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UMTRA Ground Water Project

**Results of Drilling Activities and
Resolution of Ground Water Issues at the
Mexican Hat, Utah, UMTRA Project Site**

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1.0 Introduction

Per discussion with the Navajo Nation in October 2000, the U.S. Department of Energy (DOE) agreed to install one additional monitor well at the Mexican Hat, Utah, Uranium Mill Tailings Remedial Action (UMTRA) Project site to address Navajo Nation concerns. The purpose of the monitor well was to determine if site-related contamination was present in ground water in the confined uppermost aquifer in the lower unit of the Permian Halgaito Formation (“regional aquifer”) downgradient from the Mexican Hat disposal cell. Contaminated water is present in ephemeral, perched zones in the upper unit of the Halgaito Formation. To prevent impact to ground water quality in the lower unit, casing was cemented in the borehole to isolate these zones.

This report provides information on drilling and monitor well installation, ground water sampling and analytical results, recommendations for continued monitoring, and conclusions allowing closure of the outstanding Subpart B issues at the Mexican Hat site with DOE in compliance with the requirements in 40 CFR 192.

2.0 Drilling and Monitor Well Installation

The new monitor well (HAT01-0899) is located approximately 100 feet (ft) east of the fence surrounding the disposal cell, 75 ft south of the East Toe Drain, and just inside the DOE property boundary (Figure 1). Drilling commenced on October 31, 2000, and monitor well installation was completed on November 5, 2000. Details of the lithology of the borehole and construction of the monitor well are shown in Attachment A.

The borehole was drilled using a retractable bit (“Stradex”) system with an 11-inch diameter temporary casing to 64 ft in depth. From 64 ft to total depth, dual wall reverse circulation with a down-hole hammer was used. Coring in the lower part of the borehole was not necessary because lithologic description of the chip samples through the “Cyclone” return was very good and there was no apparent sample lag.

The borehole was drilled to a depth of 224 ft. The lithologic sequence encountered in the borehole consisted of siltstone, sandstone, claystone, and limestone of the Permian Halgaito Formation (Figure 2). The borehole was designed to reach the McKim Limestone, which is the uppermost unit of the underlying Pennsylvanian Honaker Trail Formation. However, the ultimate objective was to install the monitor well in the lower part of the Halgaito Formation in the confined regional aquifer, which was encountered at approximately 190 ft; consequently, the drilling stopped short of the McKim Limestone.

The first water-bearing zone, producing less than 1 gallon per minute (gpm), was encountered at a depth of 70 ft. The driller lost circulation and had to inject water to get the drill cuttings out of the hole. The zone had dried up when a depth of 89 ft was attained. (Note: the water zone was not 19 ft thick, but difficult to determine when the driller injected water and had no returns from 75 through 90 ft). Another water zone was encountered from 95 to 97 ft in depth. This zone produced water at approximately 2.5 gpm. A third water zone was encountered from 112 to 124 ft producing water at less than 0.5 gpm. The driller circulated the hole for approximately 15 minutes and the total hole to this point was producing 2.5 to 3 gpm. The following day, water

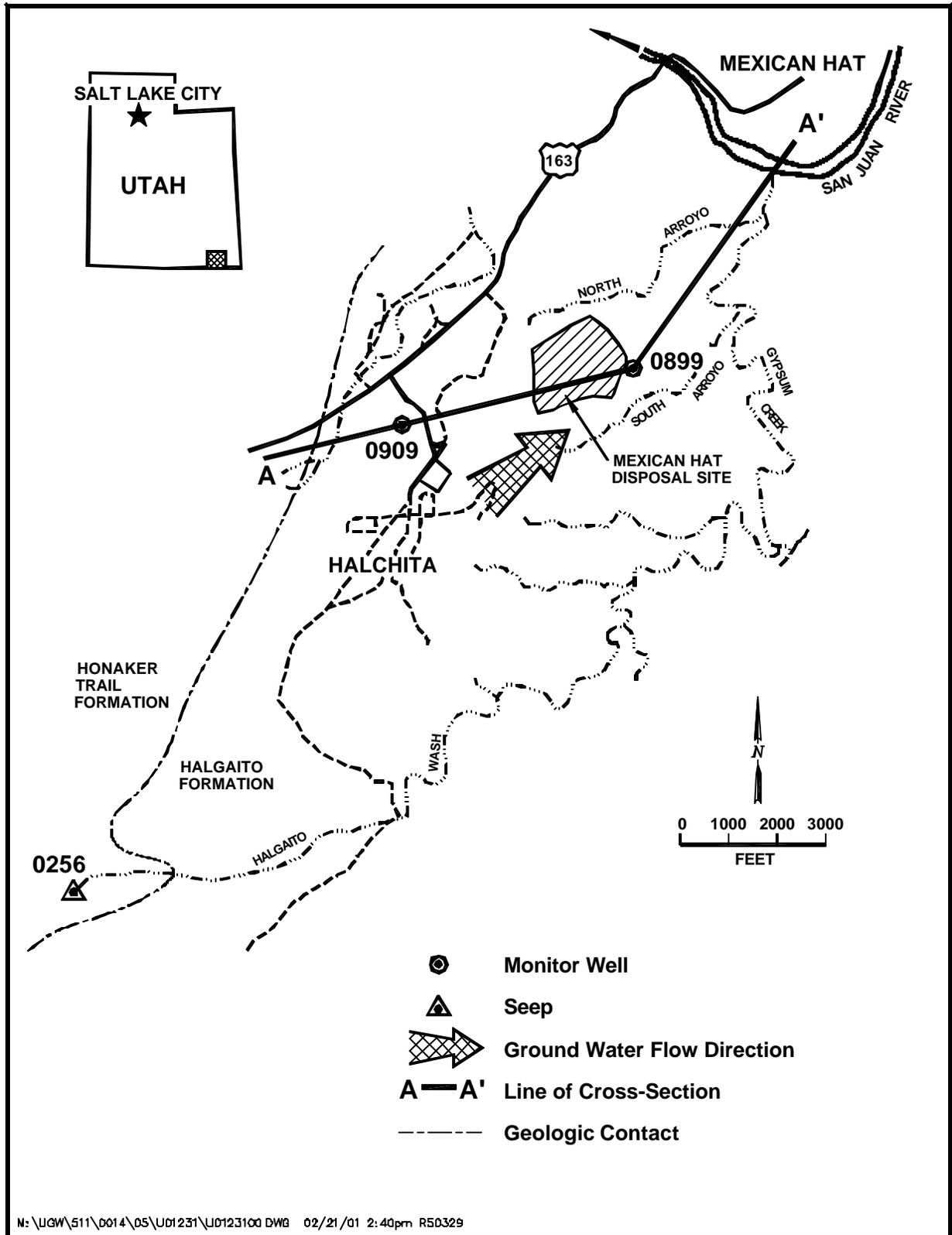


Figure 1. Location of Monitor Wells and Seeps at the Mexican Hat, Utah, Site

from the borehole was removed (approximately 100 gallons), and another water zone (with very little water) was encountered at a depth of 158 ft. The formation was dry from 159 to 164 ft. To prevent hydraulic communication between the upper and lower units of the Halgaito Formation, 6 7/8-inch diameter steel casing was installed from the surface to 164 ft, cemented in, and allowed to set up over night. Drilling continued to 190 ft where water was encountered with a flow rate of approximately 5 gpm. At 195 ft in depth the flow of water increased to 22 gpm. The borehole set for 15 minutes and the water level in the casing rose to 46 ft below the ground surface. The hole was drilled deeper to a total depth of 224 ft.

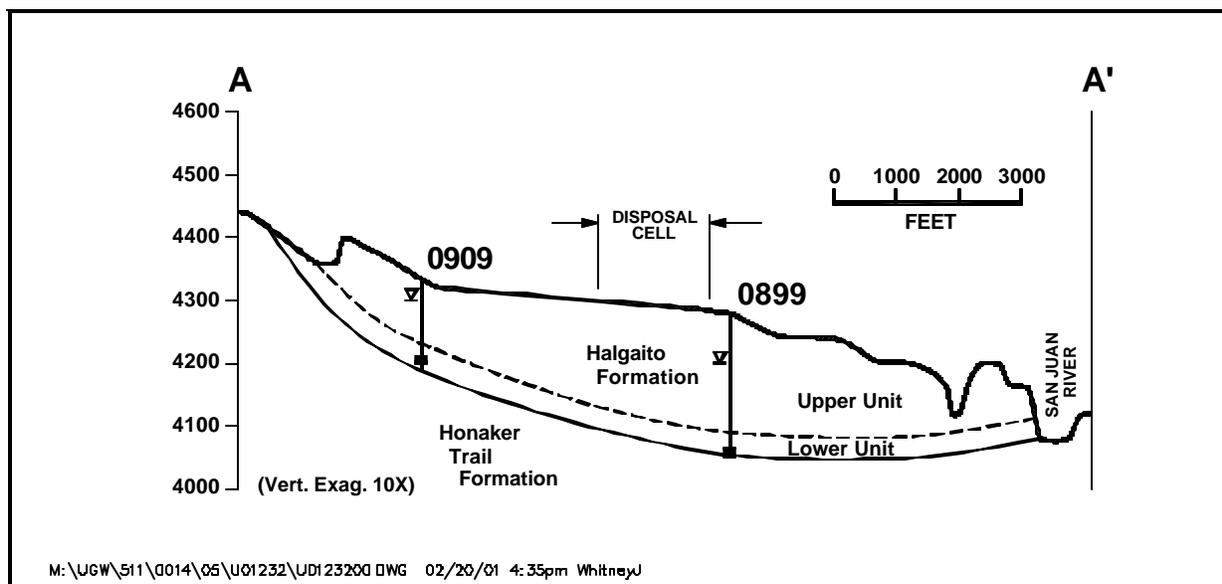


Figure 2. Cross Section of the Mexican Hat, Utah, Site

The monitor well was constructed using 2-inch-diameter Schedule 40 PVC casing with 10 ft of 0.020-inch PVC machine-slotted screen placed from 207 to 217 ft in depth in the uppermost aquifer. The screened interval was set somewhat higher in the hole to include some thin sandstone lenses. The sand pack was placed from 224 to 194 ft in depth with a 5 ft bentonite plug above this. The water level in the completed well was approximately 32 ft below the ground surface (Attachment B).

In summary, ephemeral water from several perched zones was encountered from approximately 70 to 158 ft in depth. These zones were isolated with casing cemented from the surface to 164 ft below the ground surface. Ground water from the confined uppermost aquifer in the lower unit of the Halgaito Formation (“regional aquifer”) was encountered at a depth of approximately 190 ft. There is a substantial upward hydraulic gradient from the confined aquifer as indicated by the observed water level in the completed well at approximately 32 ft below the ground surface (Figure 2).

3.0 Ground Water Sampling and Analytical Results

Ground water from monitor well 0899 was collected on November 9, 2000, for preliminary analyses of the constituents of potential concern (nitrate, sulfate, and uranium). Results indicated concentrations of 0.03 milligrams per liter (mg/L) for nitrate, 4,230 mg/L for sulfate, and 0.021 mg/L for uranium. The monitor well was sampled again on November 13, 2000, during a scheduled sampling period. Analytical results from this sampling indicated concentrations of 0.03 mg/L for nitrate, 4,200 mg/L for sulfate, and 0.014 mg/L for uranium. Analytical results were validated in January 2001, and are attached to this report (Attachment C).

Analytical results from monitor well 0899 were compared with background ground water quality in the uppermost aquifer observed in upgradient monitor well 0909 and ground water discharging from seep 0256 in Halgaito Wash (Figure 1 and Attachments D and E). Monitor well 0909 is located approximately 3,000 ft west of the disposal cell and is completed in the lower unit of the Halgaito Formation (confined regional aquifer) at a depth of 157 ft with the screened interval from 130 to 150 ft. Depth to ground water was approximately 53 ft below top of casing in November 2000. Seep 0256 is located approximately 14,000 ft southwest of the disposal cell. This seep emerges from the upper part of the Honaker Trail Formation, but water from this formation provides recharge to the confined regional aquifer in the lower unit of the Halgaito Formation. These two locations have been sampled since 1985 and 1990, respectively.

In general, background ground water quality in the confined regional aquifer is characterized by relatively high concentrations of sulfate as the dominant anion, balanced by nearly equal concentrations of sodium, calcium, and magnesium. The pH is slightly alkaline and limited Eh measurements indicate the water is oxidizing. Total dissolved solids (TDS) range from 3,170 to 5,910 mg/L (DOE 1998). Background concentrations of uranium based on monitor well 0909 average 0.047 mg/L (which is above the UMTRA Project maximum concentration limit [MCL] for uranium of 0.044 mg/L). Naturally elevated concentrations of uranium are confirmed by ground water discharging from seep 0256 with concentrations that average 0.027 mg/L. These occurrences indicate a source of uranium in ground water in these units that is not related to uranium processing activities at the Mexican Hat site. Concentrations of sulfate are naturally elevated in ground water in this area and average 2,300 mg/L. There is no UMTRA Project MCL for sulfate. Concentrations of nitrate average less than 8 mg/L which are substantially below the MCL of 44 mg/L. Concentrations of these three constituents are summarized in [Table 1](#) and analytical results are provided in Attachments C through E. Uranium and sulfate concentrations are plotted versus time in [Figures 3](#) and [4](#), respectively; nitrate concentrations were not plotted since they are below the MCL.

In summary, ground water quality in the confined regional aquifer (lower unit of the Halgaito Formation? uppermost aquifer) analyzed from monitor well 0899 is similar to background ground water quality in the vicinity of the Mexican Hat site. This indicates that there is widespread ambient uranium in ground water not related to site-specific milling activities. Also, the elevated sulfate concentrations are representative of natural ground water quality in the area. The observed strong upward vertical hydraulic gradient from this aquifer precludes migration of any site-related contaminants into this confined aquifer.

Table 1. Summary of Constituents at the Mexican Hat, Utah, Site

Constituent	HAT01-0909	HAT01-0256	HAT01-0899
Location	Background	Background	Downgradient
Uranium? MCL	0.044		
Uranium? Average	0.047	0.027	----
Uranium? Range	0.039-0.064	0.010-0.046	0.014
Sulfate? MCL	None		
Sulfate? Average	2,216	2,384	----
Sulfate? Range	1,750-2,800	1,890-3,260	4,200
Nitrate? MCL	44		
Nitrate? Average	8	<1	----
Nitrate? Range	<1-12	<1-4	<1

All concentrations in mg/L.

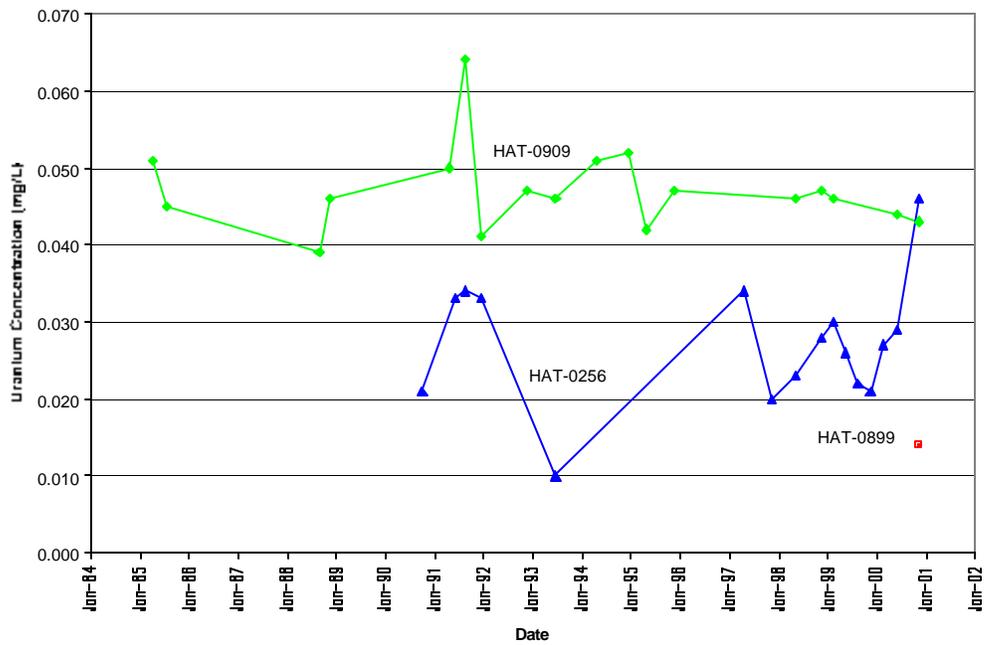


Figure 3. Uranium in Ground Water at the Mexican Hat, Utah, Site

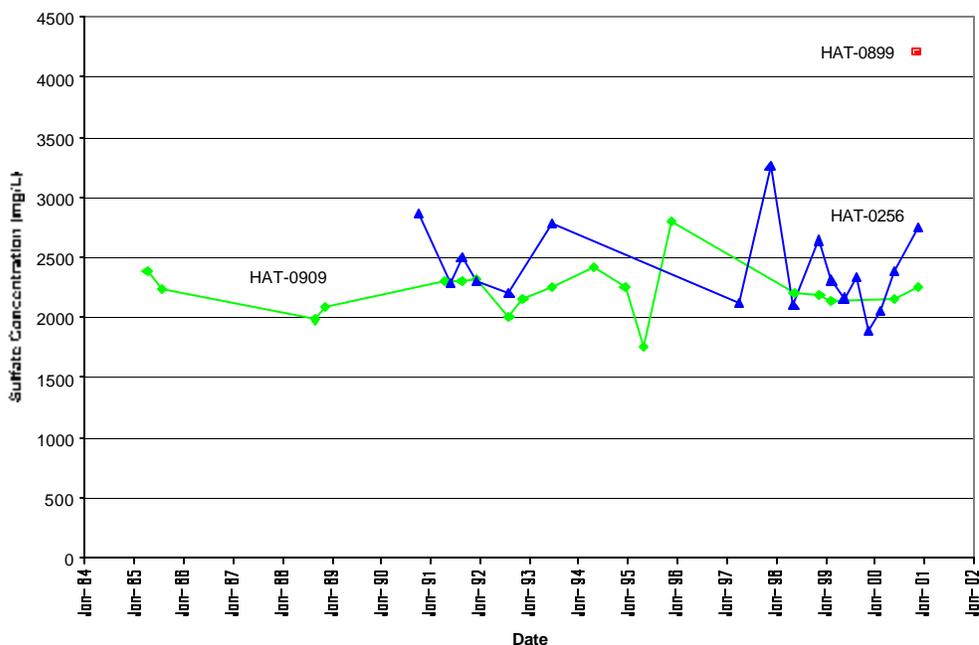


Figure 4. Sulfate in Ground Water at the Mexican Hat, Utah, Site

4.0 Monitoring Plan

Ground water quality from the background (0909) and downgradient (0899) monitor wells will continue to be monitored as a best management practice through 2002. The two monitor wells will be sampled and water levels measured during this period on a semiannual basis (February/August). Indicator parameters to be analyzed will be uranium, sulfate, and nitrate. Standard geochemical parameters will also be measured during the sampling events. At the end of the best management practice monitoring period in 2002 the need for continued monitoring will be determined. This monitoring duration is coincident with the Long-Term Surveillance and Maintenance (LTSM) seep monitoring program at the site.

5.0 Conclusions

Analytical results from this sampling demonstrate that site-related contamination is not present in ground water in the confined uppermost aquifer in the lower unit of the Halgaito Formation (“regional aquifer”) in the vicinity of the Mexican Hat site. Concentrations of uranium, sulfate, and nitrate are similar to ranges observed in background monitor well 0909 in the uppermost aquifer and the background seep 0256 in the Honaker Trail Formation upgradient from the site. In general, background ground water quality is characterized by relatively high concentrations of sulfate as the dominant anion, balanced by nearly equal concentrations of sodium, calcium, and magnesium. Background concentrations of nitrate and uranium are less than 10 and 0.050 mg/L, respectively. Downward migration of contaminants related to uranium processing activities into the uppermost aquifer has not been observed and is not expected because of the confining properties of thin limestone beds near the top of the lower unit and the observed upward hydraulic gradient from the lower unit of the Halgaito Formation.

In summary, results of this investigation demonstrate that ground water in the uppermost aquifer downgradient from the Mexican Hat processing/disposal site has not been impacted by site-related uranium milling activities. This will allow closure of the outstanding Subpart B issues at the Mexican Hat site with DOE in compliance with the requirements in 40 CFR 192.

6.0 References

U.S. Department of Energy (DOE), 1993. *Remedial Action Plan (RAP) for the Codisposal and Stabilization of the Monument Valley and Mexican Hat Uranium Mill Tailings at Mexican Hat, Utah*, UMTRA-DOE/AL-050509.0000, February.

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U.S. Nuclear Regulatory Commission (NRC), 1996. *Final Technical Evaluation Report (fTER) for the Proposed Remedial Action Plan for the Co-disposal of the Monument Valley and Mexican Hat Contaminated Materials at the Mexican Hat Tailings Site, Utah*, transmitted from NRC to DOE with letter of February 27, 1996.

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Attachment A

Monitoring Well Completion Log for HAT01-0899

Attachment B

Static Ground Water Levels for Monitor Wells 0899 and 0909

Attachment C

Ground Water Quality Data by Location for Monitor Well 0899

Attachment D

Ground Water Quality Data by Location for Monitor Well 0909

Attachment E

Surface Water Quality Data by Location for Ground Water Seep 0256