Office of Environmental Management – Grand Junction

UMTRA Project

Moab UMTRA Project Northeastern Uranium Plume Investigation Report

Revision 0

January 2012

U.S. Department of Energy

Office of Environmental Management

Prepared by the Technical Assistance Contractor under contract number DE-AC30-07CC60012 for the U.S. Department of Energy Office of Environmental Management, Grand Junction, Colorado.

DOE-EM/GJTAC2020

Moab UMTRA Project
Northeastern Uranium Plume Investigation Report

January 2012

Prepared by the Technical Assistance Contractor under contract number DE-AC30-07CC60012
for the U.S. Department of Energy Office of Environmental Management, Grand Junction, Colorado.

Moab UMTRA Project
Northeastern Uranium Plume Investigation Report

Revision 0

Review and Approval

Kenneth G. Pill — Date 1/5/12
TAC Ground Water Manager

Robert Hopping — Date 1/5/12
TAC Technical Group/Field Manager

Joseph D. Ritchey — Date 1/9/12
TAC Senior Program Manager

In concurrence:

Donald R. Metzler — Date 1-11-12
Moab Federal Project Director

Revision History

Revision No.	Date	Reason/Basis for Revision
0	January 2012	Initial issue.

Table of Contents

Figures

Tables

Appendices

1.0 Introduction

The Moab Uranium Mill Tailings Remedial Action (UMTRA) Project site is a former uranium ore-processing facility located approximately 3 miles northwest of Moab, Utah. The 16-million-ton pile of uranium mill tailings and other contaminated materials at the site is being relocated off site for permanent disposal.

Previous ground water uranium plume maps have been generated for a number of previous reports, such as the *Moab UMTRA Project 2009 Ground Water Program Report* (DOE-EM/GJTAC1941) and the *Moab UMTRA Project 2009 Well Field Optimization Plan* (DOE-EM/GJTAC1791) among others. These maps display a portion of the plume located to the northeast of the tailings pile with elevated uranium concentrations originating from the vicinity of well 0411 and continuing downgradient towards the Colorado River. There were limited locations for collecting ground water samples in this large area of the site, and the data were inconclusive regarding the specific source of the elevated concentrations.

A work plan was developed to determine if the elevated ground water uranium concentrations emanate from one source area, or if there are a number of hot spots within this area of the site. In addition, the work plan was designed to clarify the vertical and horizontal extent of the northeastern uranium plume. This report describes the activities and presents the results of this investigation.

2.0 Purpose and Scope

The purpose of this investigation was to determine if a source of the observed ground water contamination could be located and to characterize its magnitude and extent. An additional purpose was to define the extent of the elevated levels of uranium in ground water in the area. The scope of the investigation was the area of the previously defined plume based on existing well data. Methods were limited to readily available equipment on site.

3.0 Background

From approximately 1956 through 1984, operations at the Moab site resulted in contaminants entering the soil and ground water system. Characterizations of the site have been documented in Shepherd Miller, Inc., "Site Hydrogeologic and Geochemical Characterization and Alternatives Assessment for the Moab Mill Tailings Site, Moab, Utah" and the "Site Observational Work Plan for the Moab, Utah, Site" (GJO-2003-424-TAC). Those investigations relied on fewer than 10 wells in the vicinity of the former mill (Figure 1). A few observation wells were used to identify elevated levels of uranium in the area referred to as the wood chip/landfill. During the time the millsite was active, a large volume of debris associated with the milling operations was transferred to an area between the former mill and the Colorado River and disposed of in a number of unlined pits.

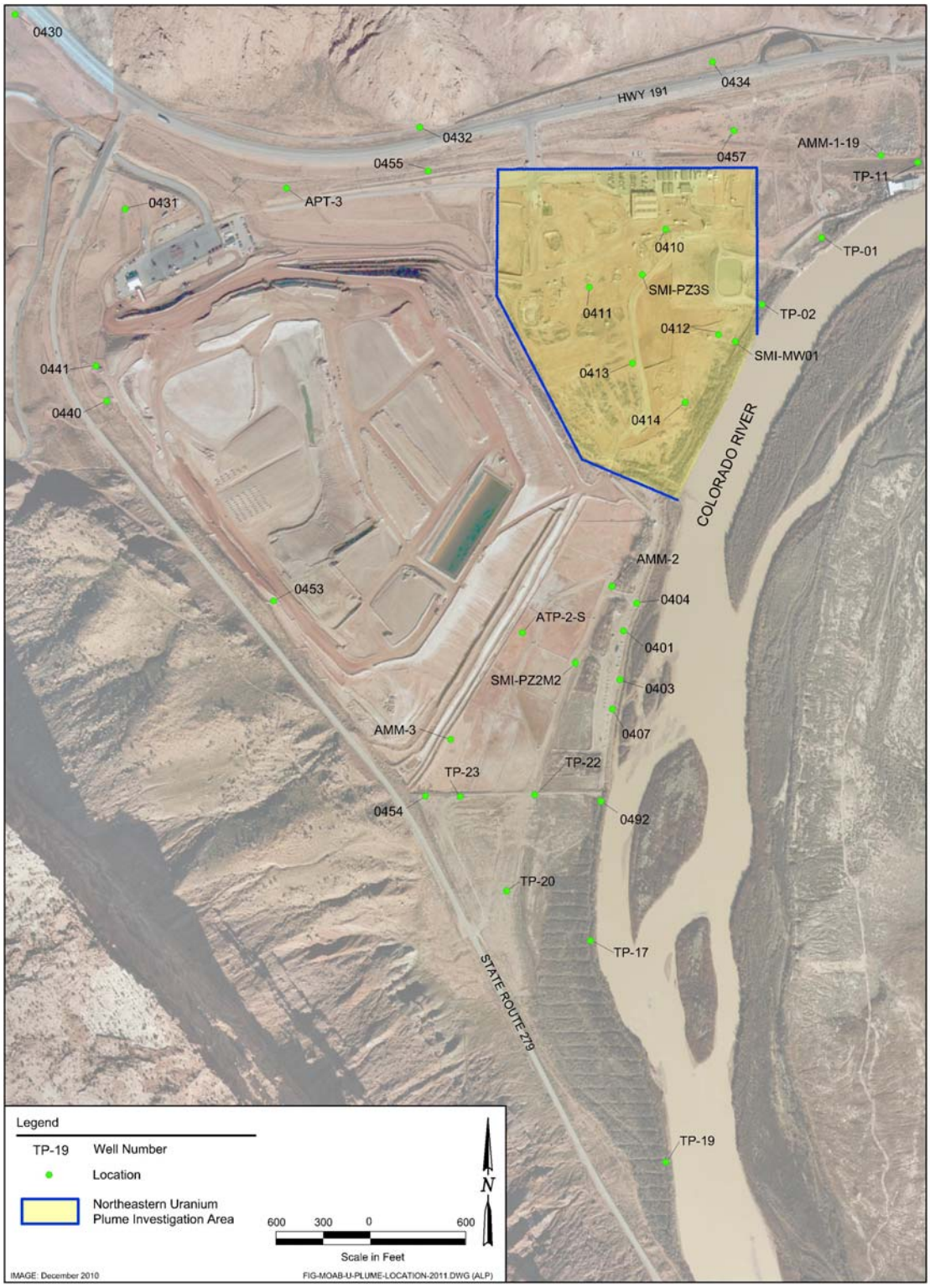

Figure 1. Northeastern Uranium Plume Investigation Site Map

During a walkthrough of the area in June 2009, some surface debris was present. In particular, sections of concrete stained with what appeared to be yellow cake were located just north of well 0411. It is possible that similar material buried in this area of the site is responsible for the presence of uranium in the ground water system.

Surface debris from a portion of the investigation area was removed as part of the surface soil cleanup effort that took place between December 2010 and April 2011. During this time frame, soils and debris from an area of approximately 20 acres located between the Colorado River and the road connecting the well field to the site administrative area were remediated.

With the exception of when the Colorado River experiences high flows during the spring runoff, ground water at this vicinity of the site flows southeast, toward the Colorado River (Figure 2).

Uranium concentrations in excess of 10 milligrams per liter (mg/L) have been measured in ground water samples collected from well 0411. Uranium concentrations in excess of 5 mg/L have been detected in samples collected from wells 0412 and 0414, which are located downgradient (to the southeast) of well 0411. Periodic sampling of observation wells at the site has been performed and reported in data validation packages and monitoring reports.

Table 1 provides the uranium concentrations detected in samples collected from several locations in 2008 and 2009. With the limited number of observation wells available, it is difficult to determine if the concentrations detected downgradient of well 0411 are related to the elevated concentration in that well or from another source.

Table 1. Uranium Concentrations Measured in Observation Wells 0410, 0411, 0412, 0413, 0414, SMI-MW01, and SMI-PZ3S in 2008 and 2009.

Location	Sample Depth (ft bgs)	Uranium Concentration (mg/L)			
		August 2008	January 2009	June 2009	October 2009
0410	25	NS	0.73	NS	0.64
0411	9	19	NS	12	NS
0412	11	5.8	NS	NS	NS
0413	11	1.5	1.5	1.5	1.1
0414	7	5.3	NS	4.9	NS
SMI-MW01	16	5.0	4.4	6.0	4.9
SMI-PZ3S	25	NS	1.7	1.4	2.4

ft bgs = feet below ground surface; NS = not sampled

4.0 Investigation Activities

To effectively and efficiently investigate the vertical and horizontal extent of the plume, a drilling rig using direct-push technology manufactured by Geoprobe, Inc., was utilized. The Geoprobe equipment allowed collection of soils and ground water samples from discrete depths down to approximately 40 feet (ft), depending on the soil lithology.

This investigation was completed in three phases. Phase 1 included the installation of eight boreholes within 100 ft of well 0411. All Phase 2 locations were based on the Phase 1 soil and ground water sampling results and were advanced to further delineate the vertical and lateral extent of the plume. Phase 3 included the installation of six observation wells.

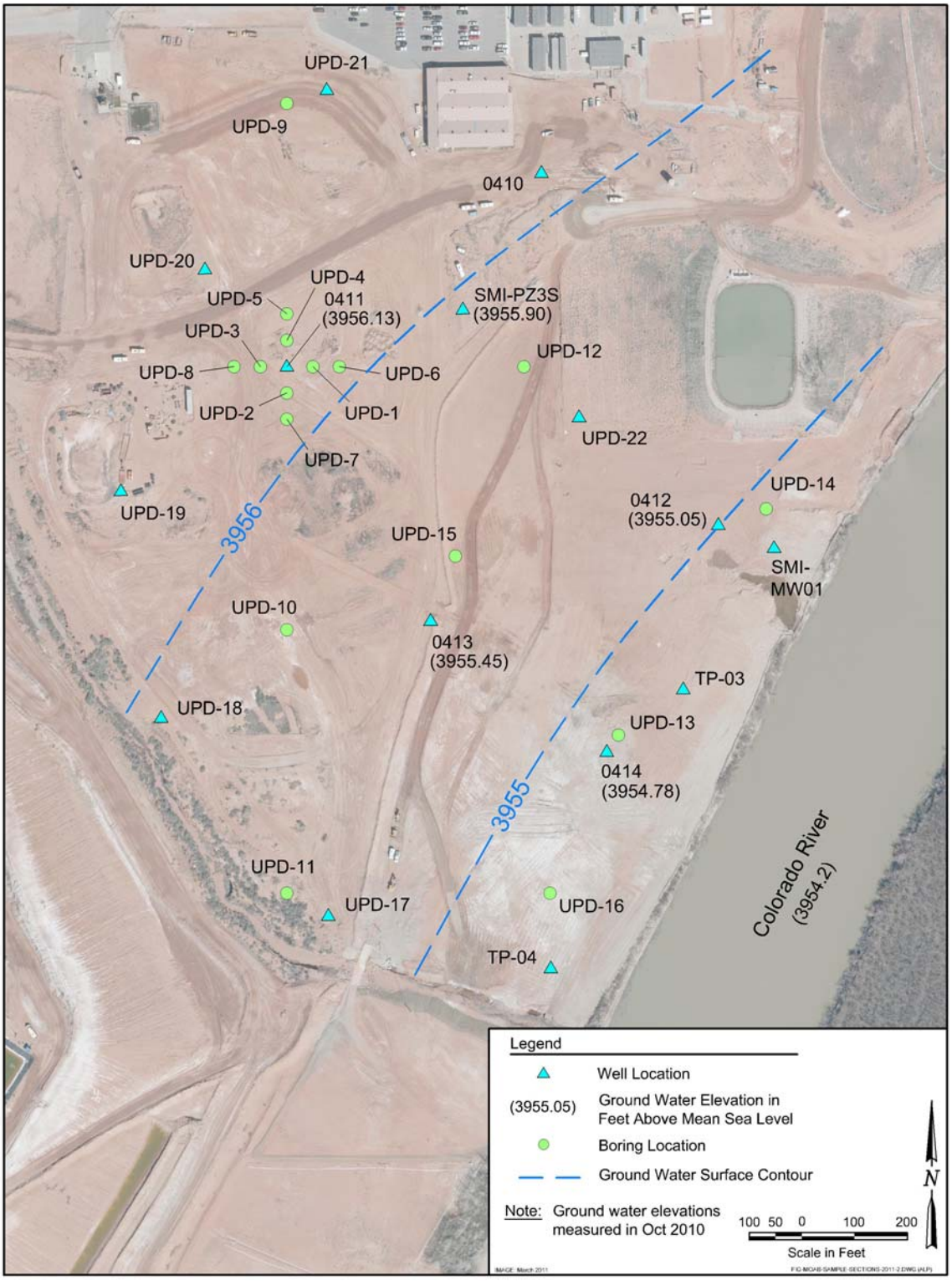

Figure 2. Northeastern Uranium Plume Borehole and Observation Well Location and Ground Water Surface Contour Map

4.1 Phase 1

Eight boreholes were advanced around well 0411 as shown on Figure 2. Ground water samples collected from well 0411 have historically had the highest uranium concentrations in this area of the site.

Boreholes UPD-1, UPD-2, UPD-3, and UPD-4 were located 50 ft to the east, south, west, and north, respectively, from well 0411. Four additional boreholes (UPD-5, UPD-6, UPD-7, and UPD-8) were located 100 ft to the north, east, south, and west, respectively, of well 0411. Between May 17 and June 6, 2010, soil and ground water grab samples were collected from these eight locations. The total depths of these boreholes were site-specific, and ranged from 21.5 to 33 ft below ground surface (bgs). Boring logs are included in Appendix A.

Soil samples were collected from the surface and at 2.5-ft intervals down to the water table, which ranged from 7.5 to 12 ft bgs. Once ground water was encountered, soil samples were collected at 5-ft intervals down to refusal. All soil samples collected were analyzed for radium (Ra)-226 on site using Opposed Crystal System (OCS) equipment following the procedure outlined in the OCS Soil Sample Analysis Criteria section of the *Moab UMTRA Project Field Services Manual* (DOE-EM/GJTAC1631).

Two adjacent boreholes were drilled within 5 ft of each other (one for the collection of soil samples and the other for the collection of ground water samples) as it was not possible to collect both sets of samples from the same borehole. In general, these ground water samples were collected starting within 1 to 2 ft below the ground water surface using equipment specifically designed to sample a discrete 1-ft interval. The remaining sample depths were based on the refusal depth of the adjacent soil sample borehole. Additional grab samples were collected from the maximum depth obtainable and then another collected near the middle between the ground water surface and the total depth.

In April 2010, ground water samples were also collected from existing site wells 0410, 0411, 0412, 0413, 0414, SMI-MW01, and SMI-PZ3S following low-flow sampling procedures. All sampling and analyses were conducted in accordance with the *Moab UMTRA Project Surface Water/Ground Water Sampling and Analysis Plan* (DOE-EM/GJTAC1830), and all data were validated following the criteria according to the *Moab UMTRA Project Standard Practice for Validation of Laboratory Data* (DOE-EM/GJTAC1855).

All ground water samples were submitted to ALS Environmental and analyzed for total uranium using method SW-846 6020A.

4.2 Phase 2

The Geoprobe equipment was also used to collect soil and ground water samples from boreholes UPD-9 through -16 (Figure 2). These boreholes were advanced between July 21 and August 24, 2010, and were located based on the soil and ground water results from Phase 1. Total depths ranged from 18 and 34 ft bgs (all boring logs are shown in Appendix A).

Borehole UPD-9 was located 400 ft directly north of UPD-5 to determine if the 8.2-mg/L concentration detected in UPD-5 was associated with a source in this region of the site.

Locations UPD-10 and UPD-11 were located 500 and 1,000 ft directly south of well 0411 to further delineate the plume in this area of the site. Borehole UPD-12 was advanced approximately 400 ft east of well 0411, and boreholes UPD-13 and UPD-15 were advanced 900 and 450 ft southeast of well 0411, respectively. UPD-14 was advanced in the vicinity of wells 0412 and SMI-MW01, and UPD-16 was located in the area of the former mill.

Ground water samples were also collected from the observation wells during this phase of the investigation. All soil and ground water samples were collected following the same procedures as outlined in Phase 1 and analyzed using the same methods.

4.3 Phase 3

The purpose of completing Phase 3 was to address any data gaps encountered during this investigation. Six observation wells were installed during Phase 3 between March and October 2011. The locations (shown on Figure 2) were based on reviewing the results associated with Phases 1 and 2 as well as historical information regarding site structures and processing areas in this vicinity of the site (Figure 3). Table 2 provides the well construction details and information regarding their respective locations for observation wells UPD-17 through 22, all of which were installed using the Geoprobe.

Table 2. Construction Details for Observation Wells UPD-17 through UPD-22

Location	Date Installed	Casing Diameter (inches)	Total Depth (ft bgs)	Screen Interval (ft bgs)	Description / Reason for Location
UPD-17	5/20/2011	1.5	15.2	5.2 – 15.2	Provides data for the SW corner of the area
UPD-18	3/18/2011	1.5	14.8	4.8 – 14.8	Provides data for the SW boundary of the area
UPD-19	4/8/2011	1.5	15.3	5.3 – 15.3	Provides data to determine any impacts to the aquifer downgradient from the emulsion pond location
UPD-20	5/20/2011	1.5	26.6	16.6 – 26.6	Located in the vicinity of soil boring R0175 (which had elevated surface contamination) and determine the NW extent of the high concentration detected in UPD-5
UPD-21	6/10/2011	1.5	27	17 – 27	Located in the vicinity of soil boring R0030 (which had elevated surface contamination).
UPD-22	10/28/2011	1.5	16.6	6.6 – 16.6	Located on the western edge of the nearby reveg plot to determine the downgradient extent of the high concentration detected in UPD-12

Ground water samples were collected from these locations in October and November 2011, and were submitted to the analytical laboratory for uranium analysis. In addition, ground water samples were collected from observation wells 0410 through 0414, SMI-MW01, and SMI-PZ35 in May and November 2011.

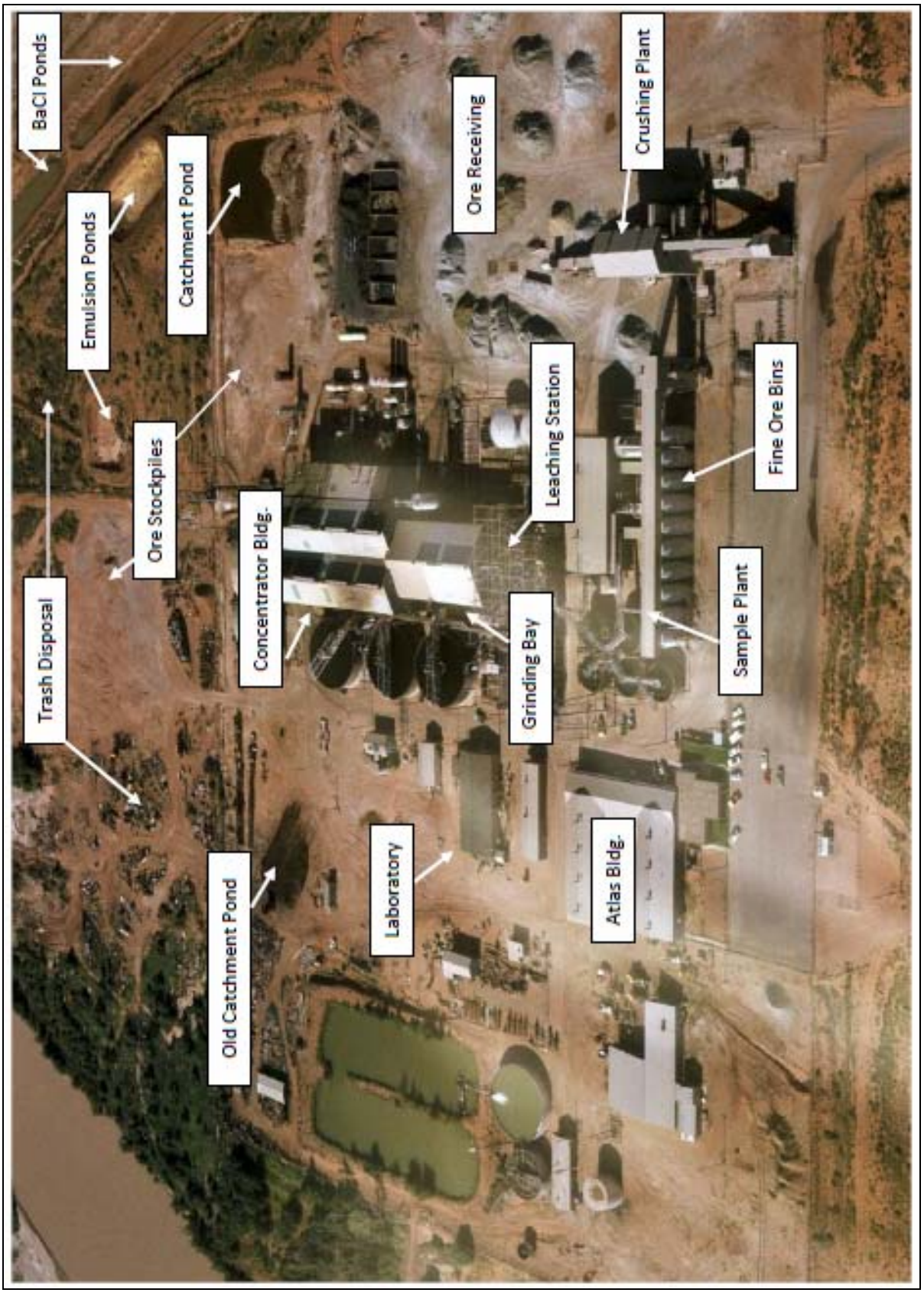

Figure 3. Photo From 1973 Showing Former Mill Structures and Features

5.0 Results

Section 5.1 presents the results from the soil sampling activities during Phase 1 and 2 of this investigation. Section 5.2 provides summary of the ground water sampling results from Phases 1, 2, and 3, including contour maps and cross-sections generated to determine the horizontal and vertical extent of the ground water plume in this vicinity of the site.

5.1 Soil Sampling

All soil sampling results for Phases 1 and 2 boreholes are shown on Figure 4. The Ra-226 concentrations ranged from 0.1 to 113.8 picocuries per gram (pCi/g), with the maximum detected in the sample collected from UPD-11 at a depth of 0 to 2.5 ft bgs. In general, the highest concentrations were detected in the shallowest samples collected and the lowest from the deepest samples collected.

Within the shallow (from ground surface to 15 ft bgs) and deep zones (from 15 to 33 ft bgs) the Ra-226 concentrations ranged from 0.1 to 113.8 pCi/g and from 0.1 to 3 pCi/g, respectively. The total uranium concentrations ranged from 3.6 to 176.3 pCi/g, with the highest concentration also associated with the shallowest sample collected from UPD-11. Total uranium concentrations measured in the soil followed a similar pattern displayed by the Ra-226 concentrations regarding the relative concentrations at depth. Within the shallow zone, the concentrations ranged from 3.8 to 176.3 pCi/g, and deep zone concentrations ranged from 3.6 to 19.4 pCi/g.

Soil sample results for uranium and Ra-226 do not indicate a correlation between soil activity and ground water contamination (Appendix B, Table B-1). Most of the soil samples were below the U.S. Environmental Protection Agency cleanup standard of 5 pCi/g of Ra-226.

Historical soil sampling data for thorium (Th)-230, Ra-226, and uranium indicate an area of contaminated soil is located over the location of borehole UPD-9 and observation well UPD-21, where the mill was once located (observation well UPD-21 had the highest uranium concentration of all of the locations sampled in this investigation, as discussed below). The Ra-226 soil concentration map presented in "Radiological Assessment for Non-Pile Areas of the Moab Project Site" (DOE-EM/GJ901-2005) indicates the maximum contamination extends up to 6 ft bgs in the vicinity of UPD-21. A similar soil map for Th-230 distribution indicates elevated concentrations in the general area of the former mill location.

Subsequent to Phase 1 and Phase 2 activities a surface cleanup effort on approximately 20 acres located to the east of the road connecting the well field to the administrative area was completed. Between December 2010 and April 2011, surface soils and debris from this portion of the investigation area were remediated to meet the standards delineated in Title 40 Code of Federal Regulations Part 192, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings and Uranium In Situ Leaching Processing Facilities."

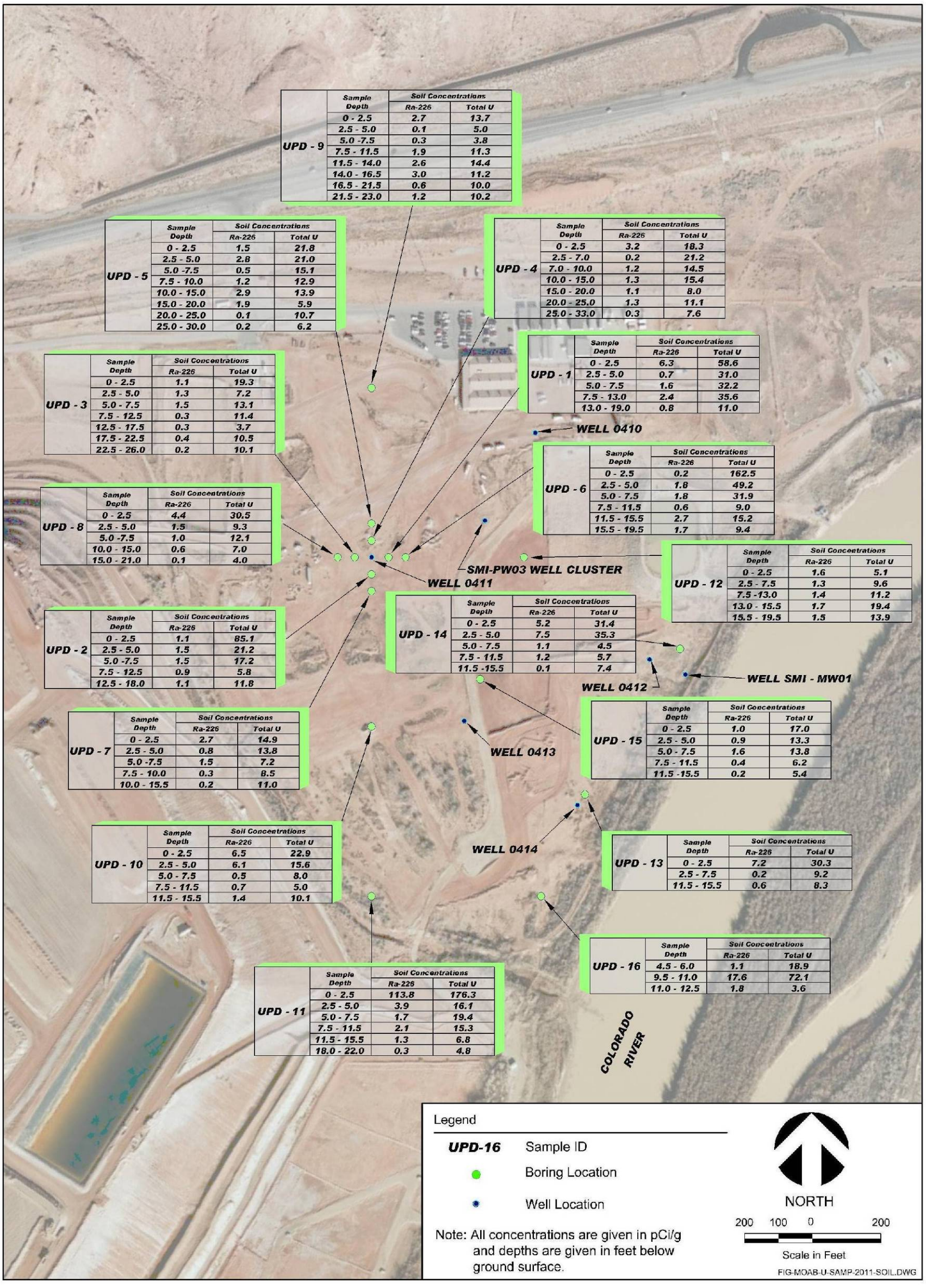

Figure 4. Soil Sampling Results for Boreholes UPD-1 Through 16

5.2 Ground Water

Contour Maps

A series of three maps (Figures 5 through 7) provide the results of the ground water sampling effort in Phases 1, 2, and 3. Figure 5 presents the uranium concentrations of samples collected from the shallow zone, which for this investigation is equivalent to an elevation of 3,950 ft above mean sea level (msl) through 3,964.5 ft msl. Uranium concentrations associated with samples collected from the intermediate zone (between elevations 3,940 and 3,950 ft msl) are presented in Figure 6, and Figure 7 provides similar data for samples collected from the depp zone (below an elevation of 3,940 ft msl).

The shallow uranium concentration contour map shows that the highest uranium values are in the shallow ground water in the vicinity of the former millsite, just west of the current trailer area (Figure 5). Another localized area of elevated uranium lies just west of the riverbank, south of the freshwater pond.

Within the intermediate zone, the uranium concentrations generally decrease; the highest value was 4.9 mg/L from the sample collected from UPD-1 at an elevation of 3,947 ft msl (Figure 6). The deep zone concentration contour map shows the uranium values continue to decrease with depth (Figure 7). The highest concentration (2.1 mg/L) was located at borehole UPD-14, at an elevation of 3,933.5 ft msl.

Cross-Sections

A series of cross-sections were also generated to further delineate the vertical and lateral extent of the uranium contamination in this vicinity of the site. The cross-section location map is shown as Figure 8. All data used to compose these cross-sections can be found in Table B-3 of Appendix B. Most of the ground water samples were collected in October 2011; however, the UPD grab samples were collected in 2010.

Cross-section A-A' runs north to south along the U-plume area (Figure 9). The northernmost portion of this cross-section runs along the historical location of the mill sample plant and concentrator building. A well in the northern portion of this cross-section (UPD-21) has the highest uranium concentration (12 mg/L) of all of the locations in this investigation. The adjacent borehole, located 25 ft west of UPD-21, had a uranium concentration of 0.61 mg/L.

Approximately 400 ft south of UPD-9 and UPD-21 are four more boreholes and observation well 0411. Generally, the highest uranium concentrations in this area are found in the shallow ground water between an elevation of 3,950 and 3,955 msl (6.1 to 8.2 mg/L). At an elevation of 3,930 ft msl, the uranium concentrations decrease to 0.004 mg/L.

Boreholes UPD-10 and UPD-11 and observation well UPD-17 are located in the southern portion of cross-section A–A'. The uranium concentrations are generally lower in this vicinity, possibly because this area is located approximately 800 ft south of the former mill. Observation well UPD-17 had a uranium concentration of 1.6 mg/L at an elevation of 3,952 ft msl.

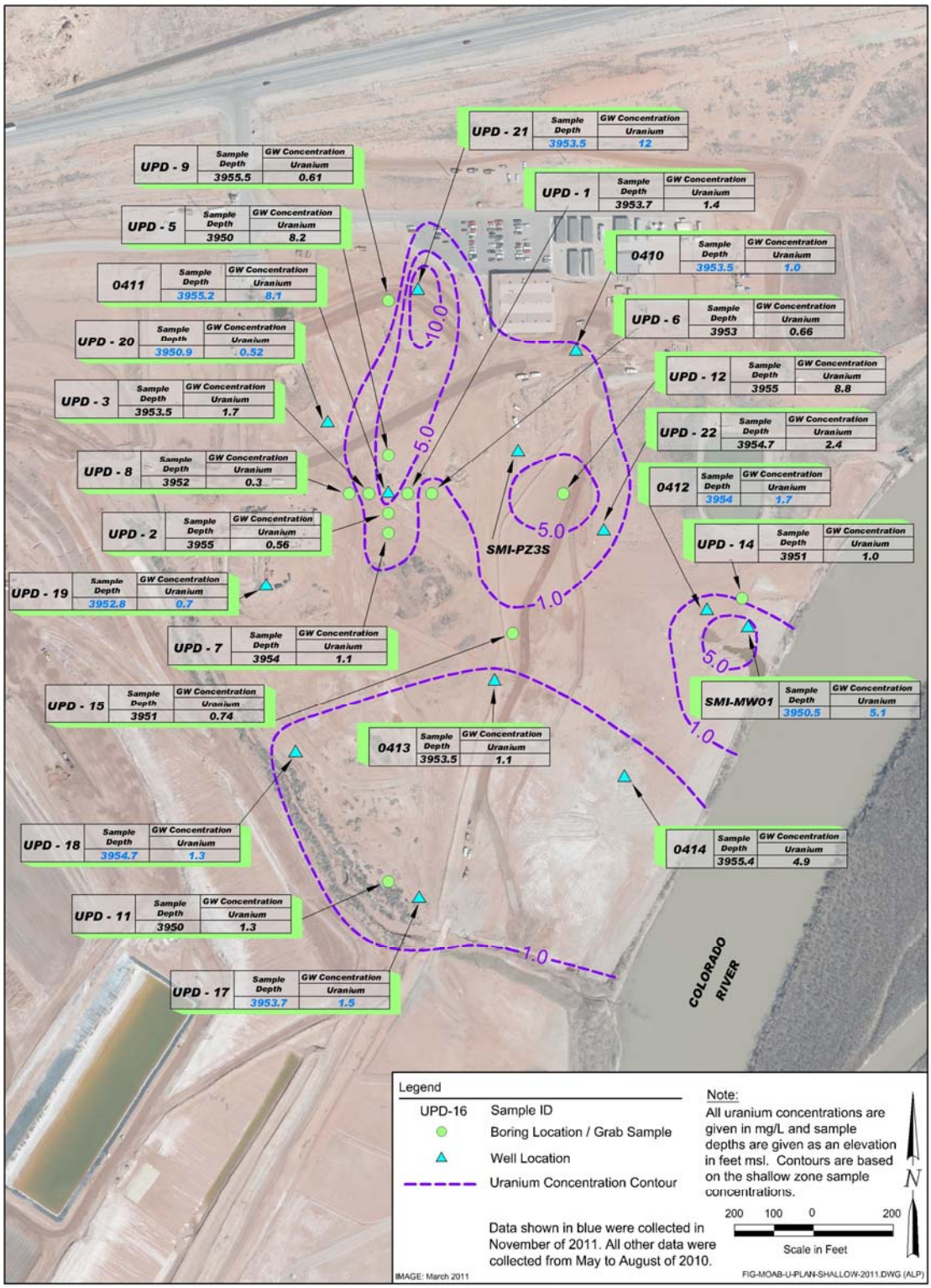

Figure 5. Shallow Zone Northeastern Uranium Plume Contour Map

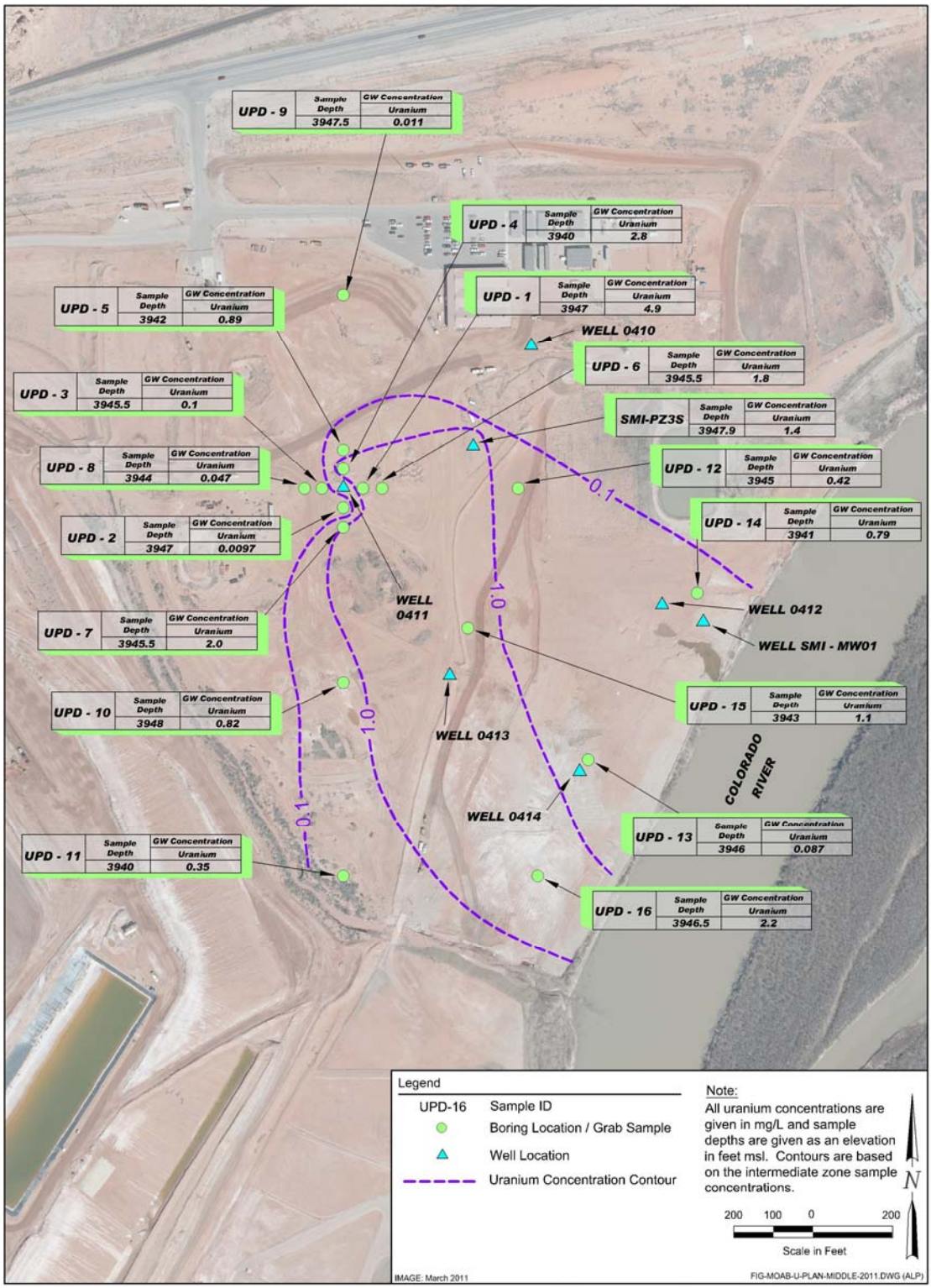

Figure 6. Intermediate Zone Northeastern Uranium Plume Contour Map

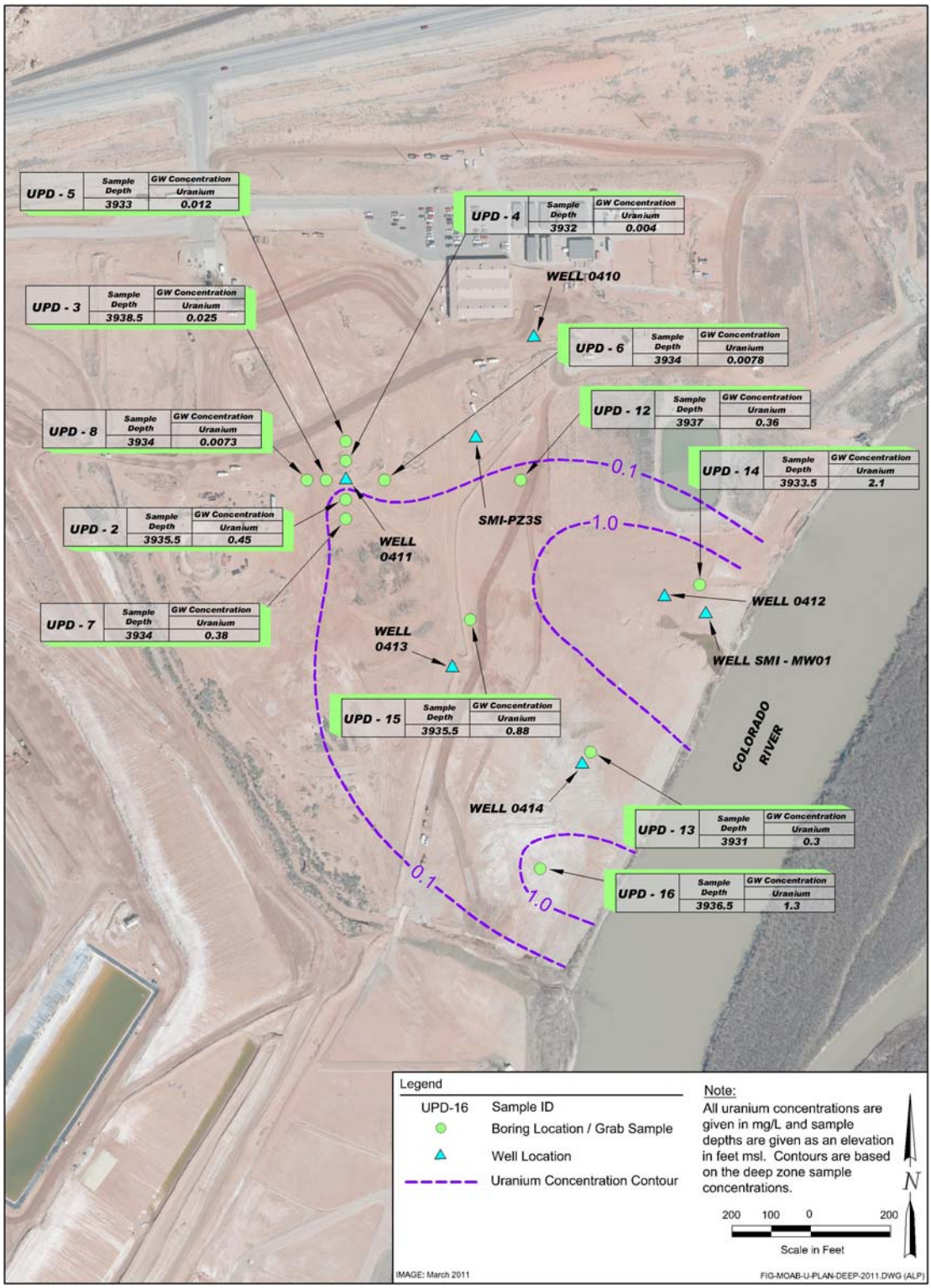

Figure 7. Deep Zone Northeastern Uranium Plume Contour Map

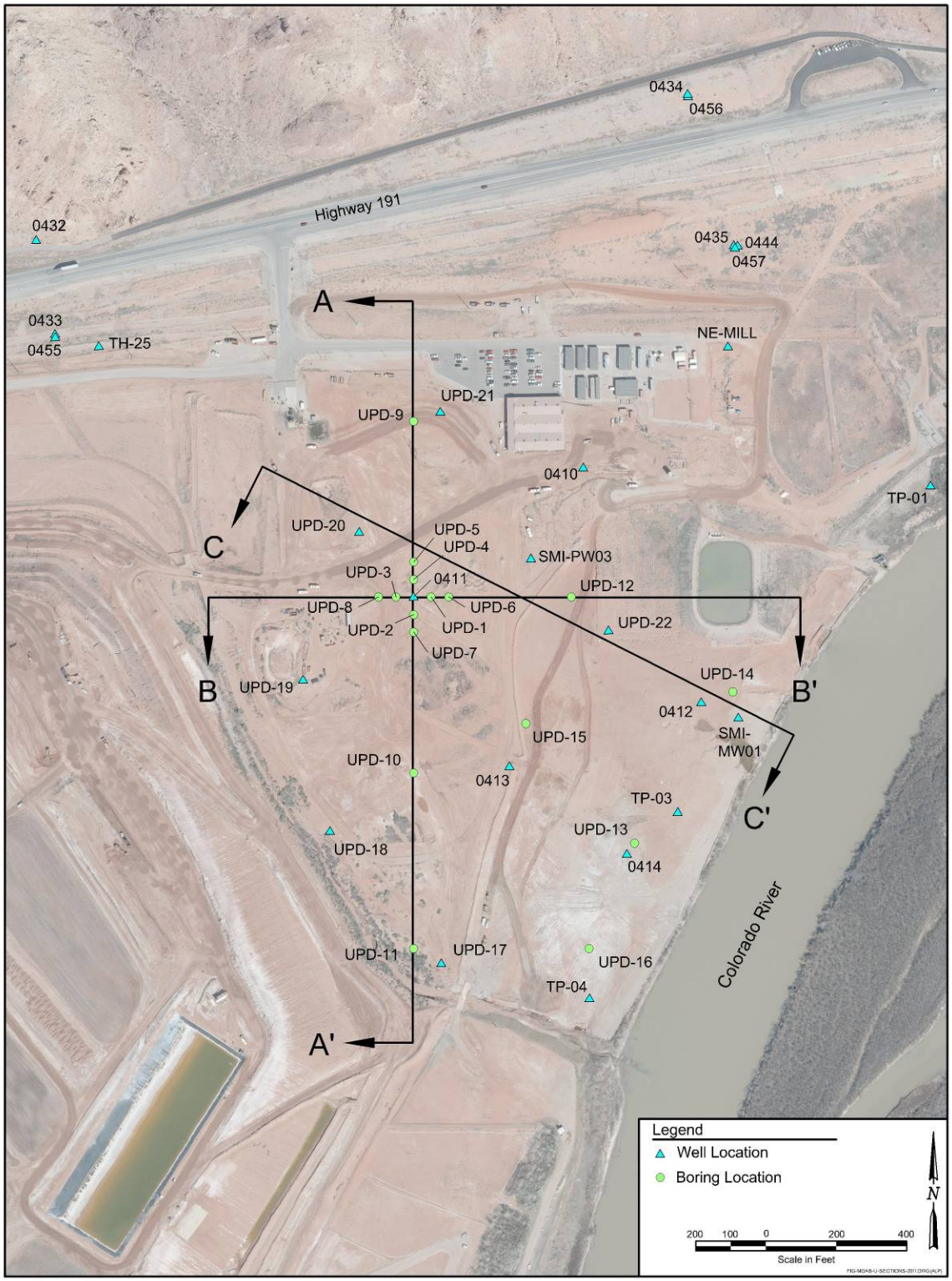

Figure 8. Northeastern Uranium Plume Area Cross-Section Location Map

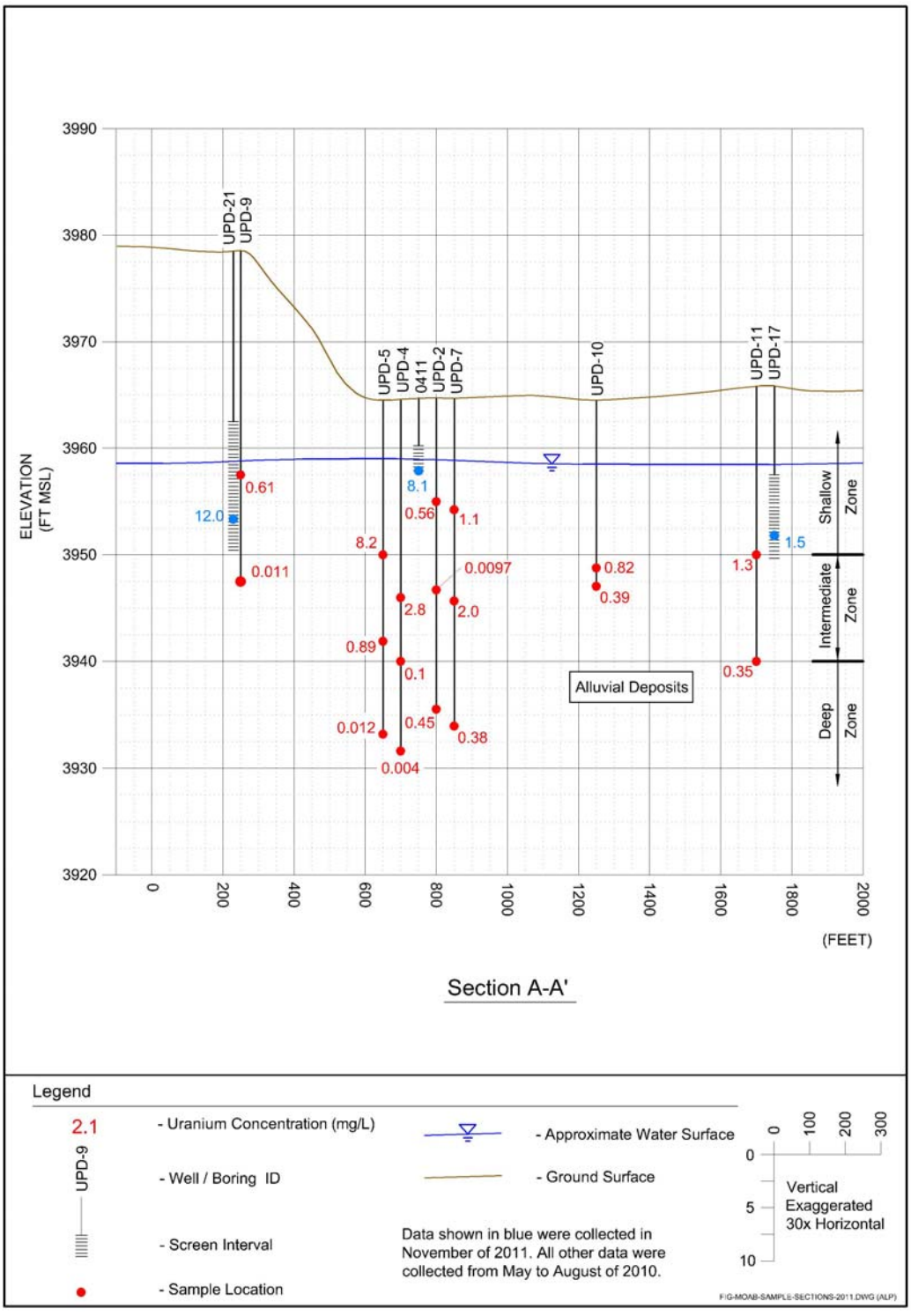

Figure 9. A-A' Cross-Section

Cross-section B-B' (Figure 10) runs from west to east across the historical location of the ore stockpile area, the concentrator building, and the catchment pond. The highest uranium concentrations (up to 8.8 mg/L) were found in the shallow ground water around 3,955 ft msl at well 0411 and borehole UPD-12. Two of the borehole locations (UPD-1 and UPD-6) had greater uranium concentrations at an elevation of 3,945 to 3,947 ft msl. This may be due to the lithology of these locations, where silty sand grades into a well-sorted sand and gravel at approximately the same elevation.

Cross-section C-C' runs from northwest to southeast to the Colorado River (Figure 11). This is the location of the former mill and trash disposal pits. The highest uranium concentrations were located in the shallow ground water (approximately 3,955 to 3,957 ft msl) at boreholes UPD-5 and UPD-12 (8.2 to 8.8 mg/L). In general, the uranium concentration decreases from 3,955 to 3,939 ft msl and then increases slightly with depth. It should be noted that borehole UPD-14 was drilled before the soil in the northern off-pile area was remediated. This area is now approximately 6 ft lower in elevation than it was during the installation of the borehole.

It is possible that the variation in uranium concentrations could be impacted by the type of ground water sample collected. During the drilling of the boreholes, one-time grab samples were collected at specific intervals. The observation well locations were sampled using low-flow purge techniques, in which the water is slowly purged from the screened zone, and parameters (pH, temperature, conductivity) are allowed to stabilize. As a result, these samples are considered to be more representative of the ground water system.

Observation Well Sampling

In addition to the grab samples collected from the boreholes, ground water samples were also collected from existing site observation wells 0410, 0411, 0412, 0413, 0414, SMI-MW01, and SMI-PZ3S in April 2010, October 2010 May 2011, and Novemver 2011. A summary of the results is provided in Table 3.

Table 3. Uranium Concentrations Measured in Wells 0410, 0411, 0412, 0413, 0414, SMI-MW01, and SMI-PZ3S in 2010 and 2011

Location	Sample Depth (ft bgs)	Uranium Concentration (mg/L)			
		April 2010	October 2010	May 2011	November 2011
0410	25	0.3	1.1	0.9	1.0
0411	9	5.6	3.9	6.1	8.1
0412	11	4.1	4.1	3.2	1.7
0413	11	1.4	1.1	1.3	NA
0414	7	5.7	4.9	4.9	NA
SMI-MW01	16	5.9	5.6	NA	5.1
SMI-PZ3S	25	1.2	1.8	1.1	1.4

NA = not applicable

Figure 12 is a time versus uranium concentration plot for these locations from 2008 through 2011. As this plot displays, the uranium concentration has fluctuated in the samples collected from 0411 since 2008, while the concentrations have gradually decreased in samples collected from 0412. The concentrations detected in samples from the remaining wells have been consistent.

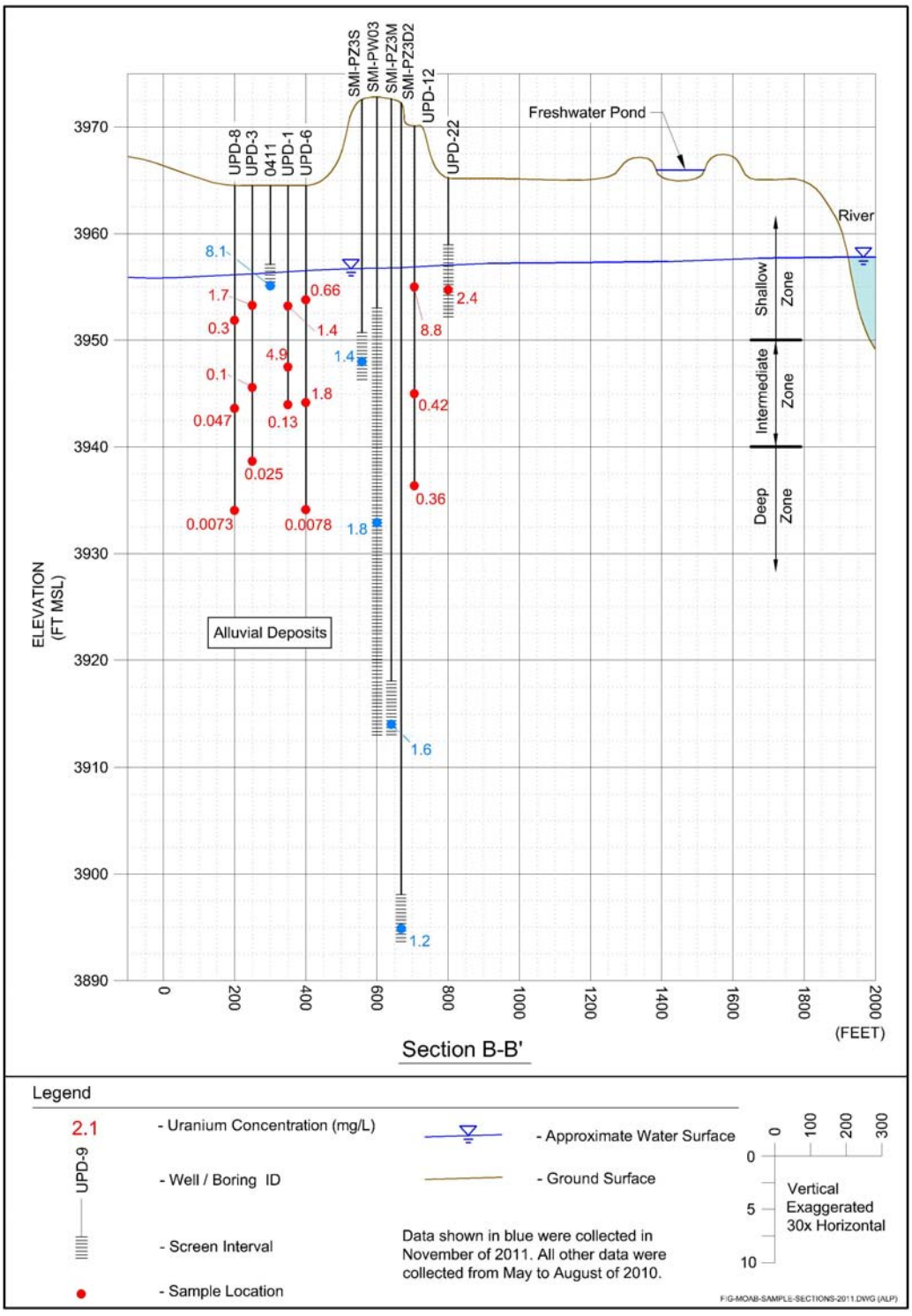

Figure 10. B-B' Cross-Section

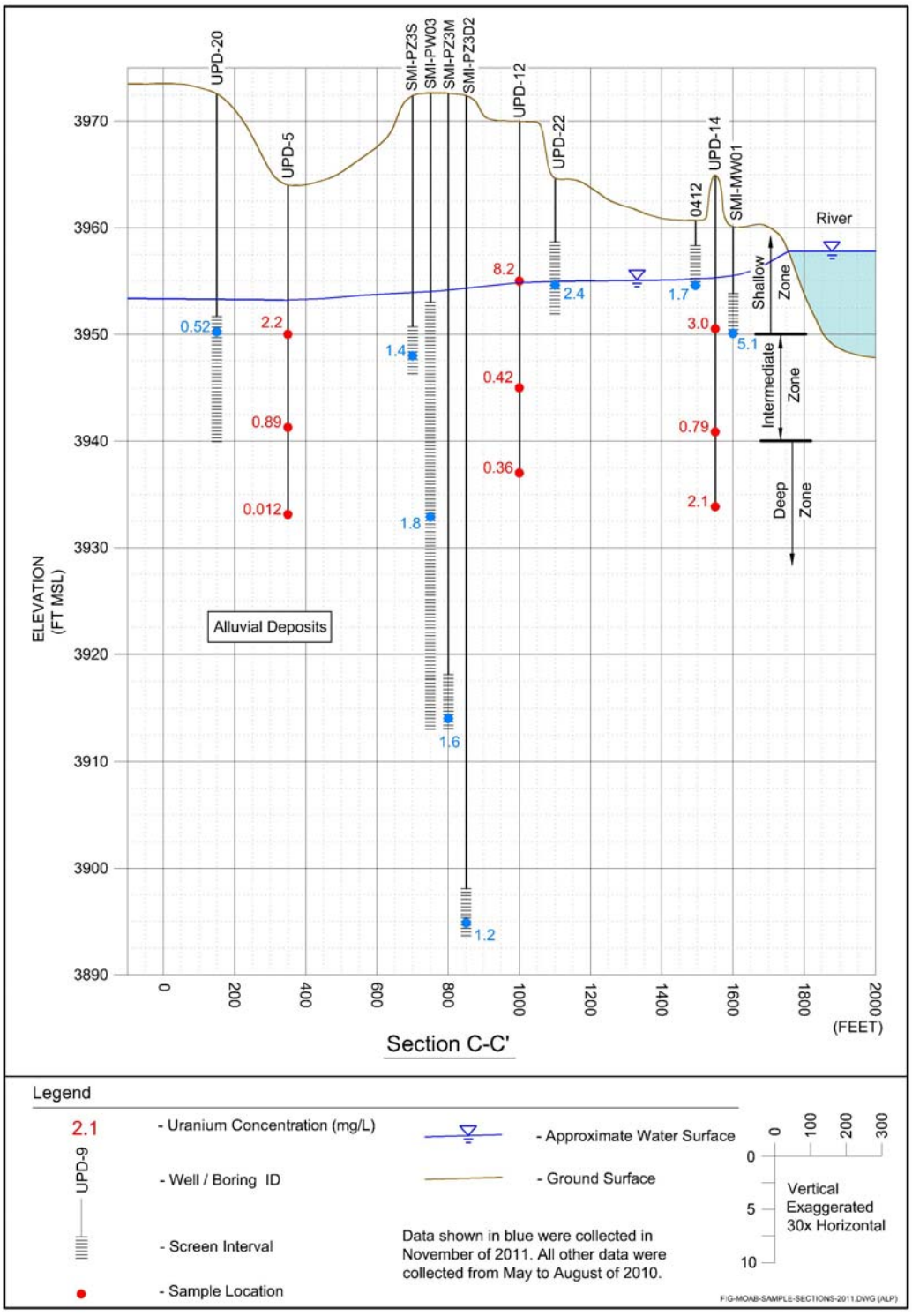

Figure 11. C-C' Cross-Section

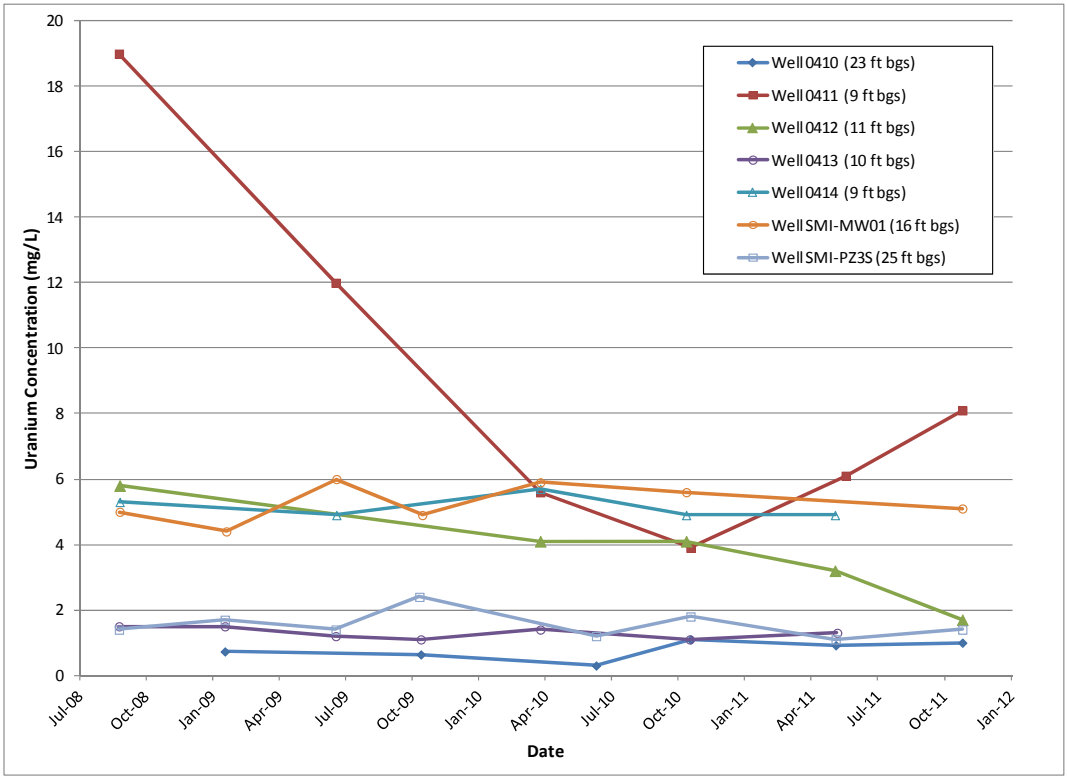

Figure 12. Time Versus Uranium Concentration Plots for Wells 0410, 0411, 0412, 0413, 0414, SMI-MW01, and SMI-PZ3S, 2008 Through 2011

6.0 Conclusions

The following conclusions are based on the soil sampling results of this investigation of the area.

- Soil sample results for uranium and Ra-226 do not indicate a correlation between soil activity and ground water contamination and did not identify a concentration of uranium or radium sufficient to establish a source of elevated concentrations of uranium in ground water.
- The highest soil concentrations were detected in the shallowest samples collected and the most shallow from the deepest samples collected. Soils concentrations decreased with depth, which is consistent with the high retentive capacity of soils for uranium.

The following conclusions are based on the ground water sampling results of this investigation of the area.

- By comparing the shallow, intermediate, and deep zone ground water concentration contour maps, it is evident that the highest uranium values are found in the location of the former millsite in the shallow ground water. While this location has the highest concentration in the shallow ground water, the highest uranium concentration in the intermediate and deep ground water is located southeast of this area. This may indicate there are two or more sources of uranium contamination in the investigation area.

- Ground water results from the 16 boreholes and six observation wells indicate that the ground water contamination does not originate from a single source, but instead as isolated areas. The areas with the highest uranium concentrations are found in the shallow ground water located in the vicinity of the former millsite, just west of the administrative area. Another area with a higher uranium concentration is located just south of the freshwater pond along the river bank. This location is where the former unlined trash pits were located.

7.0 References

40 CFR 192A (Code of Federal Regulations), "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings."

DOE (U.S. Department of Energy), *Moab UMTRA Project 2009 Ground Water Program Report* (DOE-EM/GJTAC1941), November 2010.

DOE (U.S. Department of Energy), *Moab UMTRA Project 2009 Well Field Optimization Plan* (DOE-EM/GJTAC1791), June 2009.

DOE (U.S. Department of Energy), *Moab UMTRA Project Field Services Manual* (DOE-EM/GJTAC1631), October 2010.

DOE (U.S. Department of Energy), *Moab UMTRA Project Standard Practice for Validation of Laboratory Data* (DOE-EM/GJTAC1855).

DOE (U.S. Department of Energy), *Moab UMTRA Project Surface Water/Ground Water Sampling and Analysis Plan* (DOE-EM/GJTAC1830), November 2009.

DOE (U.S. Department of Energy), "Radiological Assessment for Non-Pile Areas of the Moab Project Site" (DOE-EM/GJ901-2005), August 2005.

SMI (Shepherd Miller, Inc.), "Site Hydrogeologic and Geochemical Characterization and Alternatives Assessment for the Moab Mill Tailings Site, Moab, Utah," April 2001.

DOE (U.S. Department of Energy), "Site Observational Work Plan for the Moab, Utah Site" (GJO-2003-424-TAC), December 2003.

Appendix A.
Boring Logs

Appendix A. Boring Logs

S&K Aerospace
2021 N HWY 191
Moab, UT 84532
Telephone: 970-259-2100
Fax: 970-259-2174

BORING NUMBER UPD-1

CLIENT Department of Energy
PROJECT NAME Northeastern Uranium Plume Investigation
PROJECT NUMBER NA
PROJECT LOCATION Moab UMTRA Site
DATE STARTED 5/17/10 **COMPLETED** 5/17/10
GROUND ELEVATION 3964.2 ft **HOLE SIZE** 2"
DRILLING CONTRACTOR Moab TAC Field Services Group
DRILLING METHOD Direct Push Hydraulic Hammer
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	ENVIRONMENTAL DATA	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0					(SC/SM) SANDY SILTY CLAY, dry, well sorted, red, (2.5 YR 4/8)	
					7.0 — 3957.2	
5					(SM) SILTY SAND, moist, well sorted, brown (7.5YR 4/3)	
10					10.4 — 3953.8	
					Sample UPD-1-S	
15					15.0 — 3949.2	
					(SW) WELL GRADED SAND, moist, reddish brown (5YR 4/4)	
					17.0 — 3947.2	
20					(SW/GW) GRAVELLY WELL GRADED SAND, moist, poorly sorted, angular to subangular, yellowish red (5YR 4/6) Sample UPD-1-S	
					20.5 — 3943.7	
					Sample UPD-1-D	
					21.5 — 3942.7	
					Bottom of borehole at 21.5 feet.	

ENVIRONMENTAL BH - GINT STD US.GDT - 1/4/12 10:39 - M:\GROUNDWATER\GINT\PROJECTS\UPLUME INVESTIGATION 2010.GPJ

Appendix A. Boring Logs (continued)

S&K Aerospace
2021 N HWY 191
Moab, UT 84532
Telephone: 970-259-2100
Fax: 970-259-2174

BORING NUMBER UPD-2

CLIENT Department of Energy
PROJECT NAME Northeastern Uranium Plume Investigation
PROJECT NUMBER NA
PROJECT LOCATION Moab UMTRA Site
DATE STARTED 5/18/10 **COMPLETED** 5/19/10
GROUND ELEVATION 3964.2 ft **HOLE SIZE** 2"
DRILLING CONTRACTOR Moab TAC Field Services Group
DRILLING METHOD Direct Push Hydraulic Hammer
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	ENVIRONMENTAL DATA	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0					(SM) SILTY SAND, dry, mostly fines, red (2.5YR 4/8)	
8.0					▼ 3956.2	
9.0					(SM) SILTY SAND, moist, well sorted, <75% fines, red (2.5YR 4/8) 3955.2	
10.0					Sample UPD-2-S 3954.2	
13.0					(SC) CLAYEY SAND, moist, poor porosity, dark red (2.5YR 3/6) 3951.2	
16.0					(SW) WELL-GRADED SAND, moist, few fines, reddish brown (5YR 4/4) 3948.2	
17.0					(GP) POORLY-GRADED GRAVEL, moist, poorly sorted, angular to sub angular, reddish brown (5YR 4/4) 3947.2	
					Sample UPD-2-M	
					(SW) WELL-GRADED SAND, reddish brown (5YR 4/4)	
28.5					3935.7	
29.5					Sample UPD-3-D 3934.7	

Bottom of borehole at 29.5 feet.

ENVIRONMENTAL BH - GINT STD US.GDT - 1/4/12 10:45 - M:\GROUNDWATER\GINT\PROJECTS\UPLUME INVESTIGATION 2010.GPJ

Appendix A. Boring Logs (continued)

S&K Aerospace
2021 N HWY 191
Moab, UT 84532
Telephone: 970-259-2100
Fax: 970-259-2174

BORING NUMBER UPD-3

CLIENT Department of Energy
PROJECT NAME Northeastern Uranium Plume Investigation
PROJECT NUMBER NA
PROJECT LOCATION Moab UMTRA Site
DATE STARTED 5/19/10 **COMPLETED** 5/20/10
GROUND ELEVATION 3964.2 ft **HOLE SIZE** 2"
DRILLING CONTRACTOR Moab TAC Field Services Group
DRILLING METHOD Direct Push Hydraulic Hammer
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	ENVIRONMENTAL DATA	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
0					(SM) SILTY SAND, dry, well sorted, mostly fines, red (2.5YR 4/8)		
5							
10							
					9.5	3954.7	
					(SM) SILTY SAND, brown (7.5YR 4/3)		
					10.5	3953.7	
					Sample UPD-3-S		
15							
					18.0	3946.2	
					18.5 (SW) WELL-GRADED SAND, reddish brown (5YR 4/4)	3945.7	
					19.0	3945.2	
20					Sample UPD-3-M		
					(GP) POORLY-GRADED GRAVEL, moist, well sorted, little fines, reddish brown (5YR 4/4)		
25							
					25.5	3938.7	
					Sample UPD-3-D		
					26.5	3937.7	

Bottom of borehole at 26.5 feet.

Appendix A. Boring Logs (continued)

S&K Aerospace
2021 N HWY 191
Moab, UT 84532
Telephone: 970-259-2100
Fax: 970-259-2174

S&K Moab TAC Team

BORING NUMBER UPD-4

CLIENT Department of Energy
PROJECT NAME Northeastern Uranium Plume Investigation
PROJECT NUMBER NA
PROJECT LOCATION Moab UMTRA Site
DATE STARTED 5/24/10 **COMPLETED** 5/24/10
GROUND ELEVATION 3964.2 ft **HOLE SIZE** 2"
DRILLING CONTRACTOR Moab TAC Field Services Group
DRILLING METHOD Direct Push Hydraulic Hammer
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	ENVIRONMENTAL DATA	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0					(SM) SILTY SAND, dry, mostly fines, red (2.5YR 4/8)	
14.0						3950.2
					(SM) SILTY SAND, moist, yellowish red (5YR 5/8)	
18.0						3946.2
					Sample UPD-4-S	
21.5						3942.7
					(SW) WELL-GRADED SAND, moist, foew or now fines, well sorted, reddish brown (5YR 4/4)	
24.0						3940.2
					Sample UPD-4-M	
32.0						3932.2
33.0					(GP/GM) POORLY-GRADED SILTY GRAVEL, angular to subangular, no fines, reddish brown (5YR 4/4) Sample UPD-4-D	3931.2

Bottom of borehole at 33.0 feet.

ENVIRONMENTAL BH - GINT STD US.GDT - 1/4/12 10:49 - M:\GROUNDWATER\GINT\PROJECTS\UPLUME INVESTIGATION 2010.GPJ

Appendix A. Boring Logs (continued)

S&K Aerospace
2021 N HWY 191
Moab, UT 84532
Telephone: 970-259-2100
Fax: 970-259-2174

BORING NUMBER UPD-5

CLIENT Department of Energy
PROJECT NAME Northeastern Uranium Plume Investigation
PROJECT NUMBER NA
PROJECT LOCATION Moab UMTRA Site
DATE STARTED 5/26/10 **COMPLETED** 5/26/10
GROUND ELEVATION 3964.2 ft **HOLE SIZE** 2"
DRILLING CONTRACTOR Moab TAC Field Services Group
DRILLING METHOD Direct Push Hydraulic Hammer
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	ENVIRONMENTAL DATA	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0					(SM) SILTY SAND, dry, red (2.5YR 4/8)	
11.0						3953.2
14.0					(SC/SM) CLAYEY SILTY SAND, moist, red (2.5YR 4/8)	3950.2
17.0					(SM) SILTY SAND, dark yellowish brown (10YR 3/4) Sample UPD-5-S	3947.2
22.0					(SM) SILTY SAND, light red (2.5YR 6/8)	3942.2
26.0					(SW) WELL-GRADED SAND, reddish brown (5YR 4/4) Sample UPD-5-M	3938.2
27.0					(GP) POORLY-GRADED GRAVEL, angular to subangular, reddish brown (5YR 4/4)	3937.2
31.0					(SW) WELL-GRADED GRAVEL, well sorted, no fines	3933.2
32.0					UPD-5-D	3932.2

Bottom of borehole at 32.0 feet.

ENVIRONMENTAL BH - GINT STD US.GDT - 1/4/12 10:50 - M:\GROUNDWATER\GINT\PROJECTS\UPLUME INVESTIGATION 2010.GPJ

Appendix A. Boring Logs (continued)

S&K Aerospace
2021 N HWY 191
Moab, UT 84532
Telephone: 970-259-2100
Fax: 970-259-2174

BORING NUMBER UPD-6

CLIENT Department of Energy
PROJECT NAME Northeastern Uranium Plume Investigation
PROJECT NUMBER NA
PROJECT LOCATION Moab UMTRA Site
DATE STARTED 6/2/10 **COMPLETED** 6/2/10
GROUND ELEVATION 3964.2 ft **HOLE SIZE** 2"
DRILLING CONTRACTOR Moab TAC Field Services Group
DRILLING METHOD Direct Push Hydraulic Hammer
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	ENVIRONMENTAL DATA	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
0					(SM) SILTY SAND, very fine, red (2.5YR 4/8) void from 7.5' to 11.0'		
11.0						3953.2	
					(SM/SW) WELL-GRADED SILTY SAND, wet, well sorted, reddish brown (5YR 4/4) Sample UPD-6-S		
15.5						3948.7	
16.5					(SM) SILTY SAND, red (2.5YR 4/8)	3947.7	
18.5					(SW) WELL-GRADED SAND, wet, no fines, reddish brown (5YR 4/4) Sample UPD-6-M	3945.7	
					Sample UPD-6-D		
30.0						3934.2	

Bottom of borehole at 30.0 feet.

ENVIRONMENTAL BH - GINT STD US.GDT - 1/4/12 10:50 - M:\GROUNDWATER\GINT\PROJECTS\UPLUME INVESTIGATION 2010.GPJ

Appendix A. Boring Logs (continued)

S&K Aerospace
2021 N HWY 191
Moab, UT 84532
Telephone: 970-259-2100
Fax: 970-259-2174

BORING NUMBER UPD-7

CLIENT Department of Energy
PROJECT NAME Northeastern Uranium Plume Investigation
PROJECT NUMBER NA
PROJECT LOCATION Moab UMTRA Site
DATE STARTED 6/7/10 **COMPLETED** 6/7/10
GROUND ELEVATION 3964.2 ft **HOLE SIZE** 2"
DRILLING CONTRACTOR Moab TAC Field Services Group
DRILLING METHOD Direct Push Hydraulic Hammer
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	ENVIRONMENTAL DATA	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0					(SM) SILTY SAND, dry, mostly fines, red (2.5YR 4/8)	
9.5						3954.7
10.0					(SM/WS) WELL-GRADED SILTY SAND, wet, well sorted, less fines, yellowish red (5YR 5/6)	3954.2
					UPD-7-S	
12.5						3951.7
					(SW) WELL-GRADED SAND, wet, well sorted, gravelly sand, reddish brown (5YR 4/4)	
15.0						3949.2
16.0					(GP/GM) POORLY-GRADED SILTY GRAVEL, reddish brown (5YR 4/4)	3948.2
					Refusal	
18.5						3945.7
					UPD-7-M	
30.0						3934.2
					UPD-7-D	
					Bottom of borehole at 30.0 feet.	

ENVIRONMENTAL BH - GINT STD US.GDT - 1/4/12 10:51 - M:\GROUNDWATER\GINT\PROJECTS\UPLUME INVESTIGATION 2010.GPJ

Appendix A. Boring Logs (continued)

S&K Aerospace
2021 N HWY 191
Moab, UT 84532
Telephone: 970-259-2100
Fax: 970-259-2174

BORING NUMBER UPD-8

CLIENT Department of Energy
PROJECT NAME Northeastern Uranium Plume Investigation
PROJECT NUMBER NA
PROJECT LOCATION Moab UMTRA Site
DATE STARTED 6/7/10 **COMPLETED** 6/7/10
GROUND ELEVATION 3964.2 ft **HOLE SIZE** 2"
DRILLING CONTRACTOR Moab TAC Field Services Group
DRILLING METHOD Direct Push Hydraulic Hammer
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	ENVIRONMENTAL DATA	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0					(SM) SILTY SAND, dry, mostly fines, red (2.5YR 4/8)	
12.0					3952.2	
					(SM/SW) WELL-GRADED SILTY SAND, wet, well sorted, no fines, red (2.5YR 4/8) Sample UPD-8-S	
20.0					3944.2	
					Refusal Sample UPD-8-M	
30.0					3934.2	
					Sample UPD-8-D Bottom of borehole at 30.0 feet.	

5
10
15
20
25
30

ENVIRONMENTAL BH - GINT STD US.GDT - 1/4/12 10:51 - M:\GROUNDWATER\GINT\PROJECTS\UPLUME INVESTIGATION 2010.GPJ

Appendix A. Boring Logs (continued)

S&K Aerospace
2021 N HWY 191
Moab, UT 84532
Telephone: 970-259-2100
Fax: 970-259-2174

BORING NUMBER UPD-9

CLIENT Department of Energy
PROJECT NAME Northeastern Uranium Plume Investigation
PROJECT NUMBER NA
PROJECT LOCATION Moab UMTRA Site
DATE STARTED 7/21/10 **COMPLETED** 7/21/10
GROUND ELEVATION 3978.5 ft **HOLE SIZE** 2"
DRILLING CONTRACTOR Moab TAC Field Services Group
DRILLING METHOD Direct Push Hydraulic Hammer
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	ENVIRONMENTAL DATA	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0					(SM) SILTY SAND, dry, dark red (10R 3/6)	
					6.5 3972.0	
					Void	
					9.5 3969.0	
					(SM) SILTY SAND, dark red (10R 3/6)	
					16.5 3962.0	
					(SC) CLAYEY SAND, weak red (10R 4/4)	
					23.0 3955.5	
					23.5 Sample UPD-9-M 3955.0	
					Refusal	
					31.0 3947.5	
					Sample UPD-9-D	
					Bottom of borehole at 31.0 feet.	

ENVIRONMENTAL BH - GINT STD US.GDT - 1/4/12 10:52 - M:\GROUNDWATER\GINT\PROJECTS\UPLUME INVESTIGATION 2010.GPJ

Appendix A. Boring Logs (continued)

S&K Aerospace
2021 N HWY 191
Moab, UT 84532
Telephone: 970-259-2100
Fax: 970-259-2174

BORING NUMBER UPD-10

CLIENT Department of Energy
PROJECT NAME Northeastern Uranium Plume Investigation
PROJECT NUMBER NA
PROJECT LOCATION Moab UMTRA Site
DATE STARTED 7/20/10 **COMPLETED** 7/20/10
GROUND ELEVATION 3964 ft **HOLE SIZE** 2"
DRILLING CONTRACTOR Moab TAC Field Services Group
DRILLING METHOD Direct Push Hydraulic Hammer
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	ENVIRONMENTAL DATA	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0					(SM) SILTY SAND, dark red (10R 3/6)	
5						
					6.5 3957.5	
					7.0 Petroleum layer 3957.0	
					(SM) SILTY SAND, yellowish red (5YR 4/6)	
10					▼	
					11.0 3953.0	
					(GC) CLAYEY GRAVEL, yellowish red (5YR 4/6)	
15						
					16.0 3948.0	
					UPD-10-S	
					18.0 3946.0	
					UPD-10-D	
					Bottom of borehole at 18.0 feet.	

ENVIRONMENTAL BH - GINT STD US.GDT - 1/4/12 10:40 - M:\GROUNDWATER\GINT\PROJECTS\UPLUME INVESTIGATION 2010.GPJ

Appendix A. Boring Logs (continued)

S&K Aerospace
2021 N HWY 191
Moab, UT 84532
Telephone: 970-259-2100
Fax: 970-259-2174

BORING NUMBER UPD-11

CLIENT Department of Energy
PROJECT NAME Northeastern Uranium Plume Investigation
PROJECT NUMBER NA
PROJECT LOCATION Moab UMTRA Site
DATE STARTED 7/22/10 **COMPLETED** 7/22/10
GROUND ELEVATION 3966 ft **HOLE SIZE** 2"
DRILLING CONTRACTOR Moab TAC Field Services Group
DRILLING METHOD Direct Push Hydraulic Hammer
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	ENVIRONMENTAL DATA	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0					(SM) SILTY SAND, dry, unconsolidated, dark red (10R 3/6)	
3.5						3962.5
5					(SM/ML) SANDY SILT, reddish brown (5YR 5/4)	
11.0						3955.0
10					(GP/SM) POORLY-GRADED SANDY SILTY GRAVEL, reddish brown (5YR 5/4)	
15					▼	
16.0						3950.0
17.0					Sample UPD-11-S	3949.0
20					(SW/GP) WELL-GRADED GRAVELLY SAND, reddish brown (5YR 5/4)	
22.0						3944.0
25					Refusal	
26.0						3940.0
					Sample UPD-11-M Bottom of borehole at 26.0 feet.	

ENVIRONMENTAL BH - GINT STD US.GDT - 1/4/12 10:41 - M:\GROUNDWATER\GINT\PROJECTS\UPLUME INVESTIGATION 2010.GPJ

Appendix A. Boring Logs (continued)

S&K Aerospace
2021 N HWY 191
Moab, UT 84532
Telephone: 970-259-2100
Fax: 970-259-2174

BORING NUMBER UPD-12

CLIENT Department of Energy
PROJECT NAME Northeastern Uranium Plume Investigation
PROJECT NUMBER NA
PROJECT LOCATION Moab UMTRA Site
DATE STARTED 7/28/10 **COMPLETED** 7/28/10
GROUND ELEVATION 3970 ft **HOLE SIZE** 2"
DRILLING CONTRACTOR Moab TAC Field Services Group
DRILLING METHOD Direct Push Hydraulic Hammer
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	ENVIRONMENTAL DATA	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0					(SM/GP) SILTY SAND WITH POORLY-GRADED GRAVEL, dark red (10R 3/6)	
4.0					3966.0	
					Void	
6.0					3964.0	
					(SM/GP) SILTY SAND WITH POORLY-GRADED GRAVEL, dark red (10R 3/6)	
15.0					3955.0	
					(ML/CL) CLAYEY SILT, reddish brown (5YR 4/3) Sample UPD-12-S	
17.0					3953.0	
					(SM) SILTY SAND, reddish brown (5YR 4/3)	
19.0					3951.0	
					Soil Rejection	
25.0					3945.0	
					Sample UPD-12-M	
33.0					3937.0	
					Sample UPD-12-D	
34.0					3936.0	

Bottom of borehole at 34.0 feet.

ENVIRONMENTAL BH - GINT STD US.GDT - 1/4/12 10:41 - M:\GROUNDWATER\GINT\PROJECTS\LIPLUME INVESTIGATION 2010.GPJ

Appendix A. Boring Logs (continued)

S&K Aerospace
2021 N HWY 191
Moab, UT 84532
Telephone: 970-259-2100
Fax: 970-259-2174

BORING NUMBER UPD-13

CLIENT Department of Energy
PROJECT NAME Northeastern Uranium Plume Investigation
PROJECT NUMBER NA
PROJECT LOCATION Moab UMTRA Site
DATE STARTED 7/28/10 **COMPLETED** 7/28/10
GROUND ELEVATION 3962 ft **HOLE SIZE** 2"
DRILLING CONTRACTOR Moab TAC Field Services Group
DRILLING METHOD Direct Push Hydraulic Hammer
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	ENVIRONMENTAL DATA	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0					(SM) SILTY SAND, dark red (10R 3/6)	
					7.0 — 3955.0	
					(SM/GP) SILTY SAND WITH POORLY-GRADED GRAVEL, dark red yellowish red (5YR 4/6)	
					▼	
					15.0 — 3947.0	
					Sample Rejection	
					16.0 — 3946.0	
					Sample UPD-13-S	
					31.0 — 3931.0	
					Sample UPD-13-D	
					32.0 — 3930.0	
					Bottom of borehole at 32.0 feet.	

ENVIRONMENTAL BH - GNT STD US.GDT - 1/4/12 10:42 - M:\GROUNDWATER\GINT\PROJECTS\UPLUME INVESTIGATION 2010.GPJ

Appendix A. Boring Logs (continued)

S&K Aerospace
2021 N HWY 191
Moab, UT 84532
Telephone: 970-259-2100
Fax: 970-259-2174

BORING NUMBER UPD-14

CLIENT Department of Energy
PROJECT NAME Northeastern Uranium Plume Investigation
PROJECT NUMBER NA
PROJECT LOCATION Moab UMTRA Site
DATE STARTED 8/4/10 **COMPLETED** 8/4/10
GROUND ELEVATION 3966 ft **HOLE SIZE** 2"
DRILLING CONTRACTOR Moab TAC Field Services Group
DRILLING METHOD Direct Push Hydraulic Hammer
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	ENVIRONMENTAL DATA	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0					(SM) SILTY SAND, red (2.5YR 5/8) 3964.5	
1.5					(ML/CL) CLAYEY SILT, strong brown (7.5YR 4/6) 3962.0	
4.0					(SM) SILTY SAND, red (2.5YR 5/8) 3954.5	
11.5					(SM/GP) SILTY SAND WITH POORLY-GRADED GRAVEL, red (2.5YR 5/8) 3952.0	
14.0					(SM) SILTY SAND, light red (2.5YR 6/6) 3951.0	
15.0					Sample UPD-14-S 3949.5	
16.5					Sample Rejection 3941.0	
25.0					Sample UPD-14-M 3933.5	
32.5					Sample UPD-14-D 3932.5	
33.5					Bottom of borehole at 33.5 feet.	

ENVIRONMENTAL BH - GINT STD US.GDT - 1/4/12 10:42 - M:\GROUNDWATER\GINT\PROJECTS\UPLUME INVESTIGATION 2010.GPJ

Appendix A. Boring Logs (continued)

S&K Aerospace
2021 N HWY 191
Moab, UT 84532
Telephone: 970-259-2100
Fax: 970-259-2174

Moab TAC Team

BORING NUMBER UPD-15

CLIENT Department of Energy
PROJECT NAME Northeastern Uranium Plume Investigation
PROJECT NUMBER NA
PROJECT LOCATION Moab UMTRA Site
DATE STARTED 8/10/10 **COMPLETED** 8/10/10
GROUND ELEVATION 3965 ft **HOLE SIZE** 2"
DRILLING CONTRACTOR Moab TAC Field Services Group
DRILLING METHOD Direct Push Hydraulic Hammer
NOTES Lithology was taken from Well Completion Log of MOA01-SMI-MW01

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	ENVIRONMENTAL DATA	GRAPHIC LOG		MATERIAL DESCRIPTION		WELL DIAGRAM
0								
					5.0	(SW) WELL-GRADED SAND, yellowish red (5YR 5/6)	3960.0	
5					10.0	(SP-GP) GRAVELLY SAND, red (10YR 4/4)	3955.0	
10					14.0	(SP-GP) GRAVELLY SAND, reddish brown (10YR 6/3)	3951.0	
15						Sample UPD-15-S		
20					22.0		3943.0	
						Sample UPD-15-M		
25					26.5		3938.5	
					29.0	(GP-SP) SANDY GRAVEL, brown (7.5YR 5/4)	3936.0	
30					29.5		3935.5	
						Sample UPD-15-D		

Bottom of borehole at 30.5 feet.

ENVIRONMENTAL BH - GINT STD US.GDT - 1/4/12 10:42 - M:\GROUNDWATER\GINT\PROJECTS\UPLUME INVESTIGATION 2010.GPJ

Appendix A. Boring Logs (continued)

S&K Aerospace
2021 N HWY 191
Moab, UT 84532
Telephone: 970-259-2100
Fax: 970-259-2174

BORING NUMBER UPD-16

CLIENT Department of Energy
PROJECT NAME Northeastern Uranium Plume Investigation
PROJECT NUMBER NA
PROJECT LOCATION Moab UMTRA Site
DATE STARTED 8/24/10 **COMPLETED** 8/24/10
GROUND ELEVATION 3962 ft **HOLE SIZE** 2"
DRILLING CONTRACTOR Moab TAC Field Services Group
DRILLING METHOD Direct Push Hydraulic Hammer
NOTES Lithology was taken from Well Completion Log of MOA01-SMI-MW01

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	ENVIRONMENTAL DATA	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
0					(SW) WELL-GRADED SAND, yellowish red (5YR 5/6)		
						5.0 3957.0	
					(SP-GP) GRAVELLY SAND, red (10YR 4/4)		
						10.0 3952.0	
					(SP-GP) GRAVELLY SAND, reddish brown (10YR 6/3)		
						15.5 3946.5	
					Sample UPD-16-S		
						25.5 3936.5	
					Sample UPD-16-M		
						26.5 3935.5	

Bottom of borehole at 26.5 feet.

Appendix A. Boring Logs (continued)

S&K Aerospace
2021 N HWY 191
Moab, UT 84532
Telephone: 970-259-2100
Fax: 970-259-2174

BORING NUMBER UPD-17

CLIENT Department of Energy
PROJECT NAME Northeastern Uranium Plume Investigation
PROJECT NUMBER NA
PROJECT LOCATION Moab UMTRA Site
DATE STARTED 5/20/11 **COMPLETED** 5/20/11
GROUND ELEVATION 3967.66 ft **HOLE SIZE** 2"
DRILLING CONTRACTOR Moab TAC Field Services Group
DRILLING METHOD Direct Push Hydraulic Hammer
NOTES Lithology was taken from UPD-11, TOC Elevation = 3967.44 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	ENVIRONMENTAL DATA	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0						Casing Type: 1.5" PVC
					(SM) SILTY SAND, dry, unconsolidated, dark red (10R 3/6) 3964.2	3/8" Bentonite Chips
3.5					(SM/ML) SANDY SILT, reddish brown (5YR 5/4)	
5						
10						0.010 Slotted 1.5" PVC, 20/40 Silica Sand
11.0					(GP/SM) POORLY-GRADED SANDY SILTY GRAVEL, reddish brown (5YR 5/4) 3956.7	
15					3952.4	
15.2					Bottom of borehole at 15.2 feet.	

Appendix A. Boring Logs (continued)

S&K Aerospace
2021 N HWY 191
Moab, UT 84532
Telephone: 970-259-2100
Fax: 970-259-2174

BORING NUMBER UPD-18

CLIENT Department of Energy
PROJECT NAME Northeastern Uranium Plume Investigation
PROJECT NUMBER NA
PROJECT LOCATION Moab UMTRA Site
DATE STARTED 3/18/11 **COMPLETED** 3/18/11
GROUND ELEVATION 3968.66 ft **HOLE SIZE** 2"
DRILLING CONTRACTOR Moab TAC Field Services Group
DRILLING METHOD Direct Push Hydraulic Hammer
NOTES Lithology was taken from UPD-10, TOC Elevation = 3969.00 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	ENVIRONMENTAL DATA	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
0							Casing Type: 1.5" PVC
					(SM) SILTY SAND, dark red (10R 3/6)		3/8" Bentonite Chips
5							
					6.5	3962.2	
					7.0 Petroleum layer	3961.7	
					(SM) SILTY SAND, yellowish red (5YR 4/6)		
10							0.010 Slotted 1.5" PVC, 20/40 Silica Sand
					11.0	3957.7	
					(GC) CLAYEY GRAVEL, yellowish red (5YR 4/6)		
					14.8	3953.9	

Bottom of borehole at 14.8 feet.

ENVIRONMENTAL BH - GINT STD US.GDT - 1/4/12 10:44 - M:\GROUND WATER\GINT\PROJECTS\URANIUM INVESTIGATION 2010.GPJ

Appendix A. Boring Logs (continued)

S&K Aerospace
2021 N HWY 191
Moab, UT 84532
Telephone: 970-259-2100
Fax: 970-259-2174

BORING NUMBER UPD-19

CLIENT Department of Energy
PROJECT NAME Northeastern Uranium Plume Investigation
PROJECT NUMBER NA
PROJECT LOCATION Moab UMTRA Site
DATE STARTED 4/8/11 **COMPLETED** 4/8/11
GROUND ELEVATION 3966.78 ft **HOLE SIZE** 2"
DRILLING CONTRACTOR Moab TAC Field Services Group
DRILLING METHOD Direct Push Hydraulic Hammer
NOTES Lithology was taken from UPD-7, TOC Elevation = 3966.78 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	ENVIRONMENTAL DATA	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0						Casing Type: 1.5" PVC
					(SM) SILTY SAND, dry, mostly fines, red (2.5YR 4/8)	3/8" Bentonite Chips
5						
9.5					3957.3	
10					(SM/WS) WELL-GRADED SILTY SAND, wet, well sorted, less fines, yellowish red (5YR 5/6)	0.010 Slotted 1.5" PVC, 20/40 Silica Sand
12.5					3954.3	
15					(SW) WELL-GRADED SAND, wet, well sorted, gravelly sand, reddish brown (5YR 4/4)	
15.0					3951.8	
15.3					(GP/GM) POORLY-GRADED SILTY GRAVEL, reddish brown (5YR 4/4)	
					3951.5	
					Bottom of borehole at 15.3 feet.	

ENVIRONMENTAL.BH - GINT STD US.GDT - 1/4/12 10:44 - M:\GROUND WATER\GINT\PROJECTS\UPLUME INVESTIGATION 2010.GPJ

Appendix A. Boring Logs (continued)

S&K Aerospace
2021 N HWY 191
Moab, UT 84532
Telephone: 970-259-2100
Fax: 970-259-2174

BORING NUMBER UPD-20

CLIENT Department of Energy
PROJECT NAME Northeastern Uranium Plume Investigation
PROJECT NUMBER NA
PROJECT LOCATION Moab UMTRA Site
DATE STARTED 5/20/11 **COMPLETED** 5/20/11
GROUND ELEVATION 3975.94 ft **HOLE SIZE** 2"
DRILLING CONTRACTOR Moab TAC Field Services Group
DRILLING METHOD Direct Push Hydraulic Hammer
NOTES Lithology was taken from UPD-5, TOC Elevation = 3978.73 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	ENVIRONMENTAL DATA	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
0							Casing Type: 1.5" PVC
					(SM) SILTY SAND, dry, red (2.5YR 4/8)		
11.0						3964.9	
					(SC/SM) CLAYEY SILTY SAND, moist, red (2.5YR 4/8)		
14.0						3961.9	
					(SM) SILTY SAND, dark yellowish brown (10YR 3/4) Sample UPD-5-S		
17.0						3958.9	
					(SM) SILTY SAND, light red (2.5YR 6/8)		
22.0						3953.9	
					(SW) WELL-GRADED SAND, reddish brown (5YR 4/4)		
26.0						3949.9	
26.6					(GP) POORLY-GRADED GRAVEL, angular to subangular, reddish brown (5YR 4/4)	3949.4	
					Bottom of borehole at 26.6 feet.		

3/8" Bentonite Chips

0.010 Slotted 1.5" PVC, 20/40 Silica Sand

5 10 15 20 25

ENVIRONMENTAL BH - GINT STD US.GDT - 1/4/12 10:45 - M:\GROUND WATER\GINT\PROJECTS\UPLUME INVESTIGATION 2010.GPJ

Appendix A. Boring Logs (continued)

S&K Aerospace
2021 N HWY 191
Moab, UT 84532
Telephone: 970-259-2100
Fax: 970-259-2174

BORING NUMBER UPD-21

CLIENT Department of Energy
PROJECT NAME Northeastern Uranium Plume Investigation
PROJECT NUMBER NA
PROJECT LOCATION Moab UMTRA Site
DATE STARTED 6/10/11 **COMPLETED** 6/10/11
GROUND ELEVATION 3978.5 ft **HOLE SIZE** 2"
DRILLING CONTRACTOR Moab TAC Field Services Group
DRILLING METHOD Direct Push Hydraulic Hammer
NOTES Lithology was taken from UPD-9, TOC Elevation = 3981.45 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	ENVIRONMENTAL DATA	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
0							Casing Type: 1.5" PVC
					(SM) SILTY SAND, dry, dark red (10R 3/6)		
6.5						3972.0	
					Void		3/8" Bentonite Chips
9.5						3969.0	
					(SM) SILTY SAND, dark red (10R 3/6)		
16.5						3962.0	
					(SC) CLAYEY SAND, weak red (10R 4/4)		
					▽		0.010 Slotted 1.5" PVC, 20/40 Silica Sand
23.5						3955.0	
27.0						3951.5	

Bottom of borehole at 27.0 feet.

ENVIRONMENTAL BH - GINT STD US.GDT - 1/4/12 10:46 - M:\GROUND WATER\GINT\PROJECTS\UPLUME INVESTIGATION 2010.GPJ

Appendix A. Boring Logs (continued)

S&K Aerospace
2021 N HWY 191
Moab, UT 84532
Telephone: 970-259-2100
Fax: 970-259-2174

BORING NUMBER UPD-22

CLIENT Department of Energy
PROJECT NAME Northeastern Uranium Plume Investigation
PROJECT NUMBER NA
PROJECT LOCATION Moab UMTRA Site
DATE STARTED 10/28/11 **COMPLETED** 10/28/11
GROUND ELEVATION 3964.29 ft **HOLE SIZE** 2"
DRILLING CONTRACTOR Moab TAC Field Services Group
DRILLING METHOD Direct Push Hydraulic Hammer
NOTES Lithology was taken from UPD-12, TOC Elevation = 3966.20 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	ENVIRONMENTAL DATA	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
0							Casing Type: 1.5" PVC
					(SM/GP) SILTY SAND WITH POORLY-GRADED GRAVEL, dark red (10R 3/6)		
				4.0		3960.3	3/8" Bentonite Chips
5					Void		
				6.0		3958.3	
					(SM/GP) SILTY SAND WITH POORLY-GRADED GRAVEL, dark red (10R 3/6)		
10							0.010 Slotted 1.5" PVC, 20/40 Silica Sand
15				15.0		3949.3	
					(ML/CL) CLAYEY SILT, reddish brown (5YR 4/3)		
				16.6		3947.7	

Bottom of borehole at 16.6 feet.

ENVIRONMENTAL BH - GINT STD US.GDT - 1/4/12 10:46 - M:\GROUND WATER\GINT\PROJECTS\UPLUME INVESTIGATION 2010.GPJ

Appendix B.
Soil and Ground Water Data

Appendix B. Soil and Ground Water Data

Table B-1. Ra-226 and Total Uranium Soil Concentrations for Borings UPD-1 Through 16

Boring Number	Sample Depth (ft bgs)	Ra-226 Concentration (pCi/g)	Total Uranium Concentration (pCi/g)
UPD - 1	0 – 2.5	6.3	58.6
	2.5 – 5.0	0.7	31.0
	5.0 – 7.5	1.6	32.2
	7.5 – 13	2.4	35.6
	13 – 19	0.8	11.0
UPD - 2	0 – 2.5	1.1	85.1
	2.5 – 5.0	1.5	21.2
	5 – 7.5	1.5	17.2
	7.5 – 12.5	0.9	5.8
	12.5 – 18	1.1	11.8
UPD - 3	0 – 2.5	1.1	19.3
	2.5 – 5.0	1.3	7.2
	5.0 – 7.5	1.5	13.1
	7.5 – 12.5	0.3	11.4
	12.5 – 17.5	0.3	3.7
	17.5 – 22.5	0.4	10.5
	22.5 - 26	0.2	10.1
UPD - 4	0 – 2.5	3.2	18.3
	2.5 – 7.0	0.2	21.2
	7.0 - 10	1.2	14.5
	10 – 15	1.3	15.4
	15 – 20	1.1	8.0
	20 – 25	1.3	11.1
	25 – 33	0.3	7.6
UPD - 5	0 – 2.5	1.5	21.8
	2.5 – 5.0	2.8	21.0
	5.0 – 7.5	0.5	15.1
	7.5 – 10	1.2	12.9
	10 – 15	2.9	13.9
	15 – 20	1.9	5.9
	20 – 25	0.1	10.7
	25 – 30	0.2	6.2

Appendix B. Soil and Ground Water Data (continued)

Table B-1. Ra-226 and Total Uranium Soil Concentrations for Borings UPD-1 Through 16 (continued)

Boring Number	Sample Depth (ft bgs)	Ra-226 Concentration (pCi/g)	Total Uranium Concentration (pCi/g)
UPD - 6	0 – 2.5	0.2	162.5
	2.5 – 5.0	1.8	49.2
	5.0 – 7.5	1.8	31.9
	7.5 – 11.5	0.6	9.0
	11.5 – 15.5	2.7	15.2
	15.5 – 19.5	1.7	9.4
UPD - 7	0 – 2.5	2.7	14.9
	2.5 – 5.0	0.8	13.8
	5.0 – 7.5	1.5	7.2
	7.5 - 10	0.3	8.5
	10 – 15.5	0.2	11.0
UPD - 8	0 – 2.5	4.4	30.5
	2.5 – 5.0	1.5	9.3
	5.0 – 7.5	1.0	12.1
	10 – 15	0.6	7.0
	15 – 21	0.1	4.0
UPD - 9	0 – 2.5	2.7	13.7
	2.5 – 5.0	0.1	5.0
	5.0 – 7.5	0.3	3.8
	7.5 – 11.5	1.9	11.3
	11.5 – 14.0	2.6	14.4
	14.0 – 16.5	3.0	11.2
	16.5 – 21.5	0.6	10.0
	21.5 – 23.0	1.2	10.2
UPD - 10	0 – 2.5	6.5	22.9
	2.5 – 5.0	6.1	15.6
	5.0 – 7.5	0.5	8.0
	7.5 – 11.5	0.7	5.0
	11.5 – 15.5	1.4	10.1

Appendix B. Soil and Ground Water Data (continued)

Table B-1. Ra-226 and Total Uranium Soil Concentrations for Borings UPD-1 Through 16 (continued)

Boring Number	Sample Depth (ft bgs)	Ra-226 Concentration (pCi/g)	Total Uranium Concentration (pCi/g)
UPD – 11	0 – 2.5	113.8	176.3
	2.5 – 5.0	3.9	16.1
	5.0 – 7.5	1.7	19.4
	7.5 – 11.5	2.1	15.3
	11.5 – 15.5	1.3	6.8
	18.0 – 22.0	0.3	4.8
UPD – 12	0 – 2.5	1.6	5.1
	2.5 – 7.5	1.3	9.6
	7.5 – 13.0	1.4	11.2
	13.0 –15.5	1.7	19.4
	15.5 – 19.5	1.5	13.9
UPD – 13	0 – 2.5	7.2	30.3
	2.5 – 7.5	0.2	9.2
	11.5 – 15.5	0.6	8.3
UPD - 14	0 – 2.5	5.2	31.4
	2.5 – 5.0	7.5	35.3
	5.0 – 7.5	1.1	4.5
	7.5 – 11.5	1.2	5.7
	11.5 – 15.5	0.1	7.4
UPD-15	0 – 2.5	1.0	17.0
	2.5 – 5.0	0.9	13.3
	5.0 – 7.5	1.6	13.8
	7.5 – 11.5	0.4	6.2
	11.5 – 15.5	0.2	5.4
UPD-16[1]	4.5 – 6.0	1.1	18.9
	9.5 – 11.0	17.6	72.1
	11.0 – 12.5	1.8	3.6

Notes: Sample data are from sample location R1295 in the report *Radiological Assessment for Non-Pile Areas of the Moab Project Site* (DOE-EM/GJ901-2005)

Appendix B. Soil and Ground Water Data (continued)

Table B-2. Ground Water Uranium Concentrations of Grab Samples Collected from Borings UPD-1 Through 16

Boring Number	Sample Depth (ft bgs)	Ground Water Uranium Concentration (mg/L)
UPD - 1	10.3	1.4
	17	4.9
	20.5	0.13
UPD - 2	9	0.56
	17	0.09
	28.5	0.45
UPD - 3	10.5	1.7
	18.5	0.1
	25.5	0.02
UPD- 4	18	2.8
	24	0.1
	32	0.004
UPD - 5	14	8.2
	22	0.89
	31	0.01
UPD - 6	11	0.66
	18.5	1.8
	30	0.007
UPD - 7	10	1.1
	18.5	2
	30	0.38
UPD- 8	12	0.3
	20	0.04
	30	0.007
UPD - 9	23	0.61
	31	0.011
UPD - 10	16	0.82
	18	0.39
UPD - 11	16	1.3
	26	0.35
UPD- 12	15	8.8
	25	0.42
	33	0.36

Appendix B. Soil and Ground Water Data (continued)

Table B-2. Ground Water Uranium Concentrations of Grab Samples Collected from Borings UPD-1 Through 16

Boring Number	Sample Depth (ft bgs)	Ground Water Uranium Concentration (mg/L)
UPD - 13	16	0.087
	31	0.3
UPD - 14	15	1.0
	25	0.79
	32.5	2.1
UPD - 15	14	0.74
	22	1.1
	29.5	0.88
UPD- 16	15.5	2.2
	25.5	1.3

Appendix B. Soil and Ground Water Data (continued)

Table B-3. Uranium Sample Collection Dates and Concentrations

Boreholes		
Location	**Date Collected**	**U mg/L**
UPD-1	5/17/10	1.4/ 4.0/ 4.9
UPD-2	5/19/10	0.56/ 0.0097/ 0.45
UPD-3	5/20/10	1.7/ 0.1/ 0.025
UPD-4	5/24/10	2.8/ 0.004
UPD-5	5/26/10	8.2/ 0.89/ 0.012
UPD-6	6/2/10	0.66/ 1.8/0.0078
UPD-7	6/7/10	1.1/ 2.0/ 0.38
UPD-8	6/7/10	0.3/ 0.047/ 0.0073
UPD-9	7/21/10	0.61/ 0.011
UPD-10	7/20/10	0.82
UPD-11	7/22/10	1.3/ 0.35
UPD-12	7/28/10	8.8
UPD-13	7/28/10	0.087/ 0.3
UPD-14	8/4/10	1
UPD-15	8/10/10	0.74
UPD-16	8/24/10	2.2
Observation Wells		
UPD-17	10/5/11	1.6
	11/21/11	1.5
UPD-18	10/5/11	1.4
	11/21/11	1.3
UPD-19	10/4/11	0.89
	11/21/11	0.70
UPD-20	10/4/11	0.97
	11/21/11	0.52
UPD-21	10/4/11	11
	11/22/11	12
UPD-22	11/22/11	2.4
411	11/2/10	3.9
	11/17/11	8.1
412	10/27/10	4.1
	11/17/11	1.7
413	11/1/10	1.1
414	10/27/10	4.9
SMI-MW01	10/27/10	5.6
	11/17/11	5.1
SMI-PZ3S	11/2/10	1.8
	11/17/11	1.4