRT COMPLT RFI		29MAY97	0
A504566610	TA54: MDA G AIR SAM ISS AA DRF/INC COMNT RFI PH1	30MAY97	31JUL97	12,467
A504566612	TA54: MDA G AIR SAM AA REVW OF RFI REPRT RFI	30MAY97	31JUL97	751
A504566614	TA54: MDA G AIR SAM AA APVRL OF RFI REPT RFI PH1		31JUL97	0
A504566616	TA54: MDA G AIR SAM RFI REPORT COMPLETE RFI		31JUL97	0
TA54: MDA G PILOT				
A506566703	TA54: MDA G PILOT - COLLECT & ANALYZE DATA CMS	01OCT96	30SEP97	116,361
A506566707	TA54: MDA G PILOT - VEG/WATER BAL MODEL'G CMS	01OCT96	30SEP97	85,935
A506566710	TA54: MDA G PILOT - SOIL PROPERTY EFFECTS CMS	01OCT96	30SEP97	42,800
A506566714	TA54: MDA G PILOT - FRACTURE FILLING CHAR. CMS	01OCT96	30SEP97	77,158
A5065667	TA54: MDA G PILOT	02JAN97	30SEP97	0
TA57: AREA 1 SOIL SAMPLING RFI REPORT				
A5045668	TA57: AREA 1 SOIL SAMPLING RFI REPORT	01OCT96	13NOV96	168
A504566820	TA57: AREA 1 SOIL SAMPLG ISS AA DRF/INC COMN	01OCT96	13NOV96	7,451
A504566822	TA57: AREA 1 SOIL SAMPLG AA RVW RFI REPT RFI	01OCT96	13NOV96	909
A504566824	TA57: AREA 1 SOIL SAMPLG AA APPROVES REP RFI		13NOV96	0
A504566826	TA57: AREA 1 SOIL SAMPLG RFI REPORT CMPL RFI		13NOV96	0
TA54: MDA L PILOT				
A506566928	TA54: MDA L FAB/CAL/INST/MN TC&GYP PSY 1st QTR	01OCT96	13DEC96	64,022
A506566960	TA54: MDA L DATA ANALYSIS/REPRT 5 PREVIOUS	01OCT96	14APR97	173,879
A506566954	TA54: MDA L PASV XTRCTION TEST BH 54-1006 PART 1	02DEC96*	29APR97	56,721
A506566929	TA54: MDA L FAB/CAL/INST/MN TC&GYP PSY	02JAN97	30SEP97	42,654
A5065669	TA54: MDA L PILOT	07JAN97	29JUN98	0
A506566962	TA54: MDA L RFRB/INS INSIT PRM MEA SYS BH4927001	03MAR97*	02MAY97	65,847
A506566938	TA54: MDA L CAL/INSL/MN TC&GYP PSYC BH49-2-700-1	17MAR97*	13FEB98	87,365
A506566956	TA54: MDA L PASV XTRCTION TEST BH 54-1006 PART 2	30APR97	30SEP97	48,517
A506566958	TA54: MDA L PASSV XTRCTN TEST CHKVLV BH	01OCT97	12JAN98	49,829
A506566964	TA54: MDA L DATA ANALYSIS/REPORT ON BH PSYC	02JAN98*	29JUN98	89,218
TA54: MDA L PILOT MOD				
A506567066	TA54: MDA L PILOT MOD TO PESP (PSV BARRIER)	01OCT96	30JAN97	50,557
A5065670	TA54: MDA L PILOT MOD	01OCT96	06MAR97	0
TA57: BURNS SWALE PHASE 2				
A503567110	TA57: BURNS SWALE PREP FOR FIELD WORK RFI	01OCT97	15OCT97	8,528
A5035671	TA57: BURNS SWALE PHASE 2	01OCT97	31DEC97	2,774
A503567112	TA57: BURNS SWALE SAMPLING RFI PH2	16OCT97	16OCT97	2,265
A503567115	TA57: BURNS SWALE SAMPLE ANALYSIS RFI PH2	23OCT97	31DEC97	7,165
A503567117	TA57: BURNS SWALE DATA ASSESSMENT RFI PH2	02JAN98	15JAN98	10,532
A5045671	TA57: BURNS SWALE PHASE 2	02JAN98	01MAY98	7,179
A503567120	TA57: BURNS SWALE START RFI REPORT RFI PH2	16JAN98		0
A503567122	TA57: BURNS SWALE DEV RFI REP/ISS DRAFT RFI PH2	16JAN98	30JAN98	24,901
A503567124	TA57: BURNS SWALE LAND/DOE DRAFT COMPLT RFI		30JAN98	0
A503567126	TA57: BURNS SWALE LAND/DOE RVW/INC COMNT/APV	02FEB98	02MAR98	4,304
A503567128	TA57: BURNS SWALE AA DRAFT COMPLT RFI PH2		02MAR98	0
A503567130	TA57: BURNS SWALE ISSUE AA DRAFT/INCOR COMNT	03MAR98	01MAY98	5,801
A503567132	TA57: BURNS SWALE AA REVIEW OF RFI REPORT	03MAR98	01MAY98	933
A503567134	TA57: BURNS SWALE AA APPROVES RFI REPORT RFI		01MAY98	0
TA54: MDA L PILOT RISK				
A506567270	TA54: MDA L PILOT RSK/DATA ANLYZ SUBSRF VOA	13NOV96*	12FEB97	26,954
A5065672	TA54: MDA L PILOT RISK	09DEC96	16SEP97	0
A506567272	TA54: MDA L PILOT RISK/DATA ANLYZ SURF FLUX	13FEB97	08MAY97	31,597
A506567268	TA54: MDA L PILOT RISK REP&RECOMND VOA PLUME	09MAY97	14JUL97	15,931
A506567274	TA54: MDA L PILOT RISK DOE&AA REVW PLUME	15JUL97	16SEP97	6,131
TA57: SLUDGE DISPOSAL PIT VCA CLEANUP VCA				
A508567400	TA57: SLUDGE DSPOSL PIT DEVELOP VCA PLAN	01OCT97*	13NOV97	13,836
A5085674	TA57: SLUDGE DISPOSAL PIT VCA CLEANUP VCA	01OCT97	23SEP98	61,791
A508567410	TA57: SLUDGE DSPOSL PIT LAND/DOE RVW/CMN/APR	14NOV97	01DEC97	4,076
A508567435	TA57: SLUDGE DSPOSL PIT PREP FOR VCA CLEANUP	02DEC97	15JAN98	21,348
A508567437	TA57: SLUDGE DSPOSL PIT VCA CLEANUP VCA	16JAN98	02MAR98	187,979
A508567439	TA57: SLUDGE DSPOSL PIT VERIFICATION SMPLG	03MAR98	09MAR98	11,752
A508567441	TA57: SLUDGE DSPOSL PIT VERICATION SMPL ANAL	31MAR98	11MAY98	12,732
A508567445	TA57: SLUDGE DSPOSL PIT DEV/ISS DR CLNUP REP	12MAY98	23JUN98	25,185



57-001(b)

(Section H.11)

Draft

• MAP OF FENTON HILL GEOTHERMAL FACILITY
• BOLD LINE SHOWS APPROXIMATE PATH TAKEN BY THE NOV. 22, 1996, SPILL OF A CEMENT/MUD SLURRY.

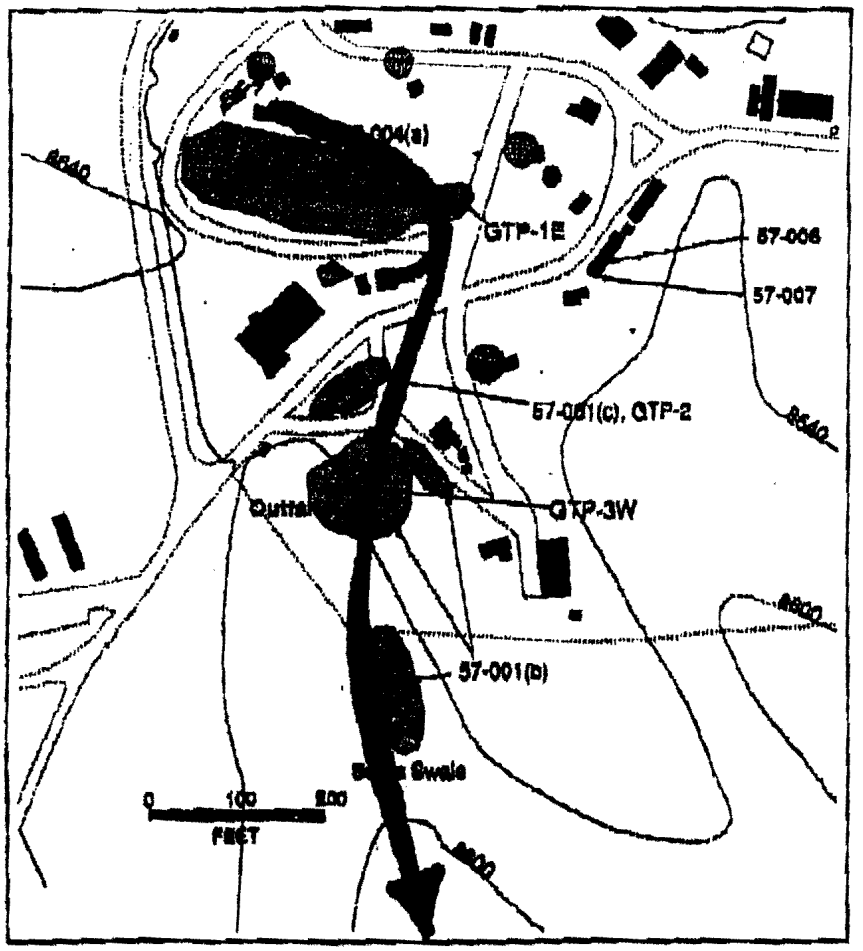


Figure 1-2. Locations of PRSs 57-001(b), 57-001(c), 57-004(a), 57-006, and 57-007

Source: FIMAD, 11/21/95, G103995
Modified by: by C. Rivera Lyons 1/20/96

BY: Bob Beers
ESH-18
667-7969
1/30/97

EXECUTIVE SUMMARY

This report describes the results of surface and shallow subsurface soil sampling at potential release sites (PRSs) 57-001(b), 57-001(c), 57-002, 57-004(a), 57-006, and 57-007 at Technical Area (TA) 57 (former Operable Unit [OU] 1154), known as the Fenton Hill facility. From the early 1970s until the early 1990s, the Laboratory carried out geothermal recovery experiments at this facility; these PRSs, which include circulation ponds, an outfall, a sludge disposal pit, and discharge areas for an on-site analytical chemistry trailer, received fluids and other materials associated with the geothermal experiments. The objective of this Phase I investigation was to confirm the presence or infer the absence of Resource Conservation and Recovery Act (RCRA) hazardous constituents at these PRSs.

During the summer of 1994, surface and shallow subsurface soil samples were collected from nine locations. All the samples were analyzed for metals. In addition, those samples collected from PRSs at which drilling materials and geothermal circulation fluids had been used were analyzed for semivolatile organic compounds; and those samples collected from the discharge areas for the analytical chemistry trailer were analyzed for volatile organic compounds.

Because no RCRA hazardous constituents were found at levels above screening action levels (SALS) in samples collected from PRSs 57-001(b) (pond portion only), 57-001(c), 57-004(a), 57-006, or 57-007, we are recommending NFA for the pond portion of PRS 57-001(b) and the other four PRSs.

For the outfall portion of PRS 57-001(b) (Burns Swale), arsenic and manganese were found in surface soils in concentrations exceeding background Upper Tolerance Limits (UTLs). For this reason, Burns Swale is scheduled for a Phase II (accelerated, focused) field investigation to determine the extent of the arsenic and manganese contamination. The Phase II data will, in addition, be used to perform a human health risk assessment for the Burns Swale area. A sampling and analysis plan for this Phase II investigation is included in this report.

Finally, for PRS 57-002, a voluntary corrective action (VCA) is recommended, because of the presence of arsenic in soils at concentrations greater than its UTL and of barium in concentrations exceeding its SAL. The VCA plan will be presented as a separate document.

Drilling fluids, produced waters, and other wastes associated with exploration, development, or production of geothermal energy are not hazardous wastes as defined in RCRA, and are exempt from RCRA hazardous waste consideration. For this reason, the PRSs reported on in this document are not listed in the Laboratory Hazardous and Solid Waste Amendments (HSWA) permit. However, as set forth in the RFI Work Plan for OU 1154, the Laboratory agreed to follow the requirements of HSWA (Module VIII of the RCRA permit) to ensure that all environmental problems are investigated in a consistent manner.

Units not on permit

5.0 SPECIFIC RESULTS, CONCLUSIONS, AND RECOMMENDATIONS

Information on the sampling done at Fenton Hill is summarized in Table 5-1 (including the depths from which samples were taken and the constituents analyzed for). The sampling locations for the main compound at Fenton Hill are shown in Figure 1-1.

TABLE 5-1

SUMMARY OF SAMPLING AT TA-57

FIMAD Site ID	Depth (ft)	PRS	Date Sampled	Metals	TCLP Metals	SVOCs	VOCs	Total U
57-2200	11-12	57-001(b)	15 Aug 94	X		X		X
57-2300	4-5	57-001(b)	16 Aug 94	X		X		X
57-2300	0-1	57-001(b)	16Aug 94	X		X		X
57-2350	3-4	57-001(b)	16 Aug 94	X		X		X
57-2350	0-1	57-001(b)	16 Aug 94	X		X		X
57-2300R	0-1	57-001(b)	16 Aug 94	X		X		X
57-2100	4.5-5	57-001(c)	15 Aug 94	X		X		X
57-3000	4.5-5	57-002	16 Aug 94	X		X		X
57-3100	9-10	57-002	16 Aug 94	X		X		X
57-2000	5.25-6	57-004(a)	15 Aug 94	X		X		X
57-2000	6-7	57-004(a)	15 Aug 94	X		X		X
57-4000	0-1*	57-007	1 Dec 94	X			X	X
57-4010	0-0.5**	57-006	15 Sep 94	X			X	X
57-4010R	0-0.5**	57-006	15 Sep 94	X			X	X
57-3000	4-5	57-002	14 Mar 95		X			

x = Analytical report received from CST-9.

* Sample collected from 0- to 6-in. depth directly below drum excavation.

** Sediment sample from leach field, collected at 0- to 1-ft depth at end of drain pipe in excavation trench.

5.1 PRS 57-001(b): Settling Ponds and Outfall

This PRS comprises two settling ponds, GTP-3E (east) and GTP-3W (west), as well as an outfall area (Burns Swale). Pond GTP-3E was originally used as the mud pit for the drilling of well GT-2. Pond GTP-3W, which was much larger (estimated to have been about 20 ft deep), was used in conjunction with not only well GT-2 but with the other deep drill holes at the site and was therefore considered to have the higher potential for contamination. For this reason, Pond GTP-3W was selected for sampling. Burns Swale, which received the discharges from Pond GTP-3W and the other settling ponds, was also sampled. On the basis of the analytical results, we recommend NFA for Pond GTP-3W and Phase II investigations for Burns Swale.

5.1.1 History

PRS 57-001(b) is discussed in detail in Section 5.2 of the RFI Work Plan for OU 1154 (LANL 1994, 1159).

Pond GTP-3W was created by constructing an approximately 10-ft-high berm across the head of Burns Swale, a natural drainage channel at the southern edge of the site, and excavating into the tuff. A spillway directed overflow water around the west end of the berm and into the swale. This pond was used as a settling pond for particulates from the water used in the drilling and circulating operations. After the particulates had settled out, the water was either recirculated or discharged into the swale. Materials entering this PRS were drilling muds (which included barite and lubricating materials) and chemical constituents dissolved by the water as it circulated through the hot rocks deep underground. In addition, dissolved solids in the water were precipitated in the settling ponds as the water cooled; these may have added contaminants such as metals to the pond-bottom sludge.

5.1.2 Description

PRS 57-001(b) is described in Section 5.2 of the RFI Work Plan for OU 1154 (LANL 1994, 1159) and in Section 1.2.1.1 of this report.

5.1.3 Previous Investigations

Investigations were conducted for this PRS and for the other settling ponds throughout the geothermal energy recovery project, because water quality, extent of infiltration from ponds, surface releases, and contaminant accumulation in plants were all of concern for experimental as well as environmental reasons. The conclusions of these investigations are summarized below. (See Section 5.2 of the RFI Work Plan for OU 1154—LANL 1994, 1159—for further details.)

5.1.3.1 Water Quality

The chemical characteristics and quality of the pond water varied greatly, depending on the type of operation being carried out; for example, in addition to additives from drilling operations being discharged to the ponds, water used in the geothermal energy recovery experiments and drilling operations was returned to the ponds for reuse, and fresh water was added periodically to replace discharged or evaporated water. Over time, through these processes, the concentrations of chemicals in the ponds increased—especially total dissolved solids and residual concentrations of elements such as arsenic, lithium, boron, and uranium. The quality of the water in ponds GTP-1E (PRS 57-004[a]) and GTP-3W (PRS 57-001[b]) was described in the RFI Work Plan as "slightly above discharge standards," as "deteriorating, due to sulfates and TDS," as "highly mineralized," and as having "elevated lithium and boron." The average chemical composition of the pond waters for 1977 and 1978 are shown in Table 5-3 of the RFI Work Plan for OU 1154 (LANL 1994, 1159).

5.1.3.2 Infiltration From Ponds

Findings from the drilling of several test holes showed that water from the settling ponds was infiltrating the underlying tuff, at a rate of about 4 million liters per year. According to water balance calculations, approximately 31% of the water brought onto the site was lost by this route. (At the same time, as discussed later in this report, sampling of the tuff beneath the ponds did not show any contamination.)

5.1.3.3 Surface Releases

Water from the settling ponds was periodically released from Pond GTP-3W into Burns Swale. To ensure compliance with EPA standards for irrigation, the water in the pond was sampled before each planned surface release; if it did not meet the standards, the water was not released until the relevant constituent concentrations had been reduced. The quality of the water ultimately released to Burns Swale, then, met EPA's proposed standards for continuous irrigation and livestock consumption.

5.1.3.4 Accumulation in Plants

Between the mid 1970s and mid 1980s, samples of vegetation were collected from the bottom and banks of Burns Swale. Although the plants showed no visible signs of stress, chemical analysis revealed concentrations of boron and lithium in the foliage, at levels reported in the literature to cause plant damage. The foliage was also analyzed for arsenic, cadmium, and fluoride, but none of these was found at levels considered toxic to the plants. Because all of these elements were known to be present in the pond water, their presence in the plants was attributed to the discharges from the ponds.

5.1.4 Field Investigation

The sampling done at PRS 57-001(b) is summarized in Table 5-2.

TABLE 5-2

PRS 57-001(b): SUMMARY OF SAMPLING

Location ID	Sample ID	Depth (ft)	Sample Matrix	Sample Request Number		
				SVOCs	INORG	TOTAL U
57-2200	AAB5560	11 - 12	soil	18570	18574	18574
57-2300	AAB5561	4 - 5	soil	18570	18574	18574
57-2300	AAB5562	0 - 1	soil	18570	18574	18574
57-2300R	AAB8396	0 - [illegible]	soil	18570	18574	18574
57-2350	AAB5563	3 - 4	soil	18570	18574	18574
57-2350	AAB5564	0 - 1	soil	18570	18574	18574

5.1.4.1 Pond GTP-3W

Pond GTP-3W, the larger and most used of the two ponds in this PRS, was the focus of the Phase I investigation; it was assumed that the contents of this pond, as revealed by sampling, would be representative of the contents of Pond GTP-3E as well. The sampling location for this pond was designated 57-2200.

At the time of its decommissioning, Pond GTP-3W was mucked out and backfilled—reportedly not only with clean soil but with large boulders taken from a local road construction project. Because the boulders were probably of the same rock type as the Bandelier Tuff underlying the pond, the sampling approach proposed in the RFI Work Plan was to drill an additional 10 ft whenever tuff

was encountered, to ensure that bedrock had been reached, not a boulder. This procedure was found to be unnecessary, however. At 11 ft, a layer of the black "service material" (sludge-like mixture of drilling mud and additives, not entirely removed by the mucking out) was encountered. The black coloration of this material may be due to the thousands of pounds of lignite (a low-grade coal) that was a component of the drilling materials. Visual observations of the "service material" and x-ray fluorescence (XRF) screening, for barium, of sediments from this layer indicated that the 11- to 12-ft depth would contain the highest concentrations of chemicals. Below this layer, at 16.25 ft, tuff bedrock was encountered. Drilling continued to a final depth of 17.25 ft.

Beginning at a depth of 3 ft, the core was sampled at 1-ft intervals; these samples were field-screened for metals by XRF and for VOCs with either an organic vapor analyzer (OVA) or a photoionization detector (PID). Per the RFI Work Plan, these field screenings, as well as visual observations, would be used to determine the horizons having the highest constituent concentrations—an approach adopted because the original depths of the ponds where the most contaminated sediments should be found were not precisely known. The samples to be submitted for laboratory analysis, one for metals and one for SVOCs, were to come from those horizons. If no horizon of high constituent concentration was indicated by the field screening for either metals or organic compounds, the sample was to be taken from the bottom of the hole. Because the Hnu meter did not measure any VOCs at any core horizon, both the metal and the SVOC samples were collected from the 11- to 12-ft depth (the "service" material) on the basis of visual observations and the relatively elevated XRF barium readings at that depth (see Table 5-3).

TABLE 5-3

SAMPLING LOCATION 57-2200: BARIUM CONCENTRATIONS IN SOILS, DETECTED BY FIELD XRF

Depth (ft)	Barium Concentration (mg/kg)
2 - 3	2285
3 - 4	1221
4 - 5	818
6 - 7	166
7 - 8	358
8 - 9	1543
9 - 10	1612
11 - 12	5318
12 - 13	5058
13 - 14	1009
14 - 15	258
15 - 16	1172
16 - 17	440
17 - 18	175

5.1.4.2 Burns Swale

Shallow surface (0-1 ft) and subsurface sediment samples were taken at two locations in Burns Swale: (1) 57-2300, just south of the perimeter fence, at the inlet of the swale; and (2) 57-2350, approximately 100 ft downstream of 57-2300. Although the RFI Work Plan had called for sampling 100 ft and 150 ft south of the site's boundary fence, the rugged terrain and extremely muddy conditions caused by recent heavy rains made the latter location inaccessible by the drill rig. It was therefore decided to collect one sample just south of the fence and the second one at

the location 100 ft south of the fence. Both of the selected sampling locations were judged to be in sediment traps within the swale.

The Work Plan also called for collection of subsurface samples from the sediments overlying the bedrock surface, unless XRF screening revealed elevated metal (barium) concentrations in intervening horizons. Bedrock was estimated to lie at a depth of 3 - 8 ft at both locations.

Sampling location 57-2300: Evidence of historical surface water discharges were noted at this location. One surface sample and a replicate were collected from the 0- to 1-ft depth and were submitted for total metals, total uranium, and SVOCs. Tuff was encountered at 7 ft, and boring continued to a final depth of 9.75 feet. The subsurface sample was collected at the 4- to 5-ft depth rather than at the tuff interface, on the basis of the slightly elevated barium concentration found at this depth as measured by XRF (Table 5-4). This sample was analyzed for total metals, total uranium, and SVOCs. No "service material" was noted on the ground surface or in the collected core.

TABLE 5-4

SAMPLING LOCATION 57-2300: BARIUM CONCENTRATIONS IN SOILS, DETECTED BY FIELD XRF

Depth (ft)	Barium Concentration (mg/kg)
0 - 1	233
1 - 2	258
3 - 4	293
4 - 5	494
5 - 6	237
6 - 7	159
7 - 8	127

Sampling location 57-2350: This site, situated at the bottom of the eroded stream channel, also shows evidence of historical surface water movement. One surface sediment sample was collected from the 0- to 1-ft depth and submitted for total metals, total uranium, and SVOC analyses. Tuff was encountered at 3.5 feet, and boring continued to a final depth of 4.5 ft. Because XRF screening of samples from shallower depths did not show elevated barium concentrations (Table 5-5), the subsurface sample was collected at the tuff interface; it was analyzed for metals, total uranium, and SVOCs.

TABLE 5-5

SAMPLING LOCATION 57-2350: BARIUM CONCENTRATIONS IN SOILS, DETECTED BY FIELD XRF

Depth (ft)	Barium Concentration (mg/kg)
3 - 4	129
4 - 5	104

5.1.5 Background Comparisons

All inorganic analytes, except silver, detected in soil samples from PRS 57-001(b) were compared with their natural background Upper Tolerance Limits (UTLs) (no UTL is available for silver). Those whose concentrations exceeded background UTLs are shown in Table 5-6. As shown in Table A-1 (Appendix A), which lists the complete analytical results for those soil samples, all of these analytes except arsenic, barium, calcium, cadmium, copper, lead, magnesium, manganese, sodium, total uranium, and zinc were eliminated as COPCs because they were detected at concentrations below their respective background UTLs. In the case of silver, for which no UTL has been established, detected concentrations were below the SAL for silver in soil (400 mg/kg). Silver was therefore eliminated as a COPC. The detection limits for antimony, which ranged from <4.9 to 5.3 mg/kg for these samples, were greater than the UTL for antimony in soil (1 mg/kg); but because all reported antimony concentrations were less than the SAL (32 mg/kg), this analyte was also eliminated as a COPC.

The locations from which samples were collected that contained analytes in concentrations exceeding background UTLs are shown in Figure 5-2.

TABLE 5-6

PRS 57-001(b): INORGANIC ANALYTES FOUND IN SOILS AT CONCENTRATIONS GREATER THAN BACKGROUND UTLs

Chemical	Location ID	Sample No.	Depth (ft)	Concentration (mg/kg)	UTL (mg/kg)
Arsenic	57-2200	AAB5560	11-12	103(J)	7.82
	57-2300	AAB5562	0-0.5	30(J)	
	57-2300R	AAB8396	0-0.5	22(J)	
Barium	57-2200	AAB5560	11-12	11200	315
	57-2300	AAB5562	0-0.5	525	
	57-2300R	AAB8396	0-0.5	523	
Calcium	57-2200	AAB5560	11-12	22900	6120
Cadmium	57-2300	AAB5561	4.4-5	4.3	2.7
	57-2350	AAB5564	0-0.5	3.1	
Chromium	57-2200	AAB5560	11-12	23.8(J)	19.3
Copper	57-2200	AAB5560	11-12	216	30.7
Magnesium	57-2200	AAB5560	11-12	25100	4610
Manganese	57-2350	AAB5564	0-0.5	862	714
Sodium	57-2200	AAB5560	11-12	2800	915
Lead	57-2200	AAB5560	11-12	167	23.3
Total Uranium	57-2300	AAB5561	4-5	1.899	1.87
Zinc	57-2200	AAB5560	11-12	221	50.8

The twelve metals shown in Table 5-6 are retained as COPCs and will be evaluated further in the screening assessment.

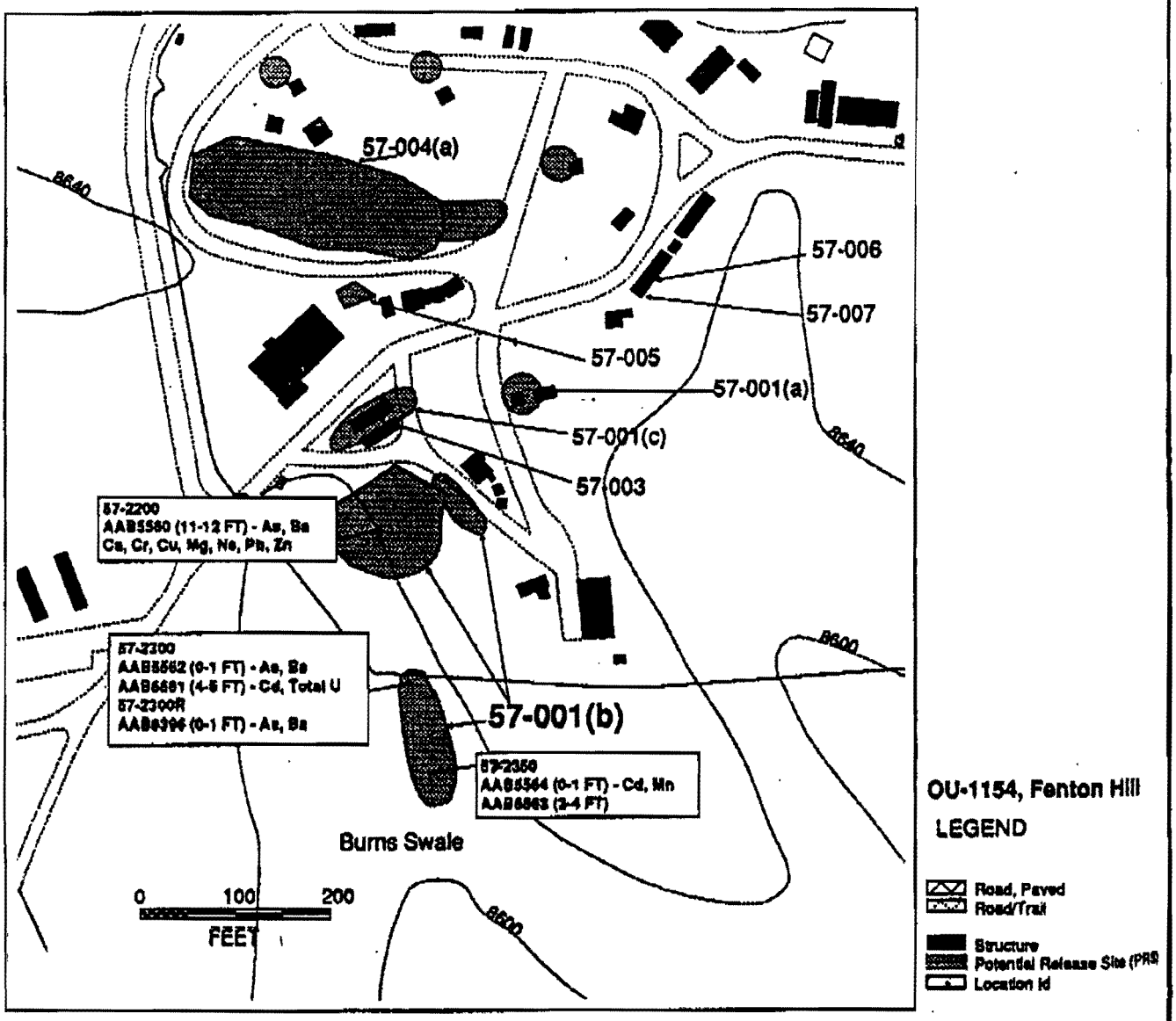


Figure 5-2. PRS 57-001(b): Locations from which samples were collected that contained analytes in concentrations exceeding background UTLs

Source: FIMAD, 11/21/95, G103966
Modified by: C. Rivera Lyons 1/28/96

5.1.6 Evaluation of Organic Constituents

No organic chemicals were detected in soil samples from PRS 57-001(b). See Chapter 4, Section 4.2.1.

5.1.7 Human Health Assessment

5.1.7.1 Screening Assessment for PRS 57-001(b)

The twelve inorganic analytes retained as COPCs after comparison with their background UTLs were next compared with their SALs.

5.1.7.1.1 Pond GTP-3W

The concentrations of the COPCs found in Pond GTP-3W, as compared with their SALs, are shown in Table 5-7.

TABLE 5-7

POND GTP-3W:
CONCENTRATIONS OF COPCs vs SALs

Chemical	Location ID	Sample No.	Depth (ft)	Type	Concentration (mg/kg)	SAL (mg/kg)
Arsenic	57-2200	AAB5560	11-12	core	103(J)	N/A
Barium	57-2200	AAB5560	11-12	core	11200	5300
Calcium	57-2200	AAB5560	11-12	core	22900	No SAL
Chromium	57-2200	AAB5560	11-12	core	23.8(J)	210
Copper	57-2200	AAB5560	11-12	core	216	2800
Lead	57-2200	AAB5560	11-12	core	167	400
Magnesium	57-2200	AAB5564	11-12	core	25100	No SAL
Manganese	57-2200	AAB5560	11-12	core	389	No SAL
Sodium	57-2200	AAB5560	11-12	core	2800	No SAL
Zinc	57-2200	AAB5560	11-12	core	221	23000

Greater than or equal to SAL. Only barium was detected at concentrations above its SAL.

No SAL. Arsenic, calcium, magnesium, manganese, and sodium fall into the No SAL category. For calcium, magnesium, and sodium, no SALs have been established because they are essential nutrients. As shown in Appendix C, their concentrations at PRS 57-001(b) are well below the recommended daily allowances (RDAs—National Research Council 1989, 1251). On that basis, calcium, magnesium, and sodium are eliminated as COPCs. For arsenic and manganese, the calculated SALs are below the background UTLs of the Los Alamos background dataset; the background UTL, then, in essence becomes the SAL. For manganese, the concentration detected in the sample from the pond was below the background UTL, and on that basis manganese is eliminated as a COPC. Arsenic is retained as a COPC because its concentration is elevated with respect to its background UTL.

Below SAL. Chromium, copper, lead, and zinc were all detected in concentrations below their respective SALs.

Multiple Chemical Evaluation. To evaluate multiple chemical effects for this data set, chemicals detected at concentrations below their respective SALs were grouped according to their toxicological effects (carcinogenic or noncarcinogenic). Because there was only one carcinogen (chromium), multiple chemical effects were evaluated only for the three noncarcinogens. The concentration of each was normalized to its SAL, and the results were summed, as described in Subsection 3.4.1. Table 5-8 shows the results of the multiple chemical evaluation for the three noncarcinogens.

TABLE 5-8

POND GTP-3W: MULTIPLE CHEMICAL EVALUATION

Chemical	Concentration (mg/kg)	SAL (mg/kg)	Normalized Value
Copper	216	2 800	0.08
Lead	167	400	0.42
Zinc	221	23 000	0.01
Sum of Normalized Values			**0.51**

The results of the multiple chemical evaluation based on noncarcinogenic effects is less than one (0.51), indicating that potential adverse human health effects from exposure to these chemicals are unlikely. Therefore, all three chemicals are eliminated as COPCs.

The COPCs remaining for Pond GTP-3W are arsenic and barium.

5.1.7.1.2 Burns Swale

Because Burns Swale did not receive any fill material (the site was not decommissioned), samples were collected from surface soils and from either the tuff interface or from the subsurface depth judged to have the highest concentration of potential contaminants. The maximum detected concentrations of the COPCs found in Burns Swale, as compared with their SALs, are shown in Table 5-9.

TABLE 5-9

BURNS SWALE:
CONCENTRATIONS OF COPCs vs SALs

Chemical	Location ID	Sample No.	Depth (ft)	Type	Concentration (mg/kg)	SAL (mg/kg)
Arsenic	57-2300	AAB5562	0-1.0	surface	30(J)	N/A
	57-2300R	AAB8396	0-1.0	surface	22(J)	
Barium	57-2300	AAB5562	0-1.0	surface	525	5 300
	57-2300R	AAB8396	0-1.0	surface	523	
Cadmium	57-2300	AAB5561	4-5	core	4.3	38
	57-2350	AAB5564	0-0.5	surface	3.1	
Manganese	57-2350	AAB5564	0-1.0	surface	662	N/A
Uranium	57-2300	AAB5561	11-12	core	1.899	230*

N/A = Not applicable. SAL is below background concentrations.

*230 mg/kg is the SAL for uranium soluble salts.

Greater than or equal to SAL. No chemicals fall into the greater than or equal to SAL category.

No SAL. Arsenic and manganese fall into the No SAL category because the calculated SALs are below the background UTLs of the Los Alamos background dataset. The background UTL, then, in essence becomes the SAL. Arsenic and manganese are retained as COPCs because their detected concentrations in Burns Swale are elevated with respect to their background UTLs.

Below SAL. The detected concentrations of barium, cadmium, and uranium were all below the respective SALs for these analytes. Antimony detection limits for these samples were all greater than the UTL but were less than the SAL for antimony in soil (32 mg/kg). For this reason, antimony is categorized as below SAL.

Multiple Chemical Evaluation. To evaluate multiple chemical effects for this data set, chemicals detected below their respective SALs were grouped according to their toxicological effects (carcinogenic or noncarcinogenic). All of the chemicals in this group are noncarcinogens. The concentration of each was normalized to its SAL, and the results were summed as described in Section 3.4.1. Table 5-10 shows the results of the multiple chemical evaluation.

TABLE 5-10

BURNS SWALE: MULTIPLE CHEMICAL EVALUATION

Chemical	Concentration (mg/kg)	SAL (mg/kg)	Normalized Value
Barium	525	5300	0.10
Cadmium	4.3	38	0.11
Uranium	1.899	230*	0.01
Sum of Normalized Values			0.22

*230 mg/kg is the SAL for uranium soluble salts.

The results of the multiple chemical evaluation based on noncarcinogenic effects is less than one (0.22), indicating that potential adverse human health effects from exposure to these chemicals are unlikely. Therefore, all three chemicals are eliminated as COPCs.

The COPCs remaining for Burns Swale, then, are arsenic and manganese.

5.1.7.2 Risk Assessment for PRS 57-001(b)

Because the elevated concentrations of arsenic and barium detected in the pond sample were all found at 11-12 ft below the ground surface, there is no plausible route under the recreational use scenario by which humans could be exposed to these contaminants. On that basis, no risk assessment is required for Pond GTP-3W.

The elevated levels of arsenic and manganese (exceeding UTLs) in Burns Swale, on the other hand, could pose an unacceptable risk to humans, and a formal risk assessment may be necessary. We therefore propose an accelerated, focused RFI (Phase II) sampling program for Burns Swale to assess the extent of contamination and thereby better estimate risk to humans.

5.1.8 Ecological Assessment

Given the largely undeveloped environs of this PRS, the potential for receptors to come in contact with contaminants is high. Threatened and endangered species and/or sensitive habitat (see Chapter 2, above) will be considered in the Phase II investigation, following the guidance of Keller (1995, 24-0074). This PRS will be assessed through the new Ecological Exposure Unit (Ecozone) approach, which considers contaminants with concentrations greater than UTLs, when that approach has been approved through the ER Project office.

5.1.9 Extent of Suspected Contamination

The purpose of the Phase I investigations was reconnaissance; the extent of suspected contamination in this PRS can be determined only if additional data are collected.

The suspected contamination of Burns Swale, which is a result of discharges from Pond GTP-3W, consists only of arsenic (location 57-2300) and manganese (location 57-2350) and apparently is limited to the surface. For arsenic, the concentration at sampling location 57-2300 (nearest the discharge point) was above the UTL in the surface sample but not in the subsurface sample. (Arsenic was below UTLs in both the surface and subsurface samples from location 57-2350, 100 ft farther downstream.) For manganese, the concentration in the surface sample at location 57-2350 slightly exceeded the UTL and in the subsurface sample was below the UTL. The extent of suspected surface soil contamination in Burns Swale, thus, can be estimated by determining arsenic and manganese concentrations in the surface soils, in the area from the discharge point to 300 ft downstream.

5.1.10 Conclusions and Recommendations

In the case of Pond GTP-3W, the potential for human contact with contaminants, which are buried 11-12 ft below the ground surface, is negligible. For this reason, we recommend NFA for the pond portion of PRS 57-001(b) on the basis of NFA criterion 4. This portion of the PRS will not be added to the HSWA Module of the Laboratory RCRA operating permit and is proposed for removal from the ER Project list. For the Burns Swale portion, we recommend Phase II sampling, to determine the extent of the arsenic and manganese contamination in surface soils

and to calculate human health risk under the recreational land-use scenario. The sampling and analysis plan for these Phase II investigations is presented below.

5.1.11 Sampling and Analysis Plan for Burns Swale Portion of PRS 57-001(b)

5.1.11.1 Problem Definition

Two inorganic analytes, arsenic and manganese, were detected in Burns Swale at concentrations exceeding the background UTL. The results of a preliminary risk screening did not support an NFA decision. The indication of elevated arsenic and manganese, however, came from only three surface soil samples (including one replicate), and these came from the middle of the drainage—the area expected to have the highest concentrations. This Phase II sampling plan is designed to determine the distributions of arsenic and manganese in Burns Swale surface soils. A human health risk assessment will be performed on the basis of the sampling results. The human health risk assessment will define whether Burns Swale can be recommended for NFA or will require corrective measures.

5.1.11.2 Site Description

Burns Swale, a small drainage off the Fenton Hill site, courses through a wooded area (see Figure 1-2 in Chapter 1 and Sections 5.1 and 5.1.1 in this chapter). The source of the arsenic and manganese found in the surface soils of the swale was the permitted liquid discharges from Pond GTP-3W—a source that no longer exists because the pond has been decommissioned.

As stated in the RFI Work Plan, the depth to the nearest groundwater (perched on the Abo Formation) at this location is approximately 450 ft. PRS 57-001(b) is not believed to pose a threat to this or any other groundwater: neither the tuff underlying the sludge layer in the pond system nor the tuff underlying the soil in Burns Swale has metal concentrations that exceed UTLs, indicating that vertical movement of contaminants into the tuff and towards groundwater is minimal.

5.1.11.2 Historical Data

Elevated arsenic and manganese levels were found in surface soil samples during Phase I sampling in Burns Swale, at locations 57-2300 and 57-2350, respectively (see Table 5-9 and Figure 5-2). This contamination probably resulted from the discharge of fluids from Pond GTP-3W.

5.1.11.3 Regulatory Drivers

Because the Fenton Hill site PRSs are not part of the HSWA permit, there are no EPA regulatory drivers for this investigation. The fact that RCRA hazardous constituents were found above UTLs on non-Laboratory property, however, means that the extent of the elevated arsenic and manganese concentrations on surface soils needs to be defined.

5.1.12 Design of Sampling and Analysis Plan

5.1.12.1 Overview of Information to be Collected

Surface soil samples will be collected in Burns Swale and analyzed for metals. The data thus obtained will be the basis for a human health risk assessment under a recreational land-use scenario for hikers and campers. The primary COPCs are arsenic and manganese; secondary COPCs are barium and lead, both of which were detected at concentrations greater than 10% of

their respective SALs (even though lead was detected in the pond and not in Burns Swale, it was deemed prudent to calculate the risk associated with the potential presence of this noncarcinogen. The pond is known to have been the source of contaminants in the swale. In this way, we can verify the absence of risk under the hiker/camper scenario). The distributions of these four analytes will be determined, and the upper 95 percent confidence limits of their mean concentrations will be estimated.

5.1.12.3 Assumptions Underlying the Design

Arsenic concentration is highly correlated with barium concentration in soil samples previously collected at the Fenton Hill site (r^2 = 0.83). For this reason, surface soil samples (0- to 6-in. depth), to be collected at the approximate locations shown in Figure 5-3, will be analyzed for barium concentrations using the XRF method (LANL 1995, 0951). Those concentrations will be used as a surrogate for arsenic, both in selecting the samples to be submitted for laboratory analysis and in determining the distribution of arsenic concentrations in soil. The precise locations from which the selected samples were taken will be entered into the FIMAD database.

5.1.12.4 Requirements for Data Quality Implied by Intended Data Use

The analytical techniques used must be capable of measuring arsenic concentrations in soil to below the SAL of 7.82 mg/kg (down to 1.0 mg/kg). The XRF instrument should be capable of detecting barium concentrations in soil as low as 25 mg/kg.

5.1.12.5 Measurements to Verify Assumptions and Requirements

The results of laboratory analyses for barium and arsenic will be used to estimate and qualitatively evaluate the correlation between the two. (A poor correlation will not be considered cause for concern if arsenic levels are close to the Lab-wide arsenic UTL.) It is assumed that areas where lead and manganese might be elevated are also closely correlated with elevated barium. The lead/barium and manganese/barium correlations will also be estimated and evaluated qualitatively. Because lead and barium are secondary COPCs and expected to contribute little to the total estimated risk, a poor correlation will not be considered cause for concern.

One field replicate sample will be collected from each of the three (or fewer) strata (see 5.1.13.1) in Burns Swale for laboratory analysis. To evaluate the level of precision of the results, we wil (1) calculate the relative percent difference between each replicate and its "original" (the difference divided by the average); (2) calculate an average for each field replicate pair in the FIMAD data base that was analyzed for arsenic by the same analytical technique as that used for the Burns Swale samples; (3) if a field replicate pair's average is within the range of the arsenic concentrations found in the Burns Swale samples, calculate a relative percent difference for that FIMAD pair; and (4) compare the FIMAD relative percent differences with those of the Burns Swale samples, using graphical techniques such as boxplots. If the distributions appear similar, we will consider the Burns Swale results as having an acceptable level of precision. If they do not, focused validation of the analytical data may be required to determine whether the Burns Swale results are acceptable. The same procedure will be used to evaluate the level of precision of the analytical results for barium, lead, and manganese.

The distribution of above-background concentrations of arsenic is expected to be limited to the first 300 ft of Burns Swale. To determine the boundaries of this distribution, a site-specific background data set will be established. Twenty background samples will be collected from undisturbed areas near Burns Swale where soils are similar to those found in the swale and will

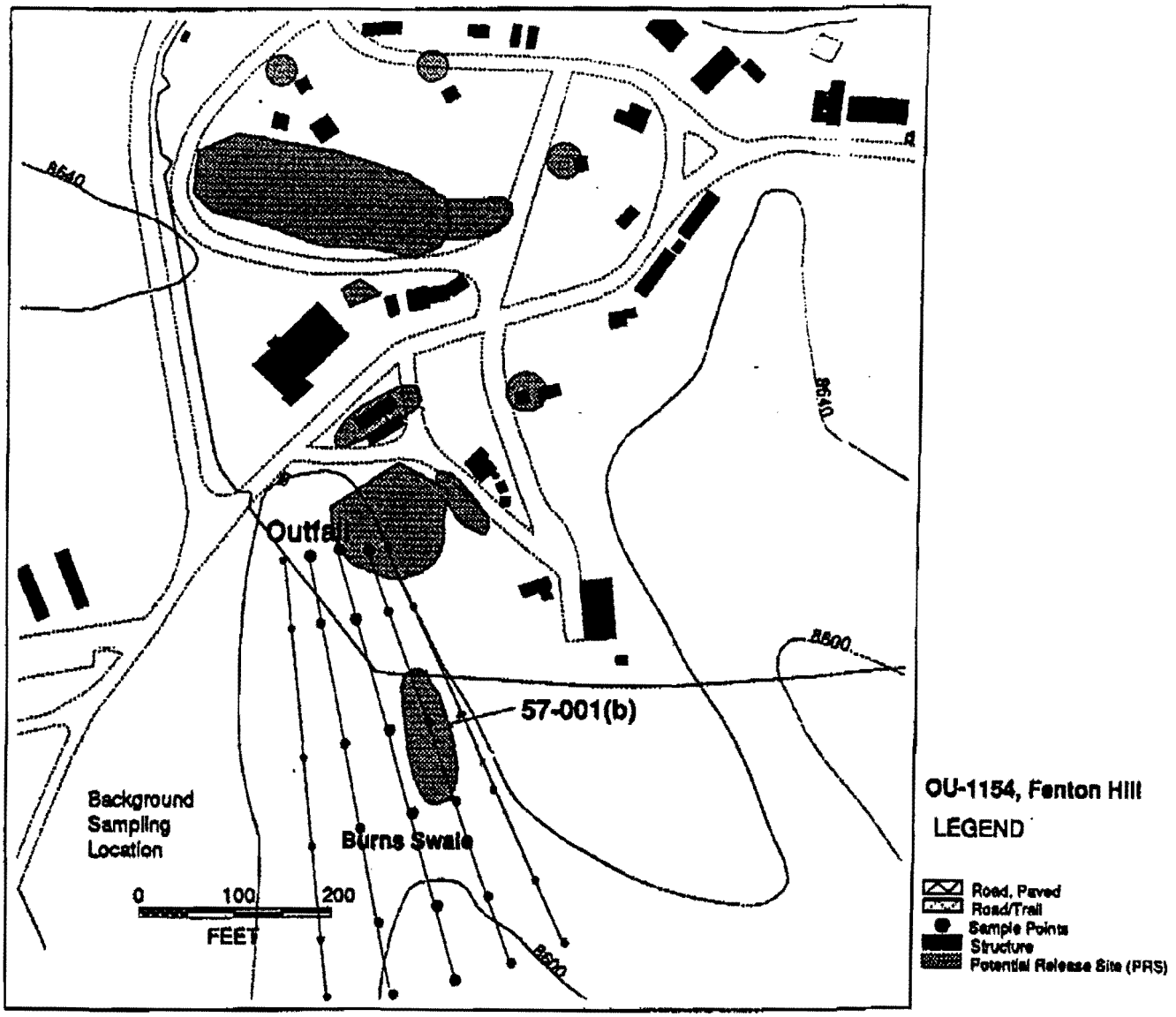


Figure 5-3. Sampling map for Phase II Sampling Plan at PRS 57-001(b) Burns Swale Portion

Source: FIMAD, 11/21/95, G103966
Modified by: C. Rivera Lyons 3/5/96

be screened for barium by XRF. The UTL (the 95 percent upper confidence limit on the 95th percentile of the background samples) for barium will be estimated. The boundaries will then be drawn to delimit the area within which the above-UTL concentrations were found.

In the event that barium concentrations on the periphery of the sampling area still exceed the UTL (i.e., the area selected for sampling was too small), the sampling area will be extended using a grid system similar to the one described below. Samples will be collected and screened by XRF until the boundaries become clear.

5.1.13 Implementation of Sampling and Analysis Plan

5.1.13.1 Field Methods

For the XRF survey, a transect line will be established from the discharge point down the center of Burns Swale, for a length of about 300 ft. On either side of this center line, two additional transect lines will be established: one along the bank of the swale (3 ft beyond the top of the bank) and one halfway between the bank and the center line, for a total for five lines. (Should the "bank" not be clearly defined, the lines will be located 3 ft and 15 ft from the channel center.) Samples will be collected at six locations along each of these lines: at approximately 30, 60, 105, 150, 225, and 300 ft from the discharge point. Field observations, a tape measure, and pin flags will be used to establish these 30 sampling locations in Burns Swale.

Because a stratified sampling scheme yields a total variance less than or equal to the variance of a simple sampling scheme, the XRF barium results will be used to stratify the sampling area in Burns Swale into not more than three strata (representing areas of relatively "elevated," relatively "low," and "background" soil concentrations of barium/arsenic). In this way, the number of off-site laboratory analyses will be minimized, as will the degree of uncertainty in the estimated mean concentrations of arsenic, barium, lead, and manganese. A subset of the XRF-screened samples —at least two samples from randomly selected locations in each of the three strata—will be submitted to an off-site laboratory; they will be analyzed for arsenic, barium, lead, and manganese by the SW-846 method (Method 3050 nitric acid extraction and appropriate analytical techniques). The number of samples submitted for wet chemistry analysis will be such that the upper 95 percent confidence level of the mean arsenic concentration is not more than 5 times the mean arsenic concentration. (For 15 samples previously collected at Fenton Hill, the range was 0.23 to 108 mg/kg, and the 95 percent confidence level of the mean was twice the mean.)

In addition, twenty locations will be selected, in deposits of a similar nature but far enough from Burns Swale to have been unaffected by the pond contaminants, for background sampling. These locations will be surveyed in accordance with LANL-ER-SOP-3.01.R1. The soil samples will be collected in accordance with LANL-ER-SOP-6.09 and will be screened by XRF for barium.

5.1.13.2 Measurement Methods

In the Building OH-15 laboratory at TA-59, each soil sample will be thoroughly dried under a heat lamp, ground with a ceramic mortar, and poured into the cups of a Spectrace 9000 XRF instrument. The barium concentrations in the samples will be measured in accordance with LANL-ER-SOP-10.08.R0. At the same time, internal standards will be calibrated and performance standards measured. All the measurements, including the internal standards and performance standard measurements, are included on printouts from the XRF instrument.

5.1.13.3 Field Decisions

As discussed in Section 5.1.12.3, the XRF barium measurements will be the basis for selection of soil samples to be analyzed for arsenic.

5.1.13.4 Sample Handling

The soil samples will be packed in a locked cooler for delivery directly to the SMO, which will send the samples to a contract laboratory. All analyses will be done by Method 3050 nitric acid extraction and the appropriate ICP or AA analytical technique.

5.1.13.5 Data Tracking

For in-house data, FIMAD will prepare a structured blank table into which ESH-19 will enter the barium XRF readings in mg/kg concentration units. Analytical data from contract laboratories will come directly to the SMO, which will be responsible for transmitting the data to FIMAD. Hard copies of these data will be supplied to a data validator, who will be responsible for focused Level One validation.

5.1.13.6 Schedule

The sampling activities, including sampling kit preparation, documentation, and surveying, should take no longer than 3 days. Preparing the samples and doing the XRF measurements should take 1.5 days. The samples will then be submitted immediately to the SMO for laboratory analysis for arsenic, barium, lead, and manganese. The off-site laboratory guarantees a 45-day turnaround. The validation of the data may take from 2 to 4 months. Sampling may take place at risk before the sampling plan has been reviewed and approved by EPA/NMED.

5.1.14 Data Assessment

5.1.14.1 Verification and Routine Data Validation

The SMO and the data validator will use their standard procedures to verify and validate the analytical results from the laboratories. The SMO will electronically transfer the data to FIMAD, and the validator will place the appropriate validation qualifiers on the FIMAD data set, which will then be available to the user by either Databrowser or Microsoft Access data accessing systems.

5.1.14.2 Data Quality Assessment

The data quality assessment will be "qualitive" in nature. A chemist will review the results of the routine validation to determine whether a focused validation is warranted for any of the data. To determine precision, field duplicate results will be compared qualitatively with other field duplicate pairs collected throughout the ER Project at LANL. A technical team comprising a chemist, a statistician, a human health risk assessor, and field personnel will assess the usability of the data for determining the extent of arsenic contamination and for risk assessment. If an estimated bias might affect the determination or the outcome of the risk assessment, the bias will be discussed and the need for further sampling will be considered.

5.1.15 Administration

5.1.15.1 Project Task Organization

The organization for the Phase II investigations will comprise the following positions.

Field Project Leader	Overall responsibility for project.
Field Team Manager	Manages all field operations for this task.
Field Team Leader	Leads team in field operations; responsible for waste management.
Site Safety Officer	Ensures that all operations are performed safely.
Samplers	Physically collect samples.
Documentation Specialist	Prepares field sampling kits and performs documentation in field.
Surveyor	Responsible for the surveying to be done in the field.
Surveyor's Helper	Assists surveyor.
XRF Operator	Operates Spectrace 9000.

5.1.15.2 Training

All personnel participating in this task will have met all the ER Project training requirements as defined in LANL-ER-AP-05.2.R1 (LANL 1995, 0951).

5.1.15.3 Records

The field records and hard copies of analytical data will be in the custody of the field team manager, who will be responsible for transmitting the information to the Records Processing Facility.

5.1.15.4 Oversight

No special oversight is being planned for this 1- to 2-day sampling operation. Because soil samples were collected in the same area, by the same field crew, and using the same methods during the Phase I investigation, a readiness review is not planned. The Health and Safety Plan will be modified slightly (new dates and names of personnel will be incorporated).

5.1.15.5 Inspection/Acceptance Policies

Not relevant.

5.1.15.6 Reports to Management

Additional reports to management are not required for this brief sampling operation.

5.2 PRS 57-001(c)—Settling Pond GTP-2

Pond GTP-2, used during experiments related to geothermal energy recovery, contained circulation fluids. After geothermal testing ceased, the pond was decommissioned, cleaned, and filled with clean soil to the level of the original ground surface. As shown in Table A-1 (Appendix A), which lists the complete analytical results for those soil samples, all of these analytes except arsenic, barium, calcium, copper, lead, magnesium, sodium, and zinc were eliminated as COPCs because they were detected at concentrations below their respective background UTLs. On the basis of NFA criterion 4, we are recommending NFA for this PRS.

5.2.1 History

PRS 57-001(c) is discussed in detail in Section 5.2 of the RFI Work for OU 1154 (LANL 1994, 1159).