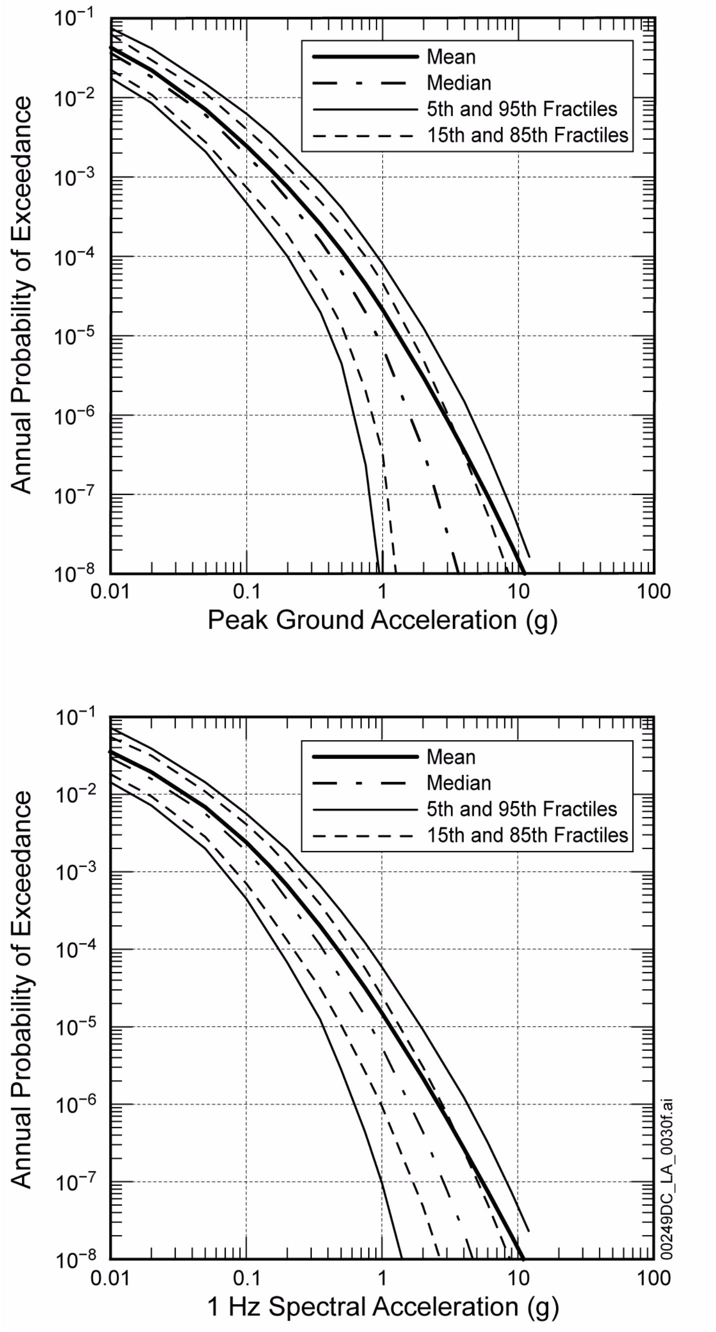


Figure 1.1-74. Hazard Curves at Reference Rock Outcrop for Peak Horizontal Ground Acceleration and 1 Hz Horizontal Spectral Acceleration

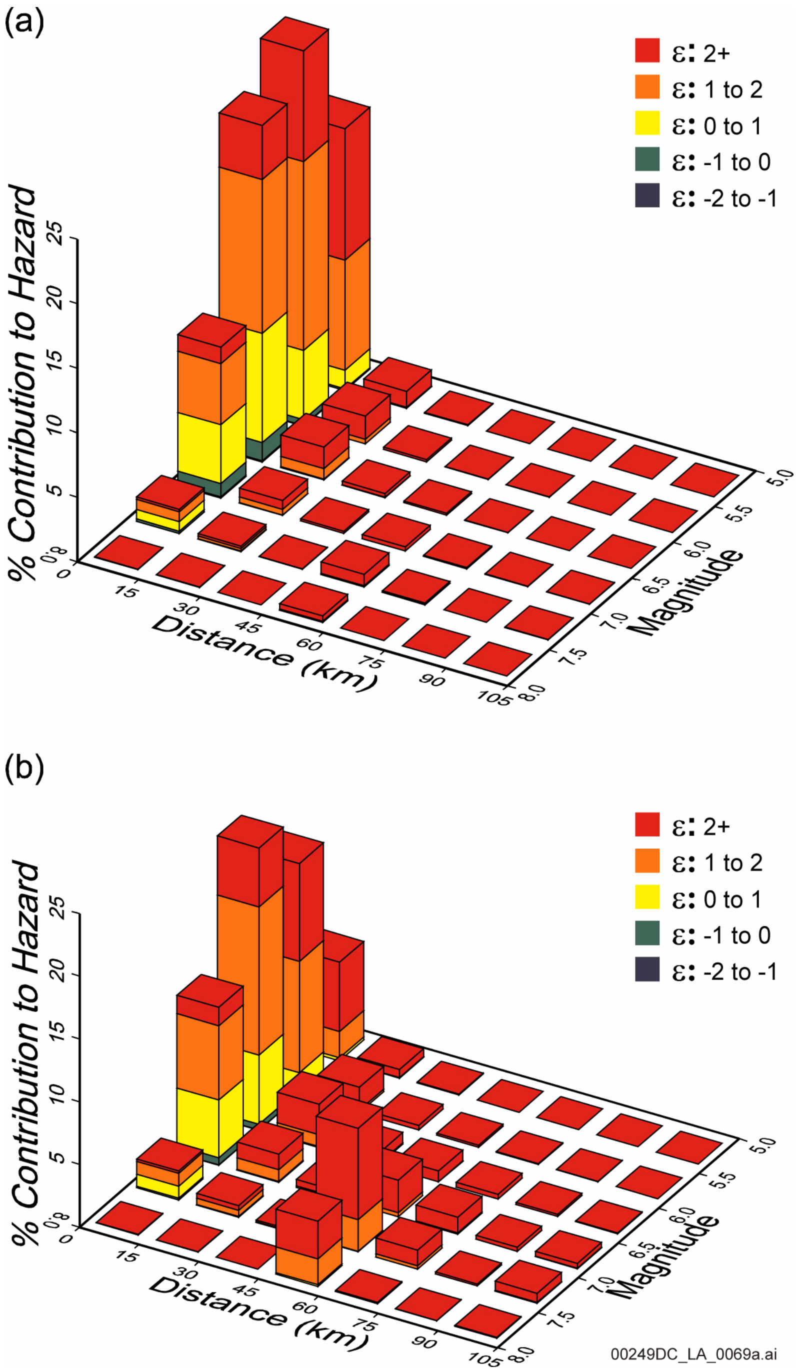


Figure 1.1-75. Deaggregation of Mean Seismic Hazard for Horizontal Spectral Acceleration at 10^{-4} Annual Exceedance Probability for the Reference Rock Outcrop

NOTE: Graph (a) is for 5 to 10 Hz horizontal spectral acceleration; graph (b) is for 1 to 2 Hz horizontal spectral acceleration.

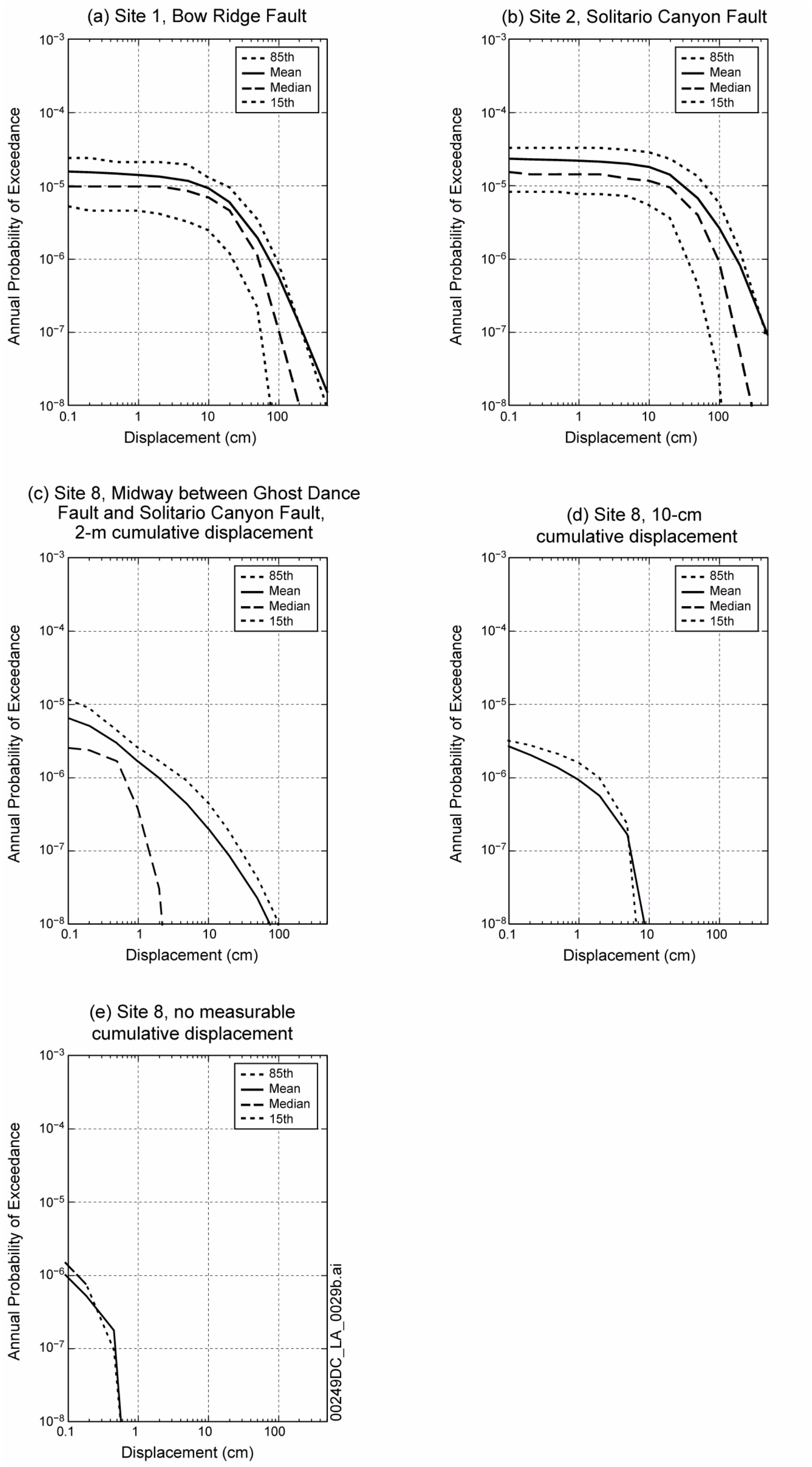


Figure 1.1-76. Example Summary Fault Displacement Hazard Curves for Yucca Mountain

NOTE: On some plots, the median and 15th percentile curves have an annual probability of exceedance of less than 10^{-8} and are not shown.

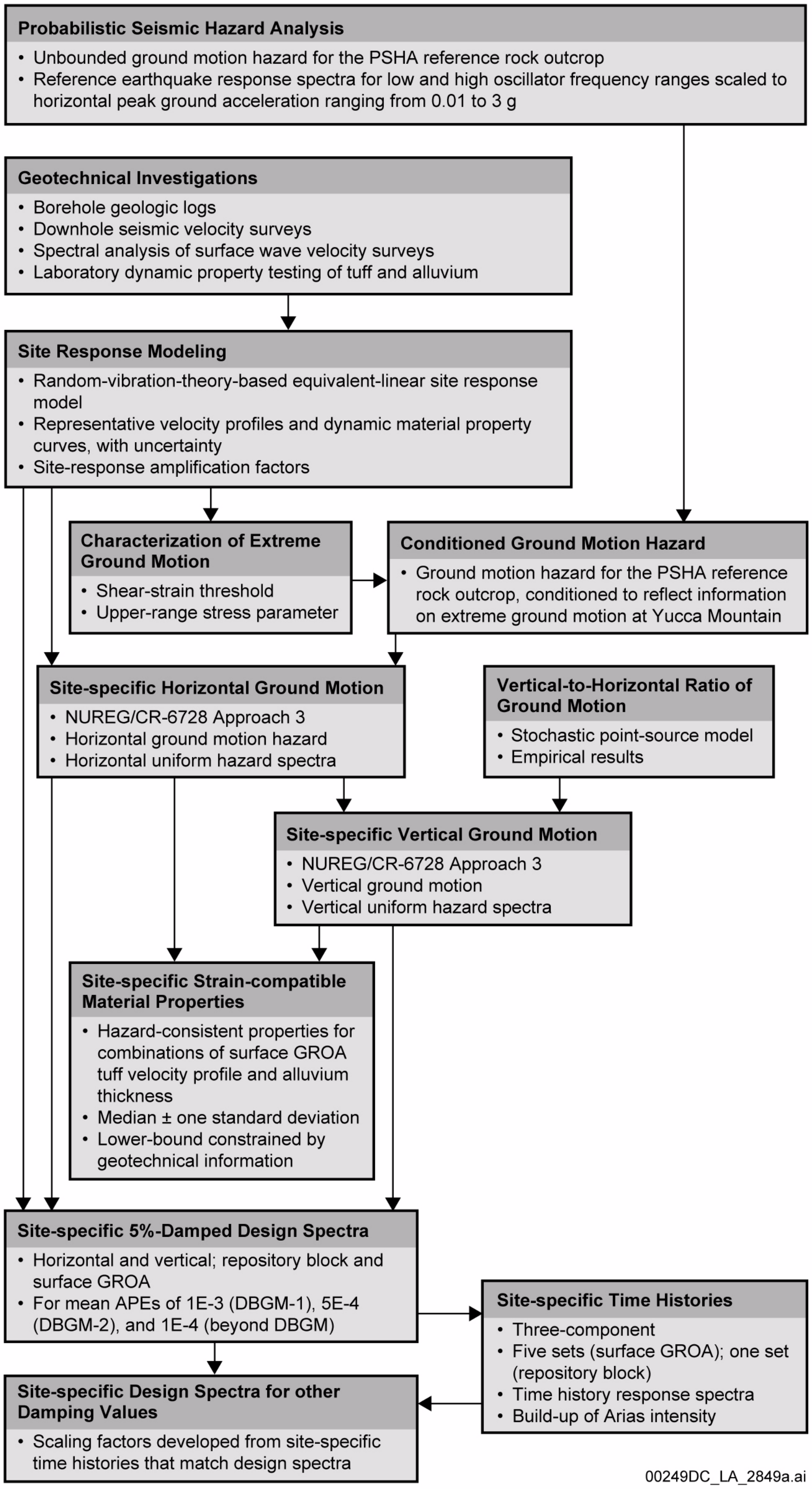


Figure 1.1-77. Schematic Representation of Development of Supplemental Ground Motions

NOTE: APEs = annual probabilities of exceedance

Source: BSC 2008c, Figure 6.1-1.

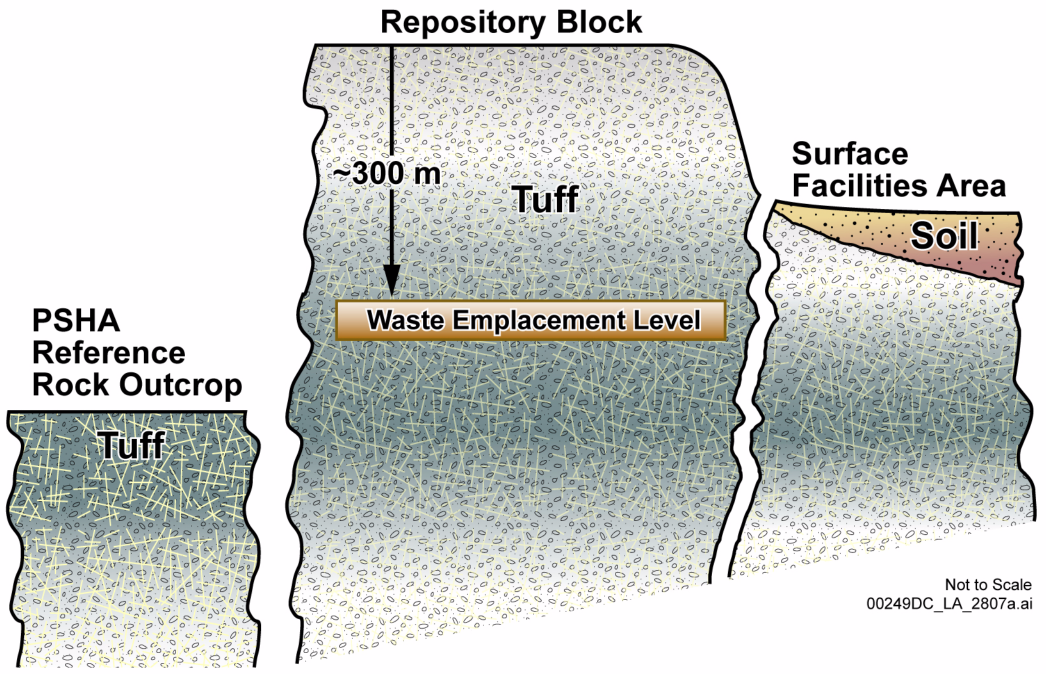


Figure 1.1-78. Schematic Representation of the Locations for Which Seismic Input Ground Motions are Developed

NOTE: Vertically exaggerated.

Source: BSC 2008c, Figure 1-1

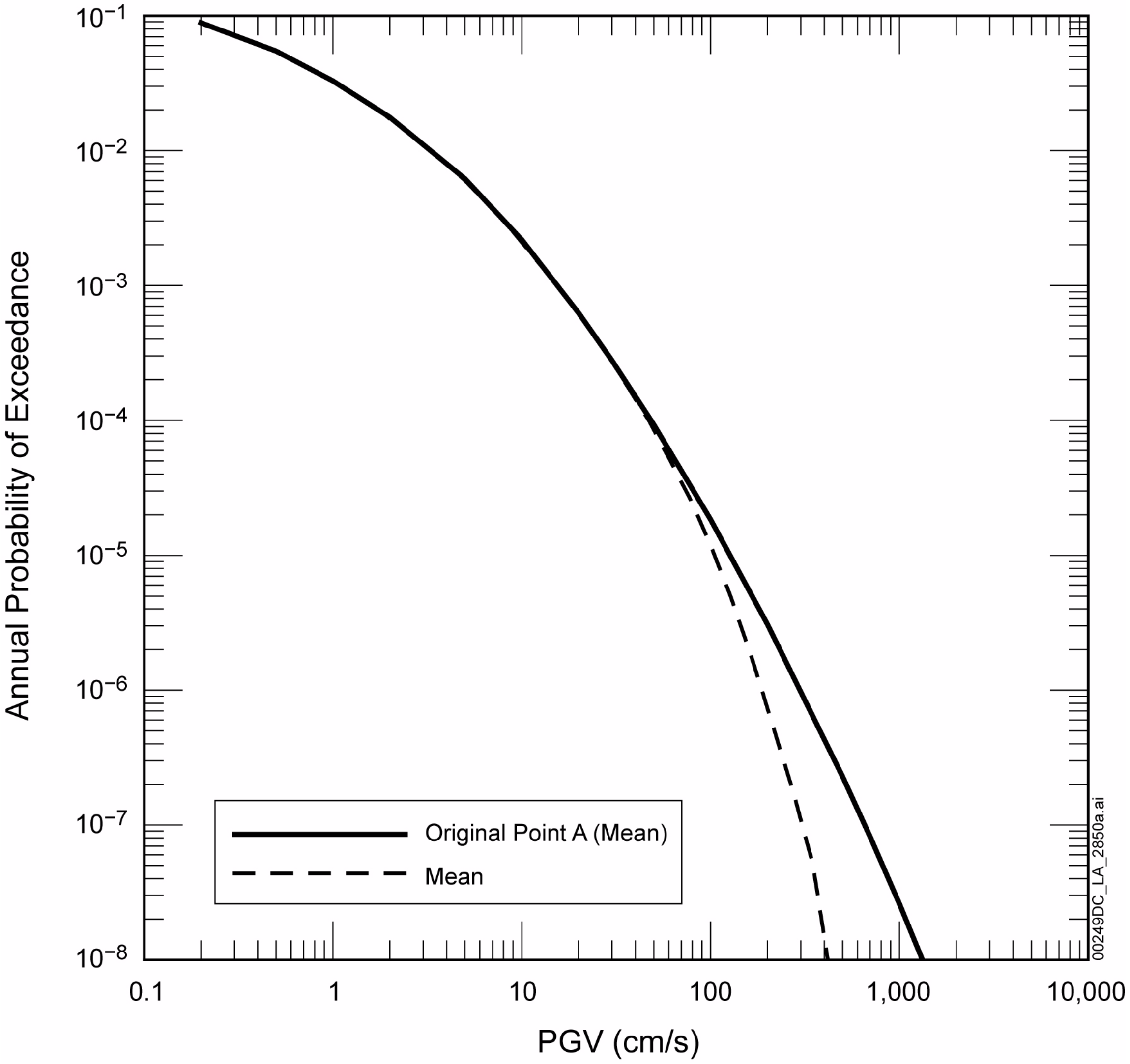


Figure 1.1-79. Conditioned and Unconditioned Reference Rock Outcrop Mean Horizontal Peak Ground Velocity Hazard Curves

NOTE: Point A = reference rock outcrop (see Figure 1.1-78); solid line = unconditioned peak ground velocity hazard curve; dashed line = conditioned peak ground velocity hazard curve.
PGV = peak ground velocity.

Source: BSC 2008c, Figure 6.5.1-7.

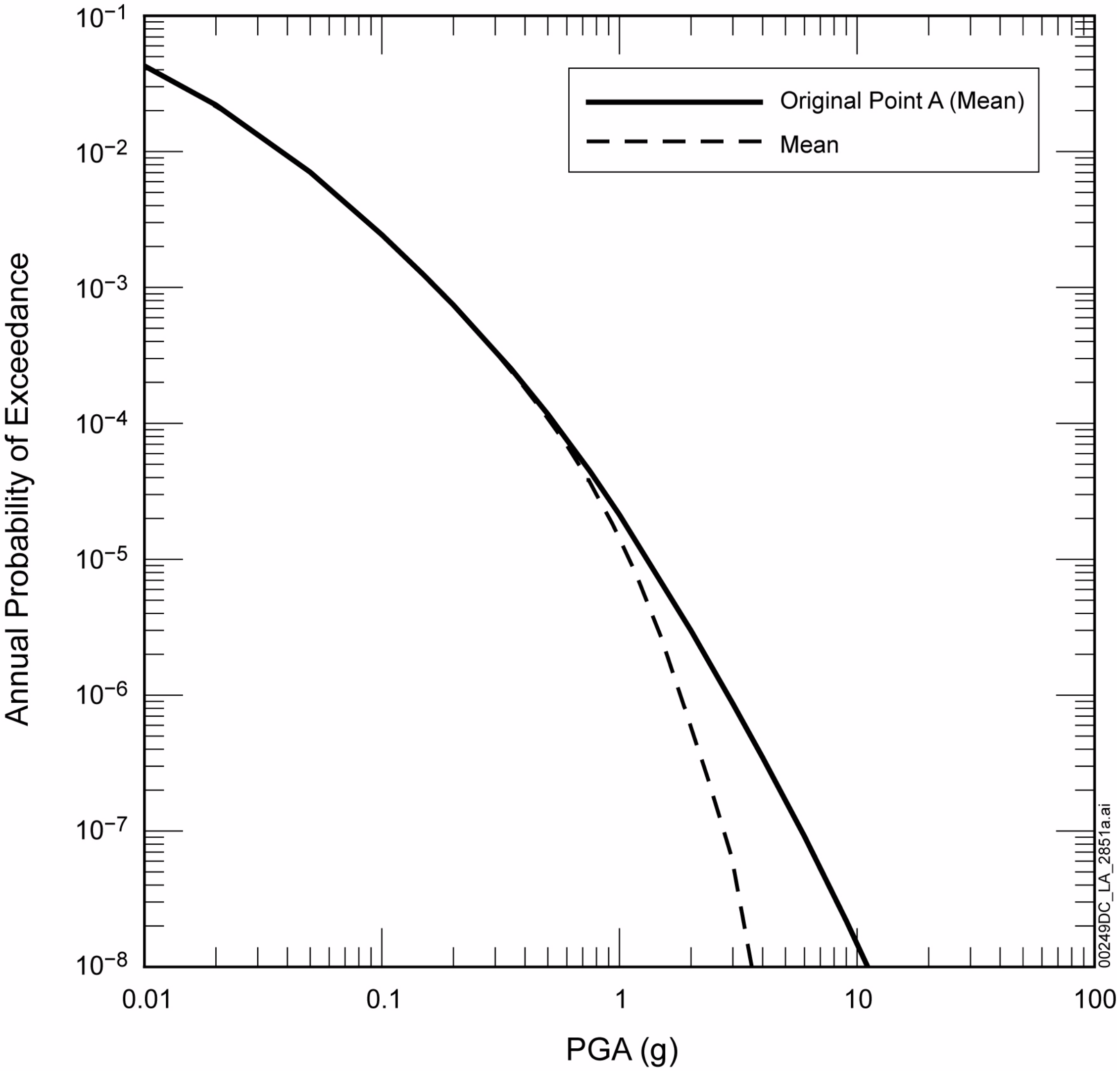


Figure 1.1-80. Conditioned and Unconditioned Reference Rock Outcrop Mean Horizontal Peak Ground Acceleration Hazard Curves

NOTE: Point A = reference rock outcrop (see Figure 1.1-78); solid line = unconditioned peak ground acceleration hazard curve; dashed line = conditioned peak ground acceleration hazard curve.
PGA = peak ground acceleration.

Source: BSC 2008c, Figure 6.5.1-8.

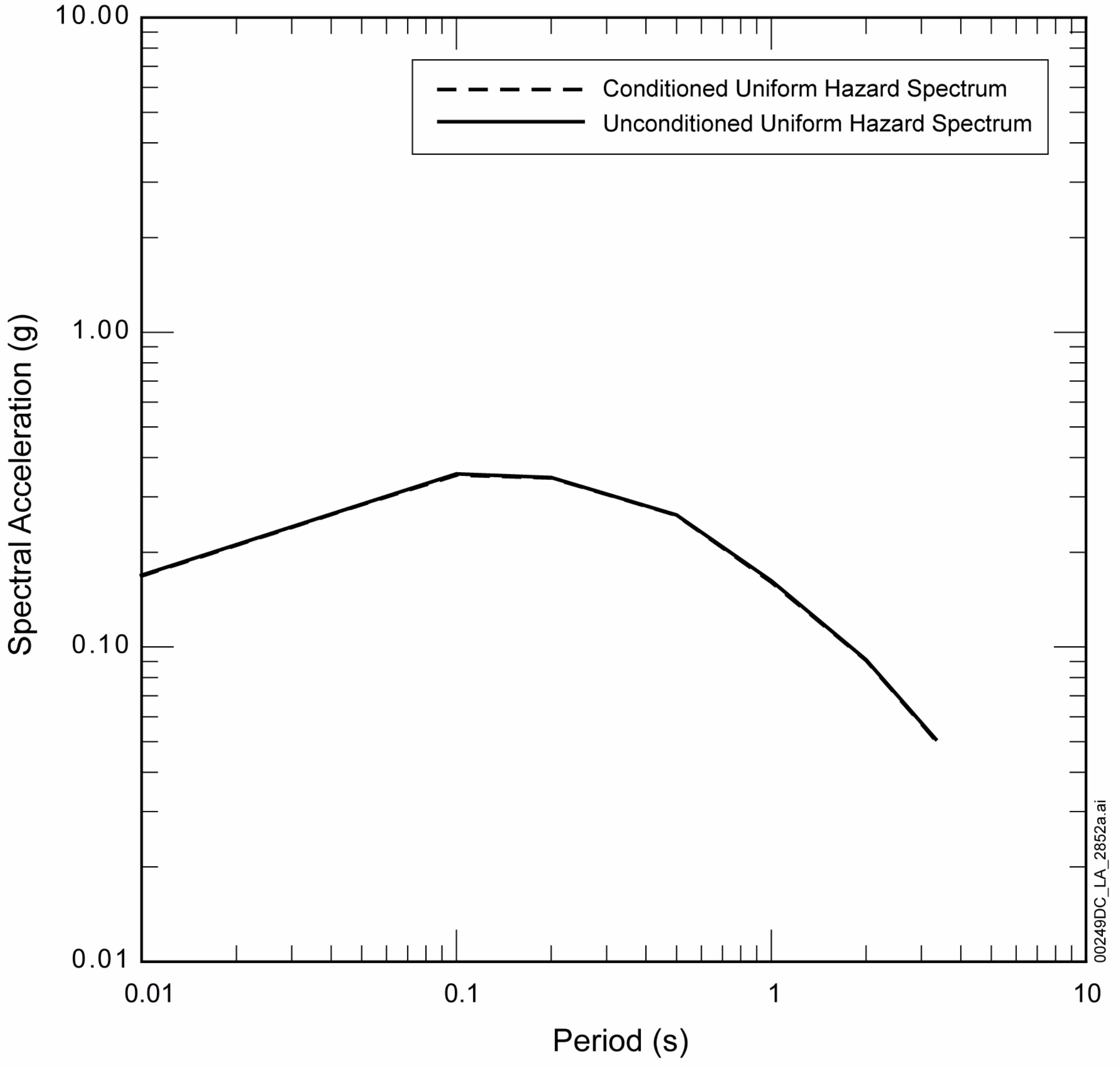


Figure 1.1-81. Reference Rock Outcrop Uniform Hazard Spectra Based on the Extreme-Stress-Drop and Shear-Strain-Threshold Conditioned and Unconditioned Hazard for an Annual Probability of Exceedance of 10^{-3}

Source: BSC 2008c, Figure 6.5.1-10.

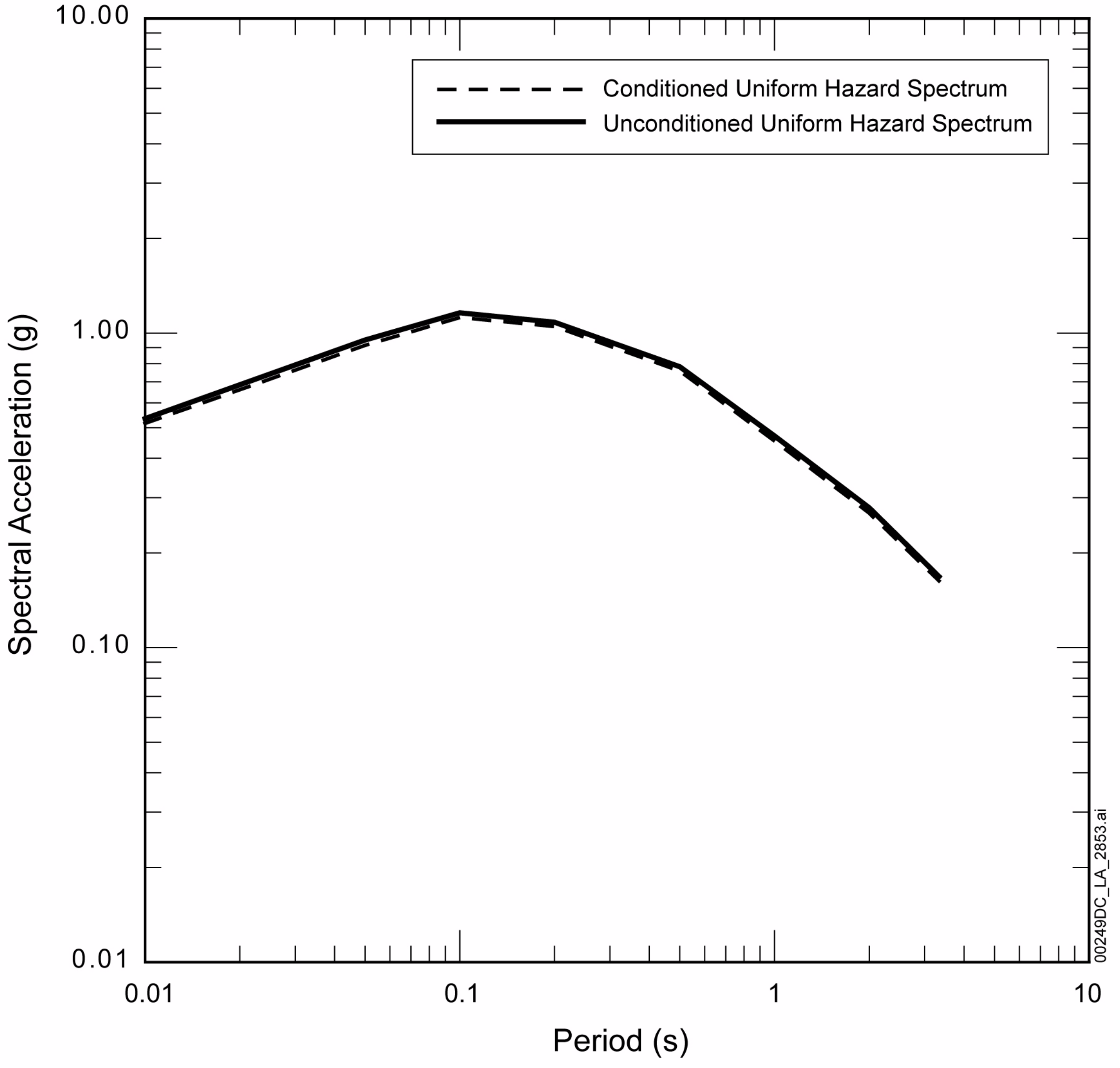


Figure 1.1-82. Reference Rock Outcrop Uniform Hazard Spectra Based on the Extreme-Stress-Drop and Shear-Strain-Threshold Conditioned and Unconditioned Hazard for an Annual Probability of Exceedance of 10^{-4}

Source: BSC 2008c, Figure 6.5.1-11.

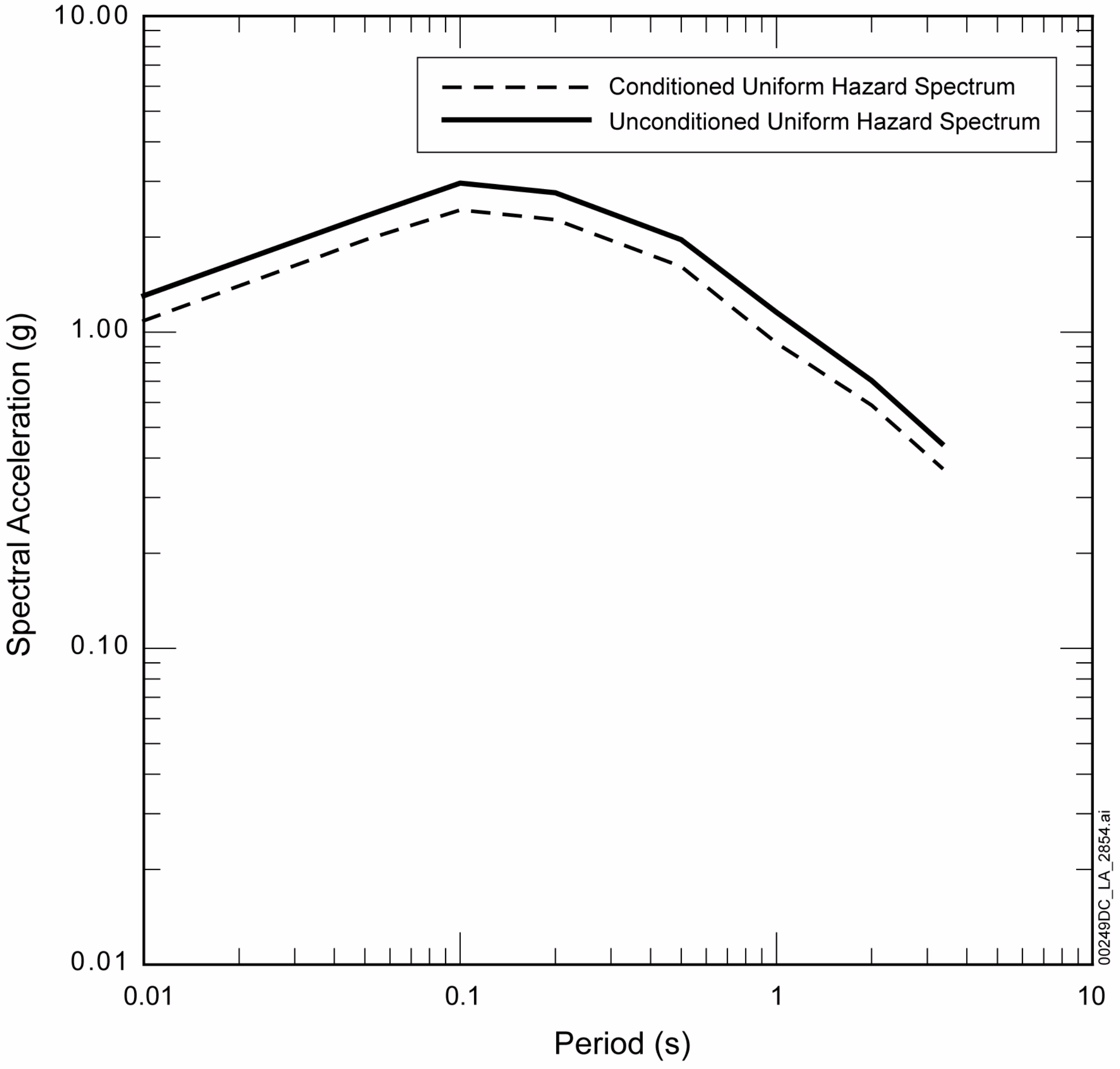


Figure 1.1-83. Reference Rock Outcrop Uniform Hazard Spectra Based on the Extreme-Stress-Drop and Shear-Strain-Threshold Conditioned and Unconditioned Hazard for an Annual Probability of Exceedance of 10^{-5}

Source: BSC 2008c, Figure 6.5.1-12.

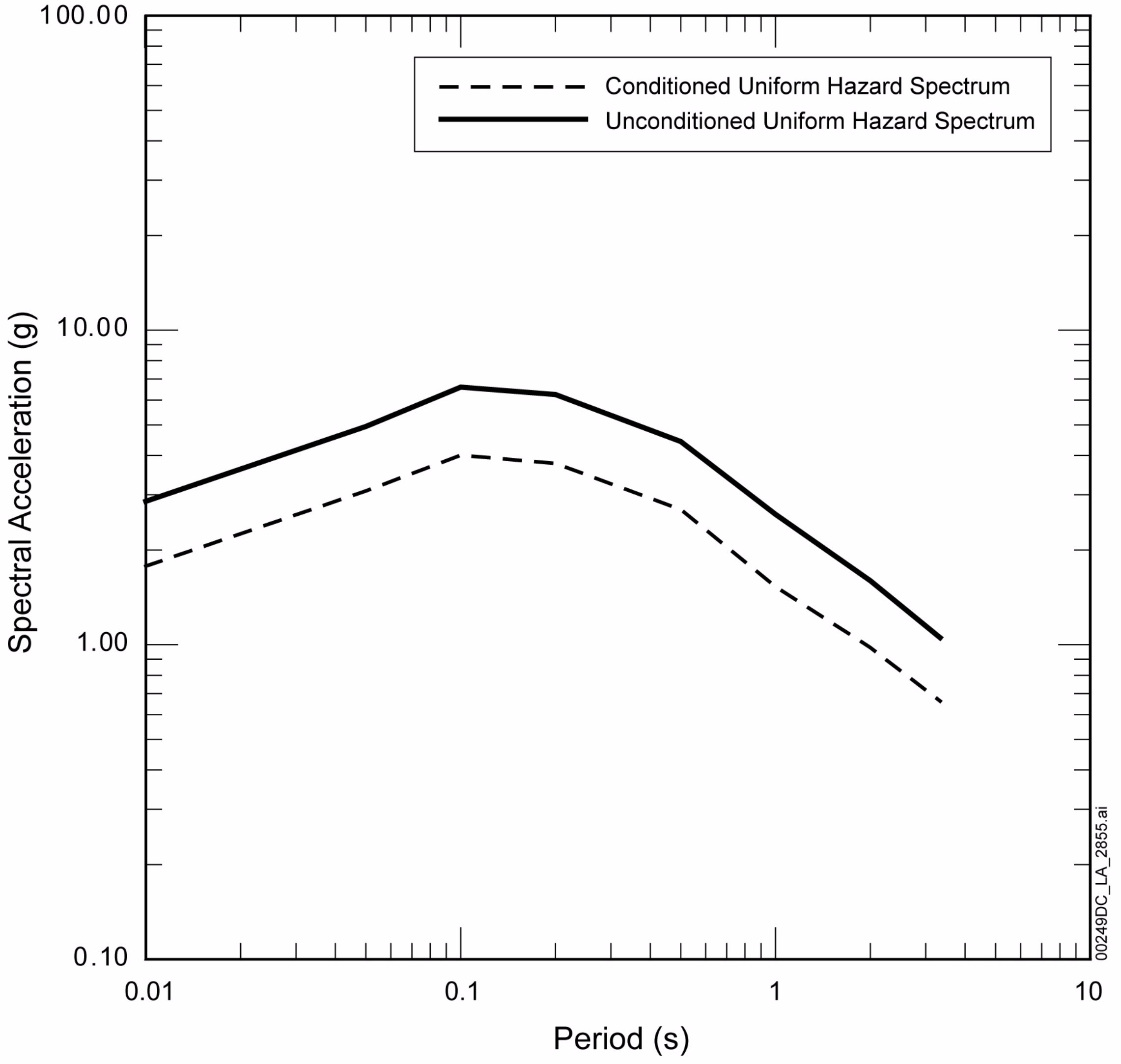


Figure 1.1-84. Reference Rock Outcrop Uniform Hazard Spectra Based on the Extreme-Stress-Drop and Shear-Strain-Threshold Conditioned and Unconditioned Hazard for an Annual Probability of Exceedance of 10^{-6}

Source: BSC 2008c, Figure 6.5.1-13.

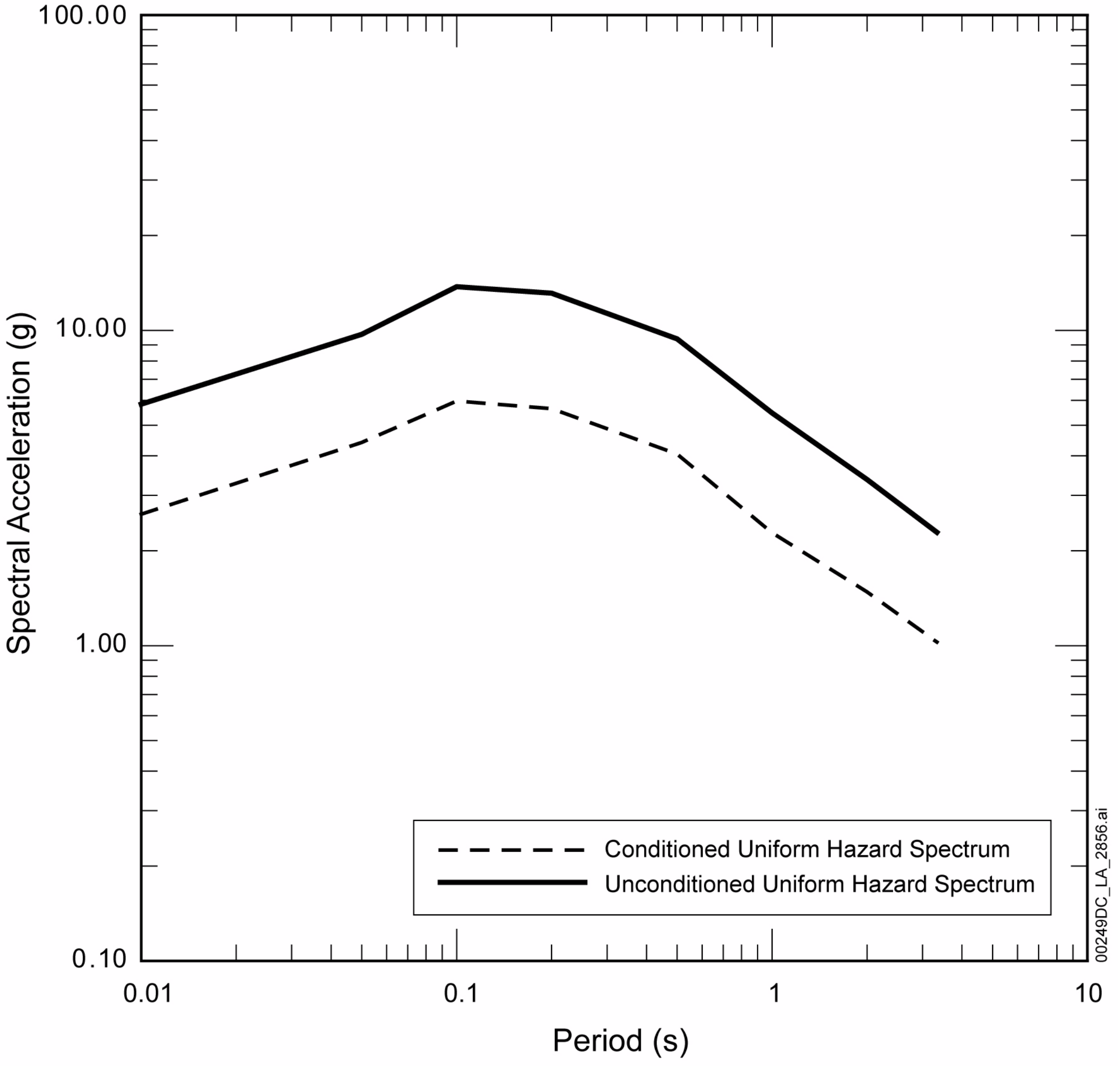


Figure 1.1-85. Reference Rock Outcrop Uniform Hazard Spectra Based on the Extreme-Stress-Drop and Shear-Strain-Threshold Conditioned and Unconditioned Hazard for an Annual Probability of Exceedance of 10^{-7}

Source: BSC 2008c, Figure 6.5.1-14.

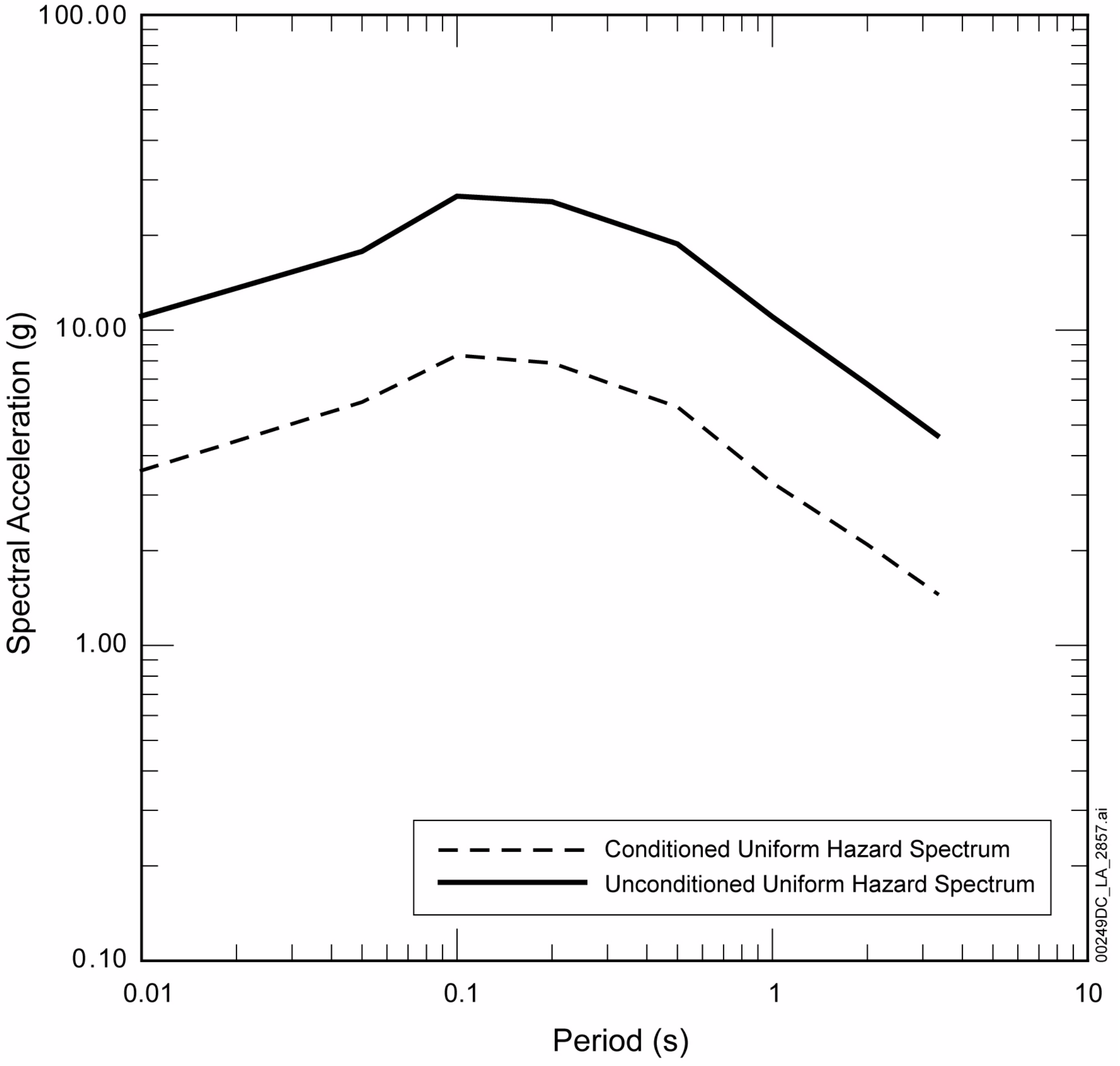


Figure 1.1-86. Reference Rock Outcrop Uniform Hazard Spectra Based on the Extreme-Stress-Drop and Shear-Strain-Threshold Conditioned and Unconditioned Hazard for an Annual Probability of Exceedance of 10^{-8}

Source: BSC 2008c, Figure 6.5.1-15.

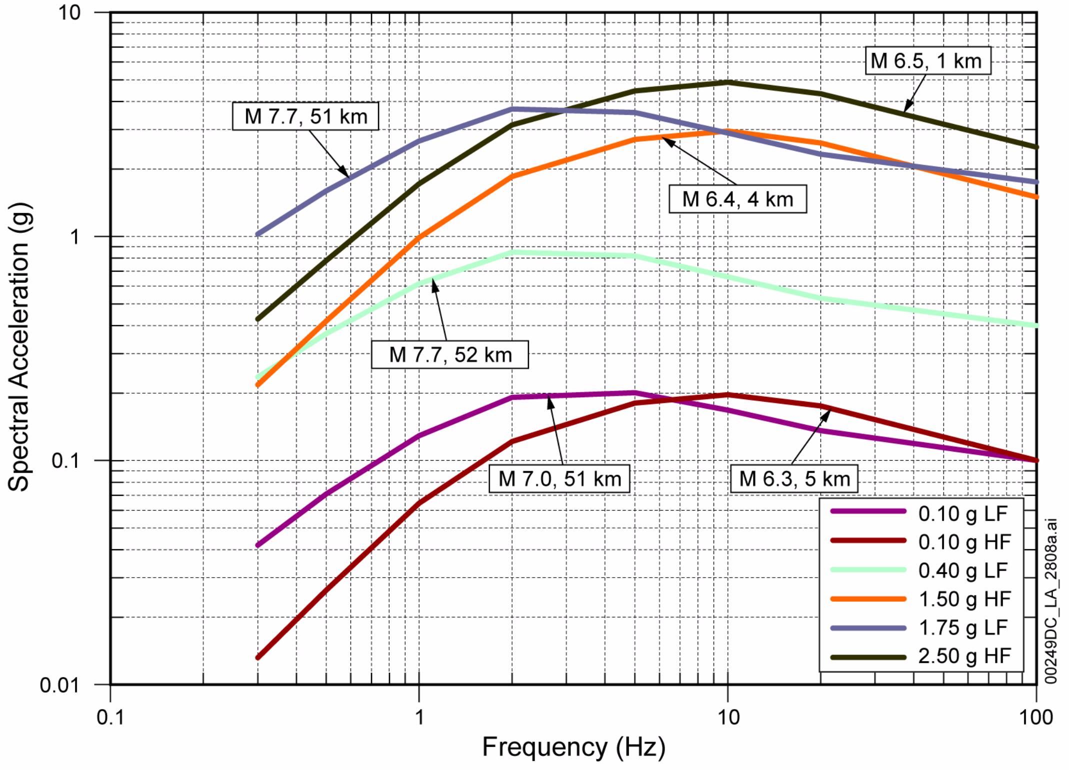


Figure 1.1-87. Representative Control Motion Response Spectra for Site Response Modeling

NOTE: 1. Labels indicate the magnitude and distance of the reference earthquake providing the response spectral shape that is scaled to the peak ground acceleration level of interest. 2. LF = low frequency (1 to 2 Hz) response spectrum; HF = high frequency (5 to 10 Hz) response spectrum.

Source: 2008c, Figure 6.4.1-17.

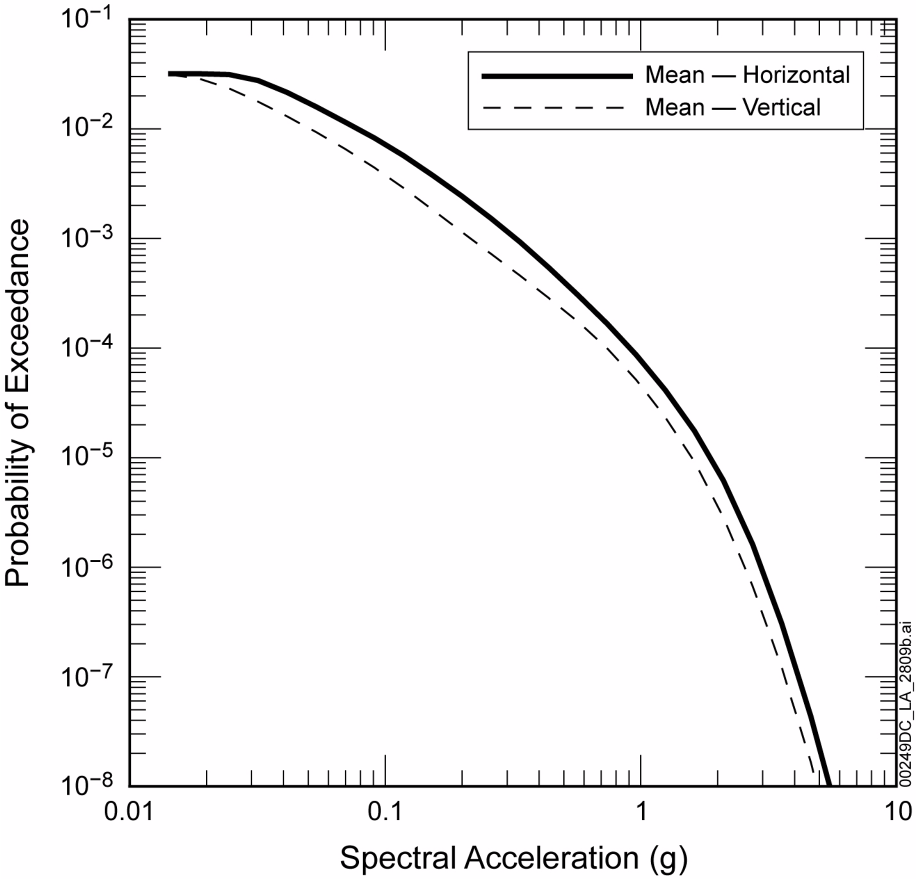


Figure 1.1-88. Mean Horizontal and Vertical Seismic Hazard Curves for Peak Ground Acceleration at the Surface Geologic Repository Operations Area

Source: BSC 2008c, Figure 6.5.2-34.

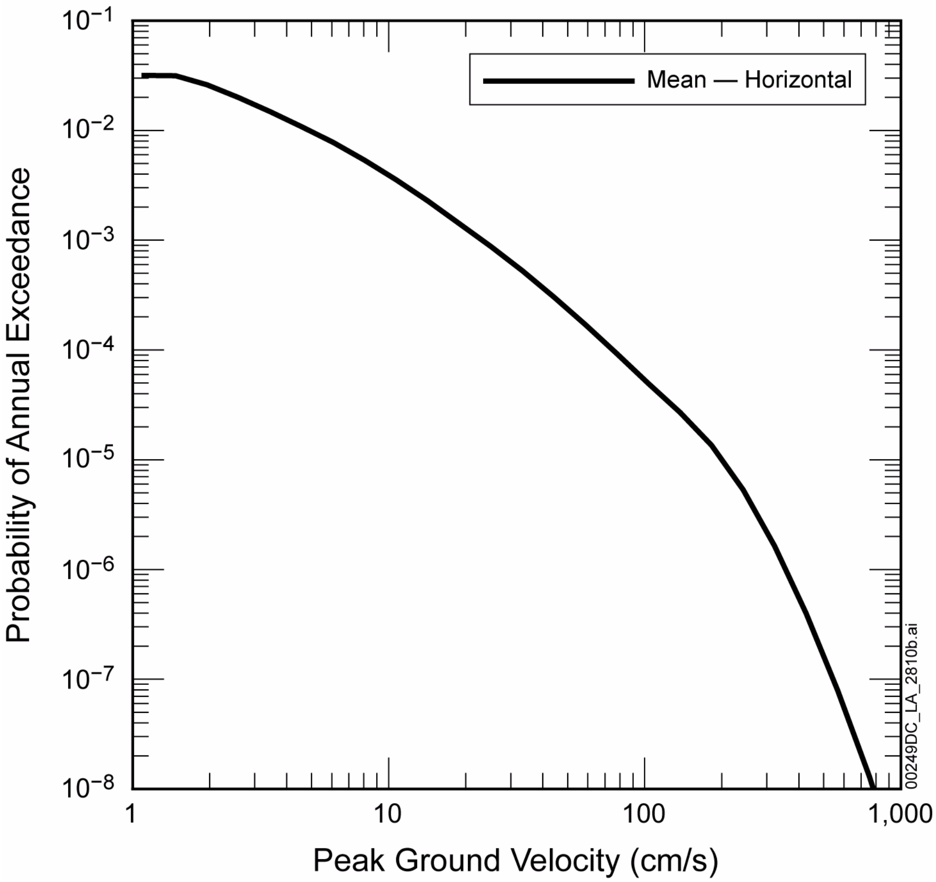


Figure 1.1-89. Mean Horizontal Seismic Hazard Curve for Peak Ground Velocity at the Surface Geologic Repository Operations Area

Source: BSC 2008c, Figure 6.5.2-42.

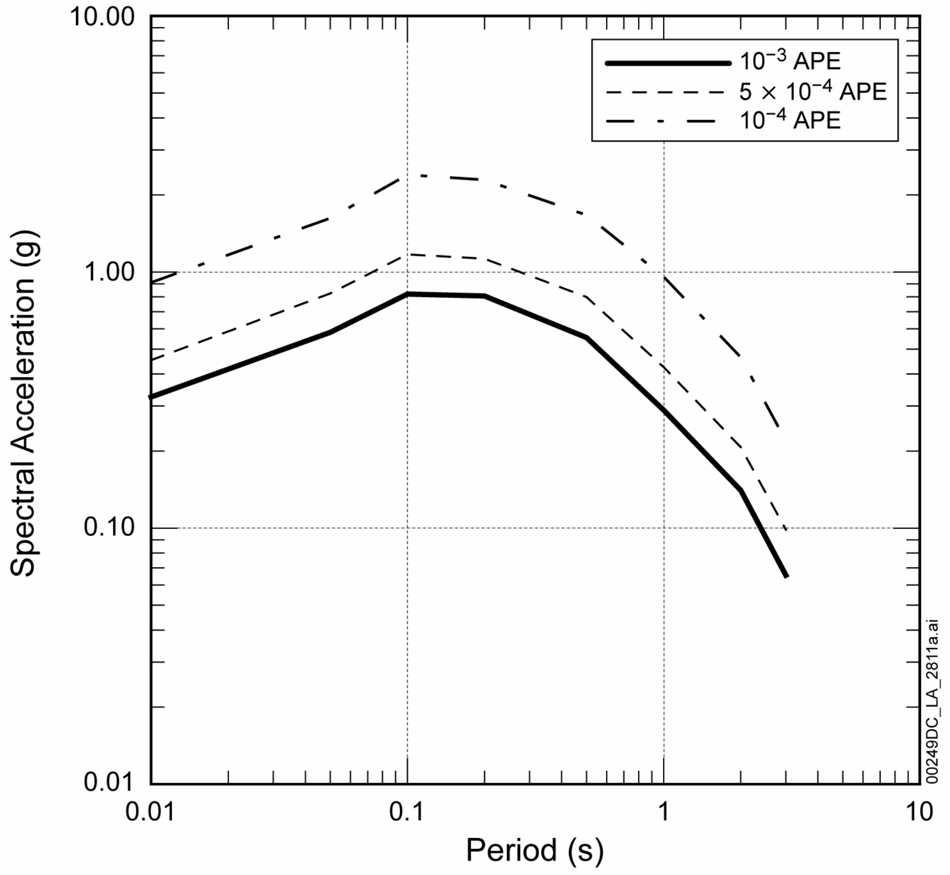


Figure 1.1-90. Surface Geologic Repository Operations Area 5%-Damped Horizontal Design Spectra for 10^{-3}, 5×10^{-4}, and 10^{-4} Annual Probabilities of Exceedance

NOTE: APE = annual probability of exceedance.

Source: BSC 2008c, Figure 6.5.2-56.

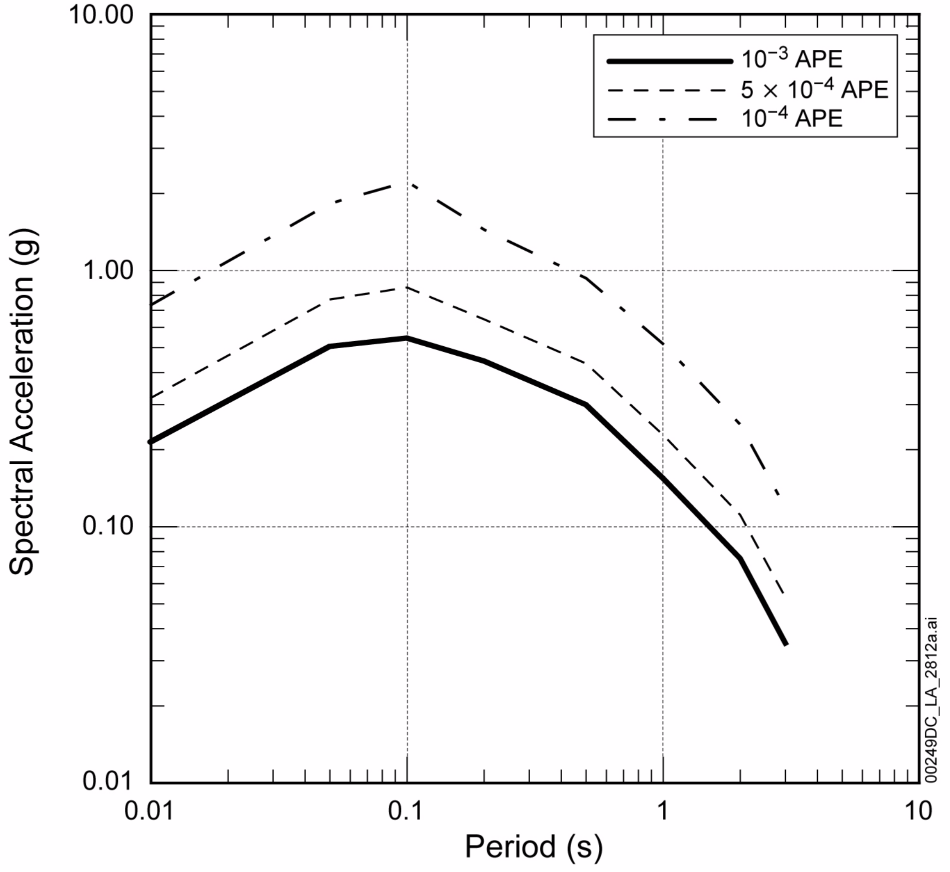


Figure 1.1-91. Surface Geologic Repository Operations Area 5%-Damped Vertical Design Spectra for 10^{-3}, 5×10^{-4}, and 10^{-4} Annual Probabilities of Exceedance

NOTE: APE = annual probability of exceedance.

Source: BSC 2008c, Figure 6.5.2-57.

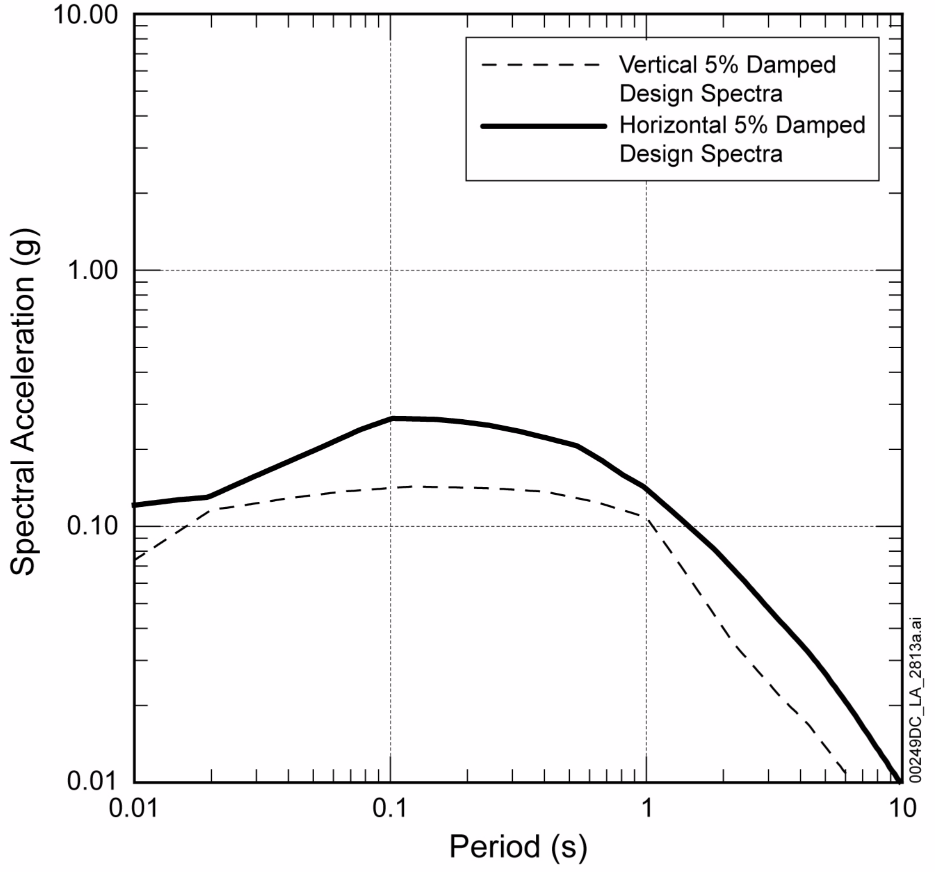


Figure 1.1-92. Horizontal and Vertical 5%-Damped Design Spectra at 10^{-3} Annual Probability of Exceedance at the Repository Block

Source: BSC 2008c, Figure 6.5.3-26.

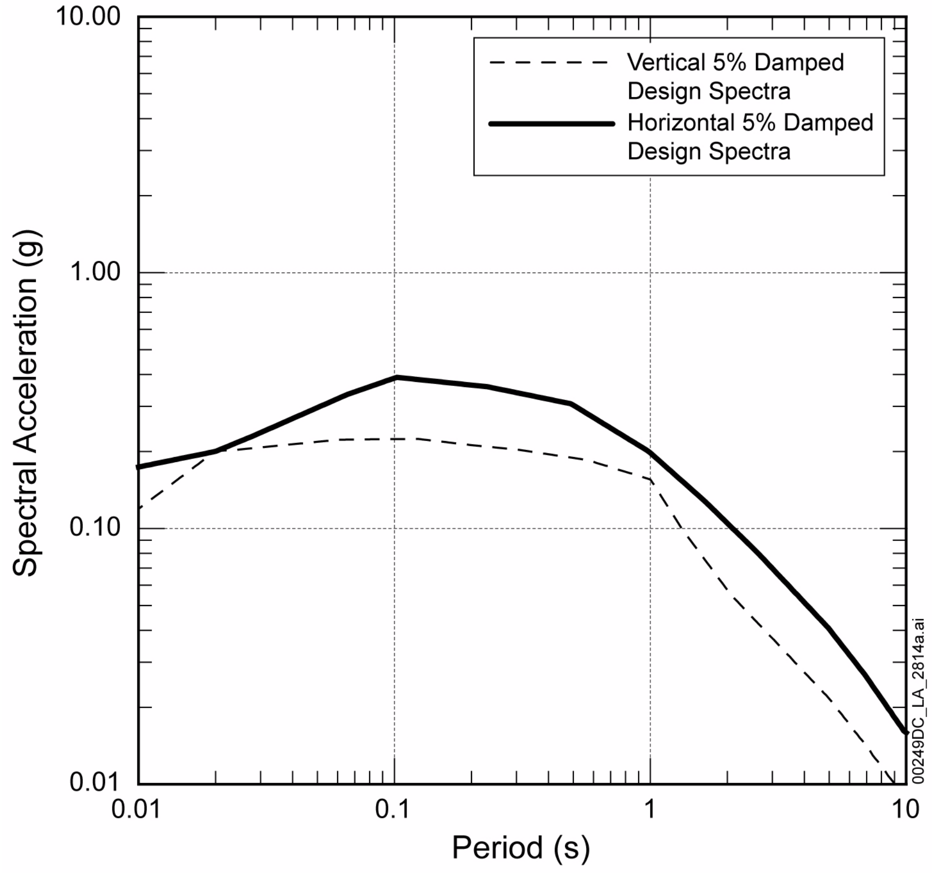


Figure 1.1-93. Horizontal and Vertical 5%-Damped Design Spectra at 5 × 10^{-4} Annual Probability of Exceedance at the Repository Block

Source: BSC 2008c, Figure 6.5.3-27.

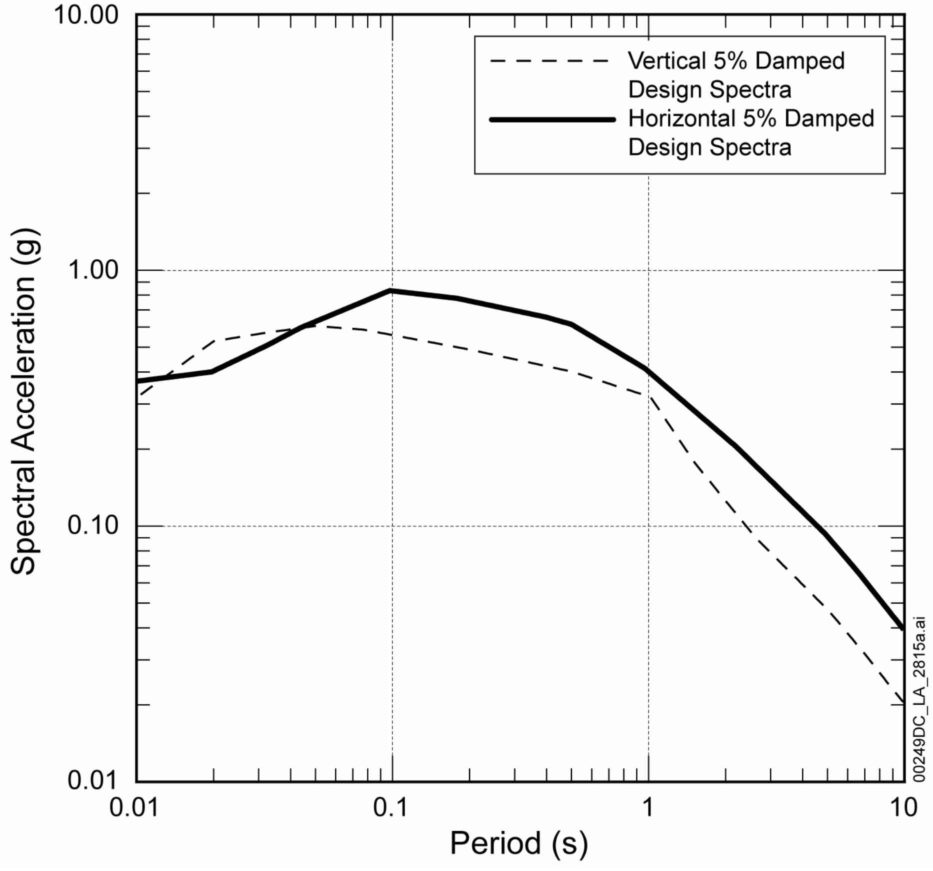
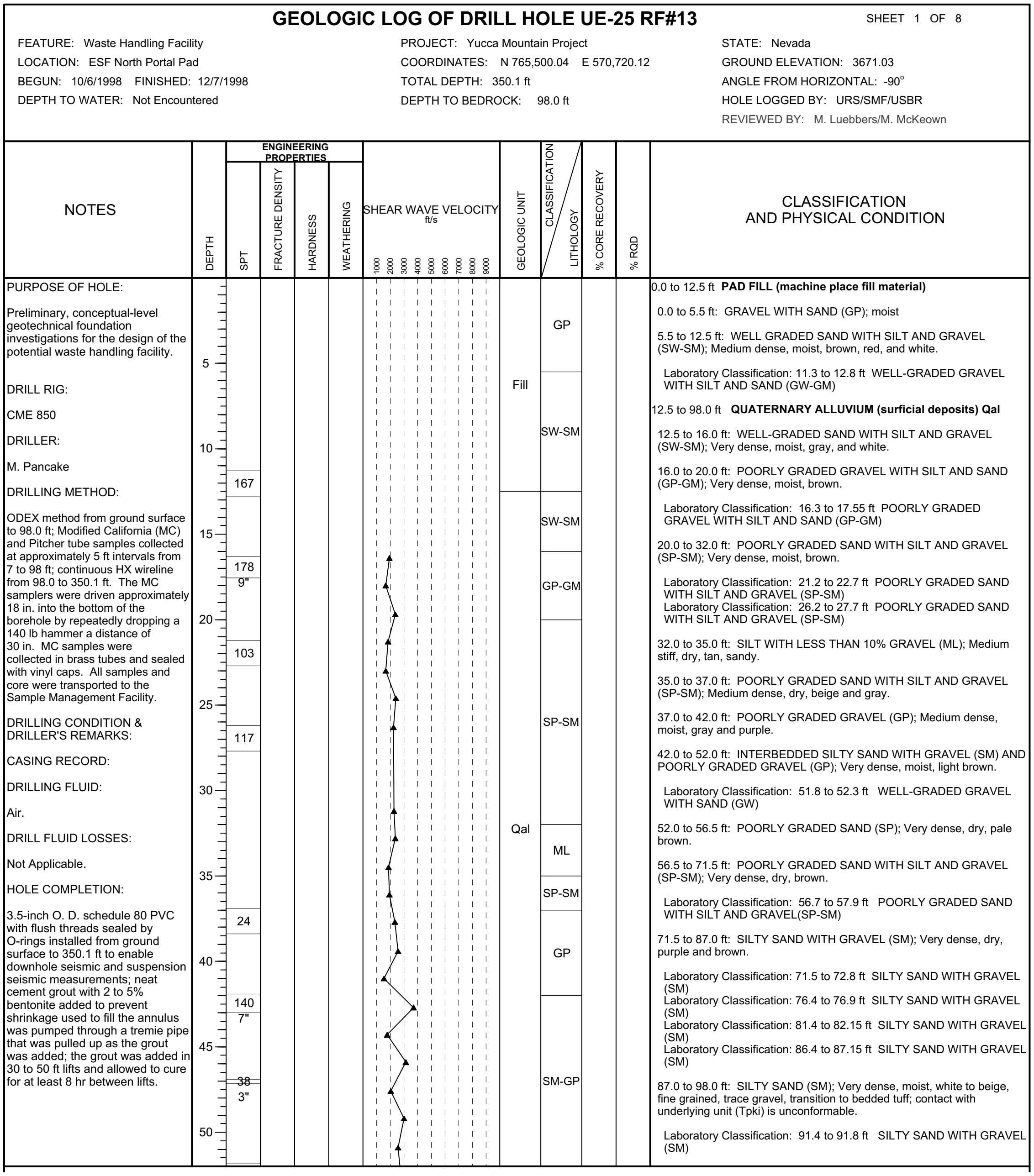


Figure 1.1-94. Horizontal and Vertical 5%-Damped Design Spectra at 10^{-4} Annual Probability of Exceedance at the Repository Block

Source: BSC 2008c, Figure 6.5.3-28.



GEOLOGIC LOG OF DRILL HOLE UE-25 RF#13

SHEET 1 OF 8

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 10/6/1998 FINISHED: 12/7/1998
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,500.04 E 570,720.12
TOTAL DEPTH: 350.1 ft
DEPTH TO BEDROCK: 98.0 ft

STATE: Nevada
GROUND ELEVATION: 3671.03
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: URS/SMF/USBR
REVIEWED BY: M. Luebbers/M. McKeown

NOTES

PURPOSE OF HOLE:

Preliminary, conceptual-level geotechnical foundation investigations for the design of the potential waste handling facility.

DRILL RIG:

CME 850

DRILLER:

M. Pancake

DRILLING METHOD:

ODEX method from ground surface to 98.0 ft; Modified California (MC) and Pitcher tube samples collected at approximately 5 ft intervals from 7 to 98 ft; continuous HX wireline from 98.0 to 350.1 ft. The MC samplers were driven approximately 18 in. into the bottom of the borehole by repeatedly dropping a 140 lb hammer a distance of 30 in. MC samples were collected in brass tubes and sealed with vinyl caps. All samples and core were transported to the Sample Management Facility.

DRILLING CONDITION & DRILLER'S REMARKS:

CASING RECORD:

DRILLING FLUID:

Air.

DRILL FLUID LOSSES:

Not Applicable.

HOLE COMPLETION:

3.5-inch O. D. schedule 80 PVC with flush threads sealed by O-rings installed from ground surface to 350.1 ft to enable downhole seismic and suspension seismic measurements; neat cement grout with 2 to 5% bentonite added to prevent shrinkage used to fill the annulus was pumped through a tremie pipe that was pulled up as the grout was added; the grout was added in 30 to 50 ft lifts and allowed to cure for at least 8 hr between lifts.

CLASSIFICATION AND PHYSICAL CONDITION

0.0 to 12.5 ft **PAD FILL (machine place fill material)**

0.0 to 5.5 ft: GRAVEL WITH SAND (GP); moist

5.5 to 12.5 ft: WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM); Medium dense, moist, brown, red, and white.

Laboratory Classification: 11.3 to 12.8 ft WELL-GRADED GRAVEL WITH SILT AND SAND (GW-GM)

12.5 to 98.0 ft **QUATERNARY ALLUVIUM (surficial deposits) Qal**

12.5 to 16.0 ft: WELL-GRADED SAND WITH SILT AND GRAVEL (SW-SM); Very dense, moist, gray, and white.

16.0 to 20.0 ft: POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM); Very dense, moist, brown.

Laboratory Classification: 16.3 to 17.55 ft POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)

20.0 to 32.0 ft: POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM); Very dense, moist, brown.

Laboratory Classification: 21.2 to 22.7 ft POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)
Laboratory Classification: 26.2 to 27.7 ft POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)

32.0 to 35.0 ft: SILT WITH LESS THAN 10% GRAVEL (ML); Medium stiff, dry, tan, sandy.

35.0 to 37.0 ft: POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM); Medium dense, dry, beige and gray.

37.0 to 42.0 ft: POORLY GRADED GRAVEL (GP); Medium dense, moist, gray and purple.

42.0 to 52.0 ft: INTERBEDDED SILTY SAND WITH GRAVEL (SM) AND POORLY GRADED GRAVEL (GP); Very dense, moist, light brown.

Laboratory Classification: 51.8 to 52.3 ft WELL-GRADED GRAVEL WITH SAND (GW)

52.0 to 56.5 ft: POORLY GRADED SAND (SP); Very dense, dry, pale brown.

56.5 to 71.5 ft: POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM); Very dense, dry, brown.

Laboratory Classification: 56.7 to 57.9 ft POORLY GRADED SAND WITH SILT AND GRAVEL(SP-SM)

71.5 to 87.0 ft: SILTY SAND WITH GRAVEL (SM); Very dense, dry, purple and brown.

Laboratory Classification: 71.5 to 72.8 ft SILTY SAND WITH GRAVEL (SM)
Laboratory Classification: 76.4 to 76.9 ft SILTY SAND WITH GRAVEL (SM)
Laboratory Classification: 81.4 to 82.15 ft SILTY SAND WITH GRAVEL (SM)
Laboratory Classification: 86.4 to 87.15 ft SILTY SAND WITH GRAVEL (SM)

87.0 to 98.0 ft: SILTY SAND (SM); Very dense, moist, white to beige, fine grained, trace gravel, transition to bedded tuff; contact with underlying unit (Tpki) is unconformable.

Laboratory Classification: 91.4 to 91.8 ft SILTY SAND WITH GRAVEL (SM)

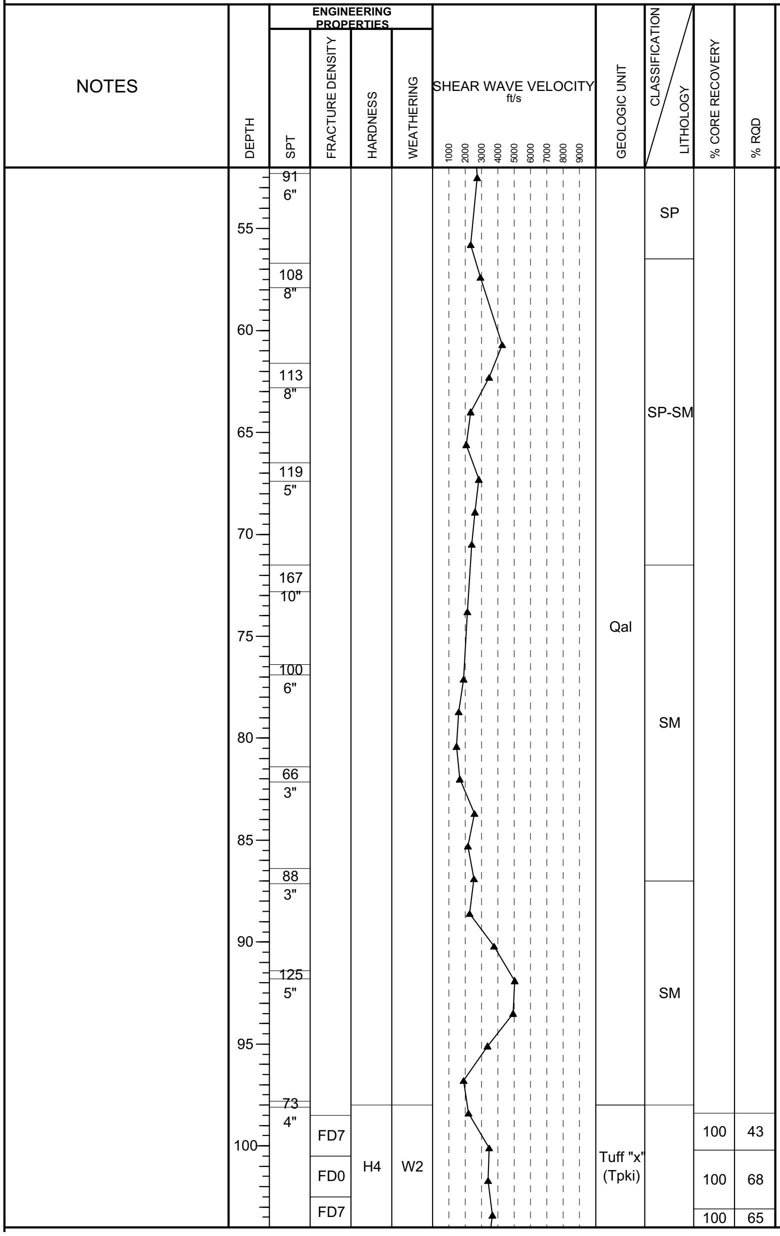
Figure 1.1-95. Geologic Log of Drill Hole UE-25 RF#13 (Sheet 1 of 8)

NOTE: Based on measurements by the drilling engineer, 12 in. of slough material was in the bottom of the borehole when Sample MC-1 was driven. A blow count of 7 was recorded for these 12 in. and a blow count of 15 was recorded for the final 4 in. of the drive. ODEX 165 pipe was used as the rod, rather than the AW rod that was used in the remaining drive samples in this boring. The sampler was not driven the full 18 in. The blow count is not to be used. In driving MC-3 from 15 to 18 in., the hammer drop exceeded a 30-in. drop. The recorded blow count of 167 is consequently too low. All of the samples on which a sieve analysis was performed were tested for reaction with dilute hydrochloric acid. A reaction was noted in all of the samples. The reaction was moderate for the two samples from 76.4 to 76.7 ft and 81.5 to 81.8 ft. The reaction was strong for the remaining samples. Two Pitcher tube samples were attempted from 7 to 9 ft and 13 to 14 ft.
RQD = rock quality designation; SPT = standard penetration test.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#13

SHEET 2 OF 8

FEATURE: Waste Handling Facility	PROJECT: Yucca Mountain Project	STATE: Nevada
LOCATION: ESF North Portal Pad	COORDINATES: N 765,500.04 E 570,720.12	GROUND ELEVATION: 3671.03
BEGUN: 10/6/1998 FINISHED: 12/7/1998	TOTAL DEPTH: 350.1 ft	ANGLE FROM HORIZONTAL: -90°
DEPTH TO WATER: Not Encountered	DEPTH TO BEDROCK: 98.0 ft	HOLE LOGGED BY: URS/SMF/USBR
		REVIEWED BY: M. Luebbers/M. McKeown



CLASSIFICATION AND PHYSICAL CONDITION

Laboratory Classification: 97.8 to 98.1 ft

98.0 to 164.4 ft: **COMB PEAK IGNIMBRITE - Tuff "X" (Tpki)**

98.0 to 98.5 ft: Very light gray; well indurated (silicified) matrix showing oriented pumice; approximately 40% pumice; 5 to 7% lithic fragments, subrounded to angular, 1 to 2% phenocrysts of quartz(?), felsics, and mafics (biotite(?)).

98.5 to 98.7 ft: Thin bed; white; very fine grained; partly silicified; no distinct pumice.

98.7 to 160.0 ft: White; nonwelded; devitrified; 25 to 30% pumice; 1 to 2% phenocrysts of feldspar, quartz, rare mafics including biotite(?); approximately 5% lithic fragments.

160.0 to 162.2 ft: White; nonwelded; devitrified; 20 to 30% pumice; 2% phenocrysts; 1% lithic fragments.

162.4 to 162.6 ft: Pinkish gray; very fine grained; 1 to 2% small (<1 mm) phenocrysts and 2% very fine grained lithic fragments.

162.6 to 164.4 ft: White; nonwelded; devitrified; approximately 25 up to 50% pumice at base; 2% phenocrysts; 2% lithic fragments.

Intensely fractured from 98.0 to 100.5 ft; unfractured from 100.5 to 102.5 ft; intensely fractured from 102.5 to 105.8 ft; slightly fractured from 105.8 to 108.1 ft; intensely to moderately fractured from 108.1 to 115.8 ft; very intensely to intensely fractured from 115.8 to 121.1 ft; moderately fractured from 121.1 to 122.8 ft; intensely to moderately fractured from 122.8 to 145.3 ft; slightly fractured from 145.3 to 161.8 ft and intensely to moderately fractured from 161.8 to 164.4 ft.

Discontinuity Measurements:

Depth (ft.)	Inclination from Core Axis (°)	Rough	Infilling
99.5	40	R2-R3	trace to paper thin light brown coating
102.9	20	R3	trace to paper thin light brown coating
104.6	60	R2	trace to paper thin light brown coating
109.0	35	R2	trace to paper thin light brown coating
120.9	30	R3	trace to paper thin light brown coating
121.7	50	R2	trace to paper thin light brown coating
125.8	40	R2	trace to paper thin light brown coating
126.0	40	R2	trace to paper thin light brown coating
136.0	45	R3	clean
145.0	30	R2-R3	clean
152.6	40	R1	paper thin light brown coating
154.9	55	R2	trace to paper thin light brown coating

164.4 to 169.3 **TIVA CANYON ASHFALL TUFF (nonwelded) Tpbt5**
Fallout tephra (?); grayish-orange pink to pale brown; argilic alteration (core damp, sticky, surface smeared by core catcher); approximately 10% white pumice; 10% variably colored, altered lithic fragments; a thin (16 mm) layer of pale to moderate red, very well sorted fallout tephra occurs at 166.8 ft; moderate red to moderate reddish orange and grayish-orange pink, heavily altered from 166.8 to 169.3 ft; moderately soft from 164.4 to 166.8 ft; moderately weathered from 164.4 to 166.8 ft; intensely to moderately fractured from 164.4 to 166.8 ft; contact with underlying unit (Tpcrn4d) dips 30° below horizontal and is distinct and separated.

Discontinuity Measurements:
No discontinuities

Figure 1.1-95. Geologic Log of Drill Hole UE-25 RF#13 (Sheet 2 of 8)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#13

SHEET 3 OF 8

FEATURE: Waste Handling Facility	PROJECT: Yucca Mountain Project	STATE: Nevada
LOCATION: ESF North Portal Pad	COORDINATES: N 765,500.04 E 570,720.12	GROUND ELEVATION: 3671.03
BEGUN: 10/6/1998 FINISHED: 12/7/1998	TOTAL DEPTH: 350.1 ft	ANGLE FROM HORIZONTAL: -90°
DEPTH TO WATER: Not Encountered	DEPTH TO BEDROCK: 98.0 ft	HOLE LOGGED BY: URS/SMF/USBR
		REVIEWED BY: M. Luebbers/M. McKeown

NOTES

DEPTH: 105, 110, 115, 120, 125, 130, 135, 140, 145, 150, 155

SPT

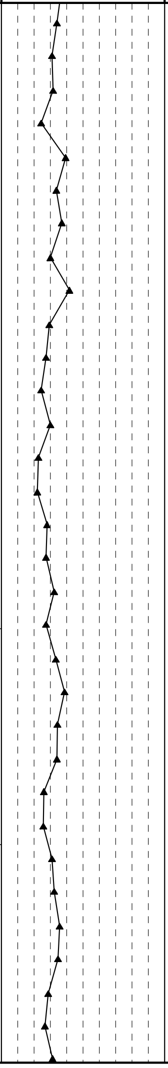
ENGINEERING PROPERTIES

FRACTURE DENSITY: FD7, FD3, FD6, FD8, FD5, FD6, FD3

HARDNESS: H4

WEATHERING: W2, W3, W1

SHEAR WAVE VELOCITY ft/s



GEOLOGIC UNIT: Tuff "x" (Tpki)

CLASSIFICATION / LITHOLOGY

% CORE RECOVERY	% RQD
100	65
100	42
98	52
72	32
94	30
16	0
68	42
100	43
96	38
100	24
100	34

CLASSIFICATION AND PHYSICAL CONDITION

169.3 to 175.9 **TIVA CANYON CRYSTAL RICH NONLITHOPHYSAL TUFF (moderately to strongly welded tuff) Tpcrn4d**
Pale red; moderately welded, devitrified; 7 to 10% vesicular pumice; 7% phenocrysts of feldspar, rare quartz, altered biotite and other mafics; lithic fragments rare to absent; moderately hard; moderately to slightly weathered; very intensely fractured; contact with underlying unit (Tpcrn3) is gradational and broken, with significant change in alteration.

Discontinuity Measurements:

Depth (ft)	Inclination from Core Axis (°)	Rough	Infilling
169.3 to 170.2	85	R2	trace to paper thin light tan coating
175.0 to 176.0	intersecting 75-85	R3	trace to paper thin white noncrystalline coating

175.9 to 186.6 **TIVA CANYON CRYSTAL-RICH NONLITHOPHYSAL TUFF (moderately to strongly welded tuff) Tpcrn3**
Pale red; matrix is highly porous; 10% phenocrysts; pumice and lithic fragments absent; clay-altered, soft, greenish fragments, not aligned, waxy textured, approximately 1 cm; large (2 cm) vesiculated pumice mixed with small flattened cavities (eroded out pumice?); moderately hard; slightly weathered to fresh; very intensely fractured; contact with underlying unit (Tpcrn2) is gradational and broken.

Discontinuity Measurements:

Depth (ft)	Inclination from Core Axis (°)	Rough	Infilling
179.1	70	R4	trace light brown
181.2	70	R4	healed with sand-size fragments; 0-1 mm white mineral
182.0	intersecting 70 and 85	R4	clean
186.5	70	R2-R3	trace white mineral

186.6 to 202.0 **TIVA CANYON CRYSTAL RICH NONLITHOPHYSAL TUFF (moderately to strongly welded tuff) Tpcrn2**
Pale red; same as overlying unit except at 191.5 ft alteration becomes intense, pumice very soft, matrix rough; matrix waxy, friable, plastic, and sticky from 195.5 to 196.5 ft with splotches of blue/white mineral (opal?); 10 to 12% phenocrysts at 200.3 ft; moderately hard; slightly weathered to fresh 186.6 to 191.4 ft, slightly weathered 191.4 to 202.0 ft; very intensely fractured; contact with underlying unit (Tpcrn1) is gradational and broken.

Discontinuity Measurements:

Depth (ft)	Inclination from Core Axis (°)	Rough	Infilling
187.4	30	R3	clean
188.0	50	R3	bluish drusy quartz and white noncrystalline coating
191.5	30	R3	trace white noncrystalline material
192.4	40	R2	trace white noncrystalline material
194.2	30	R3	local brown stain
195.2	35	R4	caliche cemented breccia
196.9	25	R3	patches of white mineral
198.3	30	R2 - R3	patches of white mineral
198.8	40	R2 - R3	patches of white mineral
200.6	45	R2	patches of white mineral

202.0 to 219.1 **TIVA CANYON CRYSTAL RICH NONLITHOPHYSAL TUFF (strongly welded tuff) Tpcrn1**
Light brownish gray, moderately welded, devitrified; 10 to 15% pumice, up to 25 to 35% locally, moderately to highly flattened, up to core diameter; 10% phenocrysts of feldspar and rare quartz(?); some vapor phase

Figure 1.1-95. Geologic Log of Drill Hole UE-25 RF#13 (Sheet 3 of 8)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#13

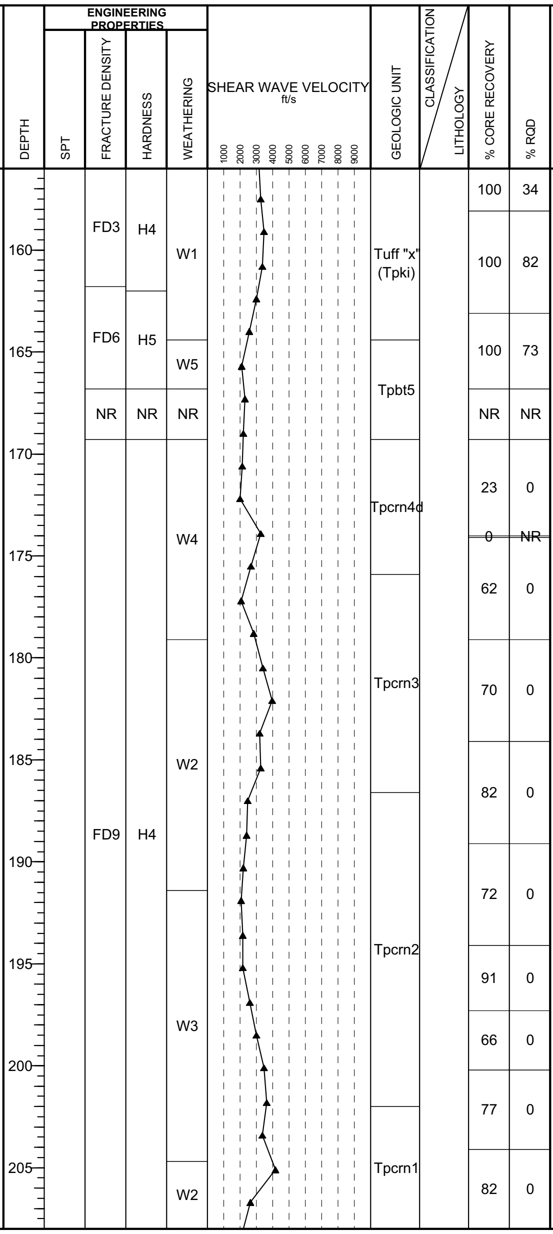
SHEET 4 OF 8

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 10/6/1998 FINISHED: 12/7/1998
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,500.04 E 570,720.12
TOTAL DEPTH: 350.1 ft
DEPTH TO BEDROCK: 98.0 ft

STATE: Nevada
GROUND ELEVATION: 3671.03
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: URS/SMF/USBR
REVIEWED BY: M. Luebbers/M. McKeown

NOTES



CLASSIFICATION AND PHYSICAL CONDITION

Alteration of matrix; moderately hard; slightly weathered from 202.0 to 204.7 ft, slightly weathered to fresh from 204.7 to 219.1 ft; contact with underlying unit (Tpcpul) is a possible fault(?) contact, broken; material from 215.4 to 219.1 ft not recovered.

Discontinuity Measurements:

Depth (ft)	Inclination from Core Axis (°)	Rough	Infilling
207.1	40	R3	trace light brown stain
212.8	80	R3	trace white mineral
212.8	50	R3	clean

219.1 to 231.5 **TIVA CANYON CRYSTAL POOR UPPER LITHOPHYSAL TUFF (strongly welded tuff) Tpcpul**

Densely welded; pale reddish-brown to grayish-orange pink; 2% pumice; 2 to 3% phenocrysts of feldspar, rare mafics; lithic fragments absent; 1% or less oblate lithophysal cavities with vapor phase minerals and light gray alteration rims, flattened and approximately 20 degrees to near-perpendicular to core axis; at 231.0 ft first concentration of well-developed spherulites; moderately hard from 219.1 to 225.6 ft, hard from 225.6 to 231.5 ft; slightly weathered to fresh; very intensely fractured; contact with underlying unit (Tpcpmn) is distinct; broken.

Discontinuity Measurements:

Depth (ft)	Inclination from Core Axis (°)	Rough	Infilling
220-223	multiple 70 - 80	R3	trace to paper thin white and light brown coating
224.8	15	R5	clean
229.0	30	R3	trace tan and light brown stain

231.5 - 286.7 **TIVA CANYON MIDDLE NONLITHOPHYSAL TUFF (densely welded) Tpcpmn**

Pale reddish-brown; densely welded; devitrified; less than 1% pumice, vapor phase altered and eroded out, up to greater than core diameter, locally occur in swarms up to 50%; approximately 5% pumice below 260 ft; 2 to 3% phenocrysts of feldspar, hornblende (?); hard from 231.5 to 271.0 ft, moderately hard from 271.0 to 271.5 ft, very hard from 271.5 to 286.7 ft; fresh from 231.5 to 271.0 ft, slightly weathered from 271.0 to 271.5 ft, slightly weathered to fresh from 271.5 to 286.7 ft; very intensely fractured from 231.5 to 231.7 ft, slightly to very slightly fractured from 231.7 to 270.5 ft, intensely to moderately fractured from 270.5 to 286.7 ft; contact with underlying unit (Tpcpmn2) is gradational.

Discontinuity Measurements:

Depth (ft)	Inclination from Core Axis (°)	Rough	Infilling
233.8	70	R2	trace tan and light brown stain
236.0	80	R4	clean
237.0	35	R4	trace tan, light brown, and white stain
237.5	40	R3	paper thin tan, light brown, and white coating
237.7	45	R3	paper thin tan, light brown, and white coating
239.0	45	R2	paper thin tan coating
241.9	20	R2	paper thin tan and white coating
242.1	40	R3	trace white mineral
242.4	40	R3	trace tan and white mineral
249.6	50	R3	trace tan and white mineral
250.5-250.7	20	R4	4 to 6 cm yellowish-orange crystalline infilling
251.6	30	R5	white crystalline infilling
256.4	15	R3	paper thin tan and white coating
257.2	70	R3	paper thin tan and white coating
261.7	30	R4	clean

Figure 1.1-95. Geologic Log of Drill Hole UE-25 RF#13 (Sheet 4 of 8)

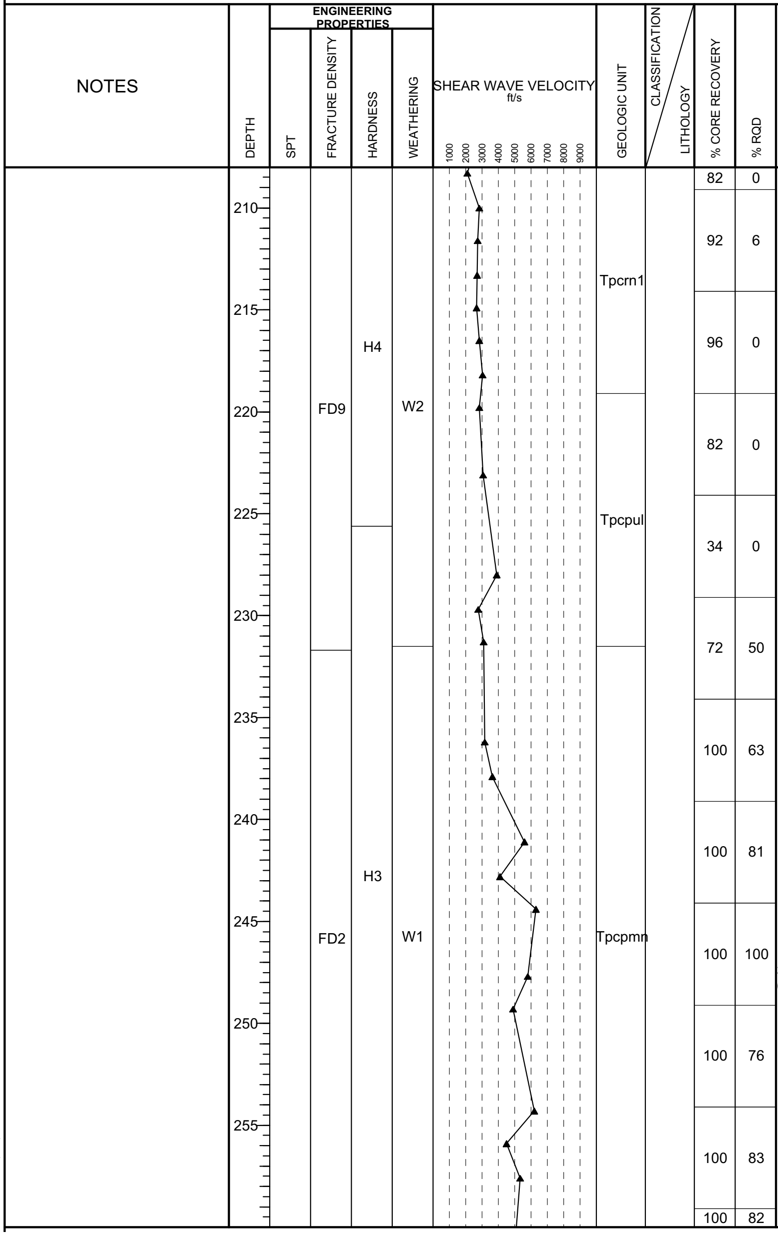
GEOLOGIC LOG OF DRILL HOLE UE-25 RF#13

SHEET 5 OF 8

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 10/6/1998 FINISHED: 12/7/1998
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,500.04 E 570,720.12
TOTAL DEPTH: 350.1 ft
DEPTH TO BEDROCK: 98.0 ft

STATE: Nevada
GROUND ELEVATION: 3671.03
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: URS/SMF/USBR
REVIEWED BY: M. Luebbers/M. McKeown



CLASSIFICATION AND PHYSICAL CONDITION

263.0	20	R4	clean
263.2	20	R4	1 mm tan and white infilling
267.2	70	R2	trace tan and white mineral
269.1	60	R2	trace to 1 mm light brown mineral
270.6	30	R5	paper thin white and light brown coating
271.7	20	R5	4 to 6 cm very pale orange, very fine grained well sorted fallout tephra
272.0	20	R5	patches of white mineral
273.0	10	R3	1 mm white mineral
274.2	40	R5	paper thin white mineral
275.0	30	R5	paper thin white mineral
275.4	45	R2	paper thin white mineral
276.7	40	R4	trace white mineral
277.2	20	R4	paper thin white mineral
278.5	55	R2	paper thin white mineral
278.7	25	R5	paper thin white and tan mineral
279.5	60	R5	paper thin white mineral
280.5	25	R5	paper thin white mineral
281.0	25	R5	paper thin white and tan mineral
282.5	15	R5	trace of white mineral
283.5	10	R5	trace to paper thin white mineral
281.4-285.7	20	R4	trace to paper thin white mineral

286.7 to 300.9 **TIVA CANYON LOWER LITHOPHYSAL TUFF densely (densely welded) Tpcpll**
Ignimbrite; pale red to moderate orange-pink; densely welded, devitrified; less than 5% pumice; 2 to 3% feldspar phenocrysts, rare mafics; rare lithic fragments; 1 to 2% lithophysae, moderately flattened with vapor phase mineral coating and alteration rims, up to core diameter; very hard; slightly weathered to fresh; intensely to moderately fractured from 286.7 to 293.0 ft, very intensely fractured from 293.0 to 300.9 ft; contact with underlying unit (Tpcpmn) is broken.

Discontinuity Measurements:

Depth (ft)	Inclination from Core Axis (°)	Rough	Infilling
287.7	20	R3	trace to paper thin white mineral
289.3	30	R2	paper thin white and yellowish brown mineral
290.3	30	R4	paper thin white mineral
291.7	25	R2	trace tan mineral
294.6-301.0	20	R3	paper thin white mineral

300.9 to 350.1 **TIVA CANYON LOWER NONLITHOPHYSAL TUFF (densely welded) Tpcpln**
Ignimbrite; light brownish gray with grayish orange pink mottling (1 to 2 mm alteration spots usually around phenocrysts); densely welded, devitrified; 2 to 3% pumice, slightly altered/eroded; 2% phenocrysts, primarily feldspar, rare mafics; rare lithic fragments; very hard; fresh from 300.9 to 316.2 ft, slightly weathered from 316.2 to 317.0 ft, fresh from 317.0 to 350.1 ft; moderately fractured.

Discontinuity Measurements:

Depth (ft)	Inclination from Core Axis (°)	Rough	Infilling
294.6-301.0	20	R3	paper thin white mineral
302.2	50	R3	trace white mineral
302.6	60	R2	paper thin white mineral

Figure 1.1-95. Geologic Log of Drill Hole UE-25 RF#13 (Sheet 5 of 8)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#13

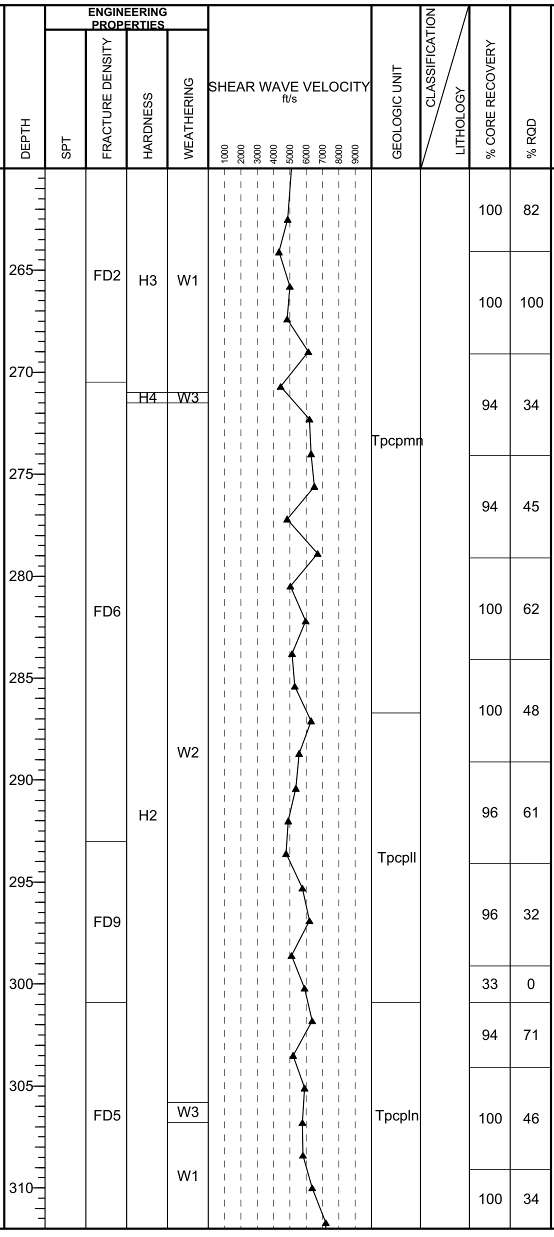
SHEET 6 OF 8

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 10/6/1998 FINISHED: 12/7/1998
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,500.04 E 570,720.12
TOTAL DEPTH: 350.1 ft
DEPTH TO BEDROCK: 98.0 ft

STATE: Nevada
GROUND ELEVATION: 3671.03
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: URS/SMF/USBR
REVIEWED BY: M. Luebbers/M. McKeown

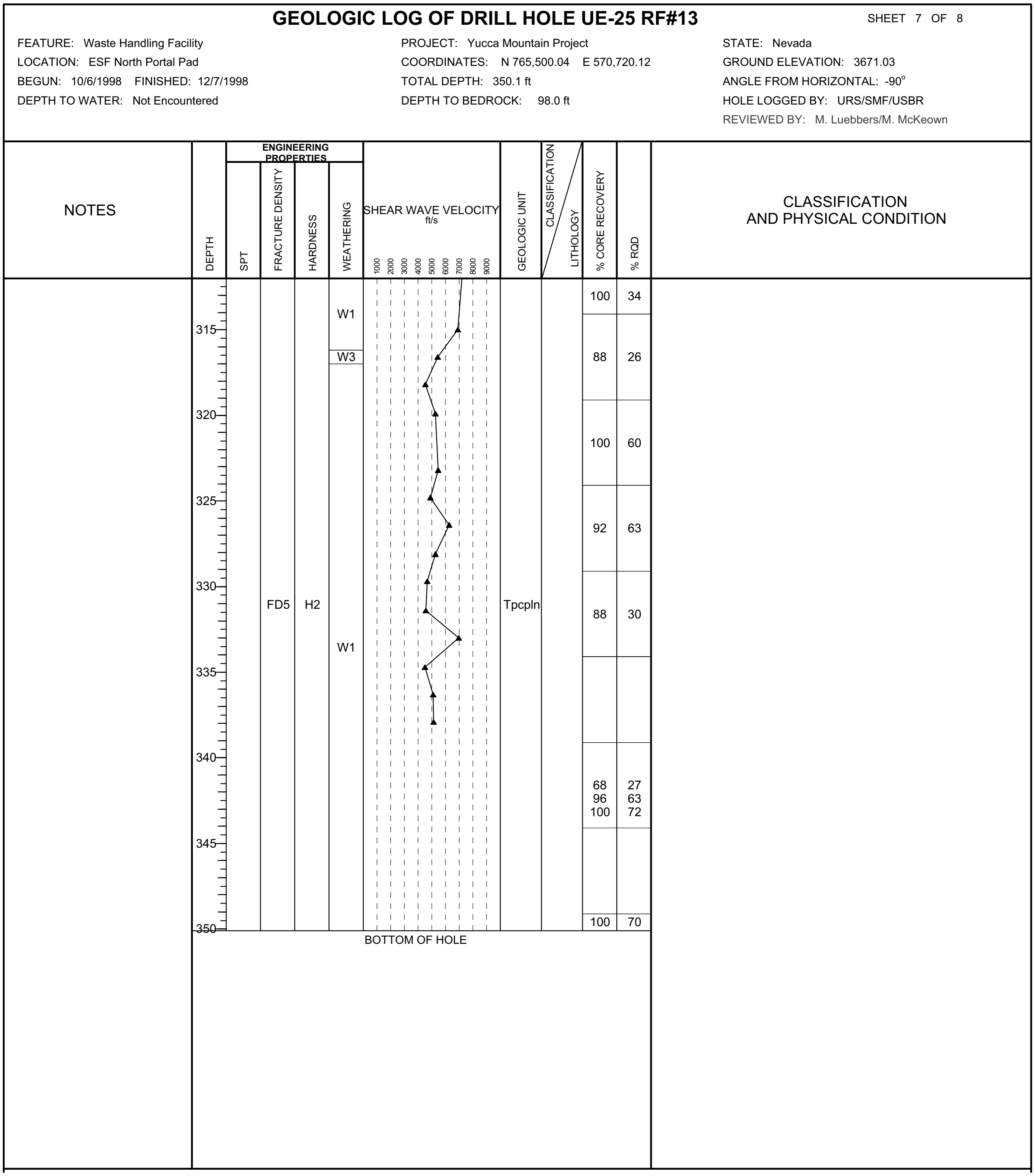
NOTES



CLASSIFICATION AND PHYSICAL CONDITION

302.6	10	R5	healed with paper thin white mineral
303.1	45	R5	paper thin white mineral
303.4	70	R3	paper thin white mineral
303.7	20	R4	clean
305.3	25	R2	1 mm white mineral
306.5	15	R3	1 mm white mineral
307.2	40	R2	1 mm white mineral
307.7	05	R4	1 mm white mineral
308.7	30	R5	partially healed with trace white mineral
309.3	30	R4	clean
309.5	25	R4	trace tan mineral
310.1	35	R5	clean
311.2	50	R3	paper thin white mineral
311.3	50	R4	patches of white mineral
311.5	40	R3	trace of white mineral
312.1	35	R4	paper thin white mineral
314.3	70	R2	healed with 3 mm white to gray mineral (vapor phase mineral?)
314.9	35	R4	paper thin white mineral
315.3	25	R3	clean
315.7	45	R3	paper thin white mineral
316-319	20	R2	paper thin white mineral
319.3	25	R2	paper thin white mineral
320.0	30	R3	paper thin white mineral
320.9	65	R2	1 mm white mineral
325.8	60	R3	clean
326.5	40	R4	clean
327.6	60	R3	1 to 2 mm white mineral
328.3	30	R3	healed with a trace of white mineral
329.6	30	R2	3 mm cemented sand and tan and white mineral
330.2	35	R3	1 mm white mineral
330.9	20	R4	paper thin white mineral
330.95	65	R4	paper thin white mineral
331.9	70	R4	paper thin white mineral
332.2	35	R4	clean
332.5	25	R4	paper thin white mineral
332.9	45	R4	4 mm white mineral
334.6	40	R4	paper thin white mineral
335.3	60	R4	paper thin white mineral
335.6	60	R2	paper thin white mineral
336.2	25	R4	tight; clean
337.0	70	R4	paper thin white mineral
337.1	40	R4	clean
337.7	45	R4	trace white mineral
337.8	50	R4	patches of white mineral
338.0	40	R4	patches of white mineral
338.4	60	R3	patches of white mineral
339.8	40	R2	patches of white mineral
340.3	45	R3	trace white mineral
340.8	35	R4	patches of white mineral
340.9	30	R4	patches of white mineral
341.5	50	R4	paper thin white mineral
342.3	20	R3	healed; 2 mm gray mineral
343.5	30	R4	patches of white mineral
343.6	25	R4	patches of white mineral
343.8	60	R2	patches of white mineral
344.1	30	R3	patches of white mineral
345.3	30	R4	1 mm white mineral
345.5	25	R4	1 mm white mineral
349.3	65	R3	1 mm white mineral

Figure 1.1-95. Geologic Log of Drill Hole UE-25 RF#13 (Sheet 6 of 8)



GEOLOGIC LOG OF DRILL HOLE UE-25 RF#13

SHEET 7 OF 8

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 10/6/1998 FINISHED: 12/7/1998
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,500.04 E 570,720.12
TOTAL DEPTH: 350.1 ft
DEPTH TO BEDROCK: 98.0 ft

STATE: Nevada
GROUND ELEVATION: 3671.03
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: URS/SMF/USBR
REVIEWED BY: M. Luebbers/M. McKeown

Figure 1.1-95. Geologic Log of Drill Hole UE-25 RF#13 (Sheet 7 of 8)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#13

SHEET 8 OF 8

FEATURE: Waste Handling Facility
PROJECT: Yucca Mountain Project
STATE: Nevada
LOCATION: ESF North Portal Pad
COORDINATES: N 765,500.04 E 570,720.12
GROUND ELEVATION: 3671.03
BEGUN: 10/6/1998 FINISHED: 12/7/1998
TOTAL DEPTH: 350.1 ft
ANGLE FROM HORIZONTAL: -90°
DEPTH TO WATER: Not Encountered
DEPTH TO BEDROCK: 98.0 ft
HOLE LOGGED BY: URS/SMF/USBR
REVIEWED BY: M. Luebbers/M. McKeown

HARDNESS

Alphanumeric descriptor	Descriptor	Criteria
H1	Extremely	Core, fragment, or exposure cannot be scratched with knife or sharp pick; can only be chipped with repeated heavy hammer blows.
H2	Very Hard	Cannot be scratched with knife or sharp pick. Core or fragment breaks with repeated heavy hammer blows.
H3	Hard	Can be scratched with knife or sharp pick with difficulty (heavy pressure). Heavy hammer blow required to break specimen.
H4	Moderately Hard	Can be scratched with knife or sharp pick with light pressure. Core or fragment breaks with moderate hammer blow.
H5	Moderately Soft	Can be grooved 1/16 in. (2 mm) deep by sharp pick with moderate or heavy pressure. Core or fragment breaks with light hammer blow or heavy manual pressure.
H6	Soft	Can be grooved or gouged easily by knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
H7	Very Soft	Can be readily indented, grooved or gouged with fingernail, or carved with a knife. Breaks with light manual pressure.

WEATHERING

Alphanumeric descriptor	Descriptor	General characteristics (strength, excavation, etc.)
W1	Fresh	Hammer rings when crystalline rocks are struck. Almost always rock excavation except for naturally weak or weakly cemented rocks such as siltstones or shales.
W2	Slightly weathered to fresh	
W3	Slightly weathered	Hammer rings when crystalline rocks are struck. Body of rock not weakened. With few exceptions, such as siltstones or shales, classified as rock excavation.
W4	Moderately to slightly weathered	
W5	Moderately weathered	Hammer does not ring when rock is struck. Body of rock is slightly weakened. Depending on fracturing, usually is rock excavation except in naturally weak rocks such as siltstones or shales.
W6	Intensely to moderately weathered	
W7	Intensely weathered	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened. Usually common excavation.
W8	Very intensely weathered	
W9	Decomposed	Can be granulated by hand. Always common excavation. Resistant minerals such as quartz may be present as "stringers" or "dikes."

FRACTURE DENSITY

Alphanumeric descriptor	Descriptor	Criteria (Excludes mechanical breaks)
FD0	Unfractured	No observed fractures.
FD1	Very slightly fractured	Core recovered mostly in lengths greater than 3 ft (1 m).
FD2	Slightly to very slightly fractured	
FD3	Slightly fractured	Core recovered mostly in lengths from 1 to 3 ft (300 to 1,000 mm) with few scattered lengths less than 1 ft (300 mm) or greater than 3 ft (1,000 mm).
FD4	Moderately to slightly fractured	
FD5	Moderately fractured	Core recovered mostly in lengths from 0.33 to 1.0 ft (100 to 300 mm) with most lengths about 0.67 ft (200 mm).
FD6	Moderately to intensely fractured	
FD7	Intensely fractured	Lengths average from 0.1 to 0.33 ft (30 to 100 mm) with fragmented intervals. Core recovered mostly in lengths less than 0.33 ft (100 mm).
FD8	Very intensely to intensely fractured	
FD9	Very intensely fractured	Core recovered mostly as chips and fragments with a few scattered short core lengths.

Figure 1.1-95. Geologic Log of Drill Hole UE-25 RF#13 (Sheet 8 of 8)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#14

SHEET 1 OF 11

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 9/13/2000 FINISHED: 9/27/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,308.73 E 571,065.44
TOTAL DEPTH: 550.0 ft
DEPTH TO BEDROCK: 101.8 ft

STATE: Nevada
GROUND ELEVATION: 3651.52
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES

Purpose of Hole:
Develop geologic design data required for waste handling facility foundation parameters and seismic hazard analysis.

Drill Equipment:
Schramm T685 Drill Rig, UDR 1000 Drill Rig

Drillers:
D. Harrison, R. Mckay; Dynatec Drilling Inc.; Salt Lake City, Utah.

Drilling Method:
Used 12 in. hammer to 5.02. Cement 10.75 O.D. casing with 1.29 stickup. Re-enter hole on 9/13/2000 with PQ coring system. Cored with PQ to 116.06. Used PQ rods as casing and installed HQ coring system. Cored with HQ to the total depth of 549.99.

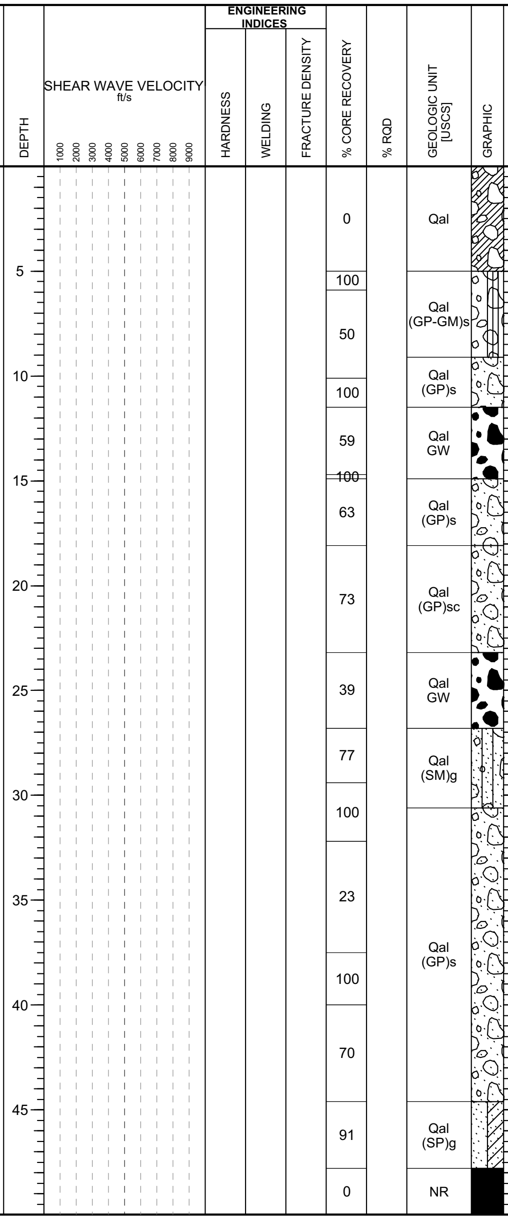
Drilling Conditions:
0.00 to 443.06: Replaced 2 bits.

Drilling Fluid:
0.00 to 5.02: Nonpotable water. 5.02 to 290.09: Nonpotable water, Quick Gel mud with EZ-Mud. 290.09 to 294.15: nonpotable water, Quik Gel mud with EZ-Mud and LCM to re-establish circulation. 294.15 to 549.99: Nonpotable water, Quick Gel mud with EZ-Mud.

Loss Intervals:
290.09 to 294.15

Casing Record:
0.00 to 4.72: 10.75 O.D. casing.
0.00 to 116.06: PQ casing
116.06 to 549.99: No casing

Hole Completion:
Ream hole from 5.00 to 550.15 with 8.5 Tricone Bit. Set and cement 512.22 of 4.5" PVC casing.



CLASSIFICATION AND PHYSICAL CONDITION

0.0 to 101.8 ft QUATERNARY ALLUVIUM (Qal)

0.0 to 5.0: No Recovery

5.0 to 9.1: POORLY GRADED GRAVEL WITH SAND AND SILT (GP-GM)s; About 50% fine to coarse, hard, subrounded to subangular gravel; about 40% predominately fine, hard, subrounded to subangular sand; about 10% nonplastic fines, no dry strength, rapid dilatancy, low toughness; maximum size 65 mm, dry, light brown; strong reaction with HCl; firm, strongly cemented.

9.1 to 11.5: POORLY GRADED GRAVEL WITH SAND (GP)s; About 60% fine to coarse, hard subrounded to subangular gravel; about 35% fine to coarse, subrounded to subangular sand; about 5% nonplastic fines, no dry strength, rapid dilatancy, low toughness; maximum size 75 mm, dry, light brown; strong reaction with HCl; firm, weak to strongly cemented.

11.5 to 14.9: WELL GRADED GRAVEL (GW); About 100% fine to coarse, hard, subrounded to angular gravel; maximum size 75 mm, light brown; 10% of gravel is partially coated with up to 1 mm white caliche.

14.9 to 18.1: POORLY GRADED GRAVEL WITH SAND (GP)s; About 70% fine to predominately coarse, hard, subrounded to subangular gravel; about 25% predominately fine sand; about 5% nonplastic fines, no dry strength, rapid dilatancy, low toughness; trace of cobbles; maximum size 95 mm, dry, light brown; weak reaction with HCl; firm, weakly cemented.

18.1 to 23.2: POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc; About 65% fine to coarse, hard, subangular to angular gravel; about 30% predominately fine sand; about 5% nonplastic fines, no dry strength, rapid dilatancy, low toughness; trace of cobbles; maximum size 215 mm, dry, light brown; weak to strong reaction with HCl; firm, weak to moderately cemented.

23.2 to 26.8: WELL GRADED GRAVEL (GW); About 100% fine to coarse, hard, subrounded to angular gravel; maximum size 75 mm, light brown; 10% of gravel is partially coated with up to 1 mm white caliche.

26.8 to 30.6: SILTY SAND WITH GRAVEL (SM)g; About 55% predominately fine sand; about 30% predominately fine to coarse, hard, subrounded to subangular gravel; about 15% nonplastic fines, no dry strength, rapid dilatancy, low toughness; maximum size 60 mm, dry; weak reaction with HCl; firm, weakly cemented.

30.6 to 44.6: POORLY GRADED GRAVEL WITH SAND (GP)s; About 60% predominately fine to coarse, hard, subangular gravel; about 35% predominately fine to medium sand; about 5% nonplastic fines, no dry strength, rapid dilatancy, low toughness; maximum size 170 mm, dry, light brown; weak reaction with HCl; firm, weakly cemented.

44.6 to 47.8: POORLY GRADED SAND WITH GRAVEL (SP)g; About 60% predominately fine to medium sand; about 35% fine to coarse, hard, subrounded to subangular gravel; about 5% nonplastic fines, no dry strength, rapid dilatancy, low toughness; maximum size 160 mm, dry, light brown; weak reaction with HCl; firm, weakly cemented.

47.8 to 52.5: NO RECOVERY

52.5 to 55.6: WELL GRADED GRAVEL (GW); About 95% fine to coarse, hard, subrounded to subangular gravel; about 5% fine to coarse, subrounded to subangular sand; maximum size 190 mm, moist; no reaction with HCl; approximately 30% of gravel is caliche coated.

Figure 1.1-96. Geologic Log of Drill Hole UE-25 RF#14 (Sheet 1 of 11)

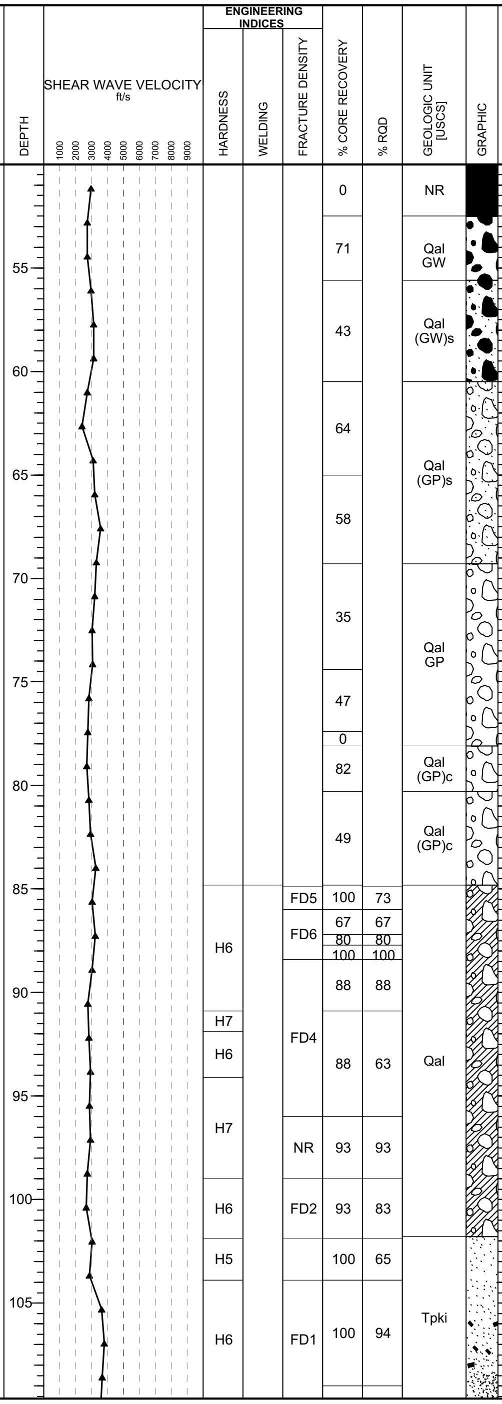
NOTE: All measurements are in feet unless noted otherwise. LCM (Lost Circulation Material) consists of cellophane cuttings. USCS classifications were determined in the field, with limited access to samples to keep samples intact for future tests. Shear Wave Velocity data from GeoVision suspension logging. Data acquired from downhole survey conducted after PVC casing installed. USCS soil classifications are based on USBR 5005-86, *Procedure for Determining Unified Soil Classification (Visual Method)*.
RQD = rock quality designation; USCS = Unified Soil Classification System.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#14

SHEET 2 OF 11

FEATURE: Waste Handling Facility	PROJECT: Yucca Mountain Project	STATE: Nevada
LOCATION: ESF North Portal Pad	COORDINATES: N 765,308.73 E 571,065.44	GROUND ELEVATION: 3651.52
BEGUN: 9/13/2000 FINISHED: 9/27/2000	TOTAL DEPTH: 550.0 ft	ANGLE FROM HORIZONTAL: -90°
DEPTH TO WATER: Not Encountered	DEPTH TO BEDROCK: 101.8 ft	HOLE LOGGED BY: USBR/SMF
		REVIEWED BY: Mark McKeown

NOTES



CLASSIFICATION AND PHYSICAL CONDITION

55.6 to 60.5: WELL GRADED GRAVEL WITH SAND (GW)s; About 85% fine to coarse, hard, subrounded to subangular gravel; about 15% predominately fine sand; trace of fines; maximum size 120 mm, dry, light brown; weak reaction with HCl; soft weakly cemented.

60.5 to 69.3: POORLY GRADED GRAVEL WITH SAND (GP)s; About 80% fine to coarse, hard, subrounded to subangular gravel; about 15% fine to coarse, subrounded to subangluar sand; about 5% nonplastic fines, no dry strength, rapid dilatancy, low toughness; maximum size 170 mm, dry; weak reaction with HCl; soft, weakly cemented.

69.3 to 78.1: POORLY GRADED GRAVEL (GP); About 100% fine to coarse, hard, subrounded to subangular gravel; maximum size 120 mm, moist; no to strong reaction with HCl.

78.1 to 80.3: POORLY GRADED GRAVEL WITH COBBLES (GP)c; About 50% coarse, hard, subangular gravel; about 50% cobbles; moist; cobbles have caliche coating.

80.3 to 84.8: POORLY GRADED GRAVEL WITH COBBLES (GP)c; About 80% coarse, subrounded to subangular gravel; about 20% cobbles; moist.

101.8 to 192.5 ft COMB PEAK IGNIMBRITE - TUFF "X" (Tpki):
Pyroclastic flow, nonwelded, moderately indurated light to medium gray tuff with 10 to 15%, light greenish-gray, pumice clasts, up to 20% grayish-red volcanic lithic clasts and 2 to 3% phenocrysts of sanidine and plagioclase. Generally the tuff is slightly weathered (W4), moderately soft (H5) to soft (H6), and very slightly fractured (FD1). Both upper and lower contacts are unconformable.

Discontinuity Measurements:

Depth	Angle*	Roughness	Infilling
102.3	75	R2	5 mm clay
115.8	05	R2	<1 mm light brown stain
140.4	15	R2	clean
172.5	25	R2	trace clay
172.2	25	R2	trace clay
188.0	20	R3 to 1	sand
189.9	30	R3	trace clay
190.2	35	R3	3 mm altered tuff
190.9	30	R2	clean

192.5 to 203.4 ft POST TIVA CANYON BEDDED TUFFS (Tpbt5):
Nonwelded, devitrified, reworked (?) fallout tephra and pyroclastic flows separated by distinct paleosols. Bedded tuffs are very pale orange with 20 to 30% pumice clasts and less than 1%, pale red, volcanic lithic clasts. The tuff has up to 1% quartz, sanidine and lesser plagioclase, with less than 1% biotite biotite and manganese oxides. Generally the bedded tuffs are very soft (H7), moderately weathered (W6), and slightly to very slightly fractured (FD2). The lower contact is unconformable.

Discontinuity Measurements:

Depth	Angle*	Roughness	Infilling
197.3	20	R3	clean
201.8	45	R3	clean

203.4 to 275.0 ft TIVA CANYON TUFF CRYSTAL RICH NONLITHOPHYSAL ZONE (Tpcrn)
Pyroclastic flow, moderately to mostly densely welded, devitrified, pale red to grayish red, with up to 15% phenocryts. Phenocryts are mostly sanidine and plagioclase with some quartz and rare biotite. Rare pumice from 212.5 to 222.8 ft and up to 15% pumice clasts from 222.8 to 269.0 ft. From 276.7 to 288.0 ft the tuff has up to 2% pumice clasts and 5 to 8% phenocryts of sanidine and plagioclase with rare biotite. Generally the tuff is moderately soft (H5) to mostly moderately hard (H4), moderately to slightly weathered (W4), and intensely to moderately fracture (FD6). The lower contact is conformable.

Discontinuity Measurements:

Depth	Angle*	Roughness	Infilling
203.6	40	R3	clean
205.0	0	R3	8 mm silica
205.4	30	R3	trace white mineral
206.2	35	R3	trace white mineral

Figure 1.1-96. Geologic Log of Drill Hole UE-25 RF#14 (Sheet 2 of 11)

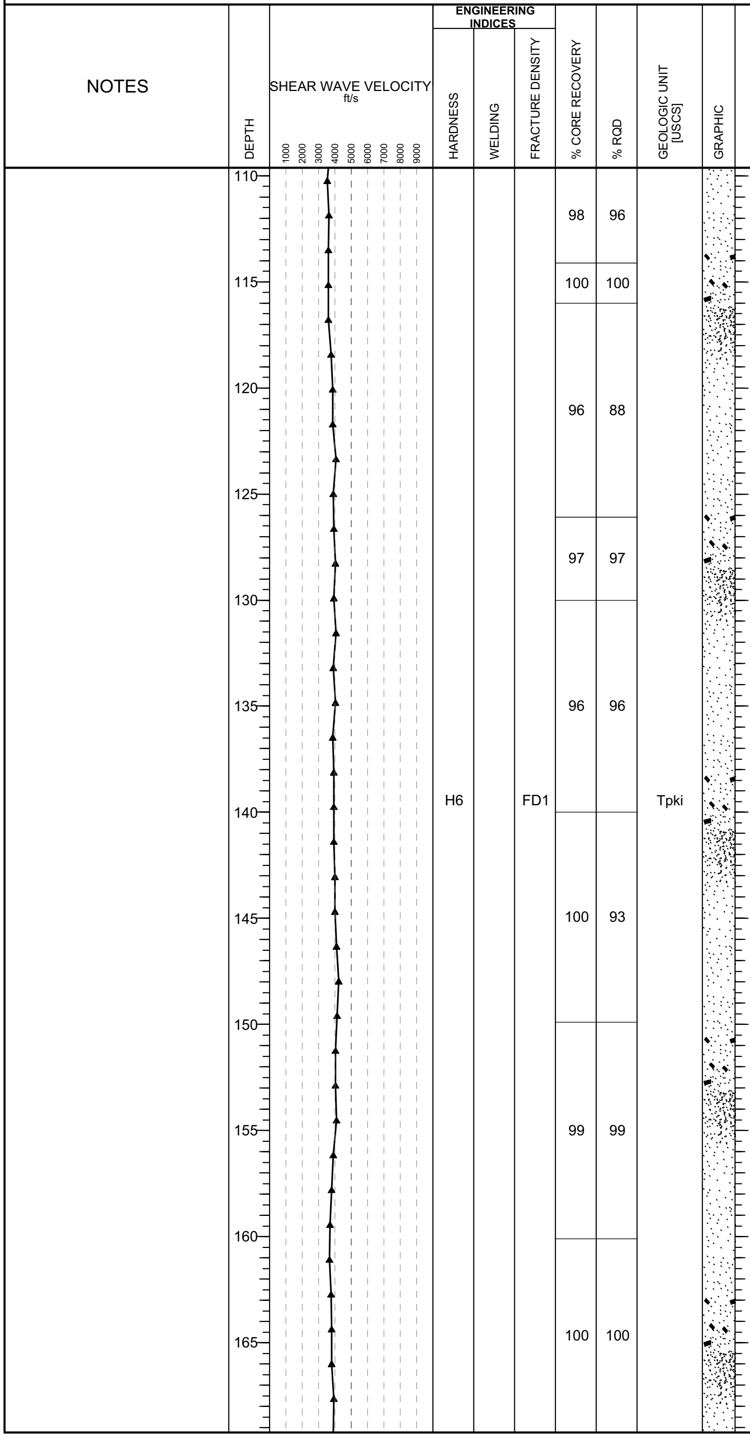
GEOLOGIC LOG OF DRILL HOLE UE-25 RF#14

SHEET 3 OF 11

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 9/13/2000 FINISHED: 9/27/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,308.73 E 571,065.44
TOTAL DEPTH: 550.0 ft
DEPTH TO BEDROCK: 101.8 ft

STATE: Nevada
GROUND ELEVATION: 3651.52
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown



CLASSIFICATION AND PHYSICAL CONDITION

206.5	40	R3	trace white mineral
206.9	20	R3	trace white mineral
208.0	10-20	R3	4 mm white mineral
208.6	30	R2	0 to 5 mm white mineral
213.6	35	R2	clean
214.7	10	R2	clean
215.8	10	R3	clean
218.1	30	R3	clean
223.5	25	R3	clean
223.7	50	R3	clean
224.7	40	R2	clean
225.3	20	R2	clean
227.8	15	R3	clean
228.4	25	R2	sand
230.0	05	R3	clean
234.7	40	R2	clean
238.4	30	R2	trace white mineral
240.1	55	R2	clean
243.3	65	R2	clean
250.1	05	R2	10 mm tan clay; polished; slicken-sided
253.2	40	R2	sand; gravel
253.9	30	R3	clean
256.3	45	R2	sand
256.7	15 to 40	R2	sand
257.3	60		1 mm white mineral
267.4	10	R3	clean
267.7	60	R2	2 mm silica
268.0	0	R3	clean
268.4	0	R3	sand
268.8	20	R3	clean
268.9	25	R3	clean
269.3	30	R3	clean
270.5	10	R2	trace white mineral
270.7	20	R2	trace white mineral
273.4	15	R3	clean
274.3	15	R3	clean

275.0 to 395.0 ft TIVA CANYON TUFF CRYSTAL POOR UPPER LITHOPHYSAL ZONE (Tpcpul)
Pyroclastic flow, densely welded, grayish orange to pale red, with 2 to 5% lithophysal cavities, up to 20 by 40 mm in size. Lithophysae increase to 15% at 310.0 ft and up to 25% at 320 ft, with up to 50% cavities partially filled with silica. Phenocryts compose less than 1% of the tuff mostly sanidine and plagioclase with minor biotite. Also up to 3% pumice clasts as large as 40 by 10 mm. Zones of nonwelded, fracture fill(?) from 334 to 359 ft, and 369 to 395 ft composed of reworked and variously bedded clay/silt-sized, tuffaceous material. Generally the tuff is moderately soft (H5) to mostly moderately hard (H4), slightly (W3) to moderately weathered (W5), and intensely to moderately fractured (FD6). Lower contact is conformable.

Discontinuity Measurements:

Depth	Angle*	Roughness	Infilling
275.9	20	R2	clean
276.0	25	R2	clean
278.7-279.4	30	R2	0.6 ft breccia; sand and gravel; cemented
279.6-280.0	60	R3	0.4 ft breccia; sand and gravel; cemented
280.1	35	R3	10 mm breccia
282.0	30	R3	trace white mineral
280.9-281.2	50-80		rotated; breccia
281.4	55	R3	breccia
284.0	20	R2	1 to 2 mm silica
283.1-284.9	0-20	R3	clean
285.0	10	R3	1 mm silica
285.3	25	R2	clean
286.0	35	R3	trace silica
287.0	25	R2	3 mm silica
287.6	25	R3	1 mm silica
288.4	60	R3	clean
288.9	35	R3	clean
289.0	70	R3	clean
289.3	15	R2	clean
289.4	65	R3	clean
289.8	10	R3	2 mm silica
290.7	25	R2	trace white mineral
291.4-291.6	35	R3	40 mm clay, sand, gravel
292.2	35	R3	gravel
291.9	75	R3	2 mm silica

Figure 1.1-96. Geologic Log of Drill Hole UE-25 RF#14 (Sheet 3 of 11)

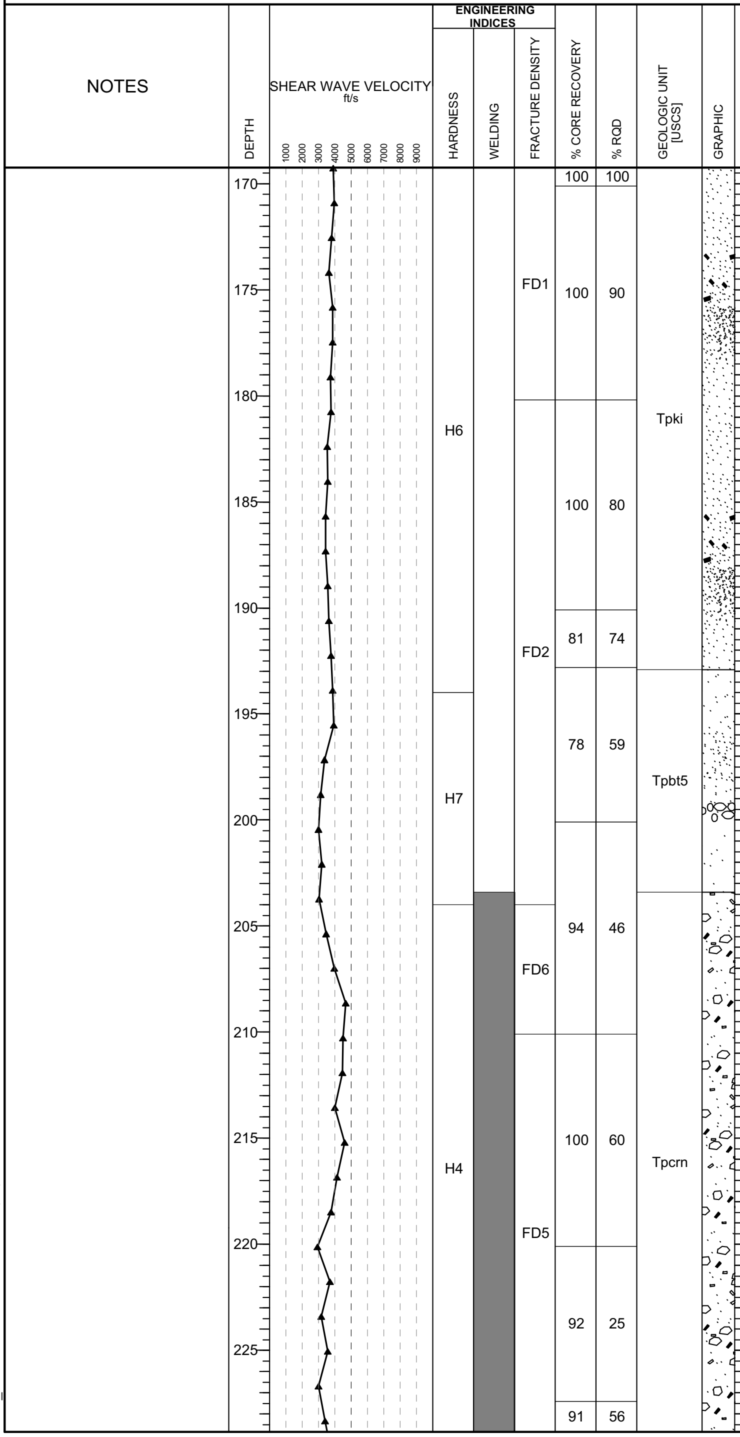
GEOLOGIC LOG OF DRILL HOLE UE-25 RF#14

SHEET 4 OF 11

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 9/13/2000 FINISHED: 9/27/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,308.73 E 571,065.44
TOTAL DEPTH: 550.0 ft
DEPTH TO BEDROCK: 101.8 ft

STATE: Nevada
GROUND ELEVATION: 3651.52
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown



CLASSIFICATION
AND PHYSICAL CONDITION

292.3	80	R3	clean
294.9	45	R3	clay, sand
295.1-295.5	30	R3	breccia, sand, gravel, trace clay
295.8-296.0	50	R3	breccia, sand, gravel, trace clay
298.6	30	R3	<1 mm silica
299.2	65	R3	clean
299.8	25	R3	clean
299.7	20	R3	clean
304.2-306.0	70	R2	clay, sand, gravel
306.8	30	R3	1 mm silica
307.2	35	R3	1 mm silica
308.9	60	R3	20 mm silica
308.4	25	R3	2 mm silica
310.4	35	R2	1 mm quartz
310.6	30	R3	none
311.3	55	R3	none
311.8	55	R3	none
312.0	45	R3	sand, trace quartz
312.2-313.3	45	R2	breccia; sand and gravel
313.8	05	R3	1 mm vapor phase minerals
314.5	35	R3	sand
315.2-316.1	45	R2	breccia; sand, gravel, clay
317.0-320.3	20	R2	sand, gravel, clay
322.5	65	R2	none
322.8	05	R2	trace white mineral
322.9	70	R2	none
323.4	50	R3	none
321.0	60	R3	8 mm vapor phase alteration
326.3	10	R3	1.2 ft clay, sand, gravel
327.3	50	R3	clean
329.2	05 to 35	R2	15 mm clay
344.8	5 to 15	R4	1 mm clay
349.0	05	R3	<1 mm white mineral and clay
351.7	35	R3	<1 mm clay(?) and MnO(?)
358.0-358.9	85	R2	clay, sand, gravel breccia
359.2	40	R3	1 mm clay
359.9	25	R2	3 mm sand, gravel, clay
360.4	30	R2	clean
361.6	25	R3	clean
362.2-362.4	65	R2	sand, gravel, clay, MnO
363.4	70	R3	trace white mineral
364.0	35	R3	clean
364.6	55	R3	trace white mineral
364.8	20	R2	MnO coating
366.8-367.5	40	R3	clay, sand, gravel

395.0 to 443.7 ft TIVA CANYON TUFF CRYSTAL POOR MIDDLE NONLITHOPHYSAL ZONE (Tpcpmn)
Pyroclastic flow, densely welded, devitrified, pale red, tuff with less than 1% lithophysae up to 50 by 10 mm. Less than 1% phenocryts of sanidine, plagioclase, and biotite. The tuff has 1 to 2% very light gray pumice clasts and pink spherulites, and up to 10% volcanic lthic fragments. Zones of nonwelded, fracture fill(?) from 402.7 to 431.7 ft, 434.0 to 435.8 ft, and 442.4 to 443.7 ft composed of reworked and variously bedded clay/silt-sized, tuffaceous material. Generally the tuff is moderately soft (H5), moderately to slightly weathered (W4), with fracture densities ranging from slightly fractured (FD3) to very intensely fractured (FD8). Lower contact is conformable.

Discontinuity Measurements:

Depth	Angle*	Roughness	Infilling
367.9	60	R3	2 mm clay
368.9	05	R2	clay, sand, gravel
370.0	30	R3	MnO stain and 5 mm clay
373.7	15	R4	contact between clayey infilling material at Tpc
373.9	60	R2	2 mm silica
374.3	35	R2	
374.3	55	R2	
374.8	60	R2	trace of clay
375.1			quartz-filled lithophysal cavity 25 mm thick
375.4	50	R3	trace of clay
375.6	60	R4	
378.6	45	R3	trace of clay
378.8	35	R3	
378.8	60	R3	
379.0	0	R4	1 mm silica
379.6	15	R4	trace silica
379.8	20	R3	
380.0	75	R3	1 mm silica
380.2	65	R3	trace silica
380.7	05	R3	

Figure 1.1-96. Geologic Log of Drill Hole UE-25 RF#14 (Sheet 4 of 11)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#14

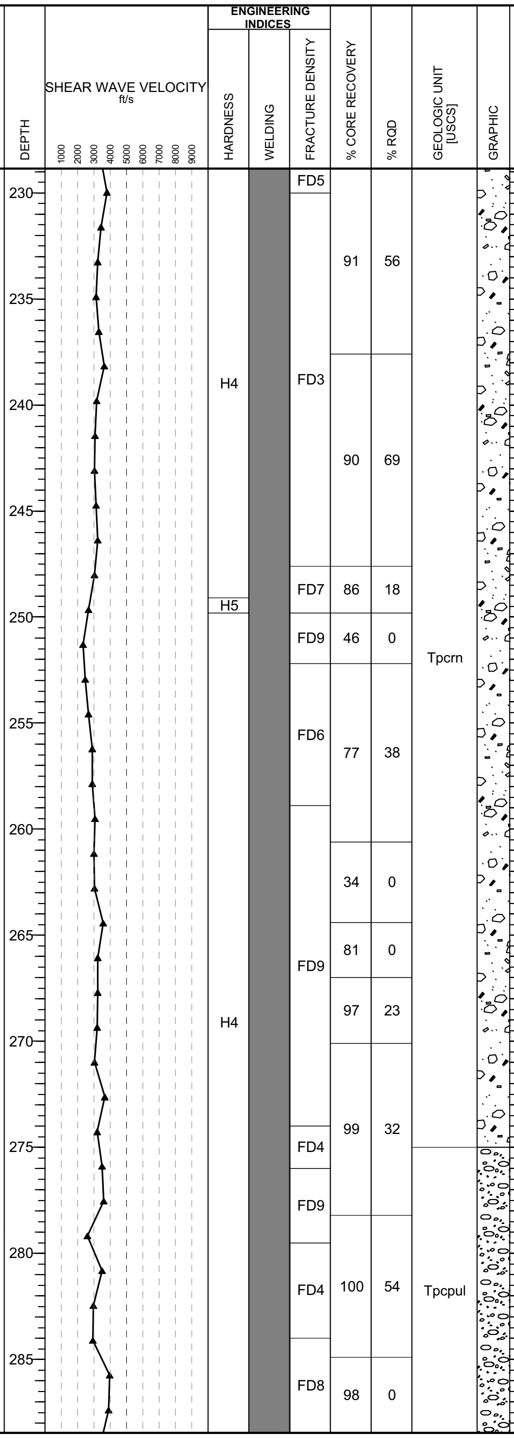
SHEET 5 OF 11

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 9/13/2000 FINISHED: 9/27/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,308.73 E 571,065.44
TOTAL DEPTH: 550.0 ft
DEPTH TO BEDROCK: 101.8 ft

STATE: Nevada
GROUND ELEVATION: 3651.52
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES



CLASSIFICATION
AND PHYSICAL CONDITION

381.0	28	R3	
380.8	55	R3	
381.4	20	R4	
381.5	10	R4	
381.7	20	R4	
382.0	15	R3	trace of clay
382.2	15	R3	trace MnO, trace clay
382.1	45	R3	
382.3	20	R3	
382.8	70	R3	
382.9	35	R4	trace MnO
383.3	30	R4	
383.7	05	R4	trace silica, trace clay
384.5	10	R2	
384.7	60	R3	
384.7	35	R3	
384.9	20	R3	
384.9	25	R3	
385.0	35	R3	
386.1	10	R4	
386.4	40	R4	
386.7	80	R3	
387.8/387.9	75	R2	3 anastamosing vpps, vp coated
388.7	20	R4	
389.3	75	R5	
389.5	75	R3	trace MnO
389.8	80	R4	
390.4	80	R3	vapor phase (Vpp)
390.7	45	R4	
390.8	75	R3	vapor phase (Vpp)
391.5	80	R4	
392.1	75	R3	
392.2	40	R4	trace vapor phase
392.6	75	R2	vapor phase to 2 mm (Vpp)
392.8	35	R4	
392.9	80	R2	vapor phase to 1 mm (Vpp)
395.2	45	R3	
396.8	75	R2	vapor phase (Vpp)
398.8	80	R2	
399.5	5	R3	
400.3	15	R3	trace MnO
400.7	80	R2	vapor phase (Vpp)
401.7	0	R3	
401.4	80	R4	
403.8	20	R2	clay 0.5 2 cm
408.6	45	R4	contact (?) between cobble and pumiceous, lithic-rich infilling
408.9/409.9	40	R4	well-cemented pumiceous lithic-rich infilling w/Tpc frags
409.9/413.4	40	R3	tuffaceous infilling with <15% white/gray altered pumice
417.8	10	R5	clay 20 mm
422.9	10	R5	clay 30 mm+ extends into next run
429.9	10	R4	bedding; fine grained
428.0	20	R4	bedding; fine grained
431.1	10	R3	2 mm clay
432.2	20	R3	trace white mineral
432.4	15	R3	trace white mineral
432.6	25	R3	trace white mineral
433.0	20	R3	1 to 4 mm tuff
434.0	15	R4	tuff
435.9	15	R3	1 mm clay and white mineral
437.3	80	R2	vpp alteration
438.7	75	R3	trace white mineral; 5 mm clay
440.3	15	R3	trace white mineral
441.3	75	R3	trace white mineral
441.4	65	R3	trace white mineral
441.8	85	R3	trace white mineral
442.0	85	R3	trace white mineral
442.1	15	R4	clay; tuff

443.7 to 455.6 ft TIVA CANYON TUFF CRYSTAL POOR LOWER LITHOPHYSAL ZONE (Tpcpll)
Pyroclastic flow, densely welded, devitrified, moderate orange pink tuff with 1% very light gray pumice. Phenocryts of sanidine and rare biotite compose less than 1% of the rock by volume. Lithophysal cavities compose up to 15% of the rock by volume and are generally 20 by 30 mm in size. Lithophysae are filled and coated with vapor phase minerals to varying degrees. Generally the tuff is moderately hard (H4), slightly weathered (W3), and intensely fractured (FD6).

Figure 1.1-96. Geologic Log of Drill Hole UE-25 RF#14 (Sheet 5 of 11)

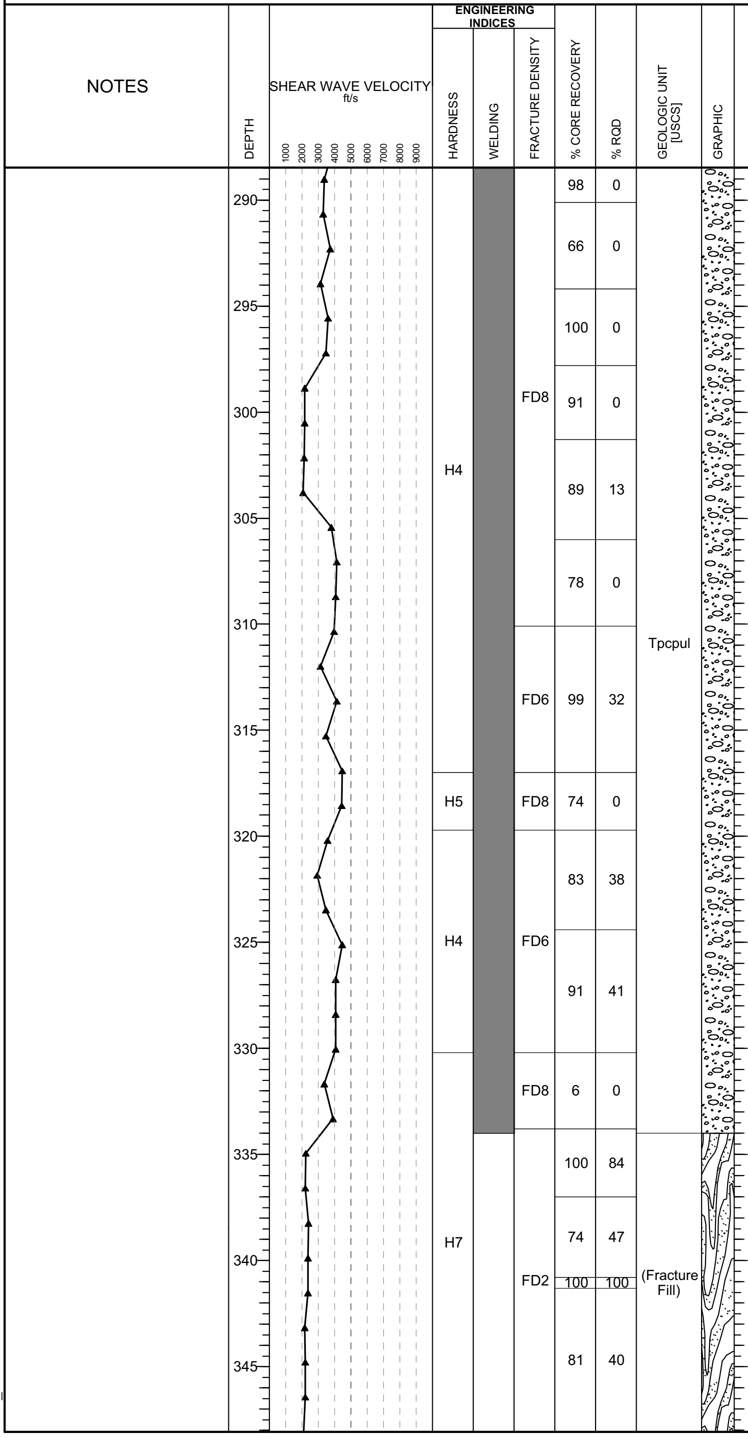
GEOLOGIC LOG OF DRILL HOLE UE-25 RF#14

SHEET 6 OF 11

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 9/13/2000 FINISHED: 9/27/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,308.73 E 571,065.44
TOTAL DEPTH: 550.0 ft
DEPTH TO BEDROCK: 101.8 ft

STATE: Nevada
GROUND ELEVATION: 3651.52
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown



CLASSIFICATION
AND PHYSICAL CONDITION

Lower contact is conformable.

Discontinuity Measurements:

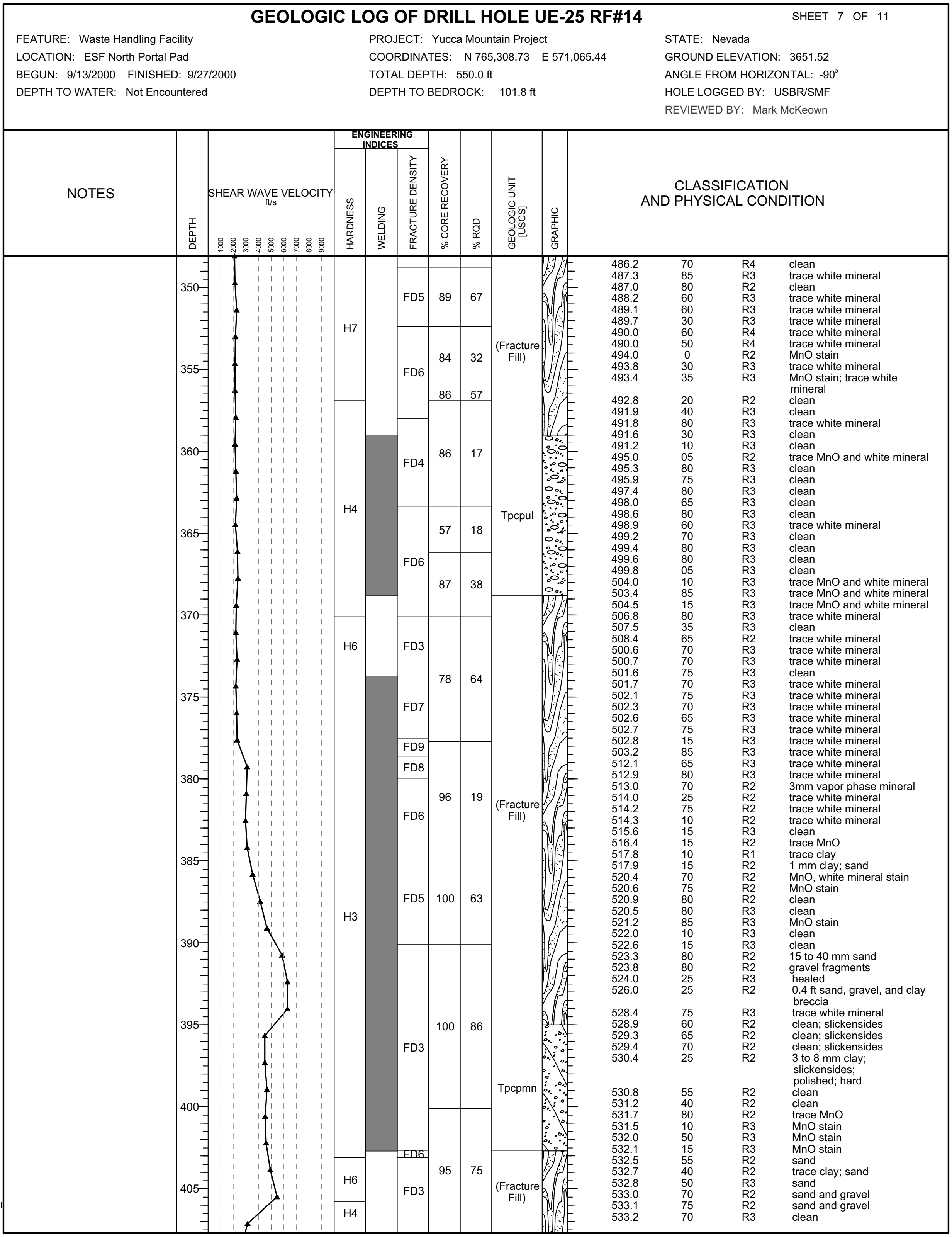
Depth	Angle*	Roughness	Infilling
443.7	60	R3	1 mm clay
444.2	75	R2	clean
444.9	60	R2	clean
445.1	35	R2	clean
446.3	15	R2	trace white mineral; sand
446.8	30	R2	sand
447.2	30	R2	sand
453.7	60	R2	1 mm silica

455.6.0 to 550.0 ft TIVA CANYON TUFF CRYSTAL POOR LOWER NONLITHOPHYSAL ZONE (Tpcpln)
Pyroclastic flow, densely welded, devitrified, moderate orange pink tuff with less than 1% light gray pumice clasts. Phenocrysts of sanidine and plagioclase compose 1 to 2% of the rock by volume. Reddish-brown lithic clasts compose less than 1% of the rock by volume. Generally the tuff is moderately hard (H4), slightly weathered (W3), with fracture densities ranging from slightly fractured (FD3) to intensely fractured (FD6). Lower contact undetermined, bottom of borehole at 550.0 ft.

Discontinuity Measurements:

Depth	Angle*	Roughness	Infilling
455.7	40	R3	clean
456.4	20	R3	0 to 1 mm silica
458.0	45	R3	clean
458.1	35	R3	3 mm silica
460.2	60	R2	trace white mineral
460.0	30	R3	trace white mineral
460.4	70	R2	clean
460.9	65	R3	trace white mineral
461.1	85	R3	trace white mineral
461.3	35	R4	MnO and trace white mineral
461.8	60	R3	clean
462.1	60	R4	clean
462.7	30	R3	clean
463.1	25	R4	trace white mineral
463.9	75	R4	clean
464.1	55	R3	trace white mineral
464.8	35	R3	trace white mineral
465.0	55	R4	clean
465.5	65	R4	clean
465.9	70	R4	trace white mineral
466.3	65	R4	trace white mineral
467.0	20	R3	trace white mineral
467.1	75	R2	trace white mineral
467.3	50	R2	4 mm sand and silica
467.7	50	R3	trace white mineral
468.0	80	R4	trace white mineral
468.2	55	R4	clean
468.4	80	R4	clean
468.5	35	R4	trace white mineral
468.7	60	R4	clean
469.0	70	R4	clean
469.4	45	R4	trace white mineral
470.0	60	R2	trace white mineral
471.2	80	R2	trace white mineral
472.4	80	R3	trace white mineral
472.8	80	R2	trace white mineral
473.1	75	R3	trace white mineral
474.5	10	R2	trace white mineral
476.8	80	R2	trace white mineral
476.2	80	R1	trace white mineral; trace silica
477.3	75	R1	trace white mineral
478.4	85	R1	vapor phase alteration-2 mm
478.5	55	R3	trace white mineral
479.0	60	R1	trace white mineral
480.3	70	R1	2 mm vapor phase minerals (healed)
480.9	75	R1	2 mm vapor phase minerals (healed)
482.4	55	R1	2 mm vapor phase minerals (healed)
483.1	45	R4	trace white minerals
484.4	65	R4	clean
484.6	60	R4	clean
485.4	80	R2	trace white mineral
485.6	75	R4	clean
485.9	50	R4	trace white mineral

Figure 1.1-96. Geologic Log of Drill Hole UE-25 RF#14 (Sheet 6 of 11)



GEOLOGIC LOG OF DRILL HOLE UE-25 RF#14

SHEET 7 OF 11

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 9/13/2000 FINISHED: 9/27/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,308.73 E 571,065.44
TOTAL DEPTH: 550.0 ft
DEPTH TO BEDROCK: 101.8 ft

STATE: Nevada
GROUND ELEVATION: 3651.52
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

CLASSIFICATION AND PHYSICAL CONDITION

486.2	70	R4	clean
487.3	85	R3	trace white mineral
487.0	80	R2	clean
488.2	60	R3	trace white mineral
489.1	60	R3	trace white mineral
489.7	30	R3	trace white mineral
490.0	60	R4	trace white mineral
490.0	50	R4	trace white mineral
494.0	0	R2	MnO stain
493.8	30	R3	trace white mineral
493.4	35	R3	MnO stain; trace white mineral
492.8	20	R2	clean
491.9	40	R3	clean
491.8	80	R3	trace white mineral
491.6	30	R3	clean
491.2	10	R3	clean
495.0	05	R2	trace MnO and white mineral
495.3	80	R3	clean
495.9	75	R3	clean
497.4	80	R3	clean
498.0	65	R3	clean
498.6	80	R3	clean
498.9	60	R3	trace white mineral
499.2	70	R3	clean
499.4	80	R3	clean
499.6	80	R3	clean
499.8	05	R3	clean
504.0	10	R3	trace MnO and white mineral
503.4	85	R3	trace MnO and white mineral
504.5	15	R3	trace MnO and white mineral
506.8	80	R3	trace white mineral
507.5	35	R3	clean
508.4	65	R2	trace white mineral
500.6	70	R3	trace white mineral
500.7	70	R3	trace white mineral
501.6	75	R3	clean
501.7	70	R3	trace white mineral
502.1	75	R3	trace white mineral
502.3	70	R3	trace white mineral
502.6	65	R3	trace white mineral
502.7	75	R3	trace white mineral
502.8	15	R3	trace white mineral
503.2	85	R3	trace white mineral
512.1	65	R3	trace white mineral
512.9	80	R3	trace white mineral
513.0	70	R2	3mm vapor phase mineral
514.0	25	R2	trace white mineral
514.2	75	R2	trace white mineral
514.3	10	R2	trace white mineral
515.6	15	R3	clean
516.4	15	R2	trace MnO
517.8	10	R1	trace clay
517.9	15	R2	1 mm clay; sand
520.4	70	R2	MnO, white mineral stain
520.6	75	R2	MnO stain
520.9	80	R2	clean
520.5	80	R3	clean
521.2	85	R3	MnO stain
522.0	10	R3	clean
522.6	15	R3	clean
523.3	80	R2	15 to 40 mm sand
523.8	80	R2	gravel fragments
524.0	25	R3	healed
526.0	25	R2	0.4 ft sand, gravel, and clay breccia
528.4	75	R3	trace white mineral
528.9	60	R2	clean; slickensides
529.3	65	R2	clean; slickensides
529.4	70	R2	clean; slickensides
530.4	25	R2	3 to 8 mm clay; slickensides; polished; hard
530.8	55	R2	clean
531.2	40	R2	clean
531.7	80	R2	trace MnO
531.5	10	R3	MnO stain
532.0	50	R3	MnO stain
532.1	15	R3	MnO stain
532.5	55	R2	sand
532.7	40	R2	trace clay; sand
532.8	50	R3	sand
533.0	70	R2	sand and gravel
533.1	75	R2	sand and gravel
533.2	70	R3	clean

Figure 1.1-96. Geologic Log of Drill Hole UE-25 RF#14 (Sheet 7 of 11)

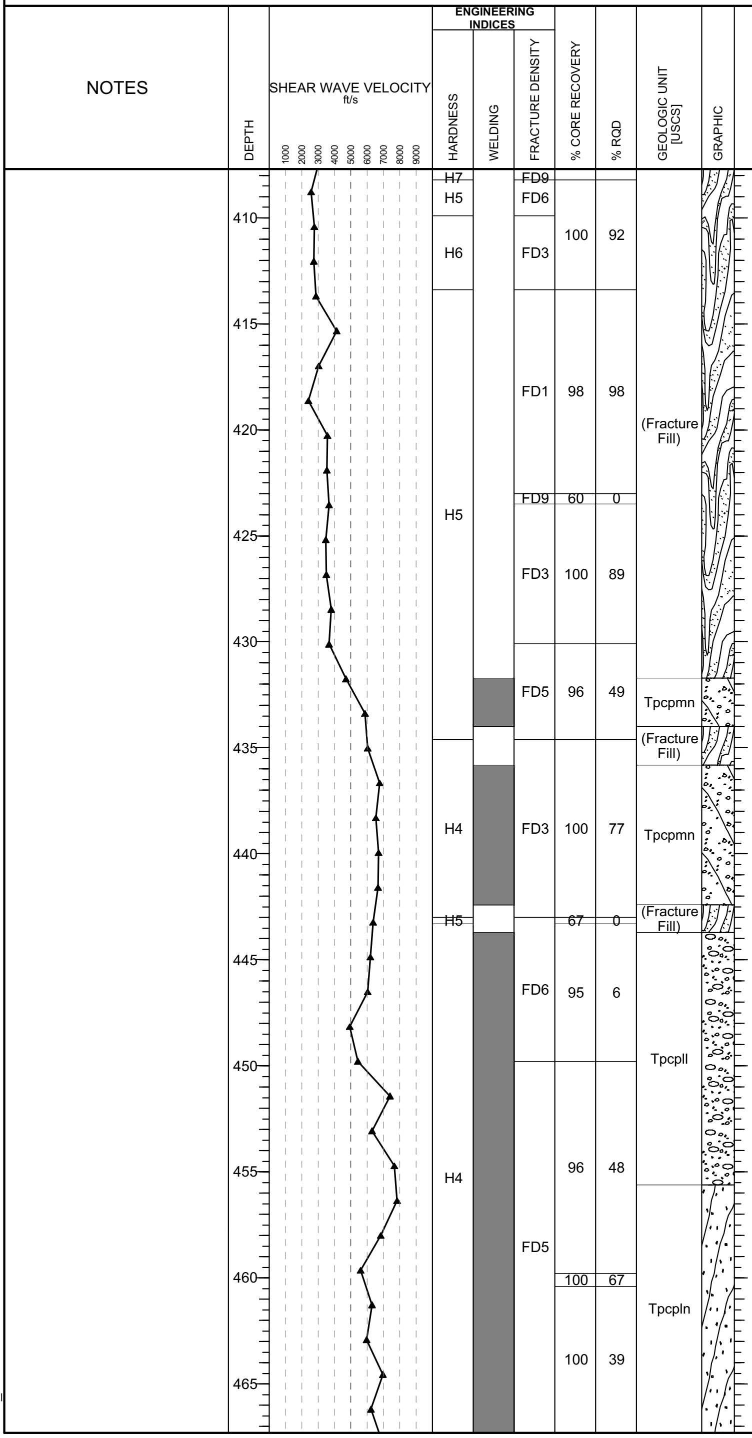
GEOLOGIC LOG OF DRILL HOLE UE-25 RF#14

SHEET 8 OF 11

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 9/13/2000 FINISHED: 9/27/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,308.73 E 571,065.44
TOTAL DEPTH: 550.0 ft
DEPTH TO BEDROCK: 101.8 ft

STATE: Nevada
GROUND ELEVATION: 3651.52
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown



CLASSIFICATION AND PHYSICAL CONDITION

533.3	65	R3	clean
533.5	65	R3	trace white mineral
536.0	70	R3	clean
534.1	45	R3	clean
534.1	45	R3	clean
534.4	50	R2	clean
534.5	15	R2	clean
534.6	80	R3	clean
534.7	70	R3	clean
534.8	30	R3	trace white mineral
535.4	60	R2	0 to 1 ft sand and gravel
535.6	70	R3	sand
536.1	80	R3	clean
536.3	80	R3	clean
536.6	80	R3	clean
536.9	80	R2	trace white mineral
537.5	60	R2	3 mm clay
537.6	70	R2	clean
537.9	75	R2	clean
538.2	80	R2	clean
538.5	55	R2	clean
538.7	85	R2	clean
538.8	85	R2	clean
538.9	85	R2	clean
539.3	65	R3	trace white mineral
539.5	70	R3	clean
539.7	75	R3	clean
539.8	75	R3	clean
540.0	15	R3	trace white mineral
540.9	20	R3	trace white mineral
540.5	70	R2	clean
540.9	60	R2	trace white mineral
540.8	30	R3	clean
541.2	60	R2	trace white mineral
541.4	20	R2	trace white mineral
541.6	80	R3	trace white mineral
541.8	85	R3	trace white mineral
542.2	80	R3	trace white mineral
542.3	80	R3	trace white mineral
542.8	85	R3	trace white mineral
543.0	80	R2	trace white mineral
543.5	10	R2	clean
543.7	85	R3	trace white mineral
543.9	80	R2	clean
544.3	85	R2	1 to 2 mm clay
544.4	85	R3	clean
545.0	85	R3	trace white mineral
545.3	50	R2	clean
545.7	10	R2	clean
545.5	10	R2	clean
546.8	80	R2	1 mm clay
546.9	50	R2	1 mm clay
547.0	75	R2	1 mm clay
549.5	40	R3	clean

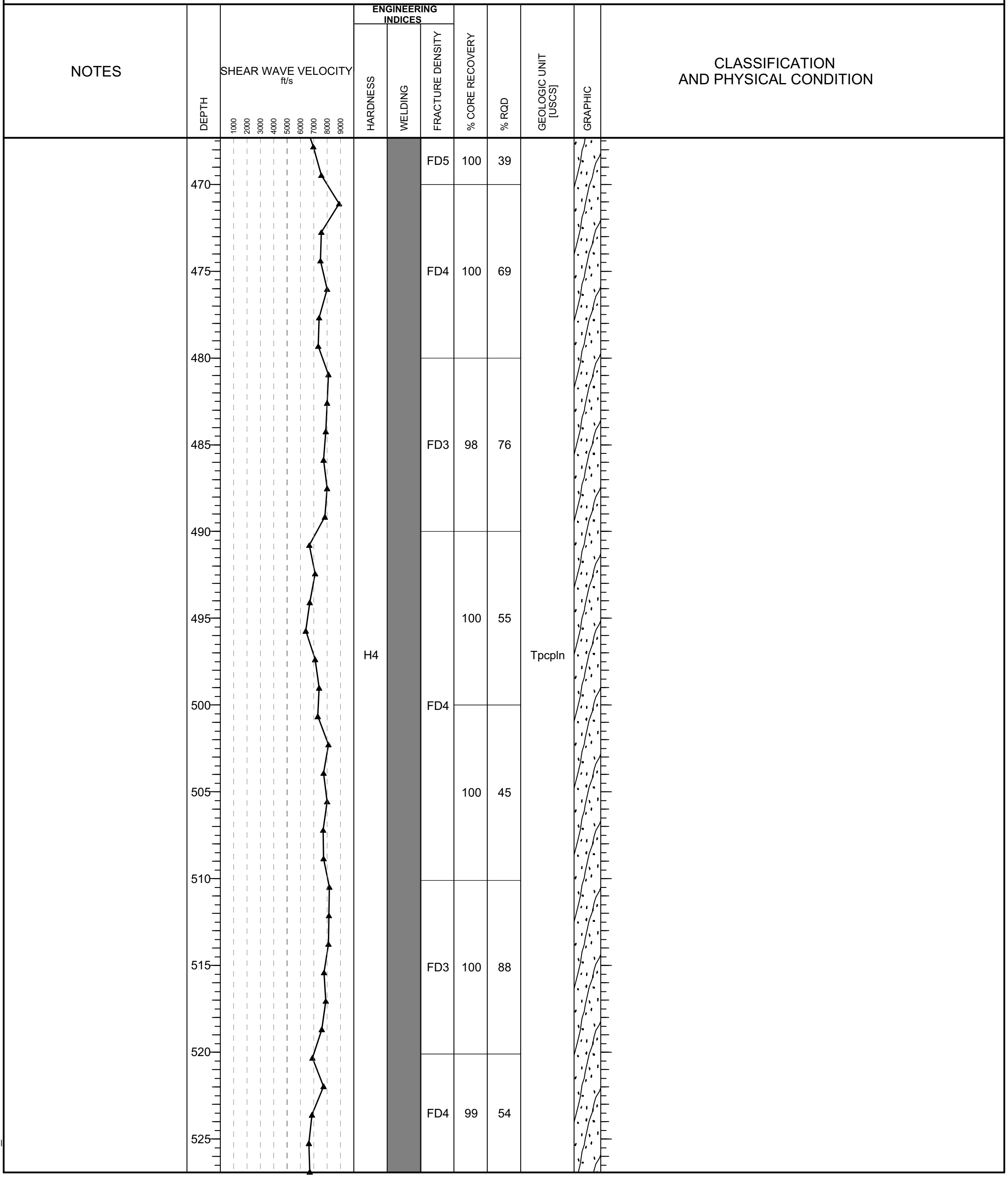
* Angles are measured from core axis and are plus or minus 5 degrees.

Figure 1.1-96. Geologic Log of Drill Hole UE-25 RF#14 (Sheet 8 of 11)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#14

SHEET 9 OF 11

FEATURE: Waste Handling Facility	PROJECT: Yucca Mountain Project	STATE: Nevada
LOCATION: ESF North Portal Pad	COORDINATES: N 765,308.73 E 571,065.44	GROUND ELEVATION: 3651.52
BEGUN: 9/13/2000 FINISHED: 9/27/2000	TOTAL DEPTH: 550.0 ft	ANGLE FROM HORIZONTAL: -90°
DEPTH TO WATER: Not Encountered	DEPTH TO BEDROCK: 101.8 ft	HOLE LOGGED BY: USBR/SMF
		REVIEWED BY: Mark McKeown



FD5	100	39
FD4	100	69
FD3	98	76
FD4	100	55
	100	45
FD3	100	88
FD4	99	54

Figure 1.1-96. Geologic Log of Drill Hole UE-25 RF#14 (Sheet 9 of 11)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#14

SHEET 10 OF 11

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 9/13/2000 FINISHED: 9/27/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,308.73 E 571,065.44
TOTAL DEPTH: 550.0 ft
DEPTH TO BEDROCK: 101.8 ft

STATE: Nevada
GROUND ELEVATION: 3651.52
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES

CLASSIFICATION AND PHYSICAL CONDITION

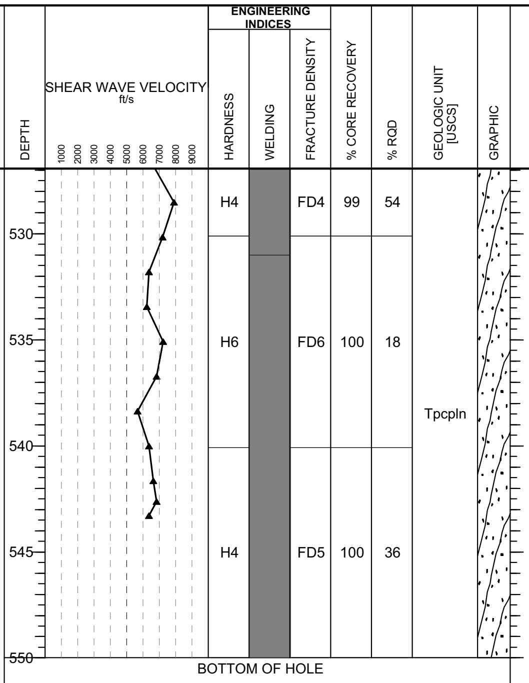


Figure 1.1-96. Geologic Log of Drill Hole UE-25 RF#14 (Sheet 10 of 11)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#14

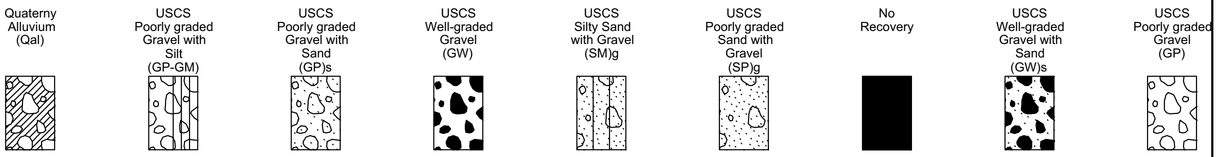
SHEET 11 OF 11

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 9/13/2000 FINISHED: 9/27/2000
DEPTH TO WATER: Not Encountered

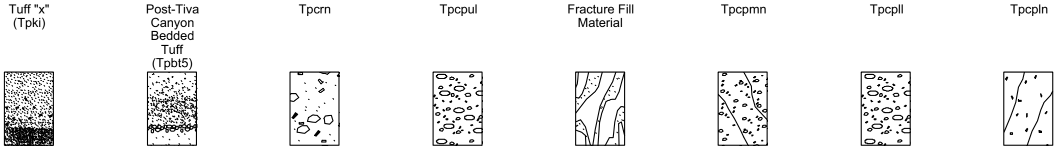
PROJECT: Yucca Mountain Project
COORDINATES: N 765,308.73 E 571,065.44
TOTAL DEPTH: 550.0 ft
DEPTH TO BEDROCK: 101.8 ft

STATE: Nevada
GROUND ELEVATION: 3651.52
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

SOIL



ROCK



WELDING

Nonwelded	Densely Welded
☐	■

HARDNESS

Alphanumeric descriptor	Descriptor	Criteria
H1	Extremely	Core, fragment, or exposure cannot be scratched with knife or sharp pick; can only be chipped with repeated heavy hammer blows.
H2	Very Hard	Cannot be scratched with knife or sharp pick. Core or fragment breaks with repeated heavy hammer blows.
H3	Hard	Can be scratched with knife or sharp pick with difficulty (heavy pressure). Heavy hammer blow required to break specimen.
H4	Moderately Hard	Can be scratched with knife or sharp pick with light pressure. Core or fragment breaks with moderate hammer blow.
H5	Moderately Soft	Can be grooved 1/16 in. (2 mm) deep by sharp pick with moderate or heavy pressure. Core or fragment breaks with light hammer blow or heavy manual pressure.
H6	Soft	Can be grooved or gouged easily by knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
H7	Very Soft	Can be readily indented, grooved or gouged with fingernail, or carved with a knife. Breaks with light manual pressure.

WEATHERING

Alphanumeric descriptor	Descriptor	General characteristics (strength, excavation, etc.)
W1	Fresh	Hammer rings when crystalline rocks are struck. Almost always rock excavation except for naturally weak or weakly cemented rocks such as siltstones or shales.
W2	Slightly weathered to fresh	
W3	Slightly weathered	Hammer rings when crystalline rocks are struck. Body of rock not weakened. With few exceptions, such as siltstones or shales, classified as rock excavation.
W4	Moderately to slightly weathered	
W5	Moderately weathered	Hammer does not ring when rock is struck. Body of rock is slightly weakened. Depending on fracturing, usually is rock excavation except in naturally weak rocks such as siltstones or shales.
W6	Intensely to moderately weathered	
W7	Intensely weathered	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened. Usually common excavation.
W8	Very intensely weathered	
W9	Decomposed	Can be granulated by hand. Always common excavation. Resistant minerals such as quartz may be present as "stringers" or "dikes."

FRACTURE DENSITY

Alphanumeric descriptor	Descriptor	Criteria (Excludes mechanical breaks)
FD0	Unfractured	No observed fractures.
FD1	Very slightly fractured	Core recovered mostly in lengths greater than 3 ft (1 m).
FD2	Slightly to very slightly fractured	
FD3	Slightly fractured	Core recovered mostly in lengths from 1 to 3 ft (300 to 1,000 mm) with few scattered lengths less than 1 ft (300 mm) or greater than 3 ft (1,000 mm).
FD4	Moderately to slightly fractured	
FD5	Moderately fractured	Core recovered mostly in lengths from 0.33 to 1.0 ft (100 to 300 mm) with most lengths about 0.67 ft (200 mm).
FD6	Moderately to intensely fractured	
FD7	Intensely fractured	Lengths average from 0.1 to 0.33 ft (30 to 100 mm) with fragmented intervals. Core recovered mostly in lengths less than 0.33 ft (100 mm).
FD8	Very intensely to intensely fractured	
FD9	Very intensely fractured	Core recovered mostly as chips and fragments with a few scattered short core lengths.

Figure 1.1-96. Geologic Log of Drill Hole UE-25 RF#14 (Sheet 11 of 11)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#15

SHEET 1 OF 7

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 8/30/2000 FINISHED: 9/11/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,773.64 E 570,224.85
TOTAL DEPTH: 330.0 ft
DEPTH TO BEDROCK: 5.0 ft

STATE: Nevada
GROUND ELEVATION: 3680.98
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES

Purpose of Hole:
Preliminary, conceptual-level geotechnical foundation investigations for the design of the waste handling facility.

Drill Equipment:
Schramm T685 Drill Rig, UDR 1000 Drill Rig

Drillers:
D. Harrison, R. Mckay, D. Fyffe; Dynatec Drilling Inc.; Salt Lake City, Utah.

Drilling Method:
Install 12 in. hammer. Hammer to 5.03. Cement 10.75 O.D. casing with 1.38 stickup. Re-enter hole on 8/30/2000 with PQ coring system. Cored with PQ to 77.16. Used PQ rods as casing and installed HQ coring system. Cored with HQ to the total depth of 330.00.

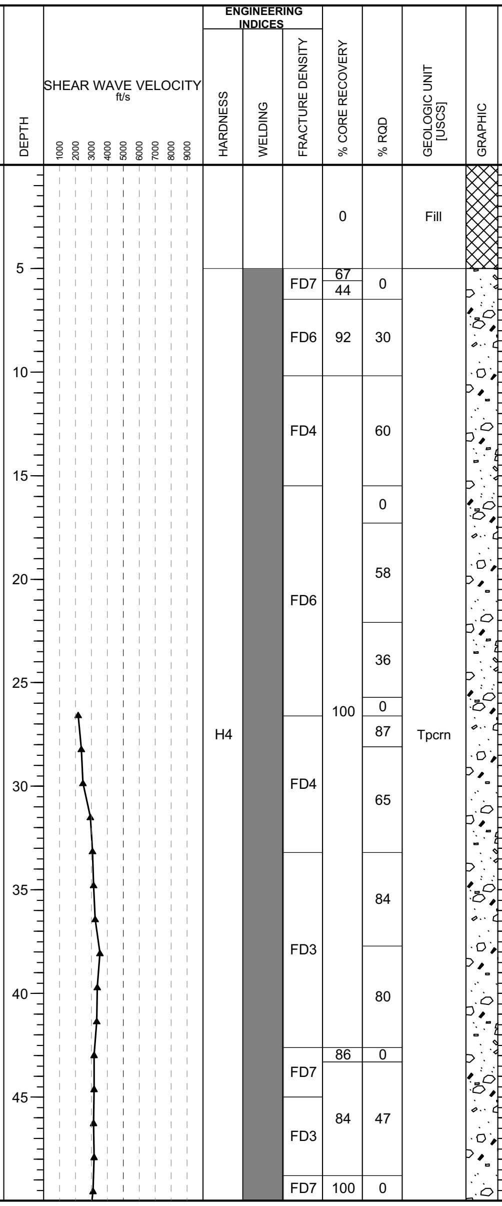
Drilling Conditions:
77.16 to 289.26 replace bit.

Drilling Fluid:
0.00 to 5.03: Nonpotable water.
5.03 to 330.00: Quick Gel mud with EZ-Mud and LCM to re-establish circulation.

Loss Intervals:
Lost circulation from 51.00 to 330.00.

Casing Record:
0.00 to 4.63: 10.75 O.D. casing.
0.00 to 77.16: PQ casing
77.16 to 330.00: No casing

Hole Completion:
Ream hole from 5.03 to 330.0. Set and cement 4.5" PVC casing.



CLASSIFICATION AND PHYSICAL CONDITION

0.0 to 5.0 ft PAD FILL (Fill)
0.0 to 5.0: POORLY GRADED GRAVEL (GP)
Predominately fine to coarse, hard, subangular gravel with a trace of nonplastic fines on gravel surfaces; derived from moderately to densely welded tuff.

5.0 to 78.0 ft TIVA CANYON TUFF CRYSTAL RICH NONLITHOPHYSAL ZONE (Tpcrn)
Pyroclastic flow, densely welded, devitrified, light gray to pale red tuff with 15 to 20% phenocrysts of plagioclase, sanidine, and minor (less than 1 percent) biotite. Pumice clasts compose up to 10% of the tuff, pumice clasts increase to up to 25 to 30% at a depth of 67.4 ft. Generally the tuff is moderately hard (H4), moderately to slightly weathered (W4), and intensely to moderately fractured (FD6). Upper contact is unconformable (erosional), lower contact is conformable.

Discontinuity Measurements:

Depth	Angle*	Roughness	Infilling
5.2	30	R3	0.5 in. calcite
6.8	65	R2	1.0 in. calcite
7.1	80	R2	0.25 in. calcite
8.7	30	R3	clean
9.2	25	R2	0.1 in. calcite
9.2	70	R2	0.25 in. calcite
11.2	30	R2	0.25 in. calcite
13.7	40		0.1 in. clay and sand
14.8	10	R3	trace clay
18.0	10	R3	0.3 in. calcite and clay
16.8	40	R3	clean
17.8	70	R2	clean
18.5	65	R2	clean
19.0	35	R2	clean
20.0	05	R2	0.75 in. calcite
22.4	55	R3	clean
24.5	30	R2	0.25 in. clay
24.8	50	R3	<0.1 in. gray noncrystalline
25.1	60	R2	<0.1 in. gray noncrystalline
26.6	70	R3	clean
27.1	60	R3	trace iron
28.4	25	R3	quartz and clay
29.0	40	R3	clay
29.3	30-90	R3	calcite? and clay
32.6 - 32.8	15	R3	quartz and clay
34.5 - 35.3	20	R3	clay and pumice
34.4	90	R3	clean
34.9	90	R3	clay and pumice
38.5	45	R2	clean
43.4 - 43.8	10	R3	clean
49.3 - 49.5	45	R2	trace clay
49.6 - 50.3	5-10	R3	trace clay
49.6 - 49.9	10	R3	clean
53.1	45	R3	trace clay
55.1 - 57.8	0-5	R4	white mineral, clay
59.6 - 59.7	5 0	R3	clay
61.7 - 62.1	10	R3	trace clay
65.6 - 66.7	10	R3	breccia zone
65.3	65	R3	sand
67.7	65	R3	0.1 in. vapor-phase coating
68.8	70	R2	0.1 in. vapor-phase coating, sand
69.8	30	R3	0.1 in. quartz, sand
70.5	30	R2	sand
68.4	80	R1	vapor-phase parting
71.4	60	R2	0.1 in. vapor-phase
71.7	60	R3	0.1 in. vapor-phase
72.2	85	R3	0.1 in. vapor-phase
72.8	50	R4	paper thin white mineral
73.2	55	R3	clean
74.1 - 74.4	40	R3	0.2 in. breccia-clay, sand, gravel

Figure 1.1-97. Geologic Log of Drill Hole UE-25 RF#15 (Sheet 1 of 7)

NOTE: All measurements are in feet unless noted otherwise. No attempts to re-establish circulation were made below 278 ft. LCM (Lost Circulation Material) consists of cellophane cuttings. USCS classifications were determined in the field, with limited access to samples to keep samples intact for future tests. Shear Wave Velocity data from GeoVision suspension logging. Data acquired from downhole survey conducted after PVC casing installed. USCS soil classifications are based on USBR 5005-86, *Procedure for Determining Unified Soil Classification (Visual Method)*.
RQD = rock quality designation; USCS = Unified Soil Classification System.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#15

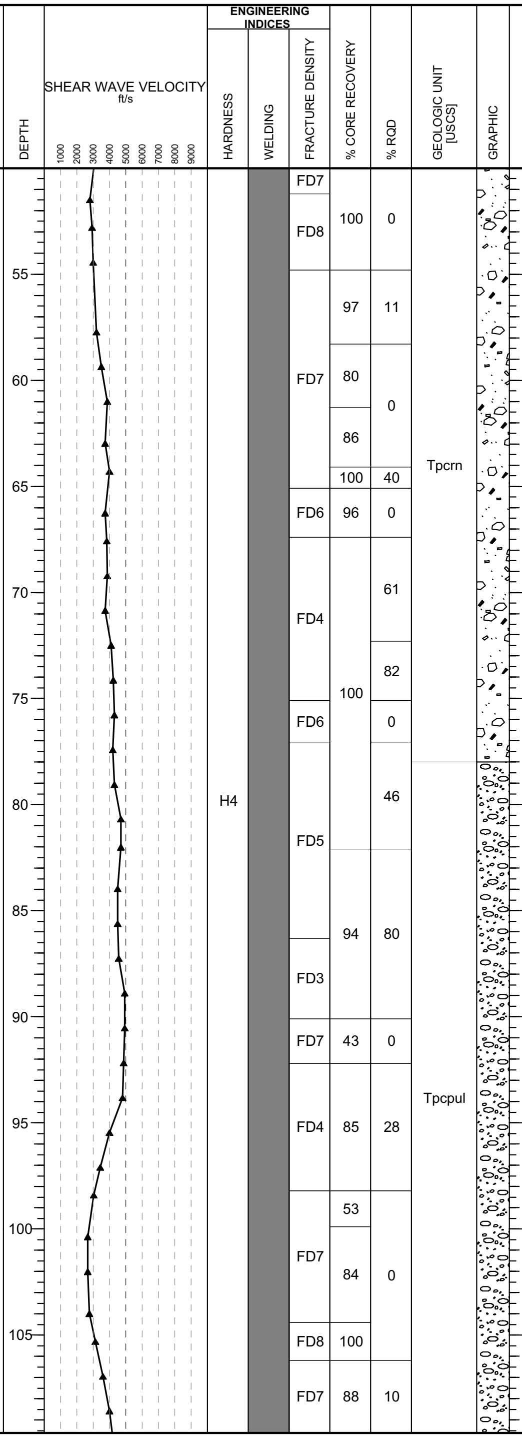
SHEET 2 OF 7

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 8/30/2000 FINISHED: 9/11/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,773.64 E 570,224.85
TOTAL DEPTH: 330.0 ft
DEPTH TO BEDROCK: 5.0 ft

STATE: Nevada
GROUND ELEVATION: 3680.98
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES



CLASSIFICATION
AND PHYSICAL CONDITION

74.6 - 74.7	40	R3	0.1 in. breccia - clay, sand, gravel
75.0	25	R2	clean
76.0	30	R2	fine gravel
77.6	45	R3	trace white mineral
78.3	55	R3	trace white mineral
78.8	70	R3	0.1 in. calcite
79.5	65	R3	clean
80.1	25	R2	1.75 in. sand, gravel, calcite
80.6	35	R2	trace calcite
80.8	70	R3	trace calcite
82.3	55	R3	clean
82.7	85	R3	trace calcite
83.2	60	R3	trace calcite
83.6	60	R4	trace calcite
85.1	55	R3	1 mm crystal calcite, quartz?
85.3	30	R3	1 mm calcite and clay
85.7	55	R3	clay and trace calcite

78.0 to 196.0 ft TIVA CANYON TUFF UPPER CRYSTAL POOR LITHOPHYSAL ZONE (Tpcpul)
Pyroclastic flow, densely welded, pale reddish-brown tuff with up to 10% lithophysae with light gray crystal coatings. Phenocrysts compose less than 5% of the tuff, consisting of plagioclase, sanidine, and biotite. At 150.0 ft lithophysae content decreases to less than 5%, becoming mostly grayish vapor phase mottling. Generally the tuff is moderately hard (H4), moderately to slightly weathered (W4), and intensely to mostly moderately fractured (FD5). Lower contact is conformable.

Discontinuity Measurements:

Depth	Angle*	Roughness	Infilling
93.0	35	R3	2 mm calcite
93.2	80	R3	trace white mineral
93.4	80	R2	trace white mineral
94.3	55	R3	clean
95.6	30	R3	trace white mineral
101.0	35	R3	trace white mineral
105.6	50	R3	clean
108.0	25	R3	clean
109.4	45	R3	
109.4	45	R2	clean
111.6	60	R2	clean
113.9	15	R3	trace white mineral, 1 mm opal(?)
117.0	60	R3	trace white mineral
118.3	25	R2	2 mm white mineral
120.9	30	R2	1 mm white mineral
122.3	35	R2	1 mm white mineral
122.9	10	R2	clean
123.9	30	R3	1 mm white mineral, sand
129.4	40	R3	4 mm white mineral
130.1	90	R2	1 mm white mineral
132.4	30	R3	1 mm white mineral
131.7	75	R3	1 mm white mineral
132.9	60	R2	sand, gravel
138.4	40	R2	1 mm white mineral
136.5	10	R2	2 mm white mineral
139.3	40	R3	trace white mineral
142.0 - 143.9	15	R3	4 mm white mineral
143.6	35	R3	1 mm white mineral
145.6	60	R2	4 mm clay
147.2	70	R2	2 mm white mineral
147.6	90	R2	clay and sand
148.9	75	R2	clean
151.1	50	R2	clean
153.0	40	R2	clay and sand shear zone
153.8 - 154.2	25	R3	1 mm white mineral
155.3	85	R3	trace clay (gray)
156.0 - 157.4	0-5	R3	trace white mineral
157.4	70	R2	1 mm white mineral
159.2	35	R3	1 mm white mineral
160.5	15	R2	1 mm white mineral, sand
162.1	55	R3	1 mm white mineral
164.8	30	R3	1 mm white mineral
165.8	20	R2	sand
167.6	90	R2	2 mm vapor-phase minerals
167.0	80	R2	2 mm vapor-phase minerals
169.9	15	R3	trace white mineral
171.1	00	R2	10 mm clay and sand breccia
172.2	45	R3	1 mm white mineral
173.2	35	R3	sand

Figure 1.1-97. Geologic Log of Drill Hole UE-25 RF#15 (Sheet 2 of 7)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#15

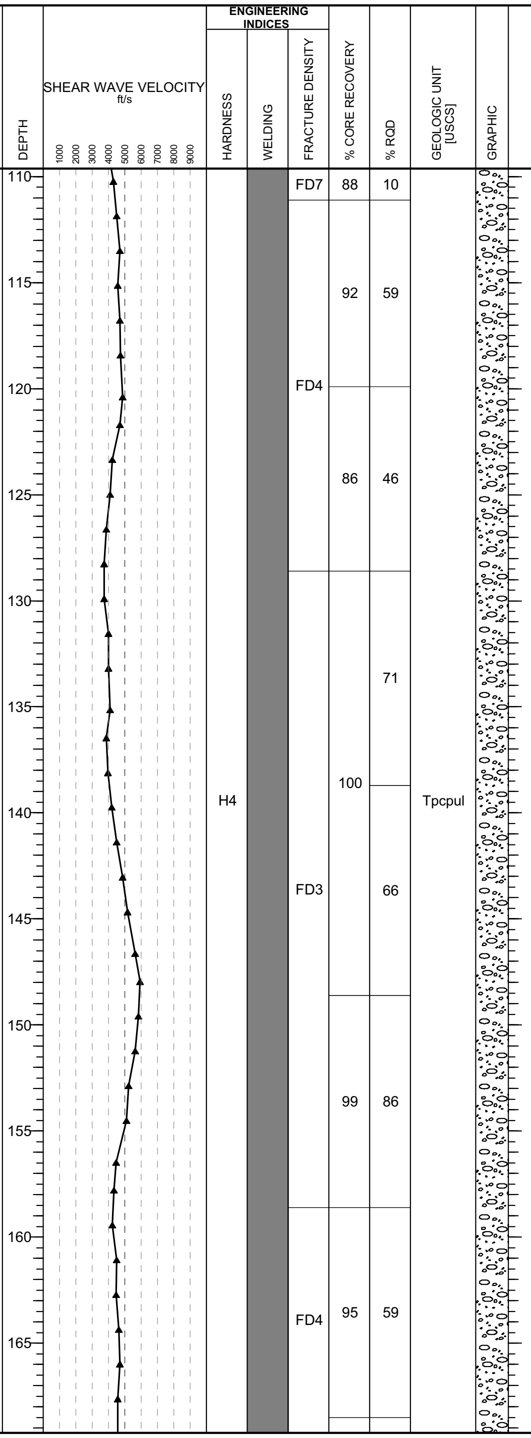
SHEET 3 OF 7

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 8/30/2000 FINISHED: 9/11/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,773.64 E 570,224.85
TOTAL DEPTH: 330.0 ft
DEPTH TO BEDROCK: 5.0 ft

STATE: Nevada
GROUND ELEVATION: 3680.98
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES



CLASSIFICATION AND PHYSICAL CONDITION

174.1	40	R3	4 mm white mineral, sand
175.4	65	R2	1 mm white mineral, sand
175.7	80	R2	1 mm white mineral, sand
176.0	20	R3	3 mm quartz
179.2	40	R2	trace white mineral
180.6	30	R2	trace white mineral
181.0	25	R2	trace white mineral, sand
181.8	70	R2	5 mm vapor-phase alteration
183.0	30	R3	trace white mineral, sand
183.2	25	R3	trace white mineral, sand
184.1	20	R3	trace white mineral, sand
186.0	60	R2	trace white mineral, sand
186.0	30	R3	trace white mineral, sand
186.5	15	R2	2 mm white mineral
187.3	75	R3	1 mm white mineral
189.0	30	R3	1 mm white mineral
190.6	85	R2	2 mm vapor-phase alteration
190.8	70	R2	clean
190.9	70	R2	trace vapor-phase alteration
191.0	30	R3	1 mm white mineral
193.1	70	R2	1 mm vapor-phase alteration
195.1	25	R3	1 mm white mineral, sand

196.0 to 242.4 ft TIVA CANYON TUFF MIDDLE NONLITHOPHYSAL ZONE (Tpcpmn)
Pyroclastic flow, densely welded, pale red tuff with less than 5% flattened pumice and less than 1% lithophysae. Phenocrysts content is less than 1% composed of plagioclase, sanidine, and biotite. From 242.4 to 256.6 ft, the tuff contains up to 30% lithophysae, some larger than core diameter. From 256.6 to 330.0 ft, the tuff has less than 1% lithophysae and pumice clasts. There is a clayey breccia zone from 276.2 to 280.3. Generally the tuff is hard (H3), moderately to slightly weathered (W4), and moderately to slightly fractured (FD4).

Discontinuity Measurements:

Depth	Angle*	Roughness	Infilling
196.5	55	R2	3 mm vapor-phase alteration
198.1	15	R2	1 mm white mineral
197.3	30	R3	0.5 in. white mineral, sand, gravel breccia
198.8	30	R3	1 mm white mineral
199.1	25	R3	1 mm white mineral
200.6	30	R2	clean
201.6	20	R3	trace white mineral
202.7	75	R2	2 mm vapor-phase alteration
203.1	75	R2	10 mm vapor-phase alteration
203.6	20	R1	trace white mineral
204.8	20	R3	8 mm white mineral, sand, gravel
205.6	15	R3	1 mm white mineral
206.0	25	R3	1 mm white mineral
209.1	85	R2	4 mm vapor-phase alteration
208.4	45	R2	3 mm white mineral
207.7	15	R2	12 mm white mineral, sand
207.0	20	R2	4 mm white mineral, sand
216.0	25	R3	1 mm white mineral
212.0	05	R2	1 mm white mineral
212.5	15	R2	1 mm white mineral
213.2	75	R2	3 mm vapor-phase alteration
214.3	15	R2	1 mm white mineral, sand
214.6	80	R2	3 mm vapor-phase alteration
215.5	30	R2	trace white mineral
216.1	30	R3	1 mm white mineral
216.3	30	R3	1 mm white mineral
216.4	15	R2	1 mm white mineral
217.0	10	R2	1 mm white mineral
217.8	30	R3	1 mm white mineral, sand
218.1	20	R3	1 mm white mineral
218.7	70	R2	6 mm white mineral
220.1	20	R3	10 mm white mineral
221.8	10	R3	trace white mineral
221.9	45	R3	8 mm white mineral
224.7	10	R2	trace white mineral
225.9	70	R3	trace white mineral
228.3	80	R3	5 mm vapor-phase alteration
231.2	85	R3	3 mm vapor-phase alteration
230.5	70	R3	clean
231.7	70	R2	1 mm vapor-phase alteration
233.9	55	R2	clean
234.3	30	R2	2 mm white mineral, trace MnO(?)

Figure 1.1-97. Geologic Log of Drill Hole UE-25 RF#15 (Sheet 3 of 7)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#15

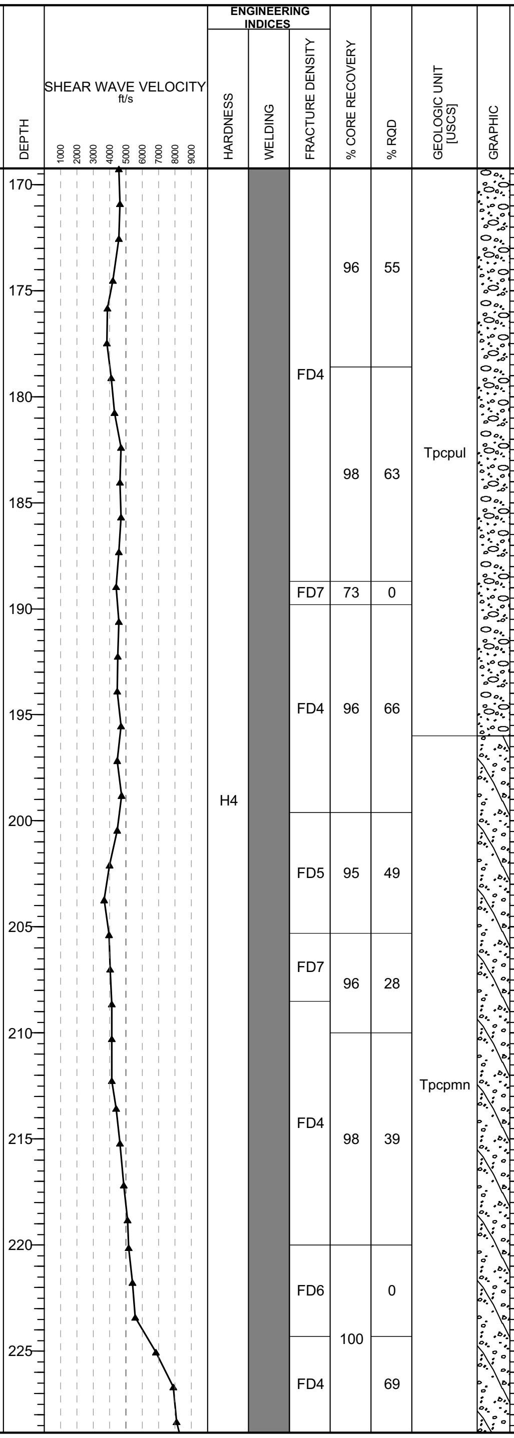
SHEET 4 OF 7

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 8/30/2000 FINISHED: 9/11/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,773.64 E 570,224.85
TOTAL DEPTH: 330.0 ft
DEPTH TO BEDROCK: 5.0 ft

STATE: Nevada
GROUND ELEVATION: 3680.98
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES



CLASSIFICATION AND PHYSICAL CONDITION

234.7	10	R3	2 mm white mineral, trace MnO(?)
235.4	25	R3	trace white mineral, trace iron
235.7	20	R3	1 in. white mineral, 1 mm MnO
236.8	40	R2	clean
237.1	20	R3	2 mm white mineral
239.1	30	R2	1 mm white mineral
239.8	30	R3	2 mm white mineral
240.6	40	R3	10 mm white mineral, 1 mm MnO
241.9	85	R2	sand, gravel

242.4 to 256.6 ft TIVA CANYON TUFF CRYSTAL POOR LOWER LITHOPHYSAL ZONE (Tpcpll)
Pyroclastic flow, densely welded, devitrified, moderate orange pink tuff with rare light gray pumice. Phenocryts of sanidine and rare biotite compose less than 1% of the rock by volume. Lithophysal cavities compose 15 to 20% of the rock by volume with some larger than core diameter. Lithophysae are filled and coated with vapor phase minerals to varying degrees. Generally the tuff is hard (H3), slightly weathered (W3), and slightly to very slightly fractured (FD2). Lower contact is conformable.

Discontinuity Measurements:

Depth	Angle*	Roughness	Infilling
243.2	60	R2	2 mm white mineral
244.9	15	R3	2 mm white mineral
244.8	75	R2	5 mm vapor-phase alteration
249.6	80	R2	1 mm gray mineral
250.3	80		
250.6	85		
256.5	10	R3	trace white mineral

256.6 to 330.0 ft TIVA CANYON TUFF CRYSTAL POOR LOWER NONLITHOPHYSAL ZONE (Tpcpln)
Pyroclastic flow, densely welded, devitrified, pale red tuff with less than 1% light gray pumice clasts. Phenocrysts of sanidine and plagioclase compose less than 1% of the rock by volume. Medium gray lithic clasts compose less 1% of the rock by volume. Clast supported breccia from 276.2 to 280.3 ft. Generally the tuff is moderately hard (H4), slightly weathered (W3), with fracture densities mostly moderately fractured (FD4) to some intensely fractured (FD7) zones. Lower contact undetermined, bottom of borehole at 330.0 ft.

Discontinuity Measurements:

Depth	Angle*	Roughness	Infilling
259.7	10	R1	trace white mineral
260.7	10	R2	trace white mineral
261.7	70	R3	trace white mineral, MnO
263.1	35	R2	trace white mineral
264.4	85	R2	trace white mineral
264.5	60	R2	trace white mineral
267.2	10		trace white mineral
266.5	40	R3	trace white mineral
267.4	25	R2	trace white mineral
269.5	30	R2	trace white mineral
270.7	65	R3	trace white mineral
271.1	60	R2	trace white mineral
271.3	70	R3	trace white mineral
271.6	60	R3	trace white mineral
272.3	85	R2	trace white mineral
272.8	80	R3	1 mm white mineral
274.1	85	R3	trace white mineral
274.9	85	R3	trace white mineral
275.3	30	R3	trace white mineral
276.0	40	R2	trace white mineral
276.1	25	R2	trace white mineral
280.3	85	R4	
280.6	10	R3	trace MnO and vapor-phase mineral
280.9	80	R3	trace MnO
283.7	65	R3	trace vapor-phase mineral
284.2	25	R3	
285.1	55	R3	
285.8	75	R3	
286.2	60	R3	vapor-phase minerals
286.3	30	R3	
286.8	25	R3	trace vapor-phase minerals
287.1	55	R3	

Figure 1.1-97. Geologic Log of Drill Hole UE-25 RF#15 (Sheet 4 of 7)

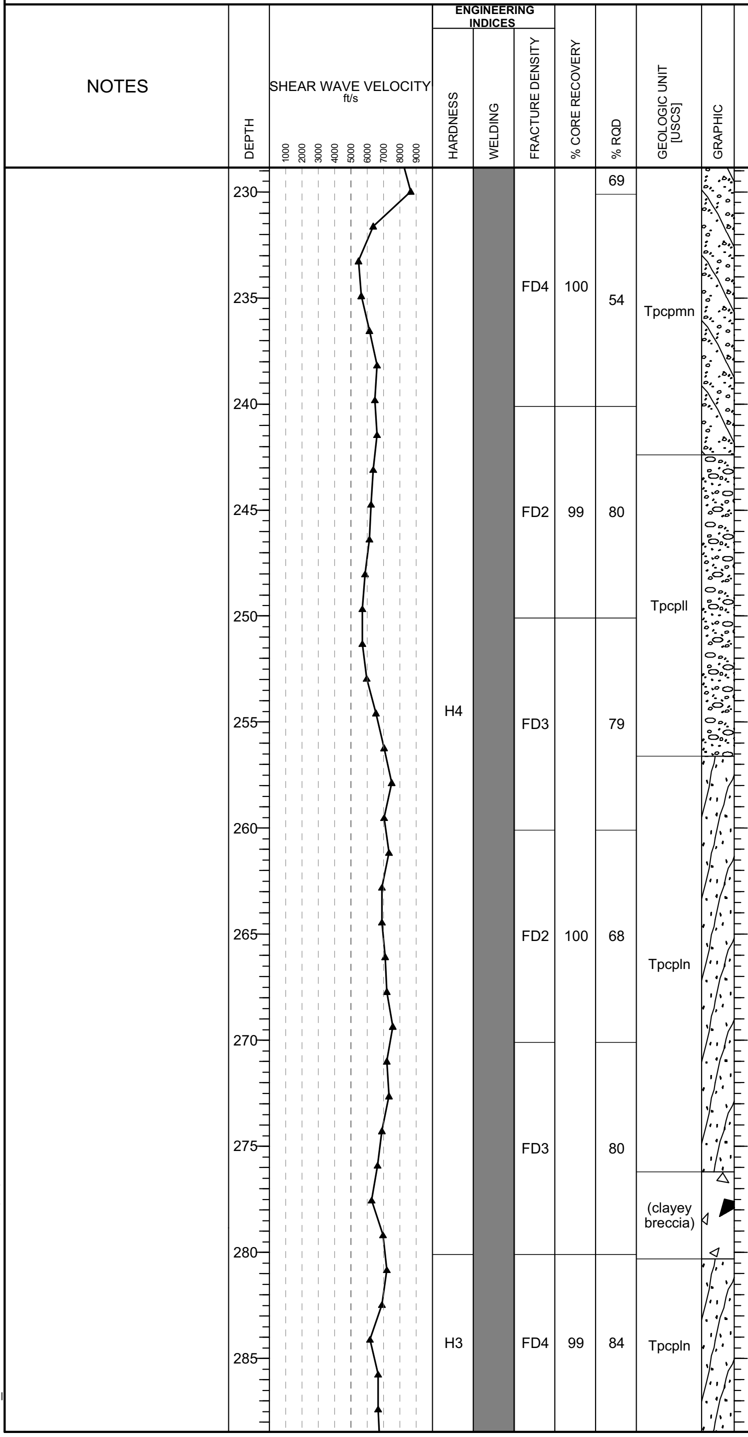
GEOLOGIC LOG OF DRILL HOLE UE-25 RF#15

SHEET 5 OF 7

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 8/30/2000 FINISHED: 9/11/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,773.64 E 570,224.85
TOTAL DEPTH: 330.0 ft
DEPTH TO BEDROCK: 5.0 ft

STATE: Nevada
GROUND ELEVATION: 3680.98
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown



CLASSIFICATION
AND PHYSICAL CONDITION

288.3	60	R3	vapor-phase minerals, trace calcite
289.0	85	R3	vapor-phase minerals
289.3	35	R4	1 mm quartz
290.2	60	R4	
290.2	30	R4	
291.8	55	R3	
293.0	45	R4	
294.1	75	R4	trace vapor-phase minerals
294.8			core broken on corroded pumice clast
295.7	25	R4	trace vapor-phase minerals
296.3	65	R3	
297.3	20	R4	trace vapor-phase minerals
298.9	25	R3	vapor-phase minerals
299.5	85	R4	trace MnO, vapor-phase minerals
300.3			core broken on pumice clast
304.3	80	R4	possible mechanical break
308.5	60	R3	mechanical break
311.5	60	R4	vapor-phase minerals
313.0	15	R4	vapor-phase minerals
313.6	80	R3	trace vapor-phase minerals
314.5	05	R2	trace MnO, calcite
314.4	85	R3	trace vapor-phase minerals
314.5	80	R3	trace MnO, vapor-phase minerals
314.9	85	R3	trace vapor-phase minerals
315.7	70	R3	trace vapor-phase minerals
316.2	20	R4	patchy calcite, trace MnO
317.1	85		core broken on argillically altered pumice
317.6	10	R3	patchy calcite, trace MnO
318.3	80	R3	3 mm botryoidal silica, 3 mm clay
319.1	15	R2	3 mm silica, most euhedral, some botryoidal, some smooth
319.9	55	R2	1 mm silica, 1 mm clay
320.5	45	R4	2 mm silica, trace clay
322.5	80	R4	patchy silica and clay

* Angles are measured from core axis and are plus or minus 5 degrees.

Figure 1.1-97. Geologic Log of Drill Hole UE-25 RF#15 (Sheet 5 of 7)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#15

SHEET 6 OF 7

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 8/30/2000 FINISHED: 9/11/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,773.64 E 570,224.85
TOTAL DEPTH: 330.0 ft
DEPTH TO BEDROCK: 5.0 ft

STATE: Nevada
GROUND ELEVATION: 3680.98
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

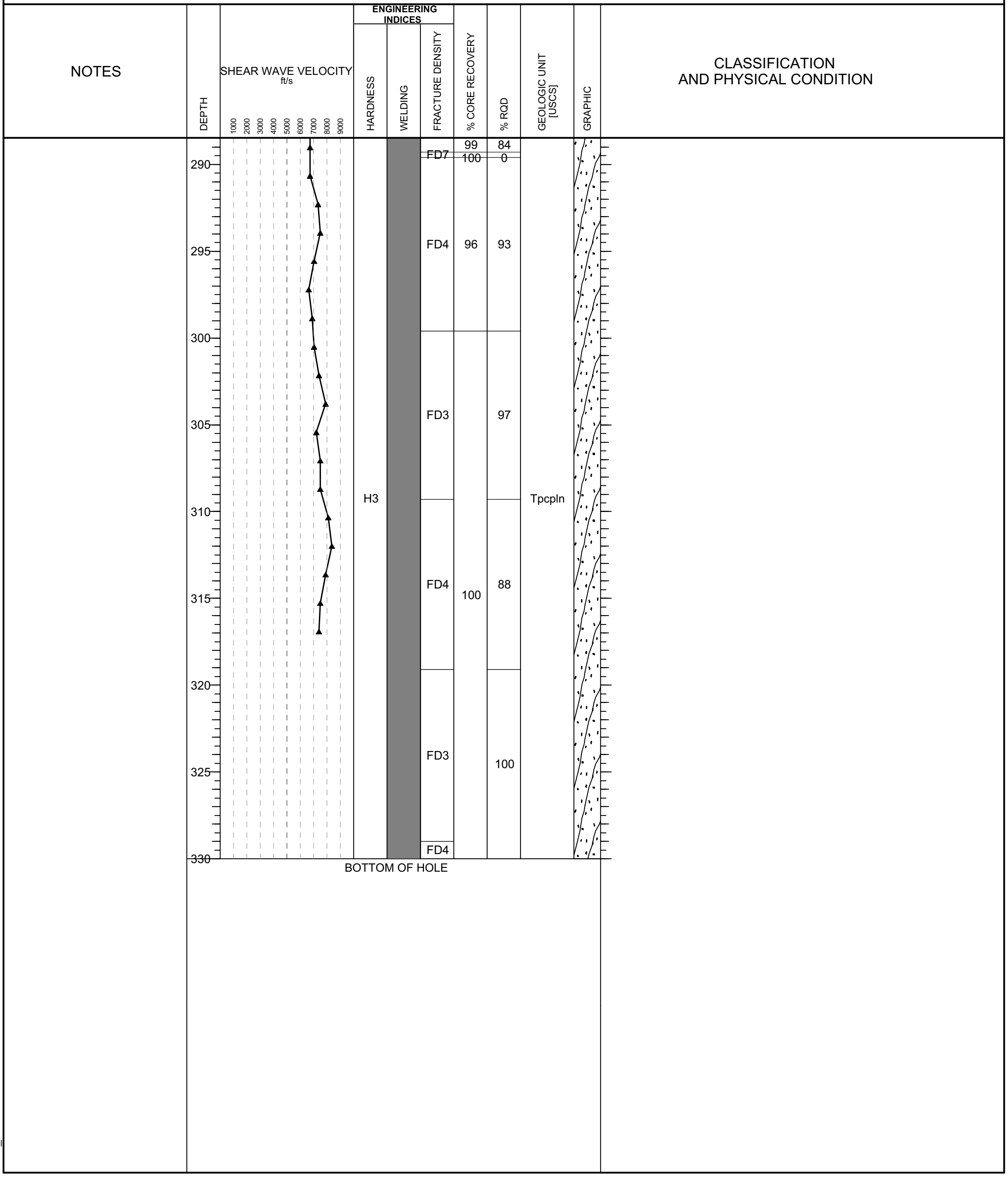


Figure 1.1-97. Geologic Log of Drill Hole UE-25 RF#15 (Sheet 6 of 7)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#15

SHEET 7 OF 7

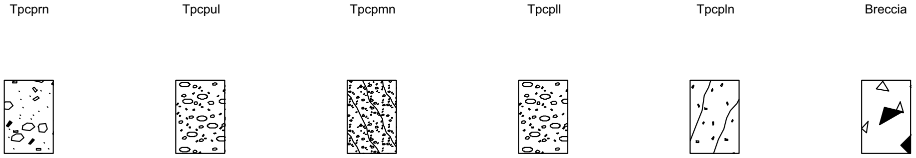
FEATURE: Waste Handling Facility	PROJECT: Yucca Mountain Project	STATE: Nevada
LOCATION: ESF North Portal Pad	COORDINATES: N 765,773.64 E 570,224.85	GROUND ELEVATION: 3680.98
BEGUN: 8/30/2000 FINISHED: 9/11/2000	TOTAL DEPTH: 330.0 ft	ANGLE FROM HORIZONTAL: -90°
DEPTH TO WATER: Not Encountered	DEPTH TO BEDROCK: 5.0 ft	HOLE LOGGED BY: USBR/SMF
		REVIEWED BY: Mark McKeown

SOIL

Fill
(made
ground)

▨

ROCK



WELDING

Densely Welded

■

HARDNESS

Alphanumeric descriptor	Descriptor	Criteria
H1	Extremely	Core, fragment, or exposure cannot be scratched with knife or sharp pick; can only be chipped with repeated heavy hammer blows.
H2	Very Hard	Cannot be scratched with knife or sharp pick. Core or fragment breaks with repeated heavy hammer blows.
H3	Hard	Can be scratched with knife or sharp pick with difficulty (heavy pressure). Heavy hammer blow required to break specimen.
H4	Moderately Hard	Can be scratched with knife or sharp pick with light pressure. Core or fragment breaks with moderate hammer blow.
H5	Moderately Soft	Can be grooved 1/16 in. (2 mm) deep by sharp pick with moderate or heavy pressure. Core or fragment breaks with light hammer blow or heavy manual pressure.
H6	Soft	Can be grooved or gouged easily by knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
H7	Very Soft	Can be readily indented, grooved or gouged with fingernail, or carved with a knife. Breaks with light manual pressure.

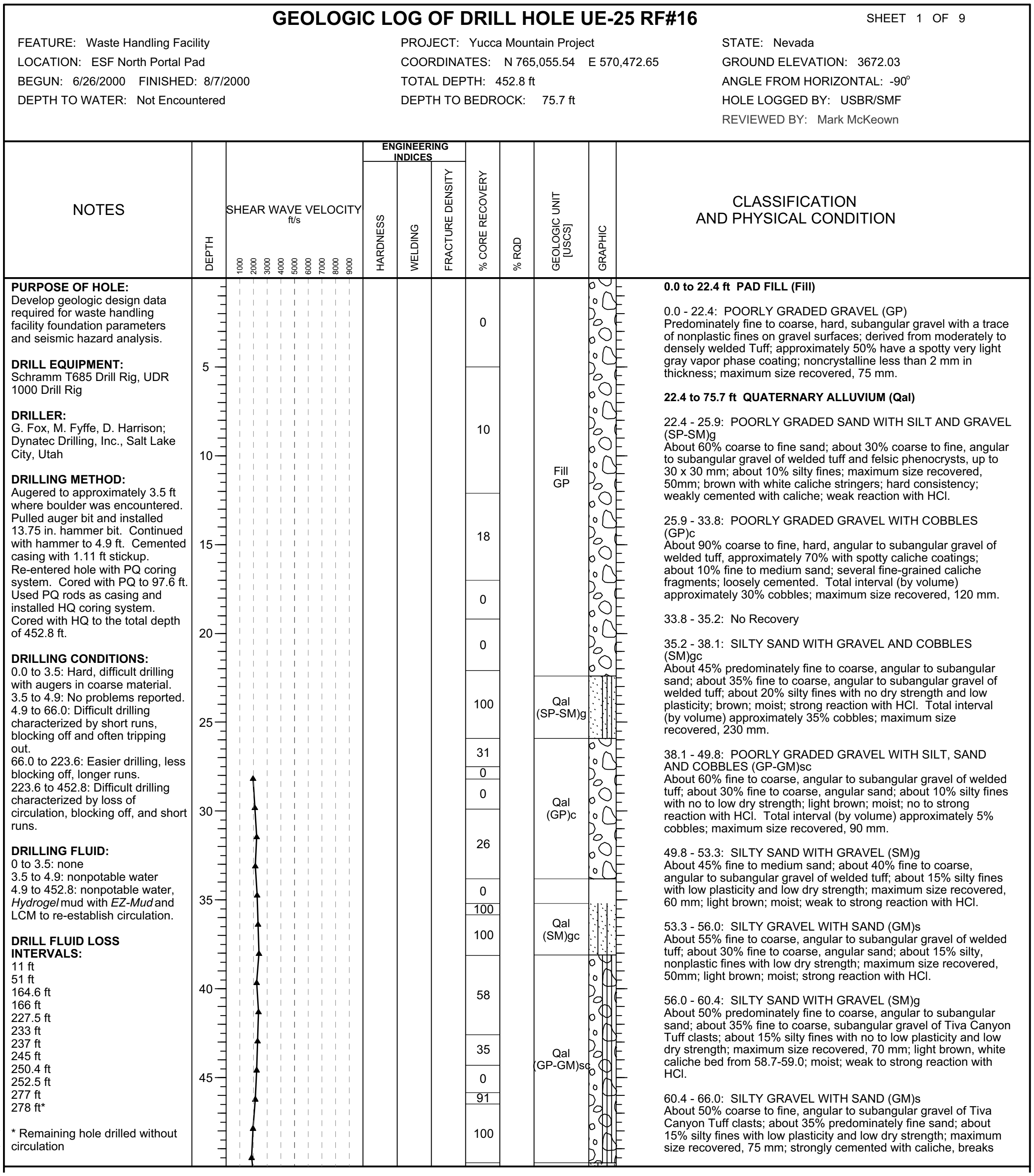
WEATHERING

Alphanumeric descriptor	Descriptor	General characteristics (strength, excavation, etc.)
W1	Fresh	Hammer rings when crystalline rocks are struck. Almost always rock excavation except for naturally weak or weakly cemented rocks such as siltstones or shales.
W2	Slightly weathered to fresh	
W3	Slightly weathered	Hammer rings when crystalline rocks are struck. Body of rock not weakened. With few exceptions, such as siltstones or shales, classified as rock excavation.
W4	Moderately to slightly weathered	
W5	Moderately weathered	Hammer does not ring when rock is struck. Body of rock is slightly weakened. Depending on fracturing, usually is rock excavation except in naturally weak rocks such as siltstones or shales.
W6	Intensely to moderately weathered	
W7	Intensely weathered	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened. Usually common excavation.
W8	Very intensely weathered	
W9	Decomposed	Can be granulated by hand. Always common excavation. Resistant minerals such as quartz may be present as "stringers" or "dikes."

FRACTURE DENSITY

Alphanumeric descriptor	Descriptor	Criteria (Excludes mechanical breaks)
FD0	Unfractured	No observed fractures.
FD1	Very slightly fractured	Core recovered mostly in lengths greater than 3 ft (1 m).
FD2	Slightly to very slightly fractured	
FD3	Slightly fractured	Core recovered mostly in lengths from 1 to 3 ft (300 to 1,000 mm) with few scattered lengths less than 1 ft (300 mm) or greater than 3 ft (1,000 mm).
FD4	Moderately to slightly fractured	
FD5	Moderately fractured	Core recovered mostly in lengths from 0.33 to 1.0 ft (100 to 300 mm) with most lengths about 0.67 ft (200 mm).
FD6	Moderately to intensely fractured	
FD7	Intensely fractured	Lengths average from 0.1 to 0.33 ft (30 to 100 mm) with fragmented intervals. Core recovered mostly in lengths less than 0.33 ft (100 mm).
FD8	Very intensely to intensely fractured	
FD9	Very intensely fractured	Core recovered mostly as chips and fragments with a few scattered short core lengths.

Figure 1.1-97. Geologic Log of Drill Hole UE-25 RF#15 (Sheet 7 of 7)



GEOLOGIC LOG OF DRILL HOLE UE-25 RF#16 SHEET 1 OF 9

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 6/26/2000 FINISHED: 8/7/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,055.54 E 570,472.65
TOTAL DEPTH: 452.8 ft
DEPTH TO BEDROCK: 75.7 ft

STATE: Nevada
GROUND ELEVATION: 3672.03
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES

PURPOSE OF HOLE:
Develop geologic design data required for waste handling facility foundation parameters and seismic hazard analysis.

DRILL EQUIPMENT:
Schramm T685 Drill Rig, UDR 1000 Drill Rig

DRILLER:
G. Fox, M. Fyffe, D. Harrison; Dynatec Drilling, Inc., Salt Lake City, Utah

DRILLING METHOD:
Augered to approximately 3.5 ft where boulder was encountered. Pulled auger bit and installed 13.75 in. hammer bit. Continued with hammer to 4.9 ft. Cemented casing with 1.11 ft stickup. Re-entered hole with PQ coring system. Cored with PQ to 97.6 ft. Used PQ rods as casing and installed HQ coring system. Cored with HQ to the total depth of 452.8 ft.

DRILLING CONDITIONS:
0.0 to 3.5: Hard, difficult drilling with augers in coarse material.
3.5 to 4.9: No problems reported.
4.9 to 66.0: Difficult drilling characterized by short runs, blocking off and often tripping out.
66.0 to 223.6: Easier drilling, less blocking off, longer runs.
223.6 to 452.8: Difficult drilling characterized by loss of circulation, blocking off, and short runs.

DRILLING FLUID:
0 to 3.5: none
3.5 to 4.9: nonpotable water
4.9 to 452.8: nonpotable water, *Hydrogel* mud with *EZ-Mud* and LCM to re-establish circulation.

DRILL FLUID LOSS INTERVALS:
11 ft
51 ft
164.6 ft
166 ft
227.5 ft
233 ft
237 ft
245 ft
250.4 ft
252.5 ft
277 ft
278 ft*

* Remaining hole drilled without circulation

CLASSIFICATION AND PHYSICAL CONDITION

0.0 to 22.4 ft PAD FILL (Fill)

0.0 - 22.4: POORLY GRADED GRAVEL (GP)
Predominately fine to coarse, hard, subangular gravel with a trace of nonplastic fines on gravel surfaces; derived from moderately to densely welded Tuff; approximately 50% have a spotty very light gray vapor phase coating; noncrystalline less than 2 mm in thickness; maximum size recovered, 75 mm.

22.4 to 75.7 ft QUATERNARY ALLUVIUM (Qal)

22.4 - 25.9: POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)g
About 60% coarse to fine sand; about 30% coarse to fine, angular to subangular gravel of welded tuff and felsic phenocrysts, up to 30 x 30 mm; about 10% silty fines; maximum size recovered, 50mm; brown with white caliche stringers; hard consistency; weakly cemented with caliche; weak reaction with HCl.

25.9 - 33.8: POORLY GRADED GRAVEL WITH COBBLES (GP)c
About 90% coarse to fine, hard, angular to subangular gravel of welded tuff, approximately 70% with spotty caliche coatings; about 10% fine to medium sand; several fine-grained caliche fragments; loosely cemented. Total interval (by volume) approximately 30% cobbles; maximum size recovered, 120 mm.

33.8 - 35.2: No Recovery

35.2 - 38.1: SILTY SAND WITH GRAVEL AND COBBLES (SM)gc
About 45% predominately fine to coarse, angular to subangular sand; about 35% fine to coarse, angular to subangular gravel of welded tuff; about 20% silty fines with no dry strength and low plasticity; brown; moist; strong reaction with HCl. Total interval (by volume) approximately 35% cobbles; maximum size recovered, 230 mm.

38.1 - 49.8: POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc
About 60% fine to coarse, angular to subangular gravel of welded tuff; about 30% fine to coarse, angular sand; about 10% silty fines with no to low dry strength; light brown; moist; no to strong reaction with HCl. Total interval (by volume) approximately 5% cobbles; maximum size recovered, 90 mm.

49.8 - 53.3: SILTY SAND WITH GRAVEL (SM)g
About 45% fine to medium sand; about 40% fine to coarse, angular to subangular gravel of welded tuff; about 15% silty fines with low plasticity and low dry strength; maximum size recovered, 60 mm; light brown; moist; weak to strong reaction with HCl.

53.3 - 56.0: SILTY GRAVEL WITH SAND (GM)s
About 55% fine to coarse, angular to subangular gravel of welded tuff; about 30% fine to coarse, angular sand; about 15% silty, nonplastic fines with low dry strength; maximum size recovered, 50mm; light brown; moist; strong reaction with HCl.

56.0 - 60.4: SILTY SAND WITH GRAVEL (SM)g
About 50% predominately fine to coarse, angular to subangular sand; about 35% fine to coarse, subangular gravel of Tiva Canyon Tuff clasts; about 15% silty fines with no to low plasticity and low dry strength; maximum size recovered, 70 mm; light brown, white caliche bed from 58.7-59.0; moist; weak to strong reaction with HCl.

60.4 - 66.0: SILTY GRAVEL WITH SAND (GM)s
About 50% coarse to fine, angular to subangular gravel of Tiva Canyon Tuff clasts; about 35% predominately fine sand; about 15% silty fines with low plasticity and low dry strength; maximum size recovered, 75 mm; strongly cemented with caliche, breaks

Figure 1.1-98. Geologic Log of Drill Hole UE-25 RF#16 (Sheet 1 of 9)

NOTE: All measurements are in feet unless noted otherwise. No attempts to re-establish circulation were made below 278 ft. LCM (Lost Circulation Material) consists of cellophane cuttings. USCS classifications were determined in the field, with limited access to samples to keep samples intact for future tests. Shear Wave Velocity data from GeoVision suspension logging. Data acquired from downhole survey conducted after PVC casing installed. USCS soil classifications are based on USBR 5005-86, *Procedure for Determining Unified Soil Classification (Visual Method)*.
RQD = rock quality designation; USCS = Unified Soil Classification System.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#16

SHEET 2 OF 9

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 6/26/2000 FINISHED: 8/7/2000
DEPTH TO WATER: Not Encountered

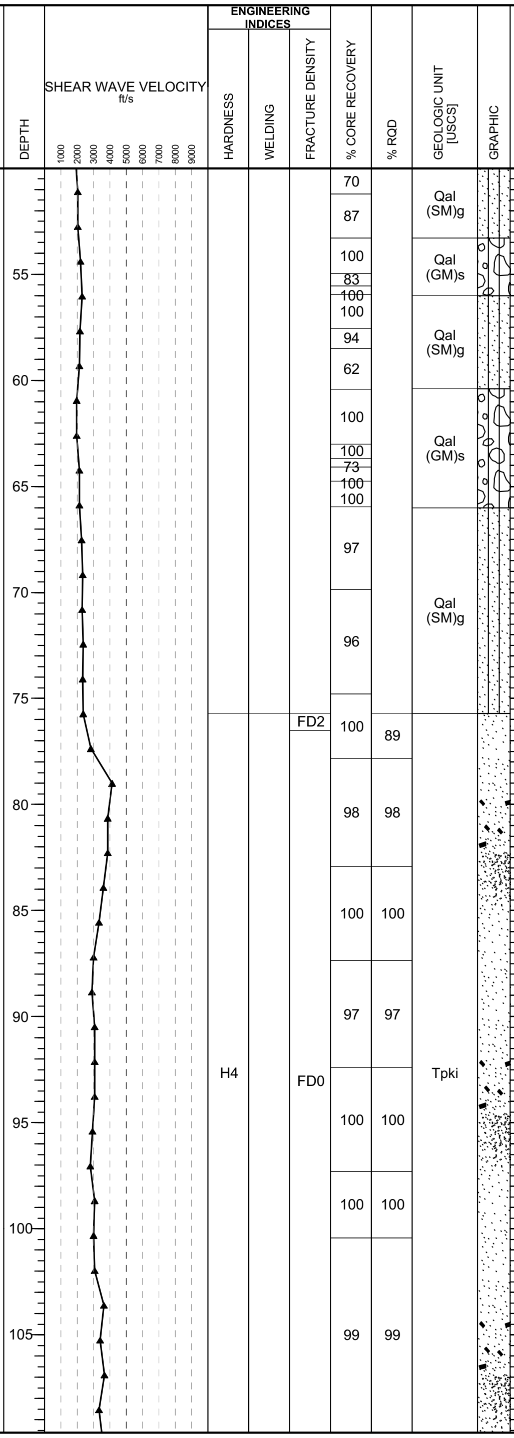
PROJECT: Yucca Mountain Project
COORDINATES: N 765,055.54 E 570,472.65
TOTAL DEPTH: 452.8 ft
DEPTH TO BEDROCK: 75.7 ft

STATE: Nevada
GROUND ELEVATION: 3672.03
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES

CASING RECORD:
0 to 4.9: 10.75 in. O.D. casing
0 to 97.6: PQ casing
97.6 to 452.8: No casing

HOLE COMPLETION:
Pulled all casing and left open for future geophysical studies.



CLASSIFICATION AND PHYSICAL CONDITION

only with hammer blow; light brown to pale orange; moist; strong reaction with HCl.

66.0 - 75.7: SILTY SAND WITH GRAVEL (SM)g
About 45% predominately fine sand; about 35% coarse to fine, angular to subangular gravel of welded Tiva Canyon Tuff and Tuff X; about 20% silty fines; maximum size recovered, 60 mm; strongly cemented with caliche, breaks only with hammer blow; light brown to pale orange; moist; strong reaction with HCl.

75.7 to 133.2 ft COMBS PEAK IGNIMBRITE - TUFF X (Tpki):
Nonwelded flow, moderately indurated, argillized and partially zeolitized, very pale orange with grayish-orange mottling. The tuff has approximately 20 to 25% pumice, up to 35 x 30 mm in size, with about 10 to 15% volcanic lithic clasts. up to 25 x 25 mm. Rare phenocrysts of sanidine, biotite (bronze), magnetite (?), and manganese oxides. Generally the tuff is moderately hard (H4) to soft (H6), slightly (W3) to moderately (W5) weathered, and unfractured (FD0) to slightly fractured (FD2). Lower contact is unconformable.

Discontinuity Measurements:

Depth	Angle*	Roughness	Infilling
75.9	70	R2	calcite
130.1	70	R3	trace iron

133.2 to 137.8 ft POST-TIVA CANYON BEDDED TUFFS (Tpbt5):
Nonwelded, possibly reworked fallout tephra and pyroclastic flows separated by distinct paleosols. The tuff is moderately indurated, devitrified, pale yellowish-brown with 10 to 15% pumice clasts (up to 10 x 7 mm), and less than 10% volcanic lithic clasts.(up to 4 x 5 mm). The bedded tuffs have about 2% phenocrysts of feldspar, quartz, and biotite. Generally the tuff is moderately hard (H4) to soft (H6), slightly (W3) to moderately (W6) weathered, and unfractured (FD0) to slightly fractured (FD3). Lower contact is unconformable.

Discontinuity Measurements:

Depth	Angle*	Roughness	Infilling
137.0	70	R3	light ash
137.3	60	R3	light ash

137.8 to 222.0 ft TIVA CANYON TUFF CRYSTAL RICH NONLITHOPHYSAL ZONE (Tpcrn)
Pyroclastic flow, densely welded, devitrified, pale red to grayish-red, with 10 to 15% phenocrysts. Phenocrysts are mostly feldspar and biotite with lesser quartz and pyroxene. Rare pumice clasts from 145.9 to 157.1 ft. and up to 20% pumice clasts from 157.1 to 192.0 ft. The tuff has up to 15% lithophysal cavities from 192.0 to 208.0 ft. Generally the tuff is moderately hard (H4), slightly (W3) weathered, and slightly fractured (FD3) to moderately fractured (FD5). The lower contact is conformable.

Discontinuity Measurements:

Depth	Angle*	Roughness	Infilling
138.3	55	R3	calcite
138.6	80	R3	calcite
139.5	80	R2	calcite
140.7-141.1	25	R4	trace calcite
141.6	70	R3	trace calcite
141.6-142.1	25	R3	calcite
141.85	80	R2	trace calcite
142.5	70	R3	trace calcite
142.5-142.8	25	R3	brown mineral
143.7	60	R3	trace calcite
143.6-144.6	20	R4	calcite
144.4	80	R2	none
147.2	85	R2	none
147.8-148.1	30	R3	none
148.9-149.5	25	R3	none
150.3-151.6	FRACTURE ZONE		
153.1-157.1	FRACTURE ZONE		
157.1-159.3	FRACTURE ZONE		
160.3-164.4	FRACTURE ZONE		
162.8 (fault?)	30	R3	none
165.3	50	R3	clay, sand
165.6 (fault?)	50	R3	clay, sand
166.3	40	R3	trace sand
168.1	50	R3	healed
168.7	90	R3	sand

Figure 1.1-98. Geologic Log of Drill Hole UE-25 RF#16 (Sheet 2 of 9)

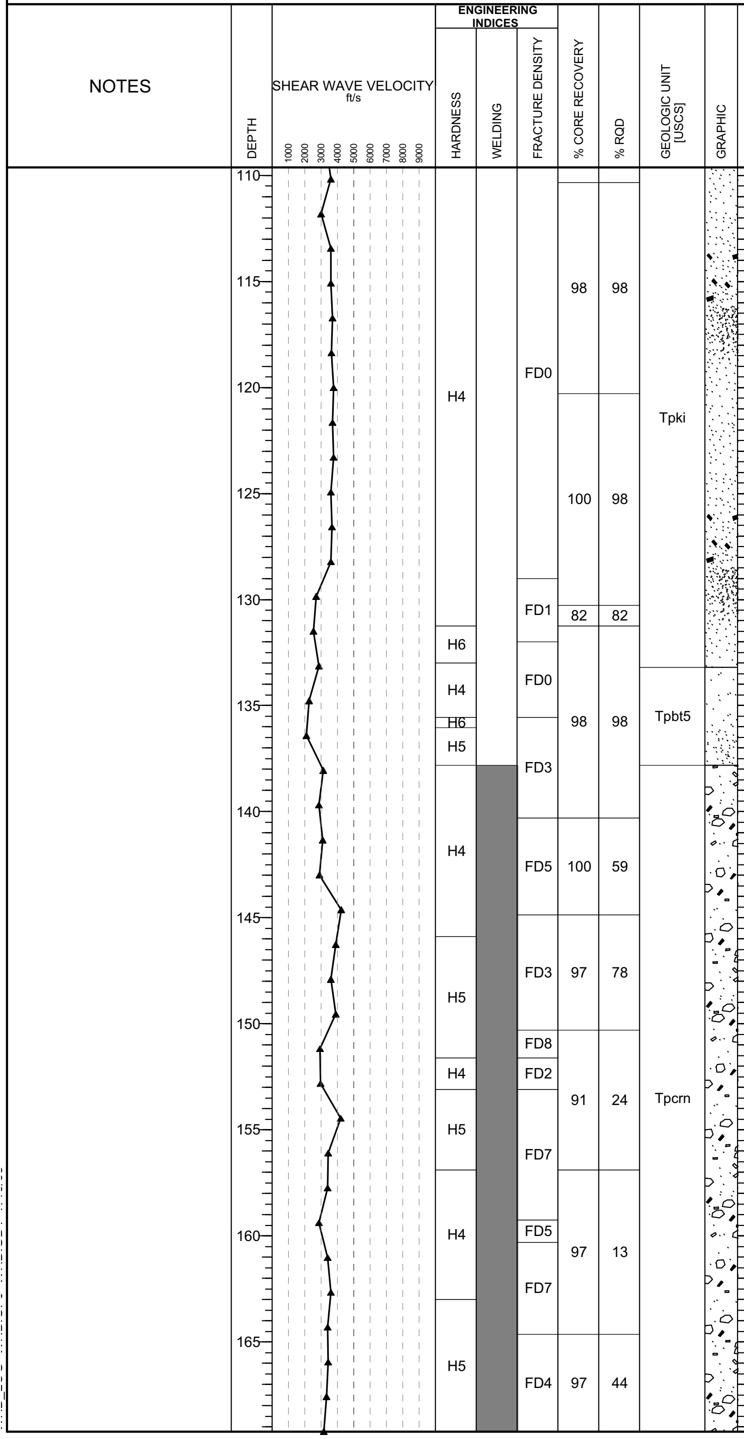
GEOLOGIC LOG OF DRILL HOLE UE-25 RF#16

SHEET 3 OF 9

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 6/26/2000 FINISHED: 8/7/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,055.54 E 570,472.65
TOTAL DEPTH: 452.8 ft
DEPTH TO BEDROCK: 75.7 ft

STATE: Nevada
GROUND ELEVATION: 3672.03
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown



CLASSIFICATION
AND PHYSICAL CONDITION

169.7	80	R3	clay
169.8	60	R3	clay
170.1	60	R3	clay, sand
170.6	90	R3	clay, sand
171.2	15	R3	sand
171.0-174.6	FRACTURE ZONE		
174.6	55	R4	trace clay
175.1	60	R4	none
176.0	15	R4	sand
176.8	50	R3	healed
177.8	20	R3	clay, sand
179.3	30	R4	clay, sand
179.4	80	R4	sand
179.7	55	R4	trace clay, sand
180.9	20	R2	clay, sand
185.2	40	R3	trace clay
185.6	40	R3	sand, trace clay
187.4	30	R3	trace clay
187.9	60	R3	trace sand
188.1	55	R3	sand
188.5	20	R3	sand, trace clay
189.0	55	R3	sand
190.6	65	R3	vapor phase alteration
191.2	65	R3	none
191.8	40	R3	none
192.0	35	R3	none
193.3	45	R4	none
193.9	45	R4	trace sand
197.3	30	R4	none
197.4	30	R3	none
197.6	25	R3	clay
198.1	60	R3	clay
198.9	25	R4	clay
199.4	55	R4	none
203.4	50	R3	sand
203.8	50	R3	none
204.0	40	R3	none
204.7	35	R3	trace sand
204.9	30	R3	trace sand
203.4-203.6	25	R3	none
203.6	90	R2	none
204.1	90	R3	none
204.2	90	R3	none
204.6	50	R2	none
204.7-204.9	30	R2	none
205.7	45	R3	none
206.8	45	R3	none
206.8-207.3	FRACTURE ZONE		
208.2-208.9	FRACTURE ZONE		
209.3	irreg.	R2	none
210.3	70	R2	none
210.5-210.7	10	R3	none
212.1-212.2	30	R2	none
213.7	45	R3	quartz crystals
216.1	75	R3	quartz crystals
221.0-221.3	25	R4	trace calcite
221.1-221.3	35	R2	none

222.0 to 360.0 ft TIVA CANYON TUFF CRYSTAL POOR UPPER LITHOPHYSAL ZONE (Tpcpul)
Pyroclastic flow, densely welded, moderate orange-pink with light gray mottling, and about 3 to 5% lithophysae (up to 50 x 50 mm) with light gray crystal coating. Tuff has approximately 5% pumice clasts (up to 10 x 4 mm). There are less than 5% phenocrysts of plagioclase and sanadine, with less than 1% biotite and manganese oxide. At 247.0 the phenocrysts content decreases to less than 1%. Lithophysae, both filled and unfilled, content increases to 20% at 301.0 ft. Generally the tuff is moderately hard (H4), slightly (W4) to moderately weathered (W6), and slightly fractured (FD3) to very intensely fractured (FD9). The lower contact is conformable.

Discontinuity Measurements:

Depth	Angle*	Roughness	Infilling
221.8-224.9	FRACTURE ZONE		
225.4	55	R4	trace calcite
225.4-225.8	FRACTURE ZONE		
225.8-226.0	10	R4	trace calcite
226.1	70	R3	none
226.1-226.7	FRACTURE ZONE		
226.7-226.8	40	R3	none
226.9-227.0	FRACTURE ZONE		
227.0-227.2	40	R3	none
227.3	80	R2	none

Figure 1.1-98. Geologic Log of Drill Hole UE-25 RF#16 (Sheet 3 of 9)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#16

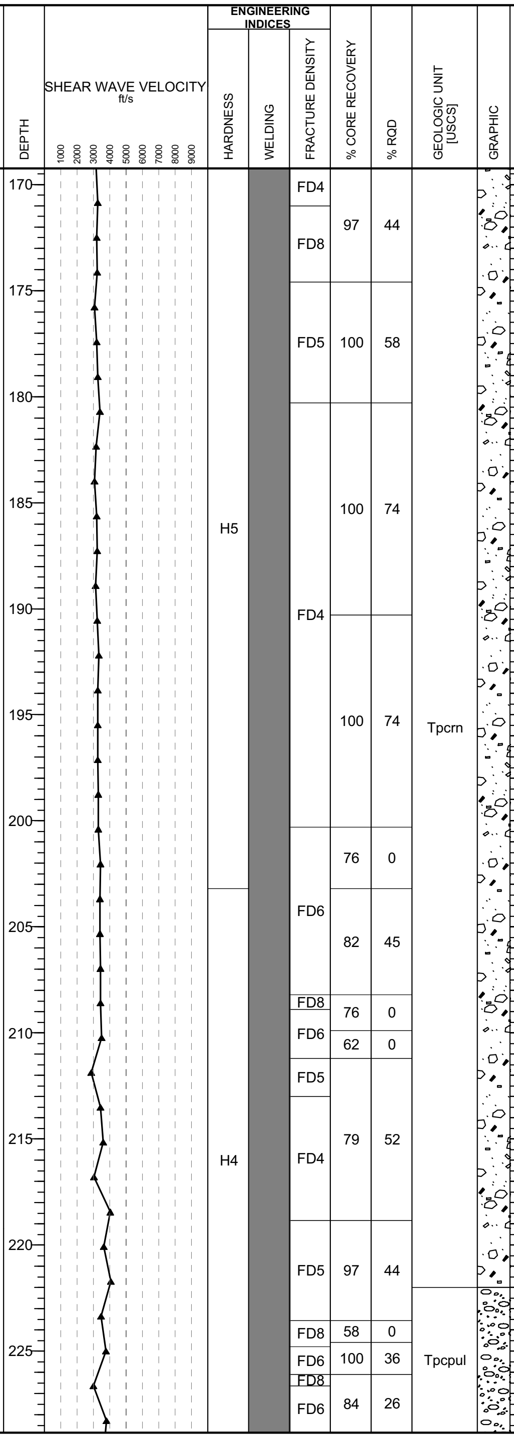
SHEET 4 OF 9

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 6/26/2000 FINISHED: 8/7/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,055.54 E 570,472.65
TOTAL DEPTH: 452.8 ft
DEPTH TO BEDROCK: 75.7 ft

STATE: Nevada
GROUND ELEVATION: 3672.03
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES



CLASSIFICATION
AND PHYSICAL CONDITION

227.7-227.8	90	R3	white mineral
228.0-228.6	15	R3	none
229.2	60	R3	none
229.2-229.6	20	R3	none
230.7-230.9	55	R2	none
231.1	90	R2	none
231.1-231.5	FRACTURE ZONE		
231.8	45	R2	trace quartz crystals
231.8-232.3	FRACTURE ZONE		
232.3	60	R3	trace quartz crystals
233.0-233.2	45	R3	quartz crystals
235.0-235.1	45	R3	trace calcite
235.8	50	R2	none
235.7-236.3	15	R3	none
235.9-236.3	25	R3	trace calcite
236.1-236.3	25	R3	none
237.9	45	R2	none
238.7-238.9	15-20	R2	quartz crystals
239.2	70	R2	quartz crystals
239.8	60	R2	quartz crystals
240.0	60	R3	none
240.2	50	R2	trace iron oxide
240.4	70	R3	none
240.4-241.1	10-15	R3	none
241.2-241.7	15	R3	none
241.8-243.8	FRACTURE ZONE		
244.5-244.7	20	R2	trace calcite
246.8	15	R2	none
248.6	20	R3	trace white mineral
248.9	25	R3	trace white mineral
249.7	30	R3	none
251.8	5	R3	none
252.5	10	R3	none
255.4	10	R2	none
255.8	15	R2	none
256.4	75	R2	lithophysal
257.5	40	R3	trace sand
259.5	30	R2	none
261.1	50	R3	none
263.5	80	R3	none
264.5	20	R2	none
265.9	15	R3	sand, trace clay
266.4	60	R3	none
266.9	30	R3	clay
269.0	20	R3	sandy breccia
272.9-277.3	FRACTURE ZONE		
277.4	0	R4	none
278.6	10	R3	none
279.1	50	R4	none
279.2	40	R4	none
279.5	25	R3	none
280.6-284.4	FRACTURE ZONE		
284.4-284.6	20	R3	none
284.6-284.8	45	R2	none
286.3-286.6	35	R3	quartz crystals
287.7	55	R4	clay, quartz crystals
289.3-290.0	0	R3	none
291.8	35	R3	clayey breccia
292.8	90	R3	clayey breccia
293.0	30	R3	clay
294.7	90	R2	clayey breccia
294.9	60	R2	clayey breccia
297.3-297.8	15	R3	trace calcite
297.6	70	R3	none
298.0	60	R2	clayey breccia
298.2	80	R3	none
298.9-302.5	FRACTURE ZONE		
301.5	45	R3	quartz crystals
303.1	35	R3	trace clay
305.0-313.7	FRACTURE ZONE		
308.6-309.1	15	R3	none
310.4-310.7	20	R2	clayey breccia
310.2-310.5	30	R2	clayey breccia
312.4-312.6	30	R4	trace clay
314.4-314.8	20	R3	none
315.2	45	R4	none
315.6-316.0	25	R3	none
318.4	50	R2	quartz crystals
322.0-322.2	20	R2	none
323.4-324.0	30	R2	clayey breccia
324.3-325.1	10	R3	clayey breccia
324.7-325.3	25	R3	clayey breccia
324.9-325.6	0	R3	clayey breccia
325.2-325.9	20	R2	clayey breccia
326.1-327.3	FRACTURE ZONE		

Figure 1.1-98. Geologic Log of Drill Hole UE-25 RF#16 (Sheet 4 of 9)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#16

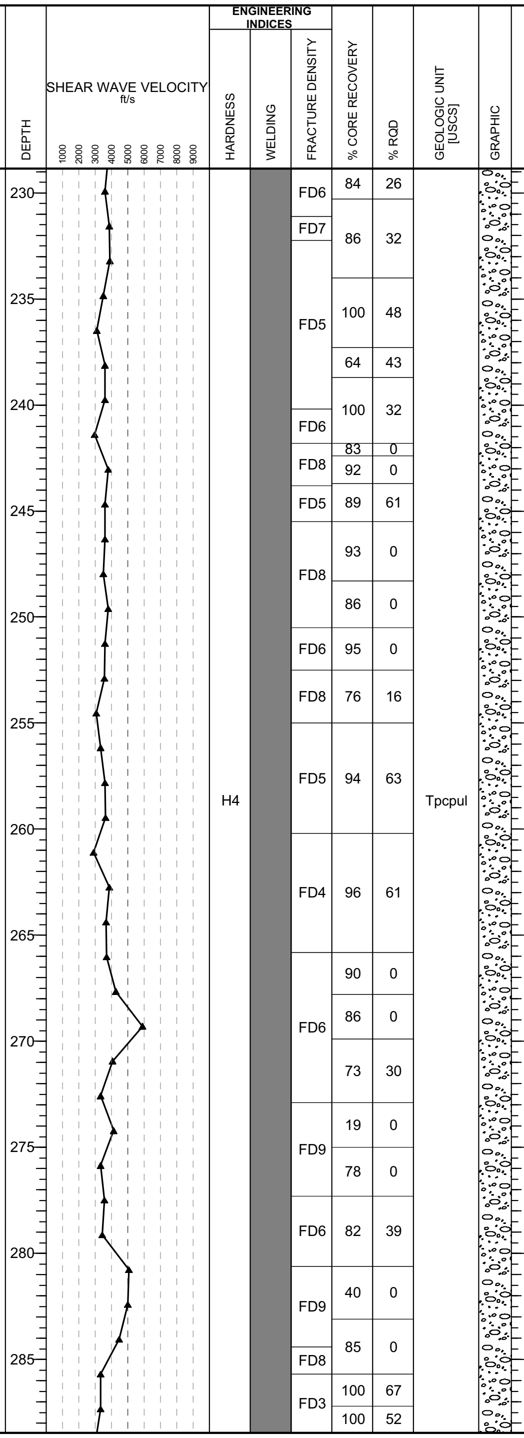
SHEET 5 OF 9

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 6/26/2000 FINISHED: 8/7/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,055.54 E 570,472.65
TOTAL DEPTH: 452.8 ft
DEPTH TO BEDROCK: 75.7 ft

STATE: Nevada
GROUND ELEVATION: 3672.03
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES



CLASSIFICATION
AND PHYSICAL CONDITION

327.3	35	R2	none
330.8-332.0	CLAYEY BRECCIA ZONE		
333.6	50	R3	none
332.7-333.3	20	R3	quartz, calcite
332.9	50	R3	none
334.7-335.9	0	R2	quartz crystals
335.1	50	R3	trace clay
335.5	75	R3	none
335.6	55	R3	none
336.1-337.3	FRACTURE ZONE		
337.9	40	R2	clayey breccia
338.0-338.4	CLAYEY BRECCIA ZONE		
338.4	40	R3	none
338.5-338.7	30	R3	none
338.6	45	R3	none
339.5-340.8	FRACTURE ZONE		
341.7-345.3	FRACTURE ZONE		
346.0	60	R2	trace quartz
346.2-347.0	10	R3	none
346.4-346.8	0	R4	none
346.5-346.9	10	R4	none
346.8	80	R3	none
347.3-348.6	FRACTURE ZONE		
348.3-348.7	20	R3	clayey breccia
348.7	40	R3	none
349.2-349.7	15	R3	none
349.0-349.4	20	R3	none
350.9	30	R3	none
351.0	60	R3	trace calcite
351.1-351.2	0	R3	clay
351.6-352.8	FRACTURE ZONE		
354.3-356.1	FRACTURE ZONE		
356.4	50	R3	trace calcite
356.5	85	R3	none
356.5-356.7	30	R3	trace calcite
356.8-357.3	0	R3	none
358.4	60	R2	clay, calcite
358.5	60	R2	calcite
358.7-359.0	20	R4	clay, quartz, calcite
358.9	80	R3	quartz, calcite
359.6	70	R3	iron oxide, calcite

360.0 to 403.0 ft TIVA CANYON TUFF MIDDLE NONLITHOPHYSAL ZONE (Tpcpmn)
Pyroclastic flow, densely welded, predominately pale red tuff with less than 5% flattened pumice, and less than 1% lithophysae. The tuff has less than 1% phenocrysts of plagioclase, sanidine, and rare manganese oxide. Volcanic lithic content increases with depth with poorly developed anastomosing vapor-phase partings. Generally the tuff is moderately hard (H4) to moderately soft (H5) in isolated zones, slightly (W3) to moderately weathered (W5), and slightly fractured (FD3) to intensely fractured (FD8).

Discontinuity Measurements:

Depth	Angle*	Roughness	Infilling
360.1-360.4	40	R3	iron oxide, calcite
360.5	85	R2	breccia, calcite
360.6-360.9	40	R3	calcite
360.7	65	R3	clay, calcite
361.2	85	R2	quartz, calcite
362.0	30	R4	calcite
362.2-362.5	25	R4	none
363.1	90	R3	none
364.0	70	R2	none
364.9-365.2	30	R4	trace calcite
365.5	80	R4	none
367.2	85	R2	none
372.9	70	R3	clay, quartz
373.1	90	R2	clay, quartz, calcite
373.2-373.7	25	R3	quartz, calcite
375.3	60	R3	trace quartz
375.8	60	R3	clay
376.5-376.9	20	R4	none
377.0-377.3	25	R3	none
377.4-377.7	30	R3	none
379.7-381.2	0	R4	none
380.8	20	R3	quartz, calcite
381.2	90	R3	trace quartz
381.4-381.6	30	R3	trace quartz, calcite
382.8-383.2	20	R4	none
383.3-383.7	CLAYEY BRECCIA ZONE		
383.8-384.2	20	R4	none
384.3	50	R3	trace quartz

Figure 1.1-98. Geologic Log of Drill Hole UE-25 RF#16 (Sheet 5 of 9)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#16

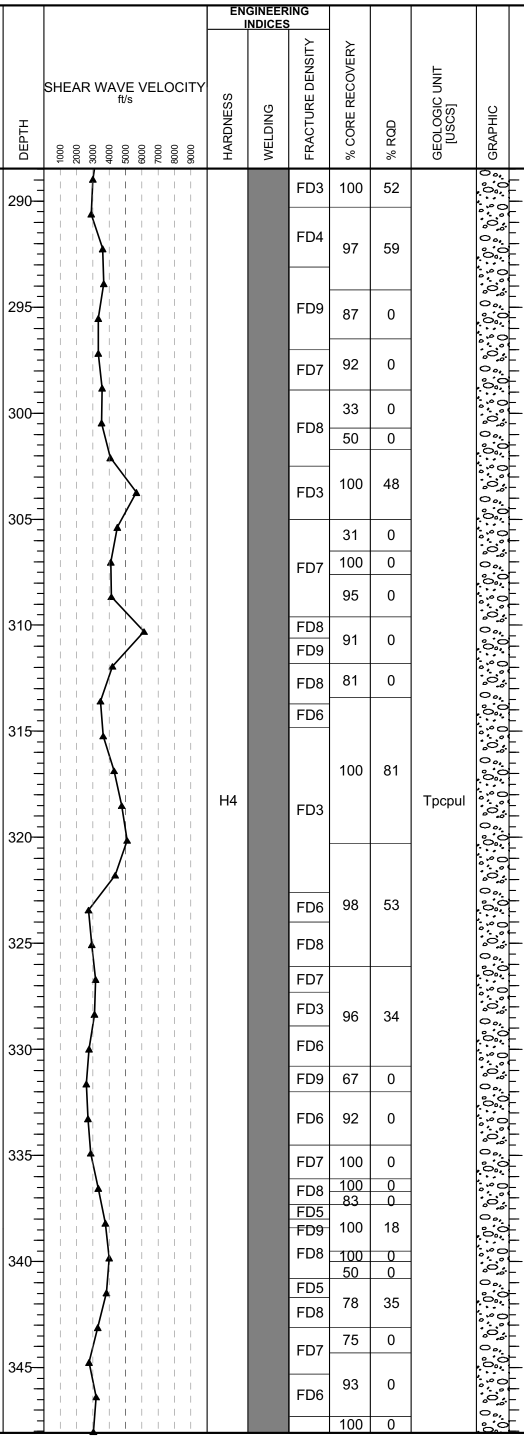
SHEET 6 OF 9

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 6/26/2000 FINISHED: 8/7/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,055.54 E 570,472.65
TOTAL DEPTH: 452.8 ft
DEPTH TO BEDROCK: 75.7 ft

STATE: Nevada
GROUND ELEVATION: 3672.03
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES



CLASSIFICATION AND PHYSICAL CONDITION

385.2-385.4	30	R3	clay, trace quartz
385.5-386.5	FRACTURE ZONE		
386.5-386.9	10	R3	trace quartz, trace calcite
388.4-389.5	CLAYEY BRECCIA ZONE		
393.1	55	R3	quartz, calcite
393.8	45	R4	quartz, calcite
394.3	30	R3	clay, quartz, calcite
395.0-395.5	30	R3	trace quartz, calcite
395.8	70	R3	quartz, trace calcite
396.2-396.4	30	R3	quartz, calcite
397.2	45	R3	clay
397.7-398.1	25	R2	none
398.2-398.6	40	R3	none
398.6	40	R3	clayey breccia
398.7	60	R2	trace calcite
399.3	60	R3	trace calcite
399.7-399.9	30	R3	none
400.2	85	R3	trace quartz, calcite
401.0	40	R3	breccia, quartz, calcite
402.3	50	R4	quartz, calcite
402.7	90	R2	none

403.0 to 422.5 ft TIVA CANYON TUFF CRYSTAL POOR LOWER LITHOPHYSAL ZONE (Tpcpll)
Pyroclastic flow, densely welded, devitrified, moderate orange pink tuff with rare light gray pumice. Phenocrysts of sanidine and rare biotite compose less than 1% of the rock by volume. Lithophysal cavities compose up to 10% of the rock by volume with vapor-phase mineral coatings, additionally 10% of the rock contains light gray vapor-phase mineral spots up to 30 by 48 mm in size. Generally the tuff is hard (H3), slightly weathered (W3), and slightly to very slightly fractured (FD2). Lower contact is conformable.

Discontinuity Measurements:

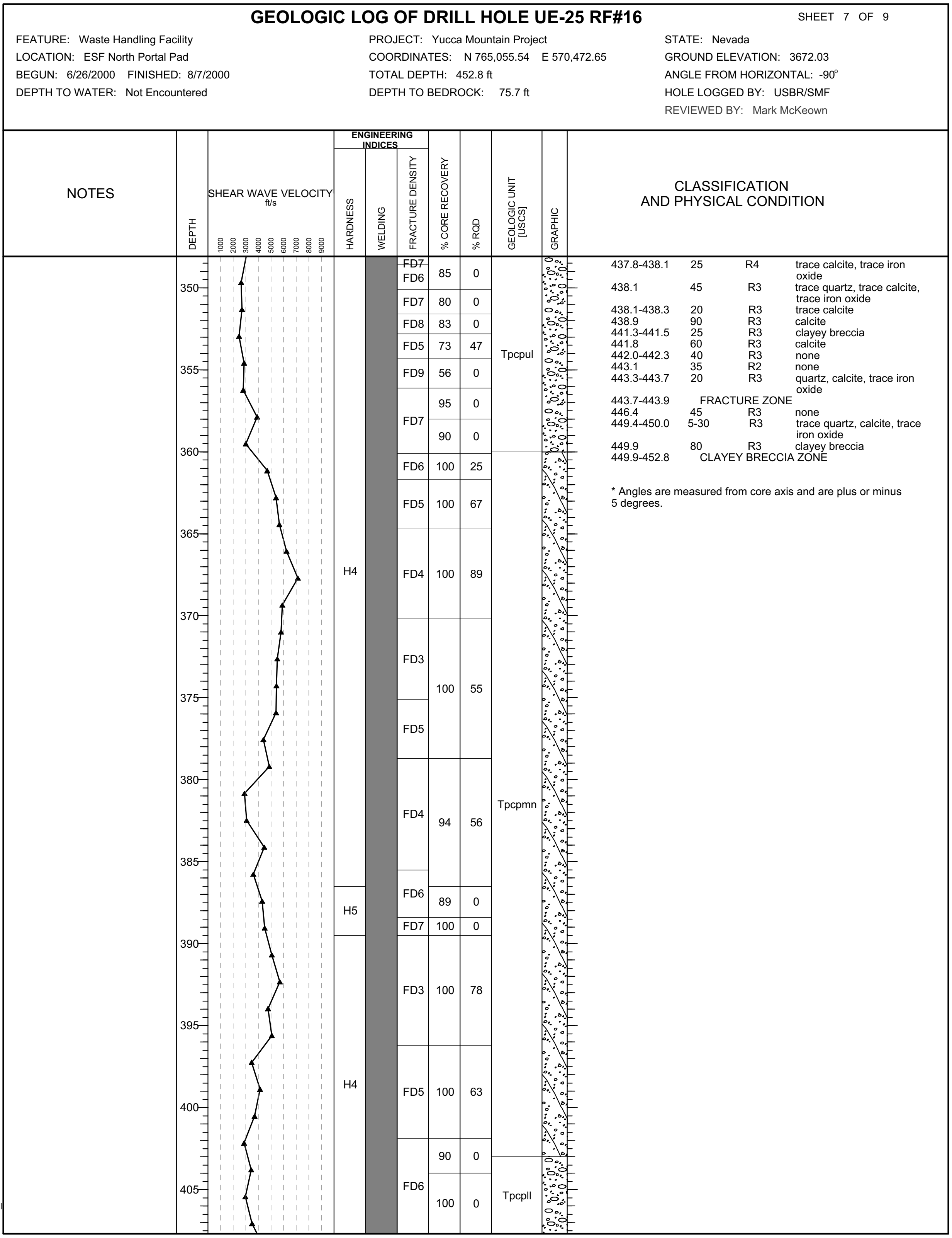
Depth	Angle*	Roughness	Infilling
403.0-403.4	30	R2	quartz, calcite
404.0	70	R3	quartz, calcite
404.3-406.0	5	R2	quartz, calcite
404.6	80	R2	none
405.9-406.2	35	R3	quartz, calcite
406.4-406.7	25	R3	none
406.4-407.6	5	R2	none
408.3	60	R3	trace quartz
409.2	60	R3	none
409.5-409.8	25	R3	trace quartz, calcite
410.2-410.6	5	R3	clay, quartz, calcite
410.6-411.7	FRACTURE ZONE		
415.7	55	R2	clay, quartz, calcite
416.0-416.5	15	R2	clayey breccia, quartz
418.8-419.7	FRACTURE ZONE		

422.5 to 452.8 ft TIVA CANYON TUFF CRYSTAL POOR LOWER NONLITHOPHYSAL ZONE (Tpcpln)
Pyroclastic flow, densely welded, devitrified, pale red tuff with less than 1% light gray pumice clasts. Phenocrysts of sanidine and plagioclase compose less than 1% of the rock by volume. Medium gray lithic clasts compose less 1% of the rock by volume. Generally the tuff is moderately hard (H4), slightly weathered (W3), with fracture densities mostly moderately fractured (FD5) to intensely fractured (FD7) zones. Lower contact undetermined, bottom of borehole at 452.8 ft.

Discontinuity Measurements:

Depth	Angle*	Roughness	Infilling
422.9-423.6	5	R3	clayey breccia, quartz, iron oxide, Calcite
424.3-424.6	20	R4	quartz, calcite
424.6-424.9	10	R3	quartz, calcite
424.7-425.1	40	R3	quartz, calcite
425.5-425.8	30	R4	calcite, trace iron oxide
426.2-429.2	FRACTURE ZONE		
429.8	30	R4	trace calcite, trace iron oxide
430.1-430.8	10	R3	trace calcite
430.6-431.3	20	R3	quartz, calcite
430.8	45	R4	calcite, trace iron oxide
431.0-431.6	0-25	R2	quartz, calcite
431.5-441.7	FRACTURE ZONE		
435.5-435.8	20	R4	trace calcite, trace iron oxide
435.4	60	R3	trace calcite
436.3	45	R4	calcite, trace iron oxide

Figure 1.1-98. Geologic Log of Drill Hole UE-25 RF#16 (Sheet 6 of 9)



GEOLOGIC LOG OF DRILL HOLE UE-25 RF#16

SHEET 7 OF 9

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 6/26/2000 FINISHED: 8/7/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,055.54 E 570,472.65
TOTAL DEPTH: 452.8 ft
DEPTH TO BEDROCK: 75.7 ft

STATE: Nevada
GROUND ELEVATION: 3672.03
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

HARDNESS	FRACTURE DENSITY	% CORE RECOVERY	% RQD	GEOLOGIC UNIT [USCS]
H4	FD7 FD6	85	0	Tpcpul
	FD7	80	0	
	FD8	83	0	
	FD5	73	47	
	FD9	56	0	
	FD7	95	0	
		90	0	
	FD6	100	25	Tpcpmn
	FD5	100	67	
	FD4	100	89	
	FD3	100	55	
	FD5			
	FD4	94	56	
H5	FD6	89	0	
	FD7	100	0	
H4	FD3	100	78	
	FD5	100	63	
	FD6	90	0	
		100	0	Tpcpll

CLASSIFICATION AND PHYSICAL CONDITION

437.8-438.1	25	R4	trace calcite, trace iron oxide
438.1	45	R3	trace quartz, trace calcite, trace iron oxide
438.1-438.3	20	R3	trace calcite
438.9	90	R3	calcite
441.3-441.5	25	R3	clayey breccia
441.8	60	R3	calcite
442.0-442.3	40	R3	none
443.1	35	R2	none
443.3-443.7	20	R3	quartz, calcite, trace iron oxide
443.7-443.9	FRACTURE ZONE		
446.4	45	R3	none
449.4-450.0	5-30	R3	trace quartz, calcite, trace iron oxide
449.9	80	R3	clayey breccia
449.9-452.8	CLAYEY BRECCIA ZONE		

* Angles are measured from core axis and are plus or minus 5 degrees.

Figure 1.1-98. Geologic Log of Drill Hole UE-25 RF#16 (Sheet 7 of 9)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#16

SHEET 8 OF 9

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 6/26/2000 FINISHED: 8/7/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,055.54 E 570,472.65
TOTAL DEPTH: 452.8 ft
DEPTH TO BEDROCK: 75.7 ft

STATE: Nevada
GROUND ELEVATION: 3672.03
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

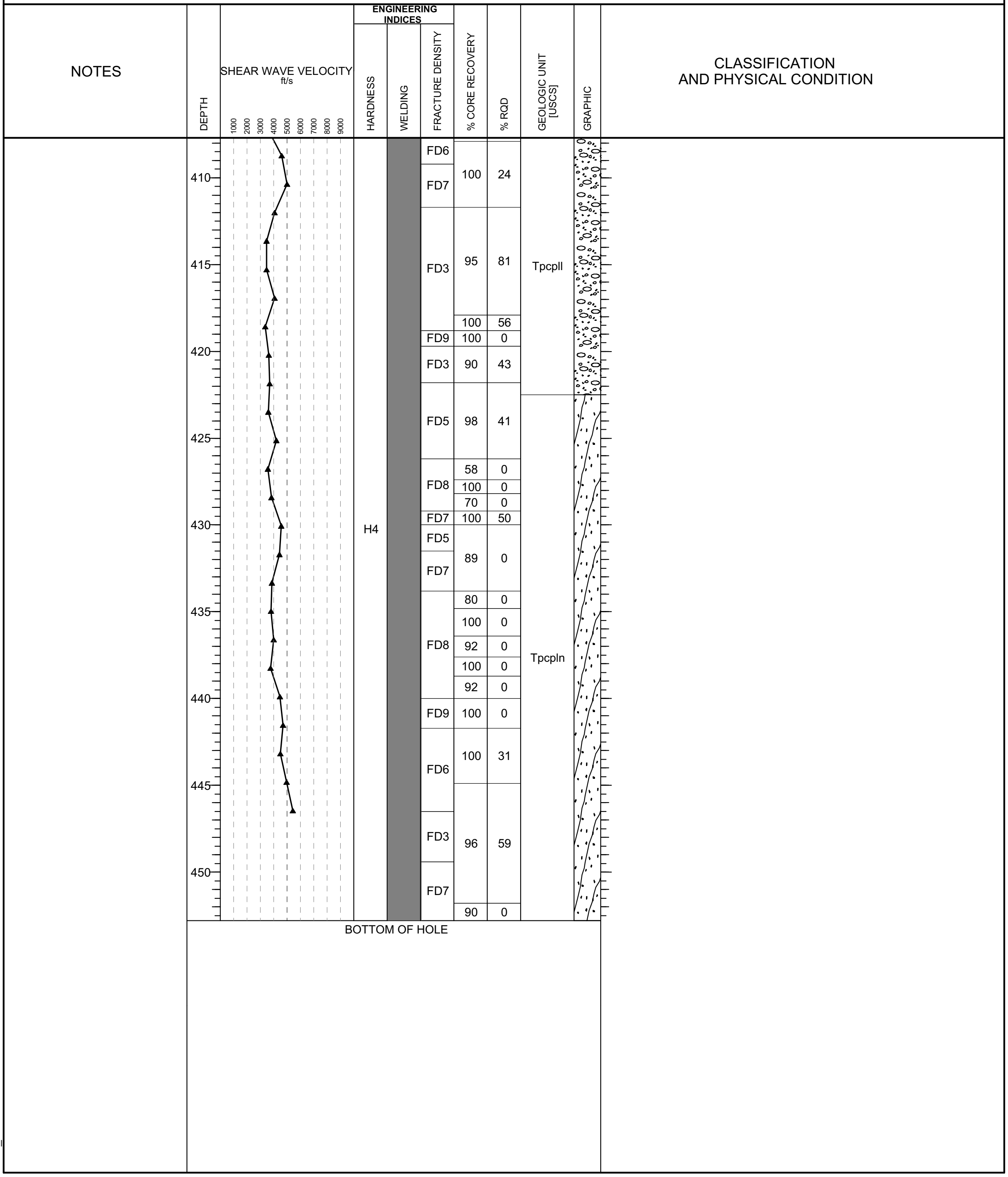


Figure 1.1-98. Geologic Log of Drill Hole UE-25 RF#16 (Sheet 8 of 9)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#16

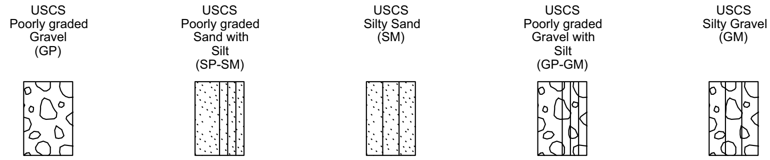
SHEET 9 OF 9

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 6/26/2000 FINISHED: 8/7/2000
DEPTH TO WATER: Not Encountered

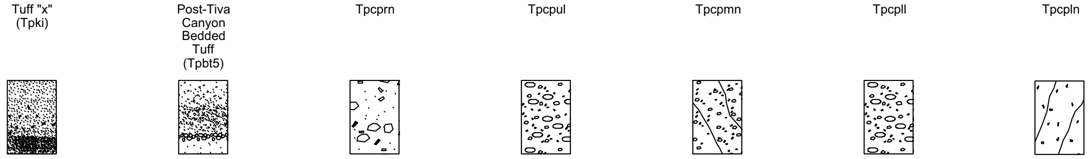
PROJECT: Yucca Mountain Project
COORDINATES: N 765,055.54 E 570,472.65
TOTAL DEPTH: 452.8 ft
DEPTH TO BEDROCK: 75.7 ft

STATE: Nevada
GROUND ELEVATION: 3672.03
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

SOIL



ROCK



WELDING

HARDNESS

Alphanumeric descriptor	Descriptor	Criteria
H1	Extremely	Core, fragment, or exposure cannot be scratched with knife or sharp pick; can only be chipped with repeated heavy hammer blows.
H2	Very Hard	Cannot be scratched with knife or sharp pick. Core or fragment breaks with repeated heavy hammer blows.
H3	Hard	Can be scratched with knife or sharp pick with difficulty (heavy pressure). Heavy hammer blow required to break specimen.
H4	Moderately Hard	Can be scratched with knife or sharp pick with light pressure. Core or fragment breaks with moderate hammer blow.
H5	Moderately Soft	Can be grooved 1/16 in. (2 mm) deep by sharp pick with moderate or heavy pressure. Core or fragment breaks with light hammer blow or heavy manual pressure.
H6	Soft	Can be grooved or gouged easily by knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
H7	Very Soft	Can be readily indented, grooved or gouged with fingernail, or carved with a knife. Breaks with light manual pressure.

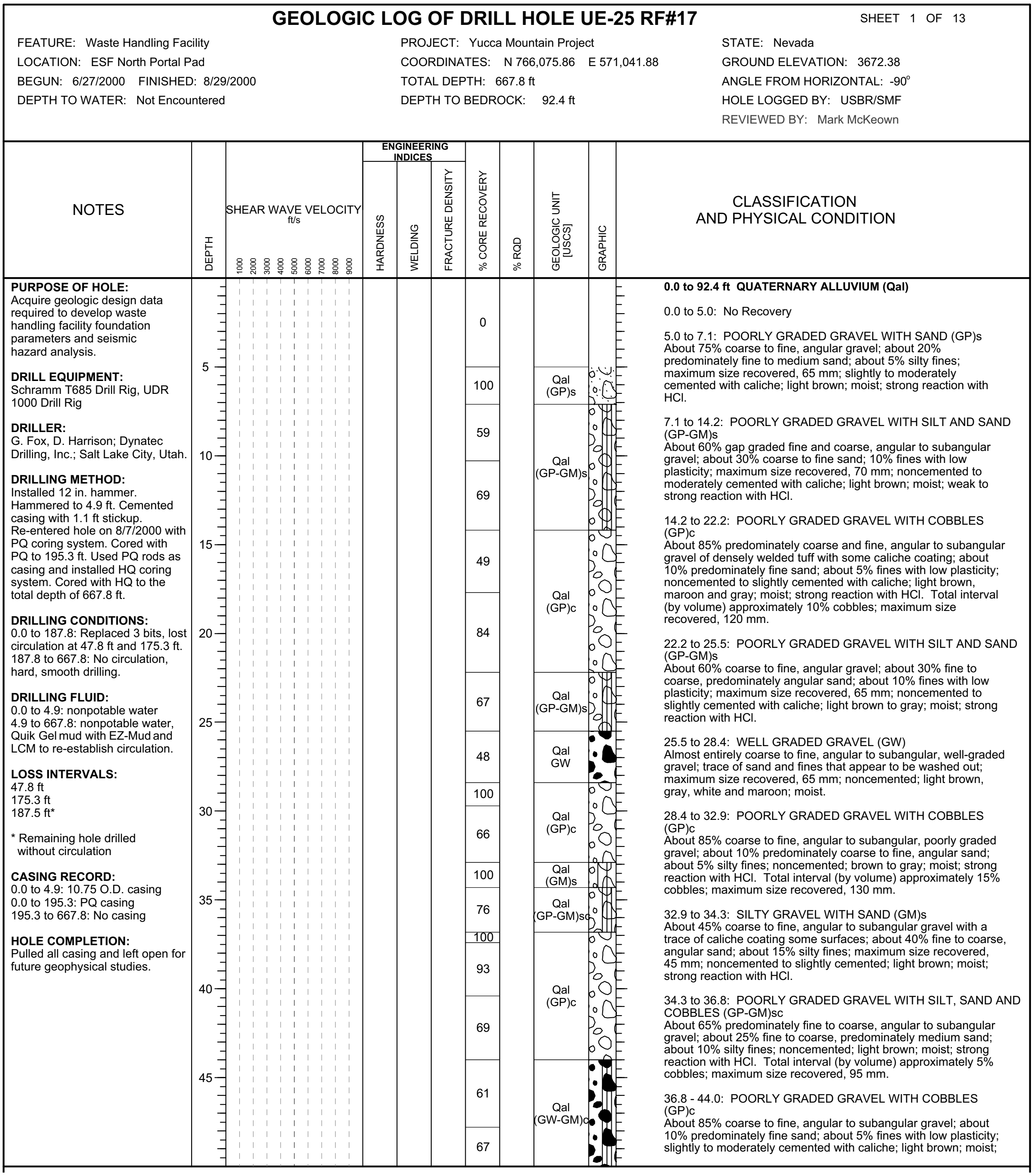
WEATHERING

Alphanumeric descriptor	Descriptor	General characteristics (strength, excavation, etc.)
W1	Fresh	Hammer rings when crystalline rocks are struck. Almost always rock excavation except for naturally weak or weakly cemented rocks such as siltstones or shales.
W2	Slightly weathered to fresh	
W3	Slightly weathered	Hammer rings when crystalline rocks are struck. Body of rock not weakened. With few exceptions, such as siltstones or shales, classified as rock excavation.
W4	Moderately to slightly weathered	
W5	Moderately weathered	Hammer does not ring when rock is struck. Body of rock is slightly weakened. Depending on fracturing, usually is rock excavation except in naturally weak rocks such as siltstones or shales.
W6	Intensely to moderately weathered	
W7	Intensely weathered	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened. Usually common excavation.
W8	Very intensely weathered	
W9	Decomposed	Can be granulated by hand. Always common excavation. Resistant minerals such as quartz may be present as "stringers" or "dikes."

FRACTURE DENSITY

Alphanumeric descriptor	Descriptor	Criteria (Excludes mechanical breaks)
FD0	Unfractured	No observed fractures.
FD1	Very slightly fractured	Core recovered mostly in lengths greater than 3 ft (1 m).
FD2	Slightly to very slightly fractured	
FD3	Slightly fractured	Core recovered mostly in lengths from 1 to 3 ft (300 to 1,000 mm) with few scattered lengths less than 1 ft (300 mm) or greater than 3 ft (1,000 mm).
FD4	Moderately to slightly fractured	
FD5	Moderately fractured	Core recovered mostly in lengths from 0.33 to 1.0 ft (100 to 300 mm) with most lengths about 0.67 ft (200 mm).
FD6	Moderately to intensely fractured	
FD7	Intensely fractured	Lengths average from 0.1 to 0.33 ft (30 to 100 mm) with fragmented intervals. Core recovered mostly in lengths less than 0.33 ft (100 mm).
FD8	Very intensely to intensely fractured	
FD9	Very intensely fractured	Core recovered mostly as chips and fragments with a few scattered short core lengths.

Figure 1.1-98. Geologic Log of Drill Hole UE-25 RF#16 (Sheet 9 of 9)



GEOLOGIC LOG OF DRILL HOLE UE-25 RF#17

SHEET 1 OF 13

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 6/27/2000 FINISHED: 8/29/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,075.86 E 571,041.88
TOTAL DEPTH: 667.8 ft
DEPTH TO BEDROCK: 92.4 ft

STATE: Nevada
GROUND ELEVATION: 3672.38
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES

PURPOSE OF HOLE:
Acquire geologic design data required to develop waste handling facility foundation parameters and seismic hazard analysis.

DRILL EQUIPMENT:
Schramm T685 Drill Rig, UDR 1000 Drill Rig

DRILLER:
G. Fox, D. Harrison; Dynatec Drilling, Inc.; Salt Lake City, Utah.

DRILLING METHOD:
Installed 12 in. hammer. Hammered to 4.9 ft. Cemented casing with 1.1 ft stickup. Re-entered hole on 8/7/2000 with PQ coring system. Cored with PQ to 195.3 ft. Used PQ rods as casing and installed HQ coring system. Cored with HQ to the total depth of 667.8 ft.

DRILLING CONDITIONS:
0.0 to 187.8: Replaced 3 bits, lost circulation at 47.8 ft and 175.3 ft.
187.8 to 667.8: No circulation, hard, smooth drilling.

DRILLING FLUID:
0.0 to 4.9: nonpotable water
4.9 to 667.8: nonpotable water, Quik Gel mud with EZ-Mud and LCM to re-establish circulation.

LOSS INTERVALS:
47.8 ft
175.3 ft
187.5 ft*

* Remaining hole drilled without circulation

CASING RECORD:
0.0 to 4.9: 10.75 O.D. casing
0.0 to 195.3: PQ casing
195.3 to 667.8: No casing

HOLE COMPLETION:
Pulled all casing and left open for future geophysical studies.

% CORE RECOVERY	GEOLOGIC UNIT [USCS]
0	
100	Qal (GP)s
59	Qal (GP-GM)s
69	
49	Qal (GP)c
84	
67	Qal (GP-GM)s
48	Qal GW
100	Qal (GP)c
66	
100	Qal (GM)s
76	Qal (GP-GM)sc
100	Qal (GP)c
93	
69	
61	Qal (GW-GM)c
67	

CLASSIFICATION AND PHYSICAL CONDITION

0.0 to 92.4 ft QUATERNARY ALLUVIUM (Qal)

0.0 to 5.0: No Recovery

5.0 to 7.1: POORLY GRADED GRAVEL WITH SAND (GP)s
About 75% coarse to fine, angular gravel; about 20% predominately fine to medium sand; about 5% silty fines; maximum size recovered, 65 mm; slightly to moderately cemented with caliche; light brown; moist; strong reaction with HCl.

7.1 to 14.2: POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)s
About 60% gap graded fine and coarse, angular to subangular gravel; about 30% coarse to fine sand; 10% fines with low plasticity; maximum size recovered, 70 mm; noncemented to moderately cemented with caliche; light brown; moist; weak to strong reaction with HCl.

14.2 to 22.2: POORLY GRADED GRAVEL WITH COBBLES (GP)c
About 85% predominately coarse and fine, angular to subangular gravel of densely welded tuff with some caliche coating; about 10% predominately fine sand; about 5% fines with low plasticity; noncemented to slightly cemented with caliche; light brown, maroon and gray; moist; strong reaction with HCl. Total interval (by volume) approximately 10% cobbles; maximum size recovered, 120 mm.

22.2 to 25.5: POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)s
About 60% coarse to fine, angular gravel; about 30% fine to coarse, predominately angular sand; about 10% fines with low plasticity; maximum size recovered, 65 mm; noncemented to slightly cemented with caliche; light brown to gray; moist; strong reaction with HCl.

25.5 to 28.4: WELL GRADED GRAVEL (GW)
Almost entirely coarse to fine, angular to subangular, well-graded gravel; trace of sand and fines that appear to be washed out; maximum size recovered, 65 mm; noncemented; light brown, gray, white and maroon; moist.

28.4 to 32.9: POORLY GRADED GRAVEL WITH COBBLES (GP)c
About 85% coarse to fine, angular to subangular, poorly graded gravel; about 10% predominately coarse to fine, angular sand; about 5% silty fines; noncemented; brown to gray; moist; strong reaction with HCl. Total interval (by volume) approximately 15% cobbles; maximum size recovered, 130 mm.

32.9 to 34.3: SILTY GRAVEL WITH SAND (GM)s
About 45% coarse to fine, angular to subangular gravel with a trace of caliche coating some surfaces; about 40% fine to coarse, angular sand; about 15% silty fines; maximum size recovered, 45 mm; noncemented to slightly cemented; light brown; moist; strong reaction with HCl.

34.3 to 36.8: POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc
About 65% predominately fine to coarse, angular to subangular gravel; about 25% fine to coarse, predominately medium sand; about 10% silty fines; noncemented; light brown; moist; strong reaction with HCl. Total interval (by volume) approximately 5% cobbles; maximum size recovered, 95 mm.

36.8 - 44.0: POORLY GRADED GRAVEL WITH COBBLES (GP)c
About 85% coarse to fine, angular to subangular gravel; about 10% predominately fine sand; about 5% fines with low plasticity; slightly to moderately cemented with caliche; light brown; moist;

Figure 1.1-99. Geologic Log of Drill Hole UE-25 RF#17 (Sheet 1 of 13)

NOTE: All measurements are in feet unless noted otherwise. No attempts to re-establish circulation were made below 187.5 ft. LCM (Lost Circulation Material) consists of cellophane cuttings. USCS classifications were determined in the field, with limited access to samples to keep samples intact for future tests. Shear Wave Velocity data from GeoVision suspension logging. Data acquired from downhole survey conducted after PVC casing installed. USCS soil classifications are based on USBR 5005-86, *Procedure for Determining Unified Soil Classification (Visual Method)*.
RQD = rock quality designation; USCS = Unified Soil Classification System.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#17

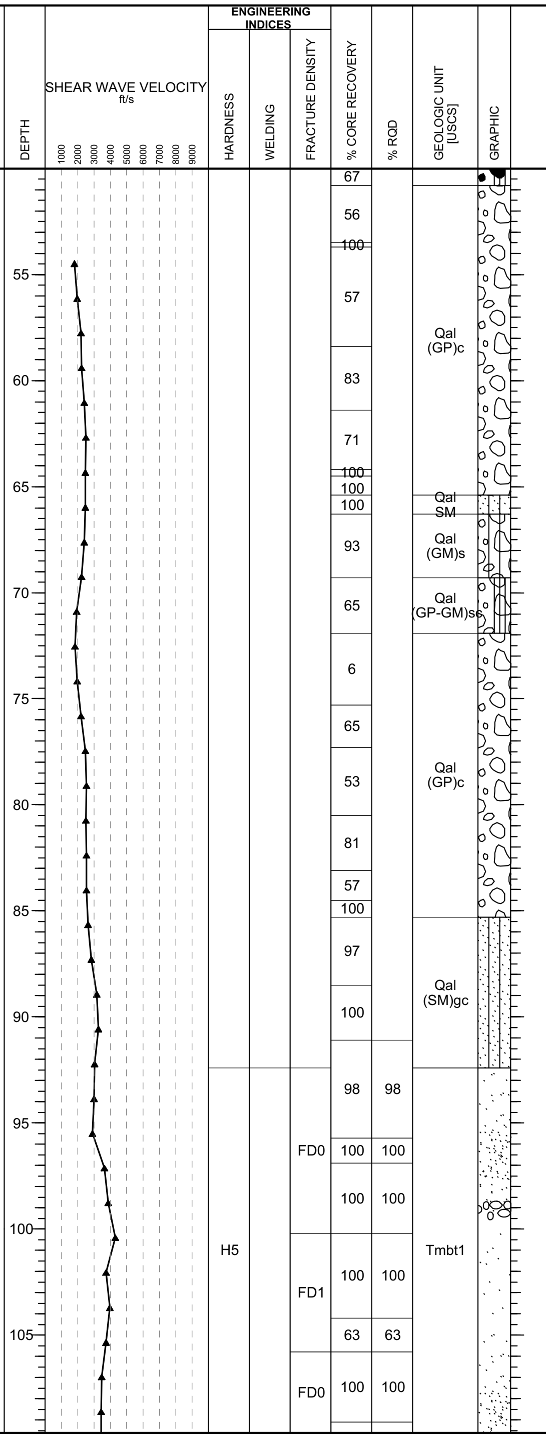
SHEET 2 OF 13

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 6/27/2000 FINISHED: 8/29/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,075.86 E 571,041.88
TOTAL DEPTH: 667.8 ft
DEPTH TO BEDROCK: 92.4 ft

STATE: Nevada
GROUND ELEVATION: 3672.38
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES



CLASSIFICATION AND PHYSICAL CONDITION

strong reaction with HCl. Total interval (by volume) approximately 15% cobbles of welded tuff; maximum size recovered, 190 mm.

44.0 to 50.8: WELL GRADED GRAVEL WITH SILT AND COBBLES (GW-GM)c
About 80% fine to coarse, angular to subangular, well graded gravel; about 10% fine to coarse, angular sand; about 10% silty fines; noncemented; light brown to gray; moist; weak to strong reaction with HCl. Total interval (by volume) approximately 5% cobbles; maximum size recovered, 110 mm.

50.8 to 65.4: POORLY GRADED GRAVEL WITH COBBLES (GP)c
About 90% coarse to fine, angular to subangular, poorly graded gravel; about 5% fine to coarse, angular sand; about 5% silty fines; noncemented to moderately cemented with caliche; light brown to gray; moist; strong reaction with HCl. Total interval (by volume) approximately 15% cobbles (greater near bottom of interval); maximum size recovered, 135 mm.

65.4 to 66.3: SILTY SAND (SM)
About 80% predominately fine sand; about 20% silty fines; trace of fine gravel; maximum size recovered, 5 mm; noncemented; light brown; moist; strong reaction with HCl.

66.3 to 69.3: SILTY GRAVEL WITH SAND (GM)s
About 55% coarse to fine, angular to subangular, poorly graded gravel; about 30% predominately fine to coarse, angular sand; about 15% silty fines; maximum size recovered, 75 mm; noncemented; light brown to gray; moist; weak reaction with HCl.

69.3 to 71.9: POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc
About 70% predominately coarse to fine, angular to subangular, poorly graded gravel; about 20% coarse to fine, angular to subangular sand; about 10% silty fines; noncemented to moderately cemented with caliche; light brown to gray; moist; no to weak reaction with HCl. Total interval (by volume) approximately 30% cobbles; maximum size recovered, 100 mm.

71.9 to 85.3: POORLY GRADED GRAVEL WITH COBBLES (GP)c
About 85% predominately coarse to fine, angular to subangular, poorly graded gravel; about 10% coarse to fine, angular sand; about 5% fines with no to low plasticity; noncemented; some caliche coating on gravel and cobbles; brown to gray; moist; no to strong reaction with HCl. Total interval (by volume) approximately 30% cobbles of welded tuff; maximum size, 150 mm.

85.3 to 92.4: SILTY SAND WITH GRAVEL AND COBBLES (SM)gc
About 45% coarse to fine, angular to subangular sand; about 40% coarse to fine, angular to subangular gravel; about 15% fines with no to low plasticity; noncemented to strongly cemented with caliche at 87.7; light brown, gray, beige; moist; weak to strong reaction with HCl. Total interval (by volume) approximately 5% cobbles; maximum size recovered, 100 mm.

92.4 to 287.2 ft BEDDED TUFF (Tmbt1)
Nonwelded pyroclastic flows with paleosols and reworked tuffaceous sediments. Medium grained (1 to 5 mm), very pale gray and generally massively bedded. Strongly caliche cemented from 92.4 to 96.1 ft. Tuff is moderately to slightly weathered (W4-5), some isolated intensely weathered (W7) zones; ranges from moderately hard (H4) to soft (H6), most moderately soft (H4); mostly unfractured (FD0) to slightly fractured (FD3) with some small zones of up to intensely fractured (FD7). Lower contact is unconformable.

Discontinuity Measurements:

Depth	Angle*	Roughness	Infilling
102.0	70	R3	clay
104.4	65	R3	clay, calcite
115.3	35	R4	none
120.0	30	R4	none
138.8	90	R2	none
141.4	45	R3	none
141.8	45	R3	none
156.7	30	R3	none
171.0-172.3	0-5	R2	none
176.8	65	R3	trace clay
175.8	60	R3	none
183.8	60	R3	none

Figure 1.1-99. Geologic Log of Drill Hole UE-25 RF#17 (Sheet 2 of 13)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#17

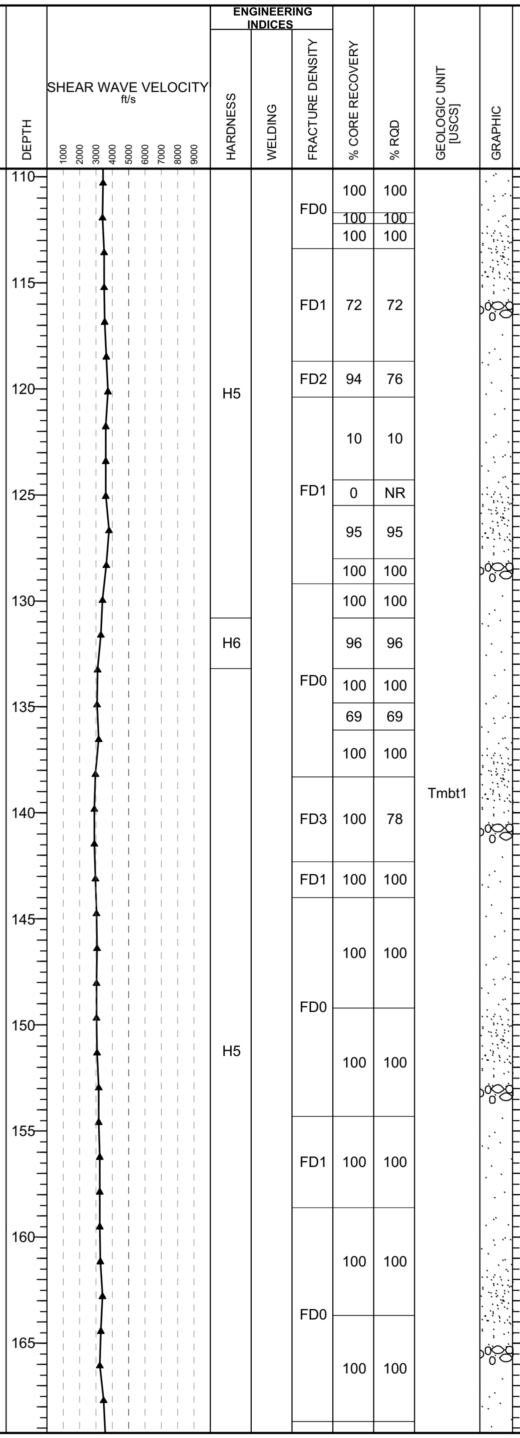
SHEET 3 OF 13

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 6/27/2000 FINISHED: 8/29/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,075.86 E 571,041.88
TOTAL DEPTH: 667.8 ft
DEPTH TO BEDROCK: 92.4 ft

STATE: Nevada
GROUND ELEVATION: 3672.38
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES



CLASSIFICATION AND PHYSICAL CONDITION

186.0	40	R3	trace clay
188.0	40	R3	clay
188.6	80	R4	none
188.8	85	R3	none
189.1	90	R3	trace black mineral
192.5	30	R2	clayey breccia
199.3	35	R3	none
199.8	90	R2	none
201.0	80	R4	trace clay
214.3	90	R3	none
231.4-243.9	CLAYEY BRECCIA ZONE		
244.6	25	R2	clay, iron oxide
247.6-247.8	FRACTURE ZONE		
248.0	90	R3	clay
249.1-249.4	15	R3	clay
250.2	60	R3	none
251.3-251.9	20	R2	none
253.8	85	R3	trace clay
254.9	85	R4	none
270.7	80	R3	none
283.2	90	R2	trace clay
291.6	80	R3	clay
300.3-300.7	30	R3	none
300.8	90	R3	none
301.6	80	R2	trace clay
305.6	65	R4	trace clay

287.2 to 348.4 ft COMB PEAK IGNIMBRITE - TUFF X (Tpki):
Nonwelded pyroclastic flow, moderately indurated, approximately 20 to 25% pumice (up to 35 x 30 mm), about 10 to 15% volcanic lithic fragments (up to 25 x 25 mm). Tuff is medium gray with rare phenocrysts of sanidine, biotite, magnetite, and manganese oxides. Generally the tuff is moderately soft (H5), moderately to slightly weathered (W4), and unfractured (FD0) to very slightly fractured (FD1).

Discontinuity Measurements:

Depth	Angle*	Roughness	Infilling
347.5-348.0	15	R2	trace clay

348.4 to 368.9 ft POST-TIVA CANYON BEDDED TUFFS (Tpbt5):
Nonwelded, possibly reworked fallout tephra and pyroclastic flows separated by distinct paleosols. The tuff is devitrified, pale yellowish-brown, moderately indurated, with 10 to 15% pumice, (up to 10 x 7 mm), and less than 10% volcanic lithic fragments generally less than 1 mm. The bedded tuffs have about 1% feldspar, quartz phenocrysts, and approximately 2% biotite. Generally the bedded tuffs are moderately soft (H5), slightly (W4) to moderately (W6) weathered, mostly unfractured (FD0) to moderately fractured (FD4) with one zone of intensely fractured (FD7) rock.

Discontinuity Measurements:

Depth	Angle*	Roughness	Infilling
364.2-364.8	20	R3	none
366.6	50	R2	none
374.3-376.2	CLAYEY BRECCIA ZONE		
376.1	35	R2	trace clay
381.2-381.6	25	R2	none

368.9 to 478.0 ft TIVA CANYON TUFF CRYSTAL RICH NONLITHOPHYSAL ZONE (Tpcrn)
Pyroclastic flow, moderately to mostly densely welded, devitrified, pale red to grayish red, with 10 to 15% phenocrysts. Phenocryts mostly feldspar and some quartz, with rare biotite and pyroxene. Rare pumice from 392.0 to 404.6 ft and up to 20% pumice from 404.6 to 457.2 ft. Up to 15% lithophysal cavities from 457.2 to 471.4 ft. Generally the rock is soft to mostly moderately hard (H4), moderately to slightly weathered (W4), slightly (FD4) to intensely fractured (FD8).

Discontinuity Measurements:

Depth	Angle*	Roughness	Infilling
381.3-382.3	10	R2	none
383.8	75	R3	none
383.8-384.3	10	R3	none
384.3-385.1	0	R3	none
385.8-386.0	25	R3	calcite
386.4-387.2	10	R2	breccia
387.0-388.5	5	R3	calcite
387.1-387.5	25	R3	none

Figure 1.1-99. Geologic Log of Drill Hole UE-25 RF#17 (Sheet 3 of 13)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#17

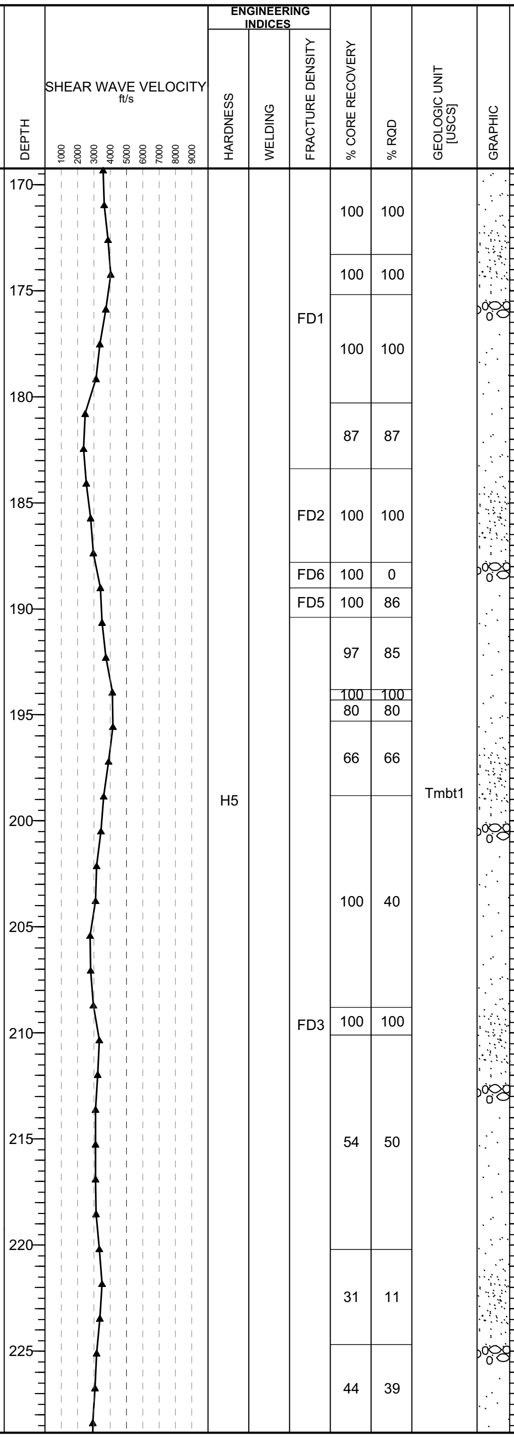
SHEET 4 OF 13

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 6/27/2000 FINISHED: 8/29/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,075.86 E 571,041.88
TOTAL DEPTH: 667.8 ft
DEPTH TO BEDROCK: 92.4 ft

STATE: Nevada
GROUND ELEVATION: 3672.38
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES



CLASSIFICATION
AND PHYSICAL CONDITION

390.0	30-90	R2	none
390.7	60	R3	none
391.0	60	R3	none
391.1-391.7	20	R2	none
391.1-391.7	FRACTURE ZONE		
394.5-397.5	FRACTURE ZONE		
397.2	40	R3	none
398.7-399.4	5-10	R2	trace clay
399.8	70	R3	none
401.1	60	R3	none
401.4-402.0	25	R3	clay
402.0-402.5	25	R2	none
403.4	50	R4	trace clay
403.8	30	R3	clay
404.4	60	R3	none
404.6	20-30	R3	clay
405.1-405.3	30	R3	clay
407.0-407.6	5-10	R2	none
407.8	65	R3	none
411.9-412.1	35	R3	clay
412.2-413.8	FRACTURE ZONE		
414.2-414.8	15	R3	clay
415.7	70	R3	quartz, calcite
417.3	35	R3	none
417.8	60	R3	none
418.8-419.9	5-15	R3	clay
419.9	45	R3	clay
421.3	35	R3	clay
422.5	55	R3	clay
423.5-424.0	10-20	R3	none
424.3-425.8	0-35	R2	none
425.9	60	R3	iron oxide
426.0	60-80	R3	trace iron oxide
427.0-427.2	45	R2	breccia
427.4-428.2	50	R2	trace calcite
428.8	55	R3	trace calcite, trace iron oxide
431.2	40	R3	clay
431.7	85-90	R2	clay, sand
434.7-437.3	FRACTURE ZONE		
438.5-440.6	FRACTURE ZONE		
441.5-442.2	5-30	R2	trace iron oxide
442.1	45	R3	trace iron oxide
443.4	50	R2	none
444.0-444.2	35	R2	trace iron oxide
444.4-444.6	40	R3	none
446.7-447.0	40-50	R3	none
447.7	40	R2	none
447.8-448.0	30	R2	none
448.2	40-50	R2	none
448.3-449.5	BRECCIA ZONE		
450.4-451.0	0-20	R2	none
451.6-452.0	0-45	R2	none
451.8-452.4	0-10	R2	none
452.2-452.4	40	R3	none
455.2-455.7	25	R2	none
458.0-458.2	40	R3	trace iron oxide
458.3-458.6	30	R3	trace iron oxide
459.4-462.9	FRACTURE ZONE		
463.5	65	R5	none
463.9	70	R2	breccia
464.2	80	R3	breccia
464.4	80	R3	breccia
466.9	75	R4	none
467.9	55	R4	none
470.7	90	R3	none

478.0 to 587.3 ft TIVA CANYON TUFF CRYSTAL POOR UPPER LITHOPHYSAL ZONE (Tpcpul)
Pyroclastic flow; densely welded; moderate orange-pink with light gray mottling; about 3 to 5% lithophysal, irregular up to 50 x 50 mm with light gray crystal coating; pumice very light gray up to 10 x 4 mm; rare felsics of sanadine; rare biotite. Hard (H3) to soft (H6), most moderately hard (H4); slightly (W4) to intensely (W7) weathered; slightly fractured (FD2) to very intensely fractured (FD9).

Discontinuity Measurements:

Depth	Angle*	Roughness	Infilling
478.3	25	R4	none
478.4	70	R4	clayey breccia
478.5	70	R4	clayey breccia
478.8	60	R4	none
479.3	55	R4	none

Figure 1.1-99. Geologic Log of Drill Hole UE-25 RF#17 (Sheet 4 of 13)

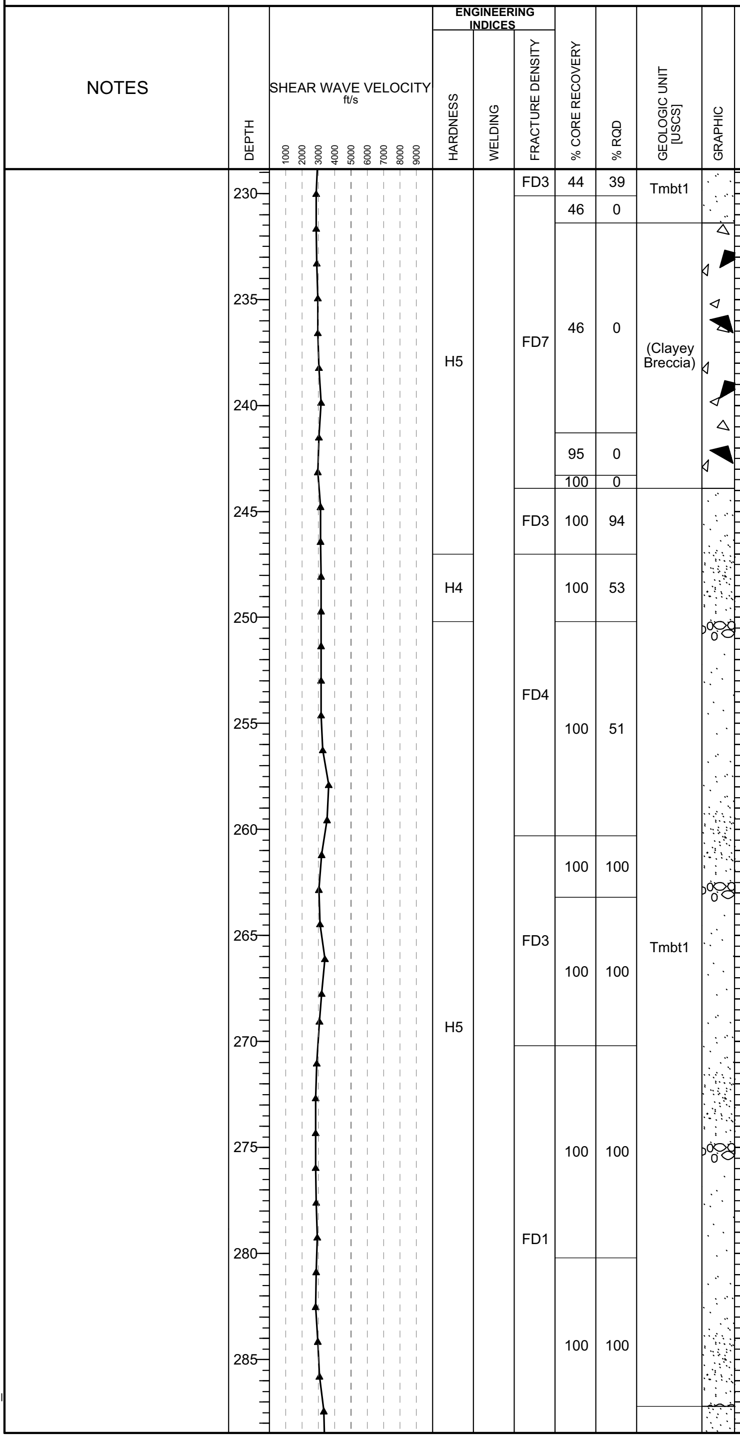
GEOLOGIC LOG OF DRILL HOLE UE-25 RF#17

SHEET 5 OF 13

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 6/27/2000 FINISHED: 8/29/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,075.86 E 571,041.88
TOTAL DEPTH: 667.8 ft
DEPTH TO BEDROCK: 92.4 ft

STATE: Nevada
GROUND ELEVATION: 3672.38
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown



CLASSIFICATION
AND PHYSICAL CONDITION

479.7	65	R5	trace calcite
479.8	45	R4	none
479.8	15	R3	none
480.0	50	R4	none
480.1	45	R4	none
480.2	50	R4	none
480.3	60	R4	none
480.3	85	R4	none
480.9	30	R3	breccia
481.3	40	R3	clayey breccia
481.7	70	R4	none
485.4	40	R3	none
488.7	50	R3	sandy, pumiceous breccia
489.8	55	R3	trace manganese oxide
491.1	55	R4	sandy, pumiceous breccia
493.6	60	R4	none
493.6	35	R4	none
493.8	25	R4	none
496.3	40	R6	clay
496.7	45	R4	none
496.9	35	R4	none
496.9	60	R4	none
497.1	55	R4	none
497.6-499.2	BRECCIA ZONE		trace iron oxide
500.1	40	R2	breccia
500.3	20	R3	none
500.5	20	R3	none
502.8	80	R5	none
506.8	45	R3	breccia
509.6	15	R3	none
518.9	45	R2	none
522.4	15	R2	trace iron oxide
522.6	65	R3	none
523.2	65	R3	none
545.0	10	R3	none
551.2	25	R2	none
551.4	30	R4	clay, gravel
552.6	5	R3	none
554.1	5	R3	none
555.8	30	R3	none
557.5	5	R3	clay, sand, gravel
559.0	5	R3	clay, sand, gravel
559.2	30	R4	sand, gravel
561.2	10	R3	none
564.9	35	R3	quartz
565.4	30	R4	clay
565.9	40	R3	none
566.9	20	R3	none
567.4	15	R2	none
568.2	35	R3	none
568.9	20	R3	quartz
569.7	10	R3	quartz
571.1	60	R3	none

587.3 to 637.6 ft TIVA CANYON TUFF CRYSTAL POOR MIDDLE NONLITHOPHYSAL ZONE (Tpcpmn)
Pyroclastic flow; densely welded; predominately pale red with mottled dark grayish red and scattered pink spots; mottling becomes fine grained and merges with rock fabric with depth; mineralization in fractures only; less than 5% flattened and altered pumice; less than 1% lithophysal; lithics increase with depth. Moderately hard (H4); slightly to moderately weathered (W4); very slightly fractured (FD1) to moderately fractured (FD6).

Discontinuity Measurements:

Depth	Angle*	Roughness	Infilling
580.4	35	R3	none
580.8	70	R3	none
581.2	30	R3	none
582.8	15	R3	trace clay
583.3	15	R3	trace clay
588.8	10	R3	quartz, sand
590.0	15	R3	trace quartz
591.5	65	R3	none
592.1	40	R3	none
594.4	15	R3	sand
595.3	20	R3	none
596.0	20	R3	quartz
597.5	10	R3	quartz
599.1	20	R3	trace quartz
610.8	30	R4	trace clay
611.2	55	R3	none
611.4	50	R3	none
612.1	30	R3	clay

Figure 1.1-99. Geologic Log of Drill Hole UE-25 RF#17 (Sheet 5 of 13)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#17

SHEET 6 OF 13

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 6/27/2000 FINISHED: 8/29/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,075.86 E 571,041.88
TOTAL DEPTH: 667.8 ft
DEPTH TO BEDROCK: 92.4 ft

STATE: Nevada
GROUND ELEVATION: 3672.38
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HOLE LOGGED BY: USBR/SMF
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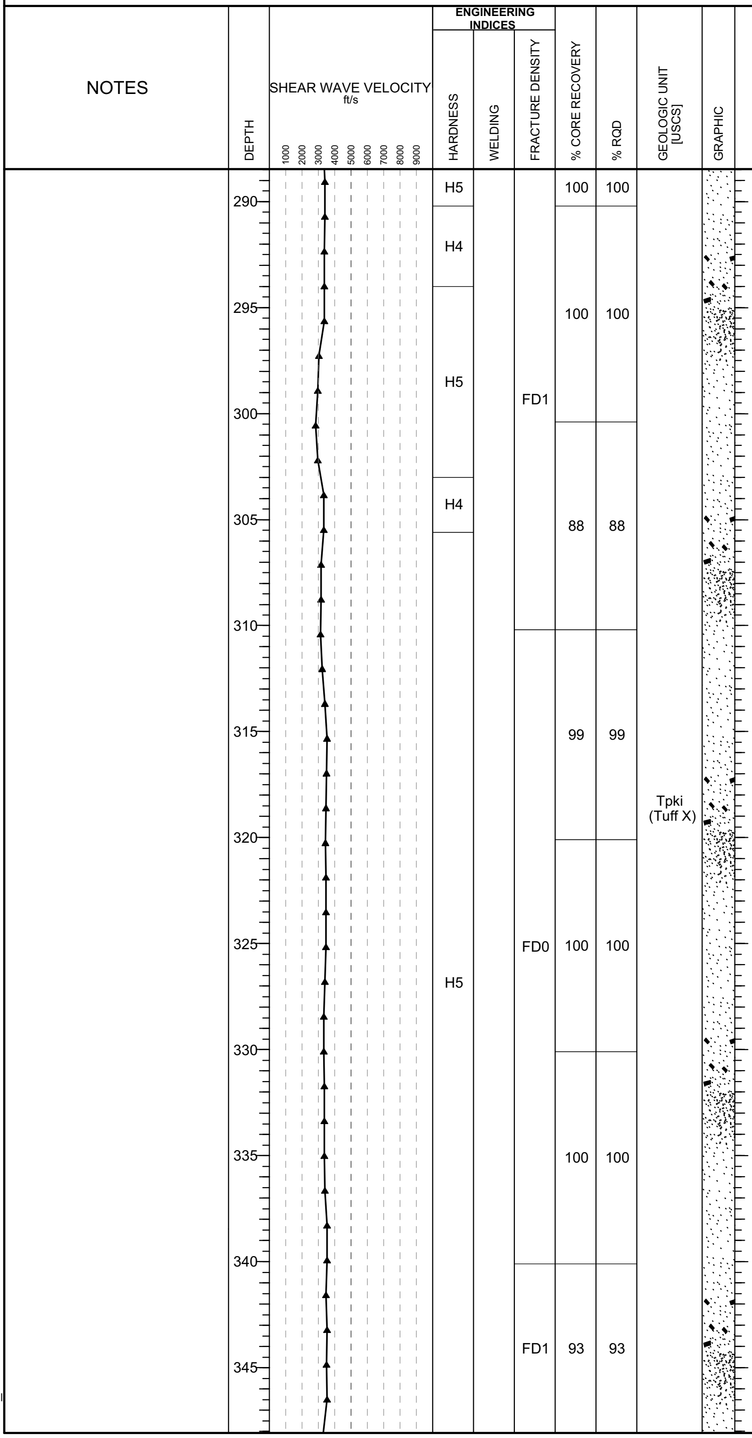


CLASSIFICATION
AND PHYSICAL CONDITION

615.4	20	R4	none
619.2	35	R2	none
621.1	15	R3	none
622.4	30	R3	none
624.0	15	R2	calcite
624.6	80	R2	none
625.7	40	R3	none
626.4	85	R2	none
628.1	35	R3	quartz
628.4	60	R2	none
630.2	15	R3	quartz
631.0	30	R3	sand, gravel
632.3	50	R3	none
633.7	40	R2	manganese oxide
634.0	15	R3	clay, sand
634.9	40	R3	clay, sand
635.4	30	R3	none
635.9	75	R2	none
636.3	5	R3	none
636.7	25	R3	none
637.4	15	R2	none

637.6 to 653.2 ft TIVA CANYON TUFF CRYSTAL POOR LOWER LITHOPHYSAL ZONE (Tpcpll)
Pyroclastic flow, densely welded, devitrified, moderate orange pink tuff with rare light gray pumice. Phenocrysts of sanidine and rare biotite compose less than 1% of the rock by volume. Lithophysal cavities compose up to 10% of the rock by volume, up to 5 by 15 mm in size. Generally the tuff is moderately hard (H4), slightly weathered (W3), and moderately to intensely fractured (FD6). Lower contact is conformable.

Discontinuity Measurements:

Depth	Angle*	Roughness	Infilling
637.8	20	R3	clay, sand, gravel
638.7	65	R3	pumice
639.0	75	R4	manganese oxide
640.1	60	R3	none
640.5	35	R3	none
641.0	35	R2	none
642.1	85	R2	none
644.0	65	R3	clay, sand
645.2	75	R2	none
646.4	70	R2	none
646.6	30	R2	trace white mineral
646.8-647.0	40	R2	clay, sand, gravel
648.0-648.7	20	R2	clay, sand, gravel
650.3	30	R3	sand
650.4	30	R3	sand
651.9	25	R3	sand

653.2 to 667.8 ft TIVA CANYON TUFF CRYSTAL POOR LOWER NONLITHOPHYSAL ZONE (Tpcpln)
Pyroclastic flow, densely welded, devitrified, pale red tuff with less than 1% light gray pumice clasts. Phenocrysts of sanidine and plagioclase compose less than 1% of the rock by volume. Medium gray lithic clasts compose less than 1% of the rock by volume. Generally the tuff is moderately hard (H4), slightly weathered (W3), with fracture densities mostly moderately to intensely fractured (FD7). Lower contact undetermined, bottom of borehole at 667.8 ft.

Discontinuity Measurements:

Depth	Angle*	Roughness	Infilling
653.5-657.4	5-15	R2	lapalli tuff
657.4	40	R2	clay, sand
658.5-658.7	25	R3	clay, sand
661.0-662.0	0-10	R4	none
661.1-661.3	30	R3	none
662.4	60	R4	none
663.0	65	R3	none
663.0-663.3	25	R4	none
663.4	55	R3	none
663.9-664.1	30	R4	quartz
664.2	65	R2	trace quartz
665.3	30	R4	none
665.7	35	R4	none
666.3	45	R3	trace calcite
666.3-666.6	30	R4	none
666.5-667.1	0-10	R3	quartz, calcite
667.2	45	R2	clayey breccia

Figure 1.1-99. Geologic Log of Drill Hole UE-25 RF#17 (Sheet 6 of 13)

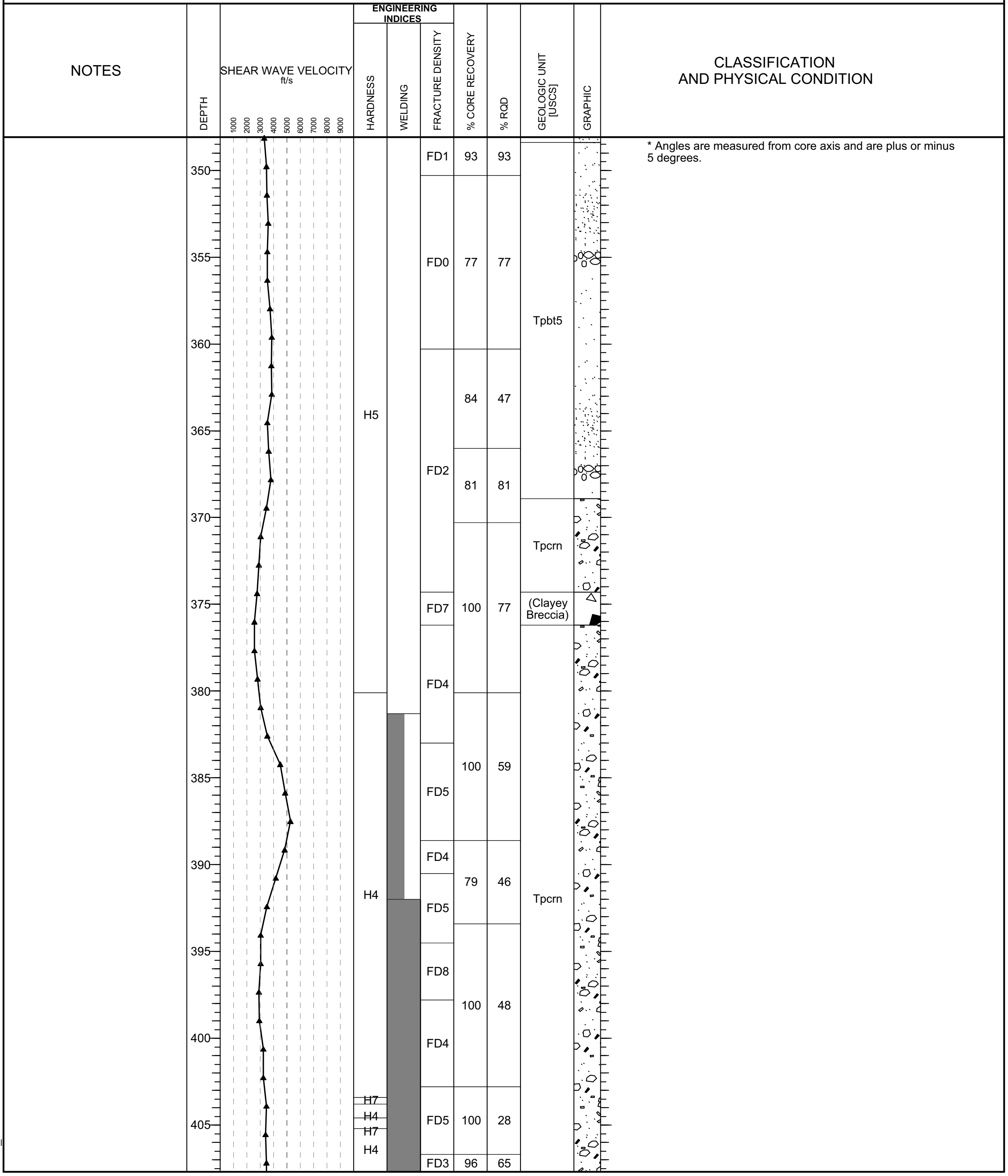
GEOLOGIC LOG OF DRILL HOLE UE-25 RF#17

SHEET 7 OF 13

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 6/27/2000 FINISHED: 8/29/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,075.86 E 571,041.88
TOTAL DEPTH: 667.8 ft
DEPTH TO BEDROCK: 92.4 ft

STATE: Nevada
GROUND ELEVATION: 3672.38
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown



* Angles are measured from core axis and are plus or minus 5 degrees.

Figure 1.1-99. Geologic Log of Drill Hole UE-25 RF#17 (Sheet 7 of 13)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#17 SHEET 8 OF 13

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 6/27/2000 FINISHED: 8/29/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,075.86 E 571,041.88
TOTAL DEPTH: 667.8 ft
DEPTH TO BEDROCK: 92.4 ft

STATE: Nevada
GROUND ELEVATION: 3672.38
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

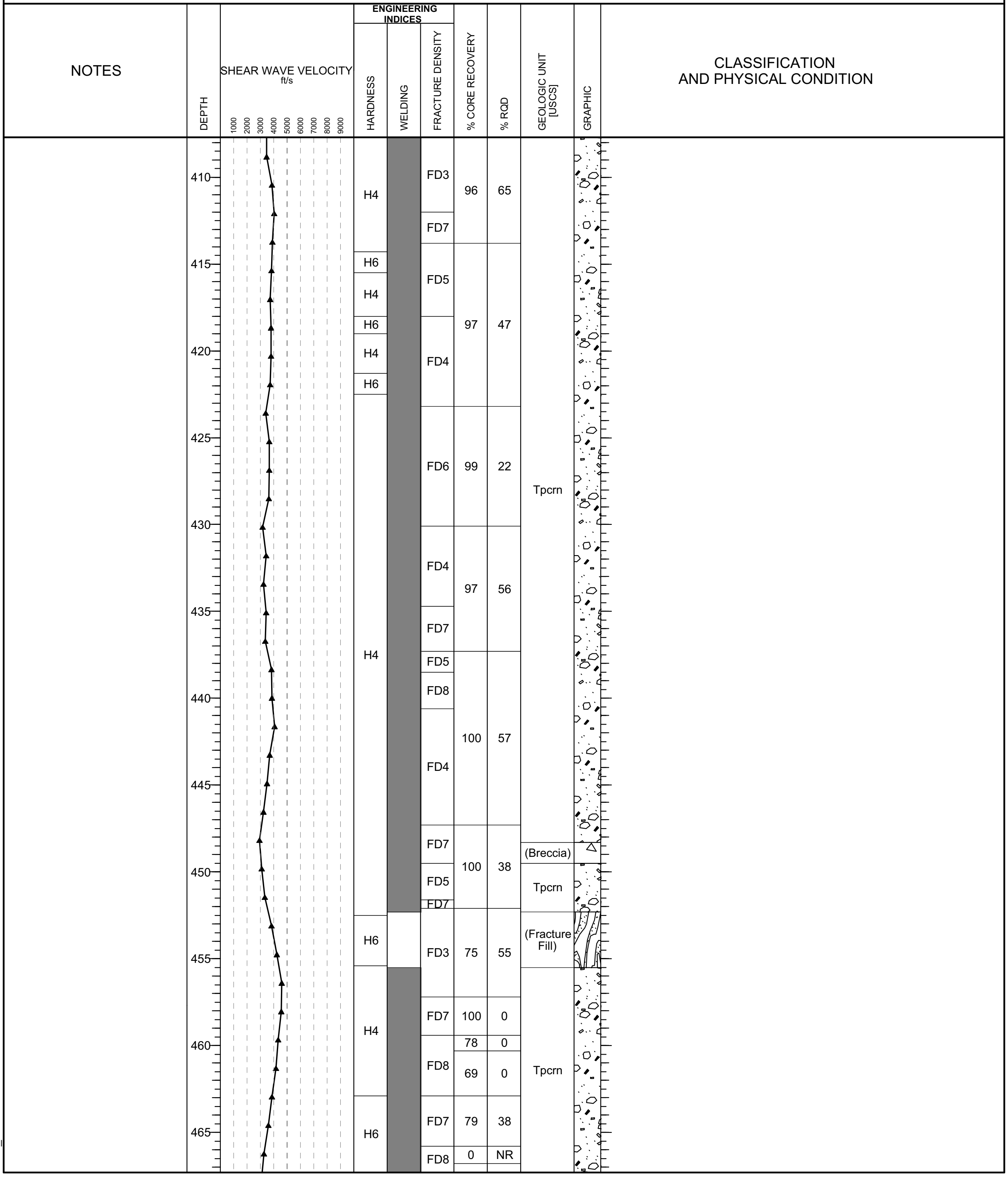


Figure 1.1-99. Geologic Log of Drill Hole UE-25 RF#17 (Sheet 8 of 13)

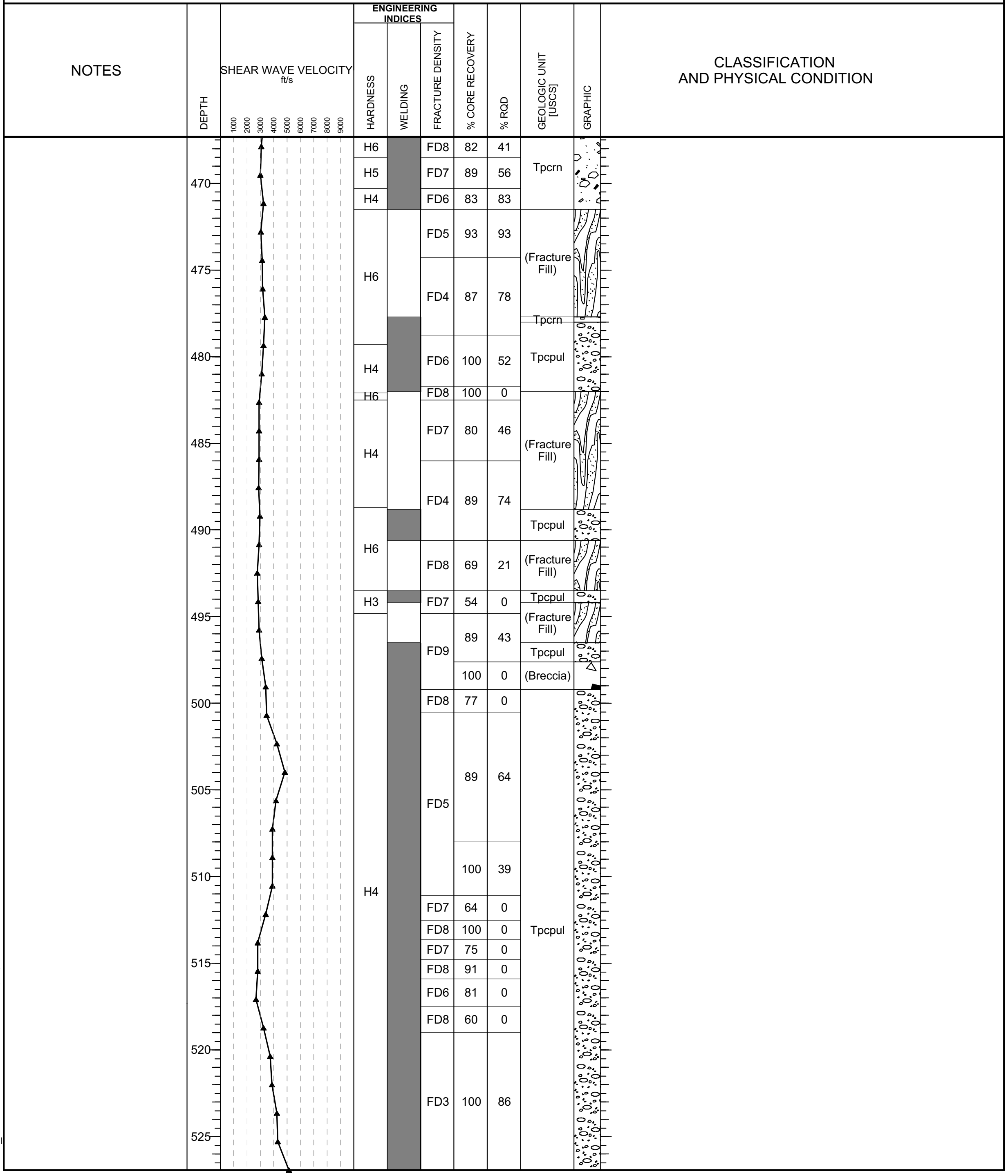
GEOLOGIC LOG OF DRILL HOLE UE-25 RF#17

SHEET 9 OF 13

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 6/27/2000 FINISHED: 8/29/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,075.86 E 571,041.88
TOTAL DEPTH: 667.8 ft
DEPTH TO BEDROCK: 92.4 ft

STATE: Nevada
GROUND ELEVATION: 3672.38
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown



HARDNESS	FRACTURE DENSITY	% CORE RECOVERY	% RQD	GEOLOGIC UNIT [USCS]
H6	FD8	82	41	Tpcrn
H5	FD7	89	56	
H4	FD6	83	83	
H6	FD5	93	93	(Fracture Fill)
	FD4	87	78	Tpcrn
H4	FD6	100	52	Tpcpul
H6	FD8	100	0	
H4	FD7	80	46	(Fracture Fill)
H6	FD4	89	74	Tpcpul
	FD8	69	21	(Fracture Fill)
H3	FD7	54	0	Tpcpul
H4	FD9	89	43	(Fracture Fill) Tpcpul
		100	0	(Breccia)
	FD8	77	0	Tpcpul
	FD5	89	64	
		100	39	
	FD7	64	0	
	FD8	100	0	
	FD7	75	0	
	FD8	91	0	
	FD6	81	0	
	FD8	60	0	
	FD3	100	86	

Figure 1.1-99. Geologic Log of Drill Hole UE-25 RF#17 (Sheet 9 of 13)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#17

SHEET 10 OF 13

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 6/27/2000 FINISHED: 8/29/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,075.86 E 571,041.88
TOTAL DEPTH: 667.8 ft
DEPTH TO BEDROCK: 92.4 ft

STATE: Nevada
GROUND ELEVATION: 3672.38
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

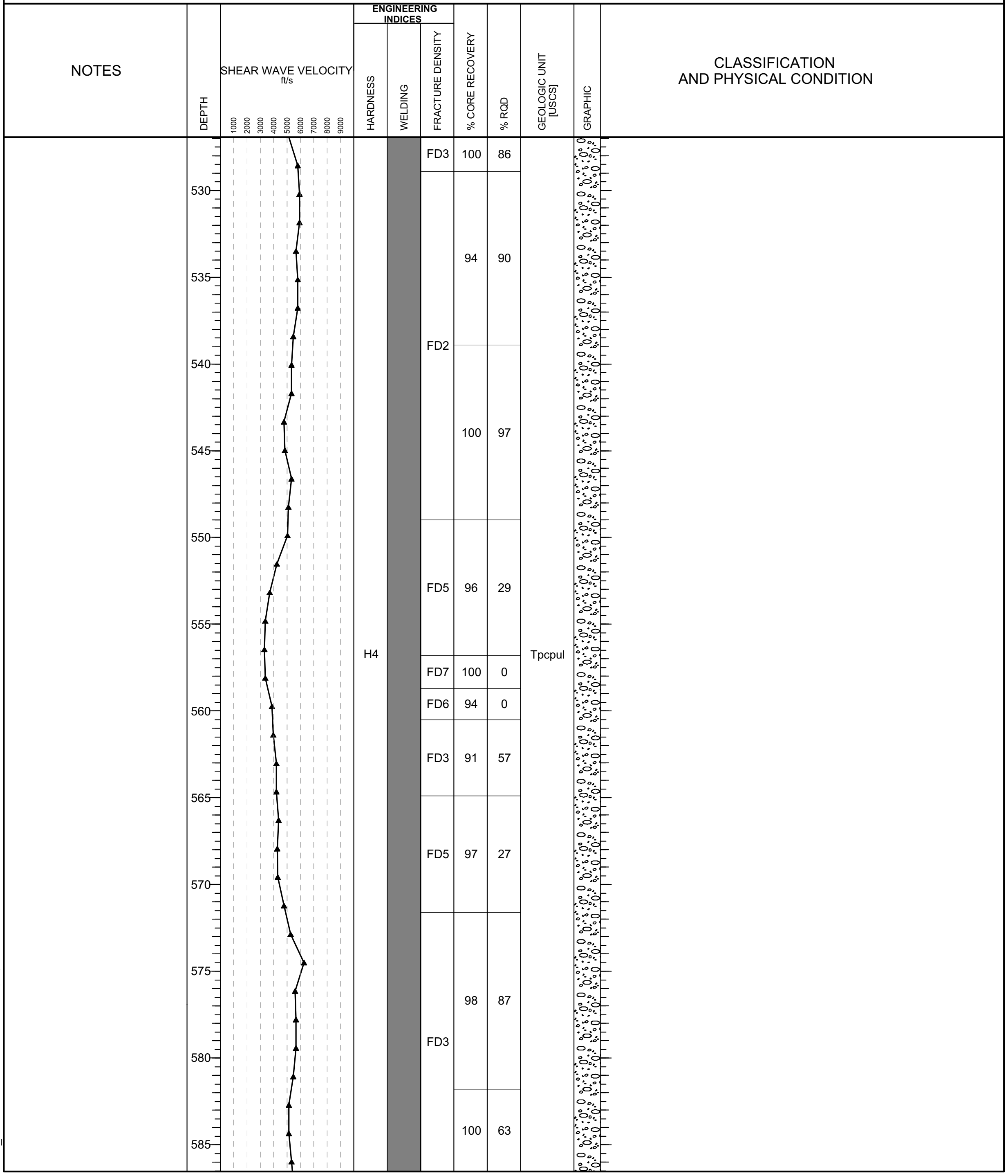


Figure 1.1-99. Geologic Log of Drill Hole UE-25 RF#17 (Sheet 10 of 13)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#17

SHEET 11 OF 13

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 6/27/2000 FINISHED: 8/29/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,075.86 E 571,041.88
TOTAL DEPTH: 667.8 ft
DEPTH TO BEDROCK: 92.4 ft

STATE: Nevada
GROUND ELEVATION: 3672.38
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

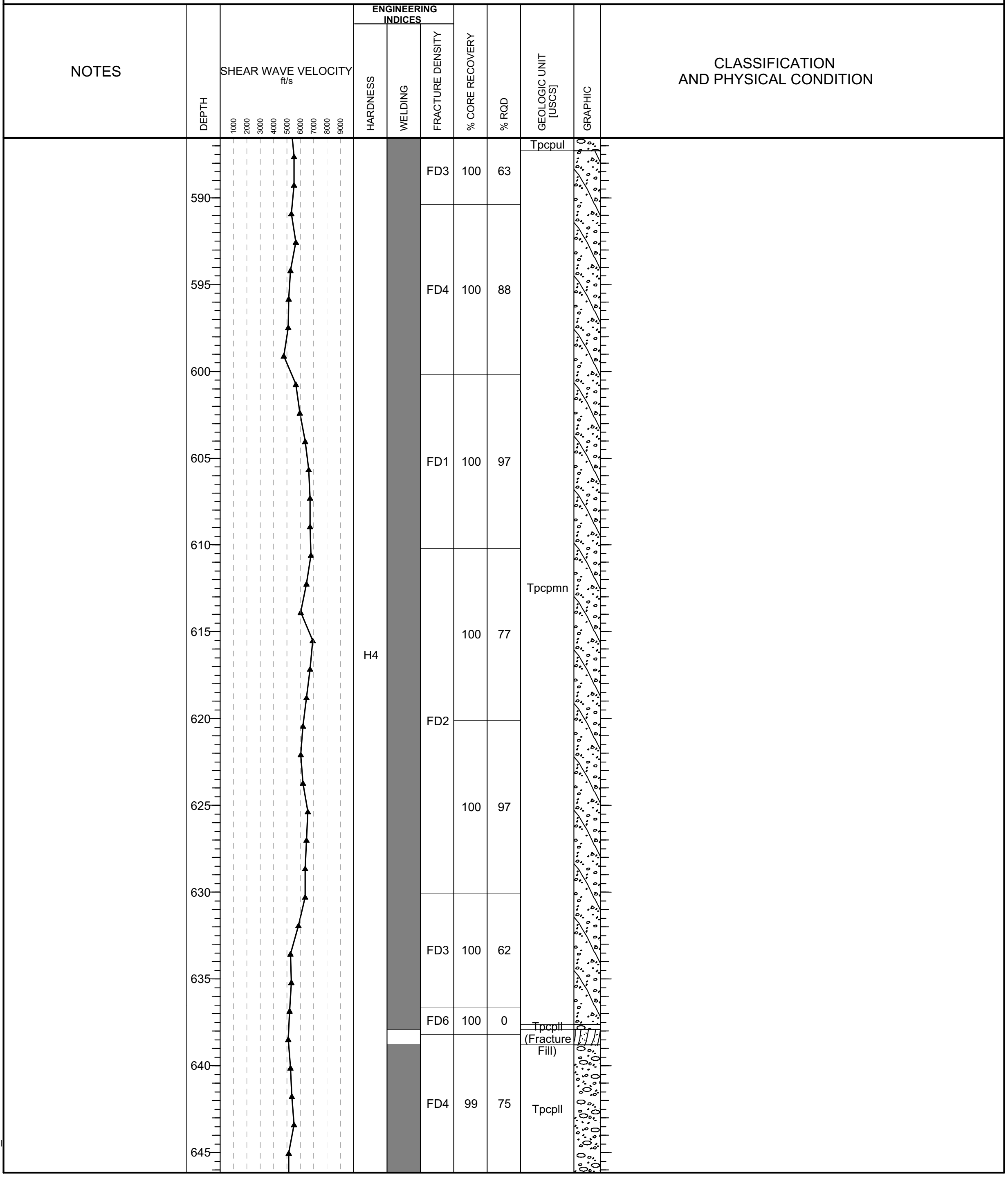


Figure 1.1-99. Geologic Log of Drill Hole UE-25 RF#17 (Sheet 11 of 13)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#17

SHEET 12 OF 13

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 6/27/2000 FINISHED: 8/29/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,075.86 E 571,041.88
TOTAL DEPTH: 667.8 ft
DEPTH TO BEDROCK: 92.4 ft

STATE: Nevada
GROUND ELEVATION: 3672.38
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

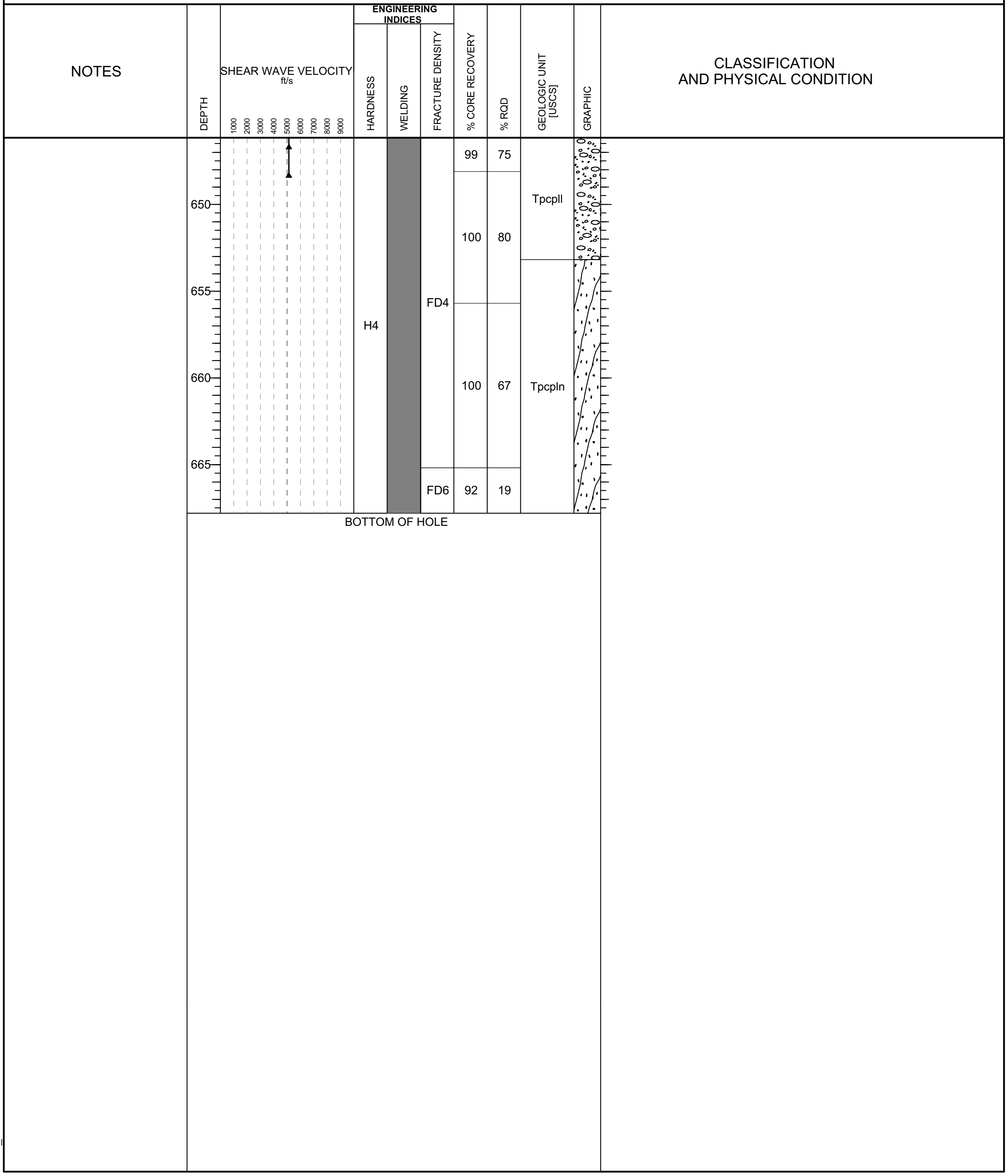


Figure 1.1-99. Geologic Log of Drill Hole UE-25 RF#17 (Sheet 12 of 13)

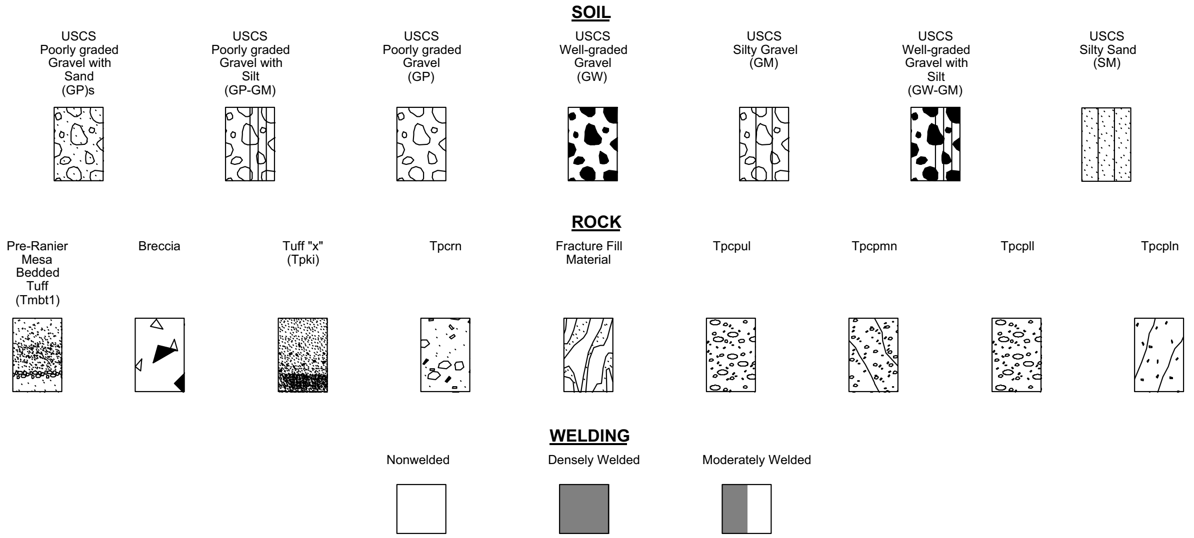
GEOLOGIC LOG OF DRILL HOLE UE-25 RF#17

SHEET 13 OF 13

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 6/27/2000 FINISHED: 8/29/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,075.86 E 571,041.88
TOTAL DEPTH: 667.8 ft
DEPTH TO BEDROCK: 92.4 ft

STATE: Nevada
GROUND ELEVATION: 3672.38
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown



HARDNESS

Alphanumeric descriptor	Descriptor	Criteria
H1	Extremely	Core, fragment, or exposure cannot be scratched with knife or sharp pick; can only be chipped with repeated heavy hammer blows.
H2	Very Hard	Cannot be scratched with knife or sharp pick. Core or fragment breaks with repeated heavy hammer blows.
H3	Hard	Can be scratched with knife or sharp pick with difficulty (heavy pressure). Heavy hammer blow required to break specimen.
H4	Moderately Hard	Can be scratched with knife or sharp pick with light pressure. Core or fragment breaks with moderate hammer blow.
H5	Moderately Soft	Can be grooved 1/16 in. (2 mm) deep by sharp pick with moderate or heavy pressure. Core or fragment breaks with light hammer blow or heavy manual pressure.
H6	Soft	Can be grooved or gouged easily by knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
H7	Very Soft	Can be readily indented, grooved or gouged with fingernail, or carved with a knife. Breaks with light manual pressure.

WEATHERING

Alphanumeric descriptor	Descriptor	General characteristics (strength, excavation, etc.)
W1	Fresh	Hammer rings when crystalline rocks are struck. Almost always rock excavation except for naturally weak or weakly cemented rocks such as siltstones or shales.
W2	Slightly weathered to fresh	
W3	Slightly weathered	Hammer rings when crystalline rocks are struck. Body of rock not weakened. With few exceptions, such as siltstones or shales, classified as rock excavation.
W4	Moderately to slightly weathered	
W5	Moderately weathered	Hammer does not ring when rock is struck. Body of rock is slightly weakened. Depending on fracturing, usually is rock excavation except in naturally weak rocks such as siltstones or shales.
W6	Intensely to moderately weathered	
W7	Intensely weathered	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened. Usually common excavation.
W8	Very intensely weathered	
W9	Decomposed	Can be granulated by hand. Always common excavation. Resistant minerals such as quartz may be present as "stringers" or "dikes".

FRACTURE DENSITY

Alphanumeric descriptor	Descriptor	Criteria (Excludes mechanical breaks)
FD0	Unfractured	No observed fractures.
FD1	Very slightly fractured	Core recovered mostly in lengths greater than 3 ft (1 m).
FD2	Slightly to very slightly fractured	
FD3	Slightly fractured	Core recovered mostly in lengths from 1 to 3 ft (300 to 1,000 mm) with few scattered lengths less than 1 ft (300 mm) or greater than 3 ft (1,000 mm).
FD4	Moderately to slightly fractured	
FD5	Moderately fractured	Core recovered mostly in lengths from 0.33 to 1.0 ft (100 to 300 mm) with most lengths about 0.67 ft (200 mm).
FD6	Moderately to intensely fractured	
FD7	Intensely fractured	Lengths average from 0.1 to 0.33 ft (30 to 100 mm) with fragmented intervals. Core recovered mostly in lengths less than 0.33 ft (100 mm).
FD8	Very intensely to intensely fractured	
FD9	Very intensely fractured	Core recovered mostly as chips and fragments with a few scattered short core lengths.

Figure 1.1-99. Geologic Log of Drill Hole UE-25 RF#17 (Sheet 13 of 13)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#18

SHEET 1 OF 6

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 9/5/2000 FINISHED: 9/21/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 764,522.34 E 570,626.93
TOTAL DEPTH: 493.6 ft
DEPTH TO BEDROCK: 65.0 ft

STATE: Nevada
GROUND ELEVATION: 3640.34
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES

Purpose of Hole:
Preliminary, conceptual-level geotechnical foundation investigations for the design of the waste handling facility.

Drill Equipment:
Schramm T685 Drill Rig

Drillers:
G. Fox, V. Mora, M. Fyffe; Dynatec Drilling Inc.; Salt Lake City, Utah.

Drilling Method:
Install 12 in. hammer. Hammer to 6.01. Cement 10.75 O.D. casing with 1.29 stickup. Re-enter hole on 9/15/2000 with 8.50 Tricone bit. Drill from 6.01 to total depth of 493.56.

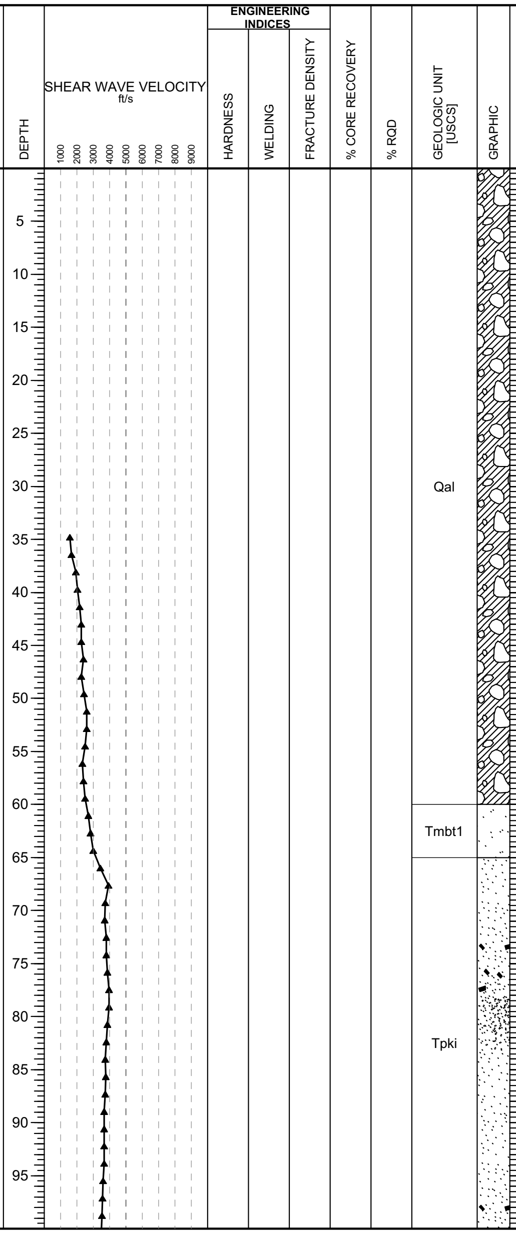
Drilling Conditions:
Lost circulation from 240.00 to 250.00.

Drilling Fluid:
0.00 to 5.00: Nonpotable water.
5.00 to 493.56: Quick Gel mud with EZ-Mud and LCM to re-establish circulation.

Loss Intervals:
240.00 to 250.00

Casing Record:
0.00 to 6.01: 10.75 O.D. casing.
6.01 to 493.56: No casing

Hole Completion:
Set and cement 492.41 of 4.50 schedule 80 PVC casing.



CLASSIFICATION AND PHYSICAL CONDITION

0.0 to 60.0 ft QUATERNARY ALLUVIUM (Qal)
Tuffaceous alluvium consisting of a mixture of pale red and light gray densely welded ignimbrite with minor fragments of white nonwelded tuff. Up to 15% of the densely welded material has white to light gray caliche coatings.

60.0 to 65.0 ft BEDDED TUFF (Tmbt1)
Bedded tuff, nonwelded, crystallized, very pale-orange with 10 to 12% pumice clasts. Tuff contains less than 1% pale to moderate red volcanic lithic clasts. Quartz and feldspar phenocrysts range from 10 to 15% of the tuff by volume, and biotite and manganese less than 1%.

65.0 to 204.0 ft COMB PEAK IGNIMBRITE - TUFF X (Tpki):
Pyroclastic flow, nonwelded, crystallized, with up to 20% pumice clasts. Tuff contains 2 to 3% sanidine, plagioclase, quartz, and less than 1% biotite and hornblende phenocrysts. Up to 20% moderate red to medium dark gray, volcanic lithic clasts.

204.0 to 292.0 ft TIVA CANYON TUFF CRYSTAL RICH NONLITHOPHYSAL ZONE (Tpcrn)
Pyroclastic flow, moderately to densely welded, crystallized, with 8 to 10% sanidine and plagioclase phenocrysts, and less than 1% biotite phenocrysts. From 207.0 to 211.0 ft moderately welded tuff has up to 8%, light gray pumice clasts. From 211.0 to 217 ft densely welded tuff has up to 10% dark gray pumice. From 217.0 to 223.0 ft grayish-brown pumice content decreases to 3 to 5%. Tuff is pumice poor (less than 1%) from 223.0 to 248.0 ft. From 248.0 to 267.0 ft. the tuff has 10 to 15% very light gray to medium light gray pumice clasts.

292.0 to 425.0 ft TIVA CANYON TUFF CRYSTAL POOR UPPER LITHOPHYSAL ZONE (Tpcpul)
Pyroclastic flow, densely welded, crystallized, vapor phase altered, light gray, with 2 to 3% sanidine and plagioclase, and less than 1% biotite phenocrysts. Tuff has up to 5%, very light gray, pumice clasts. Lithophysae are distinguished by vapor phase altered chips, indicating the edges of voids in the tuff.

425.0 to 470.0 ft TIVA CANYON TUFF CRYSTAL POOR MIDDLE NONLITHOPHYSAL ZONE (Tpcpmn)
Pyroclastic flow, densely welded, crystallized, pale red, with less than 1% sanidine, plagioclase, and biotite phencrysts. Tuff has up to 1% pumice clasts and less than 1% volcanic lithic clasts. Vapor phase altered chips indicate some lithophysae from 360.0 to 367.0 ft.

470.0 to 493.6 ft TIVA CANYON TUFF CRYSTAL POOR LOWER LITHOPHYSAL ZONE (Tpcpll)
Pyroclastic flow, densely welded, crystallized, pale reddish-brown with minor vapor phase alteration. Less than 5%, very light gray, pumice clasts and less than 1% medium gray volcanic lithic clasts. Tuff contains less than 1% sanidine, plagioclase, biotite, and manganese phenocrysts.

Figure 1.1-100. Geologic Log of Drill Hole UE-25 RF#18 (Sheet 1 of 6)

NOTE: Hole logged from cuttings. Shear Wave Velocity data from GeoVision suspension logging. Data acquired from downhole survey conducted after PVC casing installed.
RQD = rock quality designation.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#18

SHEET 2 OF 6

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 9/5/2000 FINISHED: 9/21/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 764,522.34 E 570,626.93
TOTAL DEPTH: 493.6 ft
DEPTH TO BEDROCK: 65.0 ft

STATE: Nevada
GROUND ELEVATION: 3640.34
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

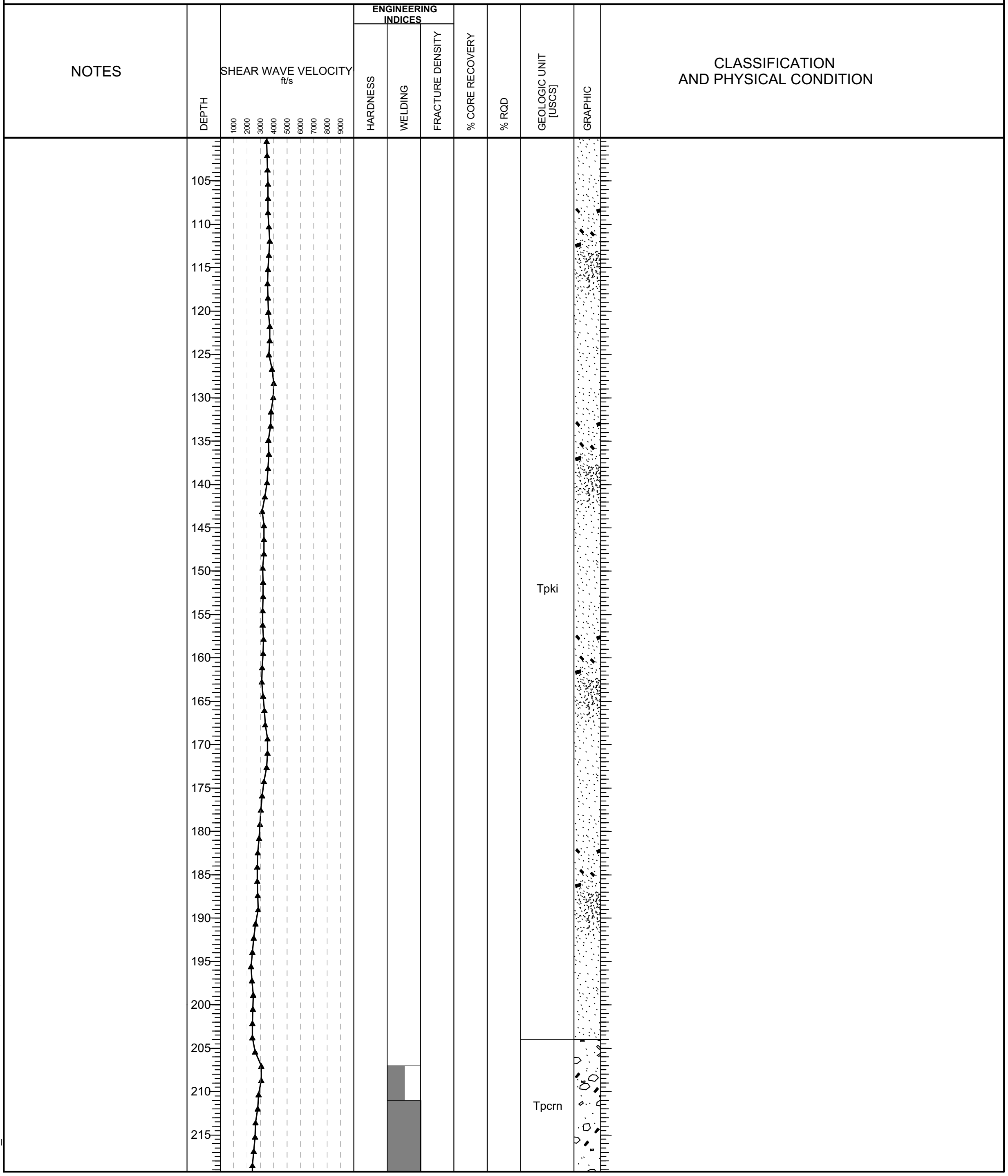


Figure 1.1-100. Geologic Log of Drill Hole UE-25 RF#18 (Sheet 2 of 6)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#18

SHEET 3 OF 6

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 9/5/2000 FINISHED: 9/21/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 764,522.34 E 570,626.93
TOTAL DEPTH: 493.6 ft
DEPTH TO BEDROCK: 65.0 ft

STATE: Nevada
GROUND ELEVATION: 3640.34
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

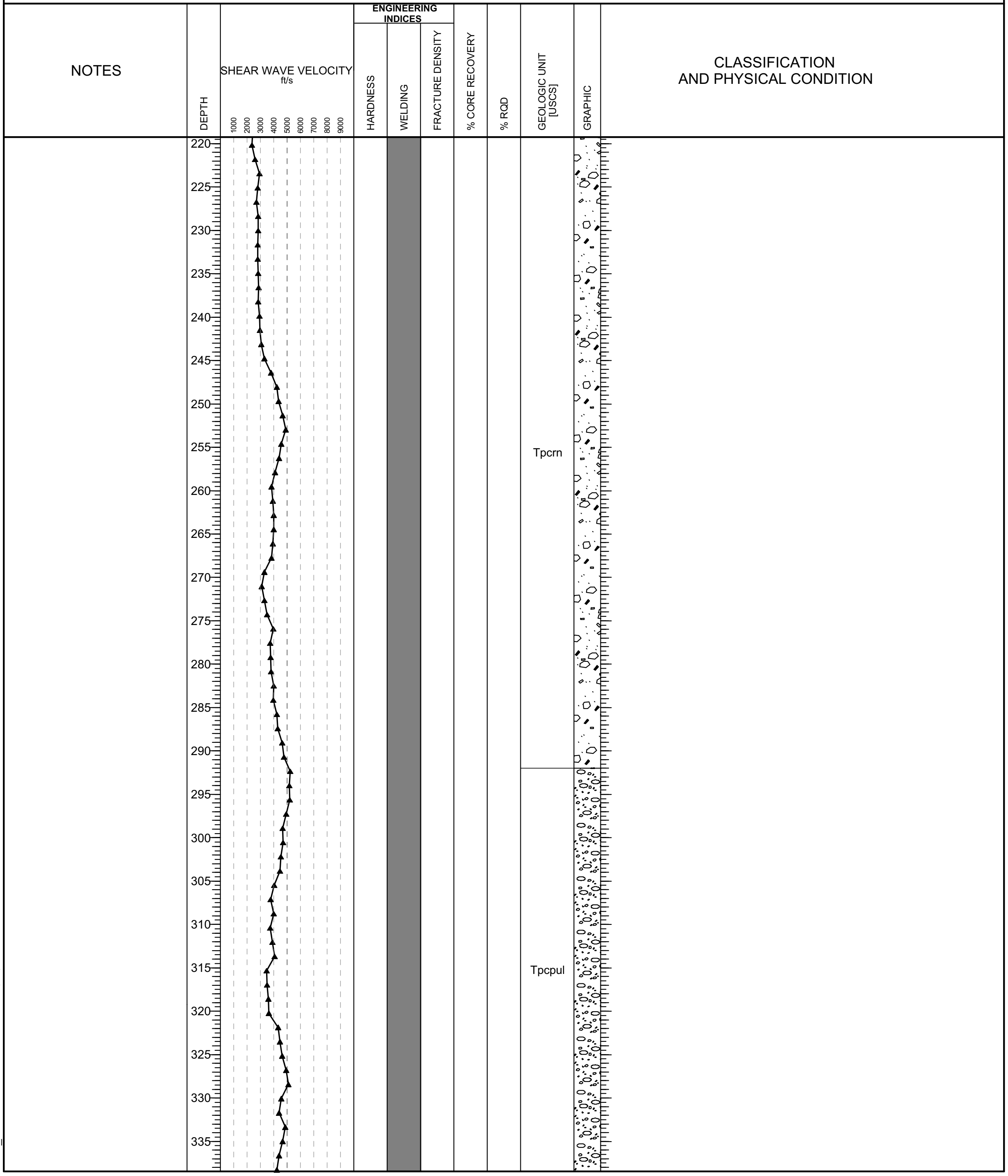


Figure 1.1-100. Geologic Log of Drill Hole UE-25 RF#18 (Sheet 3 of 6)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#18

SHEET 4 OF 6

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 9/5/2000 FINISHED: 9/21/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 764,522.34 E 570,626.93
TOTAL DEPTH: 493.6 ft
DEPTH TO BEDROCK: 65.0 ft

STATE: Nevada
GROUND ELEVATION: 3640.34
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

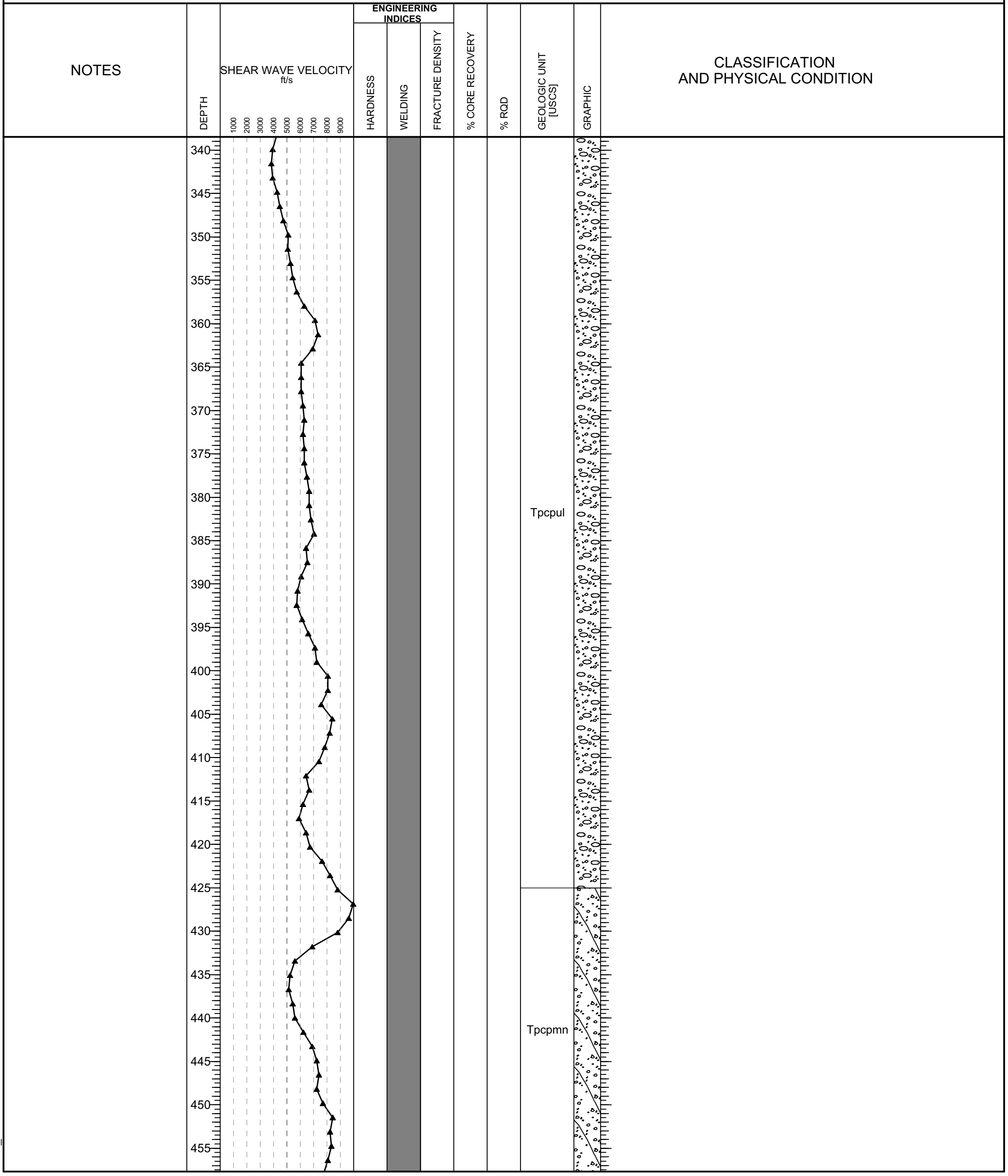


Figure 1.1-100. Geologic Log of Drill Hole UE-25 RF#18 (Sheet 4 of 6)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#18

SHEET 5 OF 6

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 9/5/2000 FINISHED: 9/21/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 764,522.34 E 570,626.93
TOTAL DEPTH: 493.6 ft
DEPTH TO BEDROCK: 65.0 ft

STATE: Nevada
GROUND ELEVATION: 3640.34
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

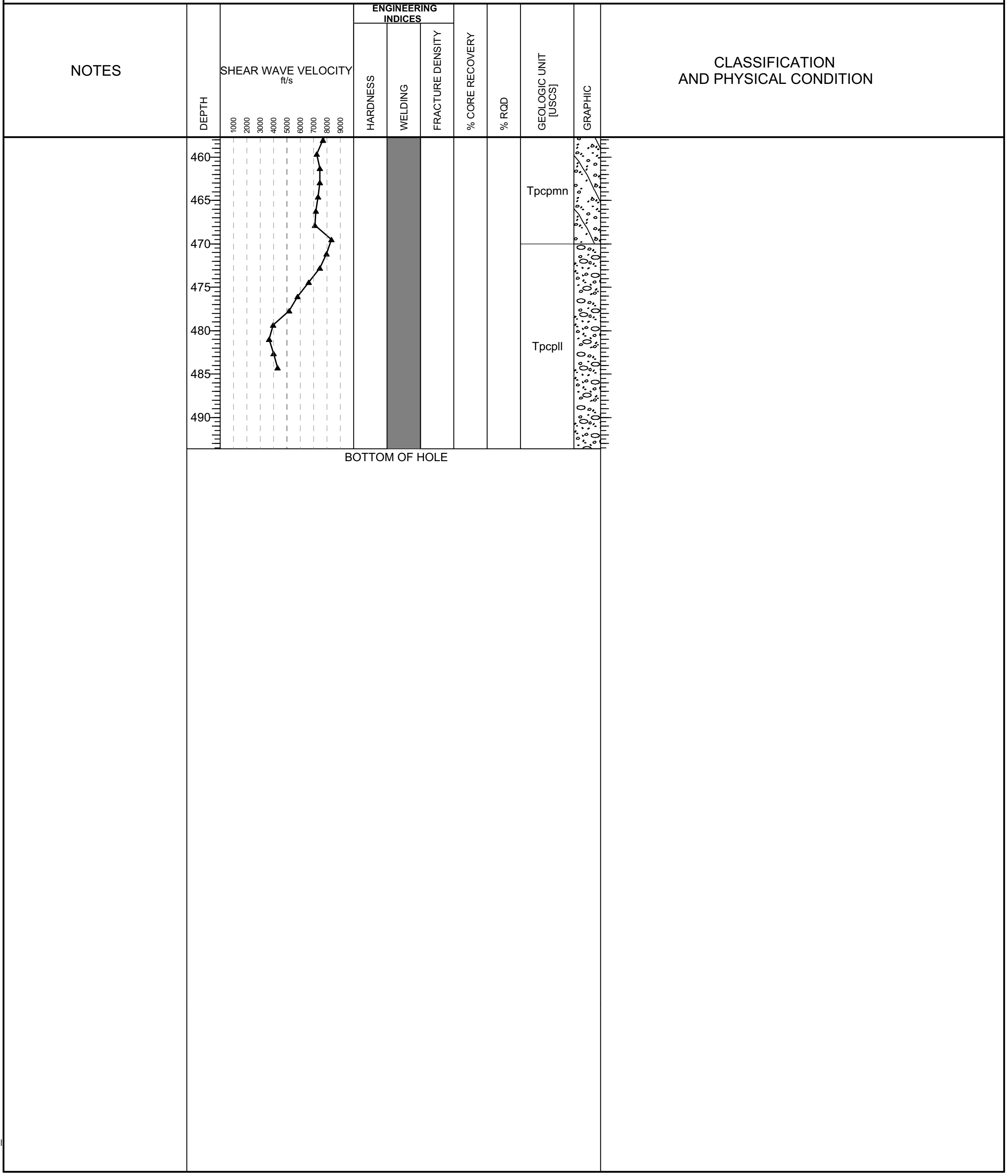


Figure 1.1-100. Geologic Log of Drill Hole UE-25 RF#18 (Sheet 5 of 6)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#18

SHEET 6 OF 6

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 9/5/2000 FINISHED: 9/21/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 764,522.34 E 570,626.93
TOTAL DEPTH: 493.6 ft
DEPTH TO BEDROCK: 65.0 ft

STATE: Nevada
GROUND ELEVATION: 3640.34
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

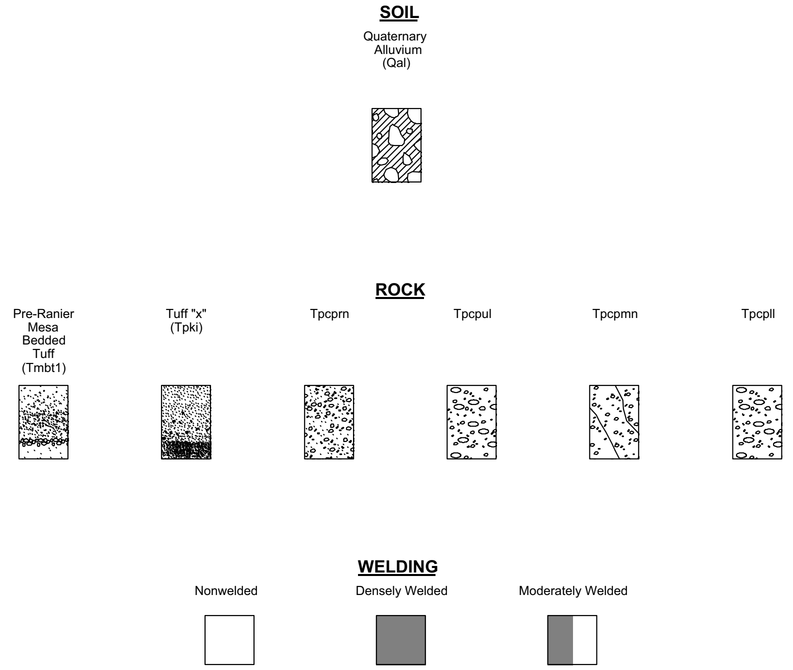
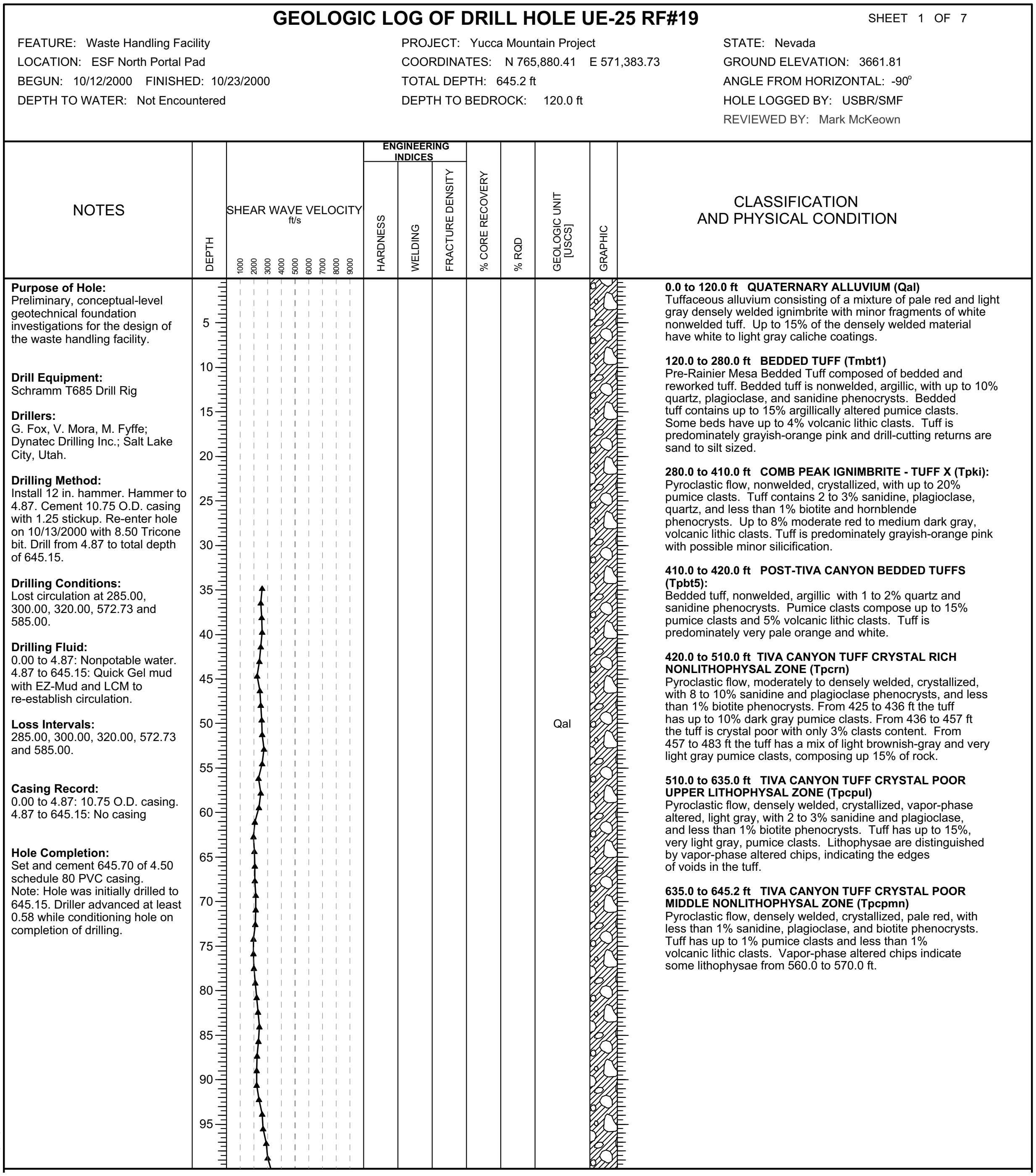


Figure 1.1-100. Geologic Log of Drill Hole UE-25 RF#18 (Sheet 6 of 6)



GEOLOGIC LOG OF DRILL HOLE UE-25 RF#19

SHEET 1 OF 7

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 10/12/2000 FINISHED: 10/23/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,880.41 E 571,383.73
TOTAL DEPTH: 645.2 ft
DEPTH TO BEDROCK: 120.0 ft

STATE: Nevada
GROUND ELEVATION: 3661.81
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

Purpose of Hole:
Preliminary, conceptual-level geotechnical foundation investigations for the design of the waste handling facility.

Drill Equipment:
Schramm T685 Drill Rig

Drillers:
G. Fox, V. Mora, M. Fyffe; Dynatec Drilling Inc.; Salt Lake City, Utah.

Drilling Method:
Install 12 in. hammer. Hammer to 4.87. Cement 10.75 O.D. casing with 1.25 stickup. Re-enter hole on 10/13/2000 with 8.50 Tricone bit. Drill from 4.87 to total depth of 645.15.

Drilling Conditions:
Lost circulation at 285.00, 300.00, 320.00, 572.73 and 585.00.

Drilling Fluid:
0.00 to 4.87: Nonpotable water.
4.87 to 645.15: Quick Gel mud with EZ-Mud and LCM to re-establish circulation.

Loss Intervals:
285.00, 300.00, 320.00, 572.73 and 585.00.

Casing Record:
0.00 to 4.87: 10.75 O.D. casing.
4.87 to 645.15: No casing

Hole Completion:
Set and cement 645.70 of 4.50 schedule 80 PVC casing.
Note: Hole was initially drilled to 645.15. Driller advanced at least 0.58 while conditioning hole on completion of drilling.

0.0 to 120.0 ft QUATERNARY ALLUVIUM (Qal)
Tuffaceous alluvium consisting of a mixture of pale red and light gray densely welded ignimbrite with minor fragments of white nonwelded tuff. Up to 15% of the densely welded material have white to light gray caliche coatings.

120.0 to 280.0 ft BEDDED TUFF (Tmbt1)
Pre-Rainier Mesa Bedded Tuff composed of bedded and reworked tuff. Bedded tuff is nonwelded, argillic, with up to 10% quartz, plagioclase, and sanidine phenocrysts. Bedded tuff contains up to 15% argillically altered pumice clasts. Some beds have up to 4% volcanic lithic clasts. Tuff is predominately grayish-orange pink and drill-cutting returns are sand to silt sized.

280.0 to 410.0 ft COMB PEAK IGNIMBRITE - TUFF X (Tpki):
Pyroclastic flow, nonwelded, crystallized, with up to 20% pumice clasts. Tuff contains 2 to 3% sanidine, plagioclase, quartz, and less than 1% biotite and hornblende phenocrysts. Up to 8% moderate red to medium dark gray, volcanic lithic clasts. Tuff is predominately grayish-orange pink with possible minor silicification.

410.0 to 420.0 ft POST-TIVA CANYON BEDDED TUFFS (Tpbt5):
Bedded tuff, nonwelded, argillic with 1 to 2% quartz and sanidine phenocrysts. Pumice clasts compose up to 15% pumice clasts and 5% volcanic lithic clasts. Tuff is predominately very pale orange and white.

420.0 to 510.0 ft TIVA CANYON TUFF CRYSTAL RICH NONLITHOPHYSAL ZONE (Tpcrn)
Pyroclastic flow, moderately to densely welded, crystallized, with 8 to 10% sanidine and plagioclase phenocrysts, and less than 1% biotite phenocrysts. From 425 to 436 ft the tuff has up to 10% dark gray pumice clasts. From 436 to 457 ft the tuff is crystal poor with only 3% clasts content. From 457 to 483 ft the tuff has a mix of light brownish-gray and very light gray pumice clasts, composing up 15% of rock.

510.0 to 635.0 ft TIVA CANYON TUFF CRYSTAL POOR UPPER LITHOPHYSAL ZONE (Tpcpul)
Pyroclastic flow, densely welded, crystallized, vapor-phase altered, light gray, with 2 to 3% sanidine and plagioclase, and less than 1% biotite phenocrysts. Tuff has up to 15%, very light gray, pumice clasts. Lithophysae are distinguished by vapor-phase altered chips, indicating the edges of voids in the tuff.

635.0 to 645.2 ft TIVA CANYON TUFF CRYSTAL POOR MIDDLE NONLITHOPHYSAL ZONE (Tpcpmn)
Pyroclastic flow, densely welded, crystallized, pale red, with less than 1% sanidine, plagioclase, and biotite phenocrysts. Tuff has up to 1% pumice clasts and less than 1% volcanic lithic clasts. Vapor-phase altered chips indicate some lithophysae from 560.0 to 570.0 ft.

Figure 1.1-101. Geologic Log of Drill Hole UE-25 RF#19 (Sheet 1 of 7)

NOTE: Hole logged from cuttings. Shear Wave Velocity data from GeoVision suspension logging. Data acquired from downhole survey conducted after PVC casing installed.
RQD = rock quality designation.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#19

SHEET 2 OF 7

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 10/12/2000 FINISHED: 10/23/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,880.41 E 571,383.73
TOTAL DEPTH: 645.2 ft
DEPTH TO BEDROCK: 120.0 ft

STATE: Nevada
GROUND ELEVATION: 3661.81
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

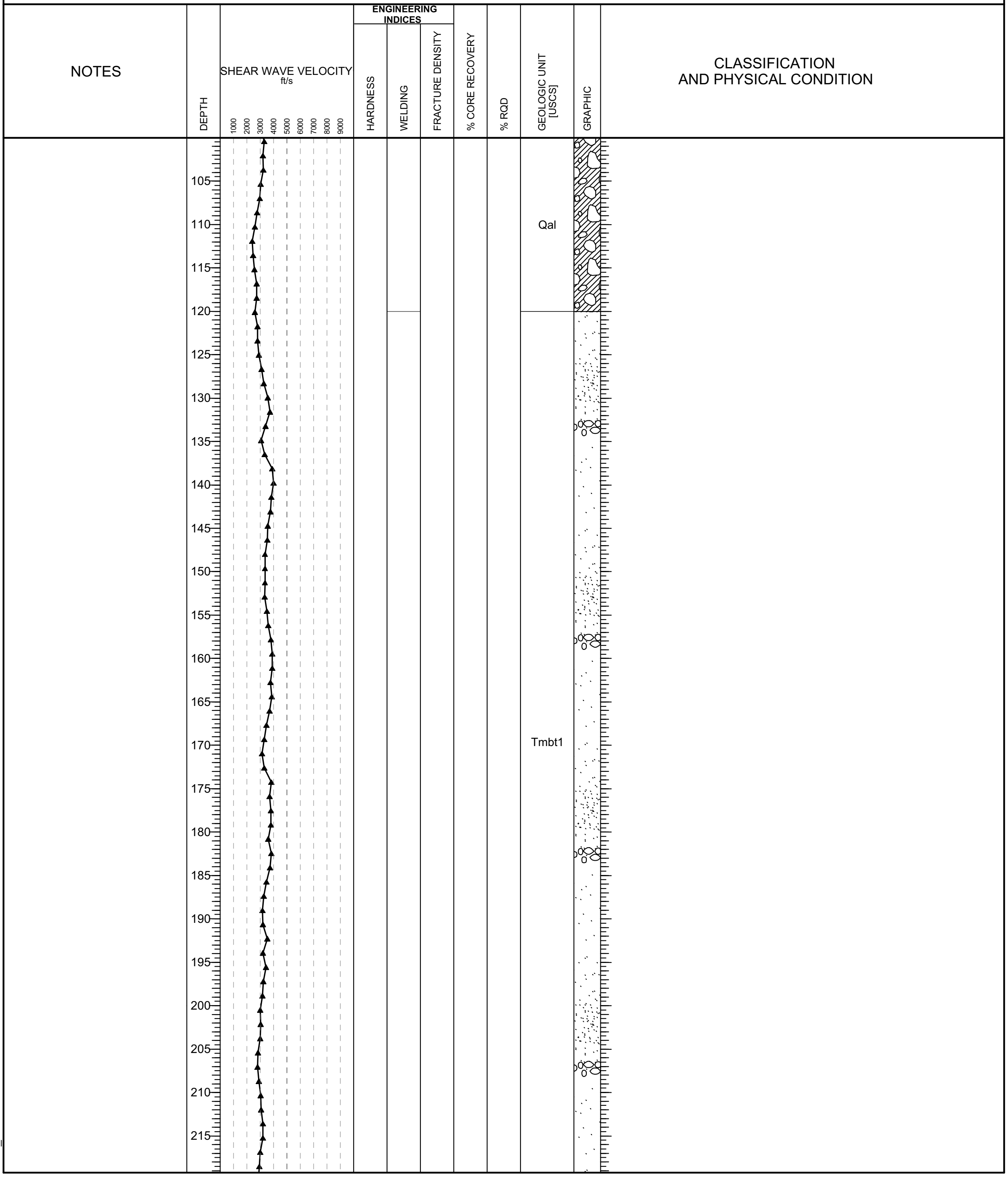


Figure 1.1-101. Geologic Log of Drill Hole UE-25 RF#19 (Sheet 2 of 7)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#19

SHEET 3 OF 7

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 10/12/2000 FINISHED: 10/23/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,880.41 E 571,383.73
TOTAL DEPTH: 645.2 ft
DEPTH TO BEDROCK: 120.0 ft

STATE: Nevada
GROUND ELEVATION: 3661.81
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

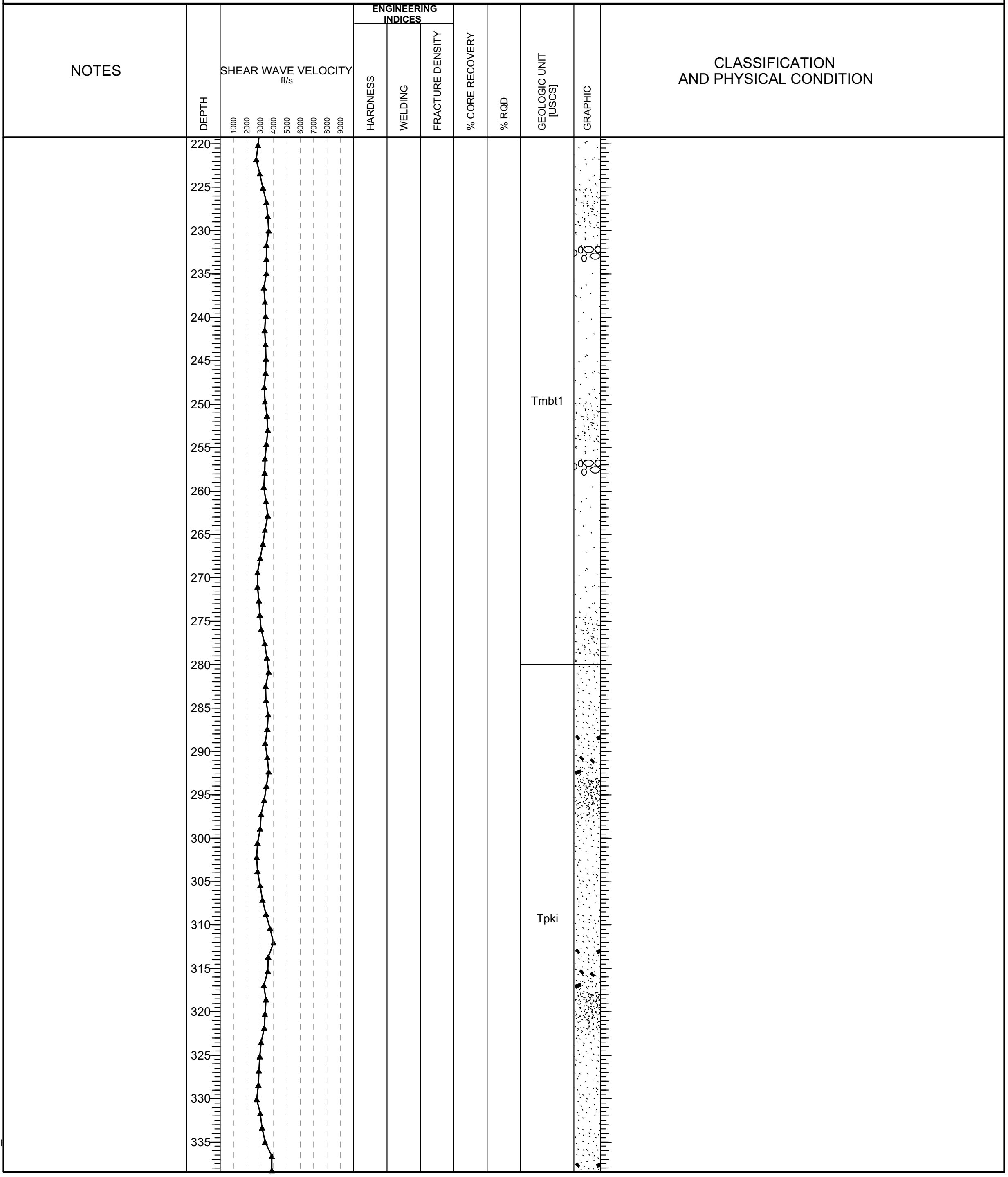


Figure 1.1-101. Geologic Log of Drill Hole UE-25 RF#19 (Sheet 3 of 7)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#19

SHEET 4 OF 7

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 10/12/2000 FINISHED: 10/23/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,880.41 E 571,383.73
TOTAL DEPTH: 645.2 ft
DEPTH TO BEDROCK: 120.0 ft

STATE: Nevada
GROUND ELEVATION: 3661.81
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

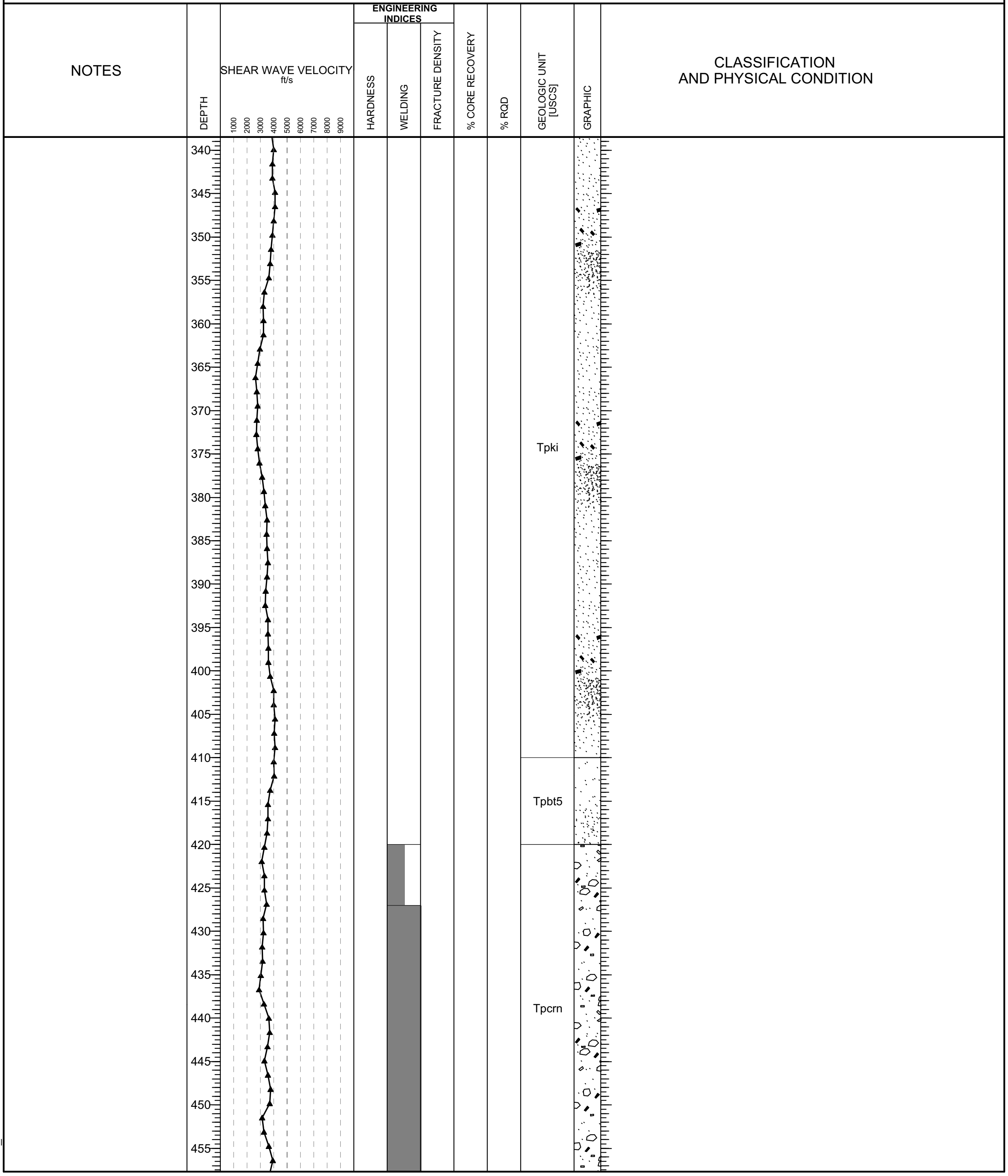


Figure 1.1-101. Geologic Log of Drill Hole UE-25 RF#19 (Sheet 4 of 7)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#19

SHEET 5 OF 7

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 10/12/2000 FINISHED: 10/23/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,880.41 E 571,383.73
TOTAL DEPTH: 645.2 ft
DEPTH TO BEDROCK: 120.0 ft

STATE: Nevada
GROUND ELEVATION: 3661.81
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

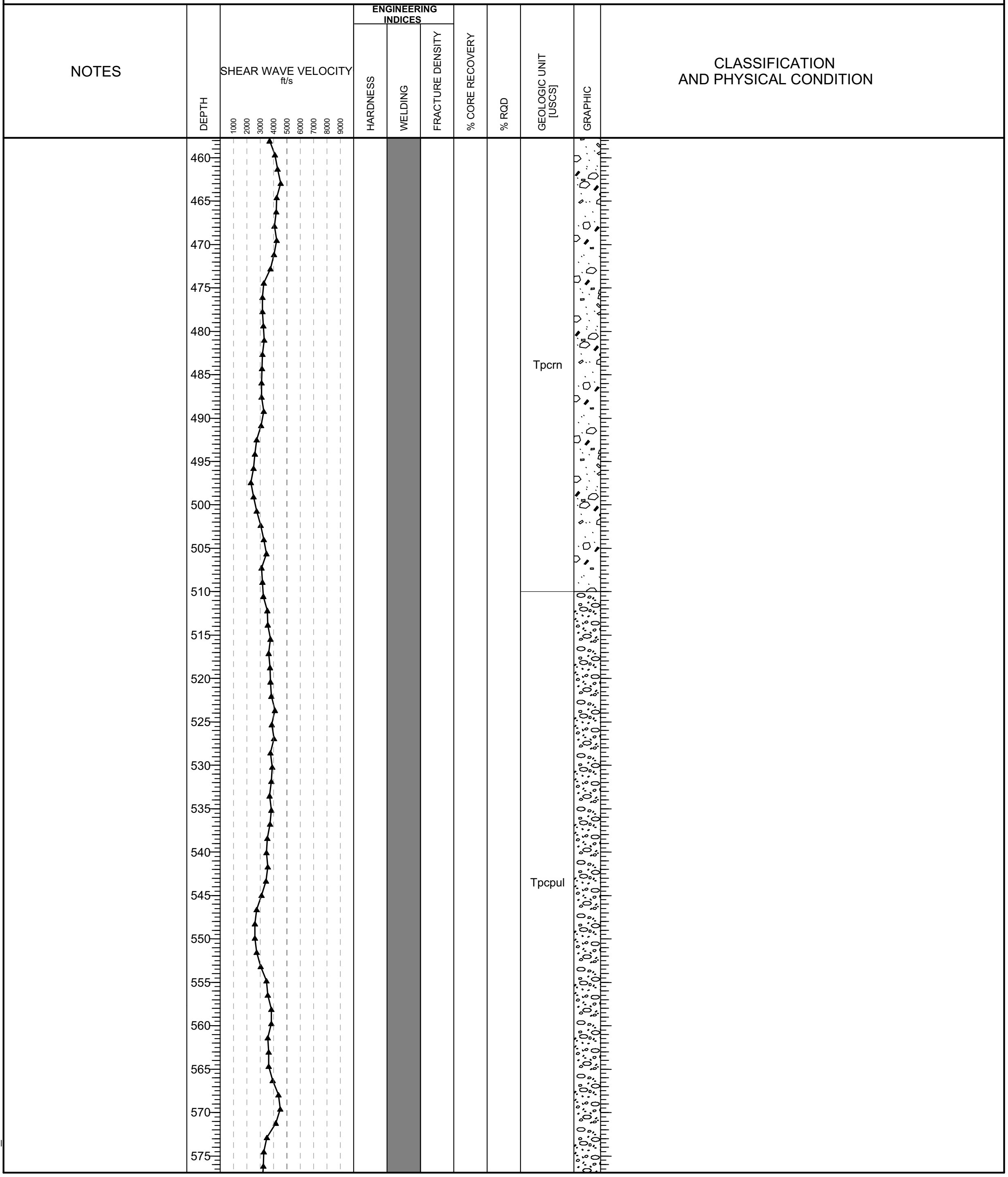


Figure 1.1-101. Geologic Log of Drill Hole UE-25 RF#19 (Sheet 5 of 7)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#19

SHEET 6 OF 7

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 10/12/2000 FINISHED: 10/23/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,880.41 E 571,383.73
TOTAL DEPTH: 645.2 ft
DEPTH TO BEDROCK: 120.0 ft

STATE: Nevada
GROUND ELEVATION: 3661.81
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

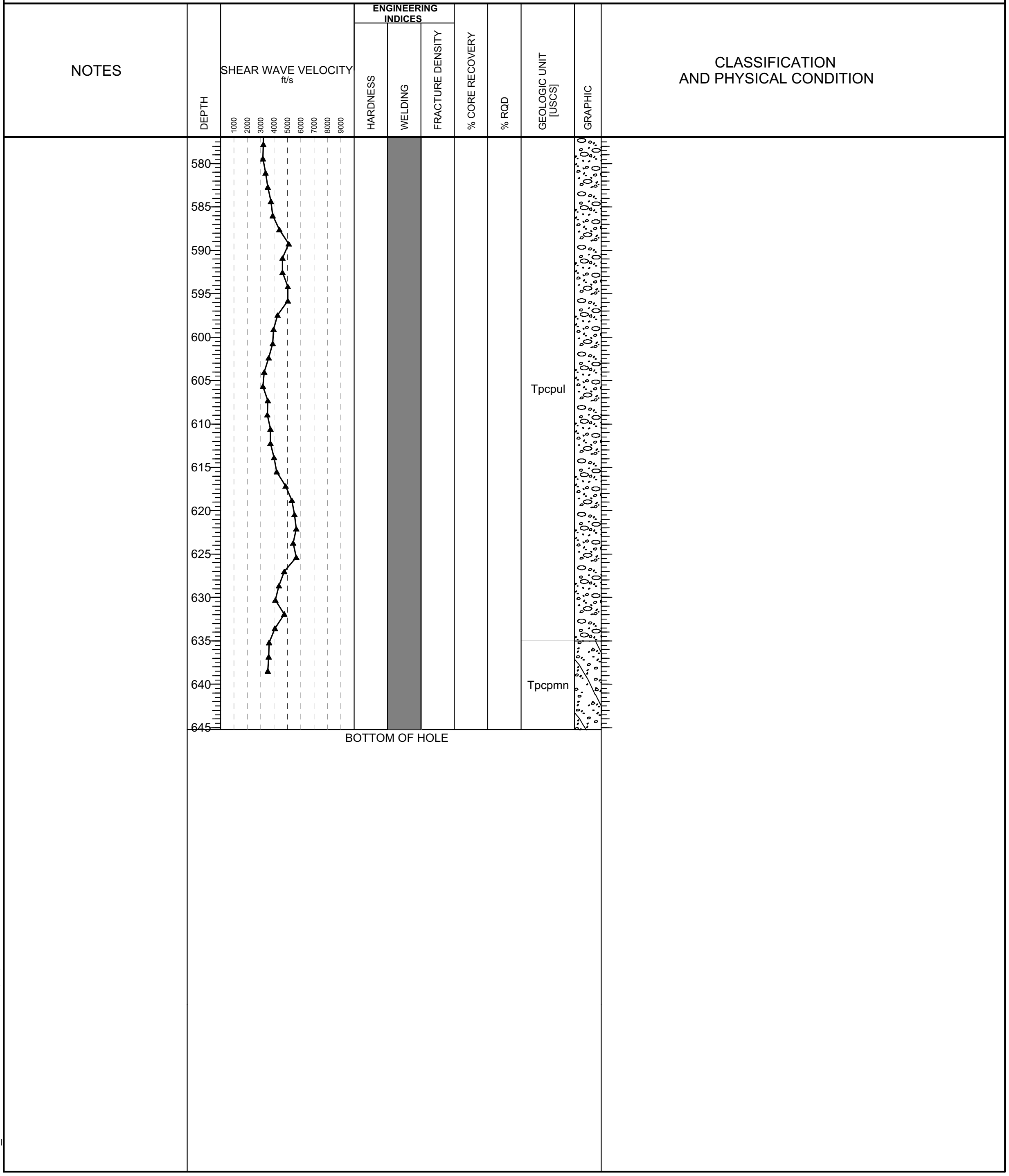


Figure 1.1-101. Geologic Log of Drill Hole UE-25 RF#19 (Sheet 6 of 7)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#19

SHEET 7 OF 7

FEATURE: Waste Handling Facility
PROJECT: Yucca Mountain Project
STATE: Nevada
LOCATION: ESF North Portal Pad
COORDINATES: N 765,880.41 E 571,383.73
GROUND ELEVATION: 3661.81
BEGUN: 10/12/2000 FINISHED: 10/23/2000
TOTAL DEPTH: 645.2 ft
ANGLE FROM HORIZONTAL: -90°
DEPTH TO WATER: Not Encountered
DEPTH TO BEDROCK: 120.0 ft
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

SOIL

Quaternary Alluvium (Qal) ▨

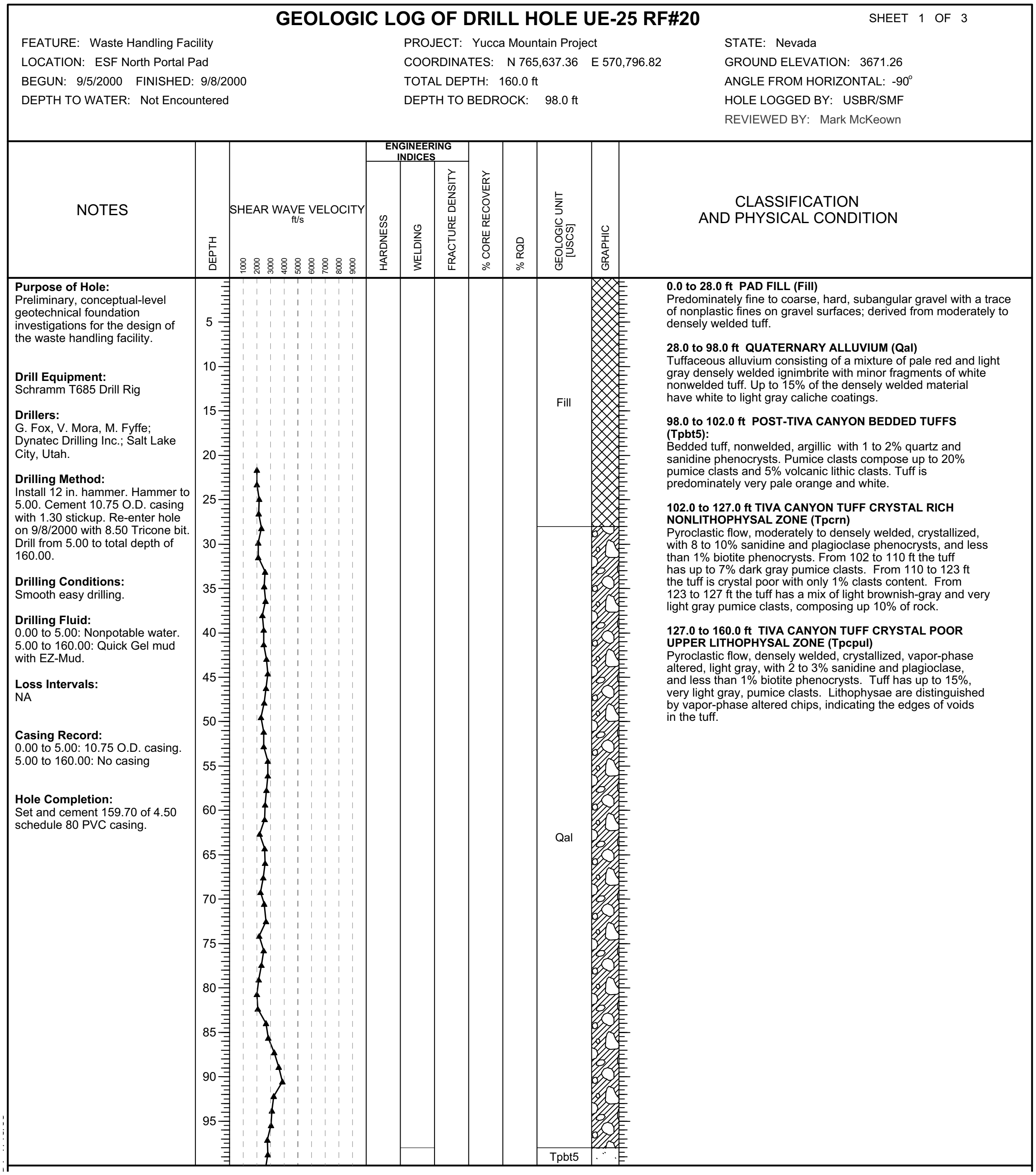
ROCK

Pre-Ranier Mesa Bedded Tuff (Tmbt1) ▒
Tuff "x" (Tpki) ▓
Post-Tiva Canyon Bedded Tuff (Tpbt5) ▒
Tpcprn ░
Tpcpul ░
Tpcpmn ░

WELDING

Nonwelded □
Densely Welded ■
Moderately Welded ◧

Figure 1.1-101. Geologic Log of Drill Hole UE-25 RF#19 (Sheet 7 of 7)



GEOLOGIC LOG OF DRILL HOLE UE-25 RF#20

SHEET 1 OF 3

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 9/5/2000 FINISHED: 9/8/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,637.36 E 570,796.82
TOTAL DEPTH: 160.0 ft
DEPTH TO BEDROCK: 98.0 ft

STATE: Nevada
GROUND ELEVATION: 3671.26
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES

Purpose of Hole:
Preliminary, conceptual-level geotechnical foundation investigations for the design of the waste handling facility.

Drill Equipment:
Schramm T685 Drill Rig

Drillers:
G. Fox, V. Mora, M. Fyffe; Dynatec Drilling Inc.; Salt Lake City, Utah.

Drilling Method:
Install 12 in. hammer. Hammer to 5.00. Cement 10.75 O.D. casing with 1.30 stickup. Re-enter hole on 9/8/2000 with 8.50 Tricone bit. Drill from 5.00 to total depth of 160.00.

Drilling Conditions:
Smooth easy drilling.

Drilling Fluid:
0.00 to 5.00: Nonpotable water.
5.00 to 160.00: Quick Gel mud with EZ-Mud.

Loss Intervals:
NA

Casing Record:
0.00 to 5.00: 10.75 O.D. casing.
5.00 to 160.00: No casing

Hole Completion:
Set and cement 159.70 of 4.50 schedule 80 PVC casing.

CLASSIFICATION AND PHYSICAL CONDITION

0.0 to 28.0 ft PAD FILL (Fill)
Predominately fine to coarse, hard, subangular gravel with a trace of nonplastic fines on gravel surfaces; derived from moderately to densely welded tuff.

28.0 to 98.0 ft QUATERNARY ALLUVIUM (Qal)
Tuffaceous alluvium consisting of a mixture of pale red and light gray densely welded ignimbrite with minor fragments of white nonwelded tuff. Up to 15% of the densely welded material have white to light gray caliche coatings.

98.0 to 102.0 ft POST-TIVA CANYON BEDDED TUFFS (Tpbt5):
Bedded tuff, nonwelded, argillic with 1 to 2% quartz and sanidine phenocrysts. Pumice clasts compose up to 20% pumice clasts and 5% volcanic lithic clasts. Tuff is predominately very pale orange and white.

102.0 to 127.0 ft TIVA CANYON TUFF CRYSTAL RICH NONLITHOPHYSAL ZONE (Tpcrn)
Pyroclastic flow, moderately to densely welded, crystallized, with 8 to 10% sanidine and plagioclase phenocrysts, and less than 1% biotite phenocrysts. From 102 to 110 ft the tuff has up to 7% dark gray pumice clasts. From 110 to 123 ft the tuff is crystal poor with only 1% clasts content. From 123 to 127 ft the tuff has a mix of light brownish-gray and very light gray pumice clasts, composing up 10% of rock.

127.0 to 160.0 ft TIVA CANYON TUFF CRYSTAL POOR UPPER LITHOPHYSAL ZONE (Tpcpul)
Pyroclastic flow, densely welded, crystallized, vapor-phase altered, light gray, with 2 to 3% sanidine and plagioclase, and less than 1% biotite phenocrysts. Tuff has up to 15%, very light gray, pumice clasts. Lithophysae are distinguished by vapor-phase altered chips, indicating the edges of voids in the tuff.

Figure 1.1-102. Geologic Log of Drill Hole UE-25 RF#20 (Sheet 1 of 3)

NOTE: Hole logged from cuttings. Shear Wave Velocity data from GeoVision suspension logging. Data acquired from downhole survey conducted after PVC casing installed.
RQD = rock quality designation.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#20

SHEET 2 OF 3

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 9/5/2000 FINISHED: 9/8/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,637.36 E 570,796.82
TOTAL DEPTH: 160.0 ft
DEPTH TO BEDROCK: 98.0 ft

STATE: Nevada
GROUND ELEVATION: 3671.26
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

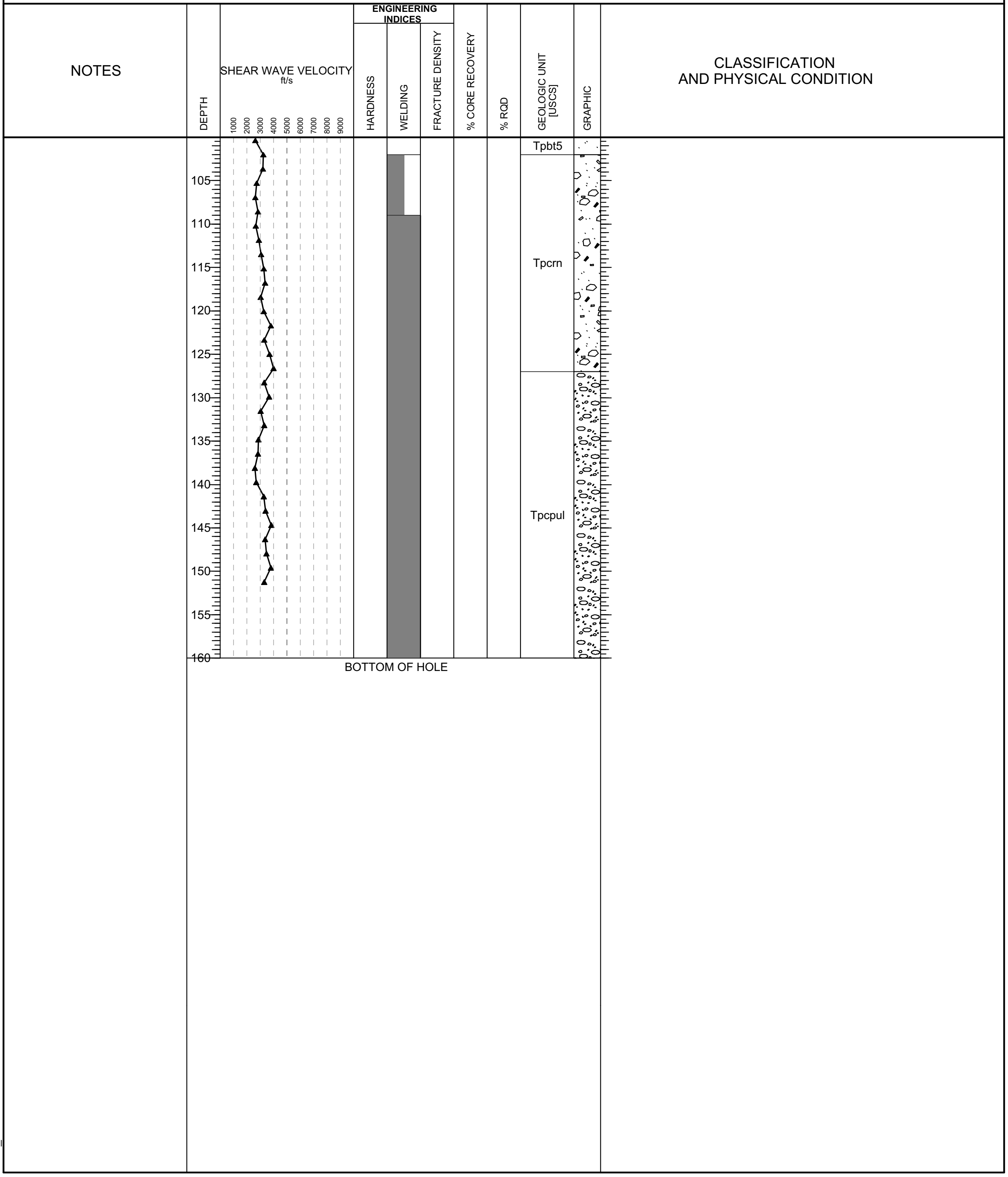


Figure 1.1-102. Geologic Log of Drill Hole UE-25 RF#20 (Sheet 2 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#20

SHEET 3 OF 3

FEATURE: Waste Handling Facility
PROJECT: Yucca Mountain Project
STATE: Nevada
LOCATION: ESF North Portal Pad
COORDINATES: N 765,637.36 E 570,796.82
GROUND ELEVATION: 3671.26
BEGUN: 9/5/2000 FINISHED: 9/8/2000
TOTAL DEPTH: 160.0 ft
ANGLE FROM HORIZONTAL: -90°
DEPTH TO WATER: Not Encountered
DEPTH TO BEDROCK: 98.0 ft
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

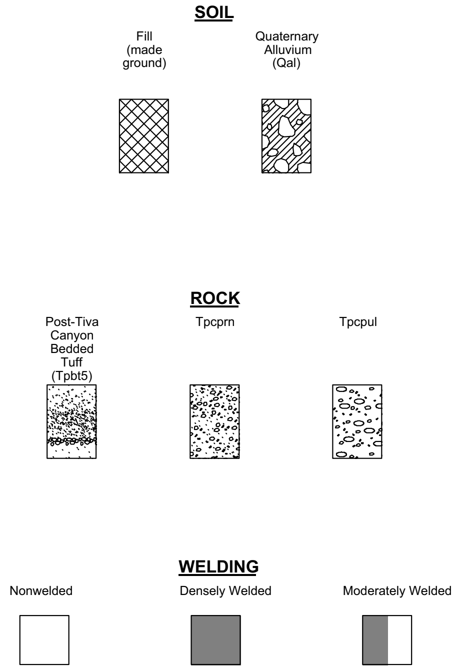


Figure 1.1-102. Geologic Log of Drill Hole UE-25 RF#20 (Sheet 3 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#21

SHEET 1 OF 3

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 9/6/2000 FINISHED: 9/7/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,898.81 E 570,739.18
TOTAL DEPTH: 192.2 ft
DEPTH TO BEDROCK: 115.0 ft

STATE: Nevada
GROUND ELEVATION: 3673.02
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES

Purpose of Hole:
Preliminary, conceptual-level geotechnical foundation investigations for the design of the waste handling facility.

Drill Equipment:
Schramm T685 Drill Rig

Drillers:
G. Fox, V. Mora, M. Fyffe; Dynatec Drilling Inc.; Salt Lake City, Utah.

Drilling Method:
Install 12 in. hammer. Hammer to 5.01. Cement 10.75 O.D. casing with 1.00 stickup. Re-enter hole on 9/6/2000 with 8.50 Tricone bit. Drill from 5.01 to total depth of 192.23.

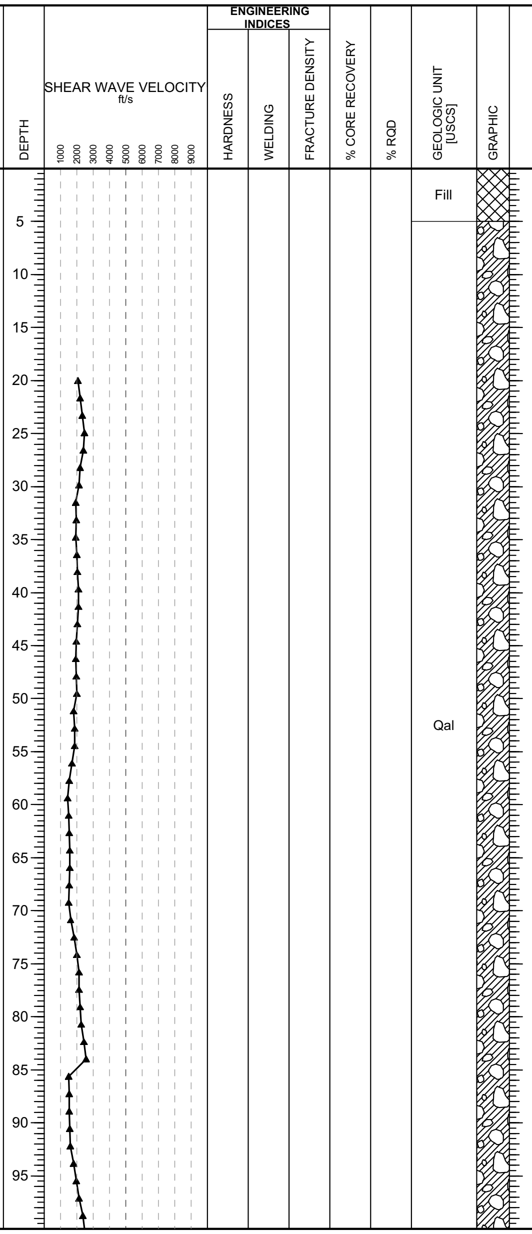
Drilling Conditions:
Lost circulation at 125.00 and 190.00

Drilling Fluid:
0.00 to 5.01: Nonpotable water. 5.01 to 125.00: Quick Gel mud with EZ-Mud. 125.00 to 192.23: Quick Gel with EZ-Mud and LCM to re-establish circulation.

Loss Intervals:
125.00 and 190.00

Casing Record:
0.00 to 5.01: 10.75 O.D. casing. 5.01 to 192.23: No casing

Hole Completion:
Set and cement 192.04 of 4.50 schedule 80 PVC casing.



CLASSIFICATION AND PHYSICAL CONDITION

0.0 to 5.0 ft PAD FILL (Fill)
Predominately fine to coarse, hard, subangular gravel with a trace of nonplastic fines on gravel surfaces; derived from moderately to densely welded tuff.

5.0 to 115.0 ft QUATERNARY ALLUVIUM (Qal)
Tuffaceous alluvium consisting of a mixture of pale red and light gray densely welded ignimbrite with minor fragments of white nonwelded tuff. Up to 15% of the densely welded material has white to light gray caliche coatings.

115.0 to 165.0 ft TIVA CANYON TUFF CRYSTAL RICH NONLITHOPHYSAL ZONE (Tpcrn)
Pyroclastic flow, moderately to densely welded, crystallized, with 8 to 10% sanidine and plagioclase phenocrysts, and less than 1% biotite phenocrysts. From 102 to 110 ft the tuff has up to 7% dark gray pumice clasts. From 110 to 123 ft the tuff is crystal poor with only 1% clast content. From 123 to 127 ft the tuff has a mix of light brownish-gray and very light gray pumice clasts, composing up 10% of rock.

165.0 to 192.2 ft TIVA CANYON TUFF CRYSTAL POOR UPPER LITHOPHYSAL ZONE (Tpcpul)
Pyroclastic flow, densely welded, crystallized, vapor-phase altered, light gray, with 2 to 3% sanidine and plagioclase, and less than 1% biotite phenocrysts. Tuff has up to 15%, very light gray, pumice clasts. Lithophysae are distinguished by vapor-phase altered chips, indicating the edges of voids in the tuff.

Figure 1.1-103. Geologic Log of Drill Hole UE-25 RF#21 (Sheet 1 of 3)

NOTE: Hole logged from cuttings. LCM (Lost Circulation Material) consists of cellophane cuttings or cotton seed hulls. Shear Wave Velocity data from GeoVision suspension logging. Data acquired from downhole survey conducted after PVC casing installed.
RQD = rock quality designation.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#21

SHEET 2 OF 3

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 9/6/2000 FINISHED: 9/7/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,898.81 E 570,739.18
TOTAL DEPTH: 192.2 ft
DEPTH TO BEDROCK: 115.0 ft

STATE: Nevada
GROUND ELEVATION: 3673.02
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

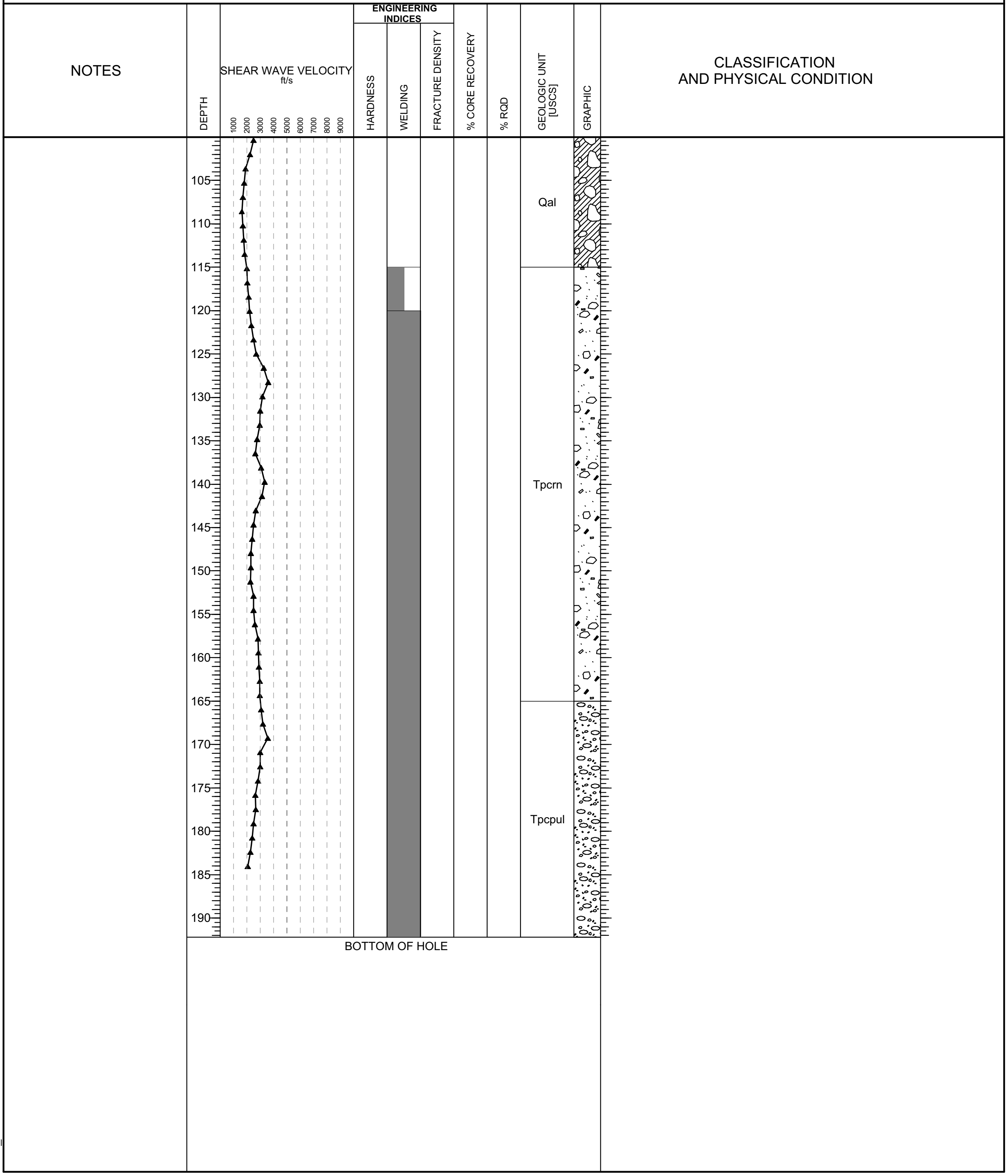


Figure 1.1-103. Geologic Log of Drill Hole UE-25 RF#21 (Sheet 2 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#21

SHEET 3 OF 3

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 9/6/2000 FINISHED: 9/7/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,898.81 E 570,739.18
TOTAL DEPTH: 192.2 ft
DEPTH TO BEDROCK: 115.0 ft

STATE: Nevada
GROUND ELEVATION: 3673.02
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

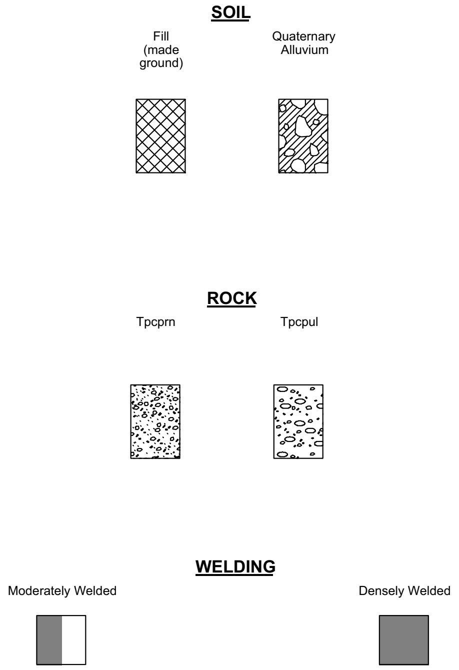


Figure 1.1-103. Geologic Log of Drill Hole UE-25 RF#21 (Sheet 3 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#22

SHEET 1 OF 6

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 7/25/2000 FINISHED: 8/15/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,206.2 E 570,793.48
TOTAL DEPTH: 540.6 ft
DEPTH TO BEDROCK: 80.0 ft

STATE: Nevada
GROUND ELEVATION: 3679.17
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES | DEPTH | SHEAR WAVE VELOCITY ft/s (1000 2000 3000 4000 5000 6000 7000 8000 9000) | ENGINEERING INDICES: HARDNESS | WELDING | FRACTURE DENSITY | % CORE RECOVERY | % RQD | GEOLOGIC UNIT [USCS] | GRAPHIC | CLASSIFICATION AND PHYSICAL CONDITION

Purpose of Hole:
Develop geologic design data required to develop waste handling facility foundation parameters and seismic hazard analysis.

Drill Equipment:
Schramm T685 Drill Rig, UDR 1000 Drill Rig.

Drillers:
George Fox, D Harrison, R Mckay; Dynatec Drilling Inc.; Salt Lake City, Utah.

Drilling Method:
Install 12 in. hammer. Hammer to 5.00. Cement 10.75 O.D. casing with 1.02 stickup. Drill to depth of 511.47 with 8.50 Tricone bit. Install PQ rods to serve as temporary casing. Install HQ core system. Core with HQ to total depth of 540.56.

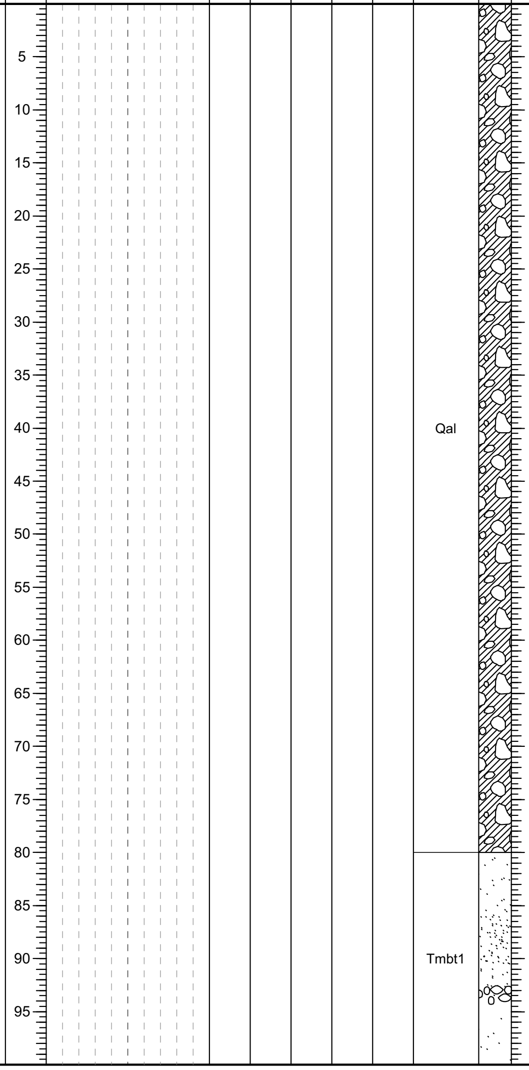
Drilling Conditions:

Drilling Fluid:
0.00 to 5.00: Nonpotable water.
5.00 to 540.56: Nonpotable water, Quick Gel Mud with EZ-Mud and LCM to re-establish circulation.

Loss Intervals:
443.00 to 490.00: circulation was re-established in some intervals.

Casing Record:
0.00 to 5.00: 10.75 O.D. casing.
5.00 to 511.47: No casing
511.47 to 540.56: PQ casing (?)

Hole Completion:
PVC casing set and cemented to total depth of 511.38.



0.0 to 80.0 ft QUATERNARY ALLUVIUM (Qal)
Tuffaceous alluvium consisting of a mixture of pale red and light gray densely welded ignimbrite with minor fragments of white nonwelded tuff. Up to 15% of the densely welded material have white to light gray caliche coatings.

80.0 to 318.0 ft BEDDED TUFF (Tmbt1)
Pre-Rainier Mesa Bedded Tuff composed of bedded and reworked tuff. Bedded tuff is nonwelded, argillic, with up to 10% quartz, plagioclase, and sanidine phenocrysts. Bedded tuff contains up to 15% argillically altered pumice clasts. Some beds have up to 4% volcanic lithic clasts. Tuff is predominately grayish-orange pink and drill cuttings returns are sand to silt sized.

318.0 to 415.0 ft COMB PEAK IGNIMBRITE - TUFF X (Tpki):
Pyroclastic flow, nonwelded, crystallized, with up to 15% pumice clasts. Tuff contains 2 to 3% sanidine, plagioclase, quartz, and less than 1% biotite and hornblende phenocrysts. Up to 3% moderate red to medium dark gray, volcanic lithic clasts. Tuff is predominately grayish-orange pink with possible minor silicification.

415.0 to 438.0 ft POST-TIVA CANYON BEDDED TUFFS (Tpbt5):
Bedded tuff, nonwelded, argillic with 1 to 2% quartz and sanidine phenocrysts. Pumice clasts compose up to 15% pumice clasts and 5% volcanic lithic clasts. Tuff is predominately very pale orange and white.

438.0 to 530.5 ft TIVA CANYON TUFF CRYSTAL RICH NONLITHOPHYSAL ZONE (Tpcrn)
From 438.0 to 511.5 ft borehole was mud-rotary drilled, the following is a description of drill chips. Pyroclastic flow, moderately to densely welded, crystallized, with 8 to 10% sanidine and plagioclase phenocrysts, and less than 1% biotite phenocrysts. From 455 to 485 ft the tuff has a mix of light brownish-gray and very light gray pumice clasts, composing up 10% of rock. No recovery from 485 to 505.4 ft. Borehole cored from 511.5 to 540.56 ft, the following is a description of drill core. Pyroclastic flow, densely welded, crystallized with vapor phase alteration. Tuff has 10 to 15%, brownish-gray pumice clasts up to 20 by 5 mm in size. Up to 10% sanidine and plagioclase phenocrysts with less than 1% biotite phenocrysts. Generally the rock is soft to mostly moderately hard (H4), moderately to slightly weathered (W4), slightly (FD4) to moderately fractured (FD5).

Discontinuity Measurements:

Depth	Angle*	Roughness	Infilling
511.7	90	R3	
512.0	90	R3	
512.1	90	R3	
512.15	90	R2	
512.4 - 513.0	Fracture Zone		Vapor Phase
513.1	20	R2	
514.1	90	R3	
514.15	50	R3	
516.35	90	R3	
518.3	90	R3	
518.4	90	R3	
519.9	60	R3	
521.5	60	R3	
522.4 - 522.6	90	R2	
522.8	73	R4	
525.0	90	R3	
525.5	47	R4	
526.4 - 527.1	90	R3	Fracture Zone
528.0	40	R3	

Figure 1.1-104. Geologic Log of Drill Hole UE-25 RF#22 (Sheet 1 of 6)

NOTE: Hole logged from cuttings to 511.47 ft and core from 511.47 to 540.56 ft. Shear Wave Velocity data from GeoVision suspension logging. Data acquired from downhole survey conducted after PVC casing installed. No usable velocity data acquired above 229 ft.
RQD = rock quality designation; SPT = standard penetration test.

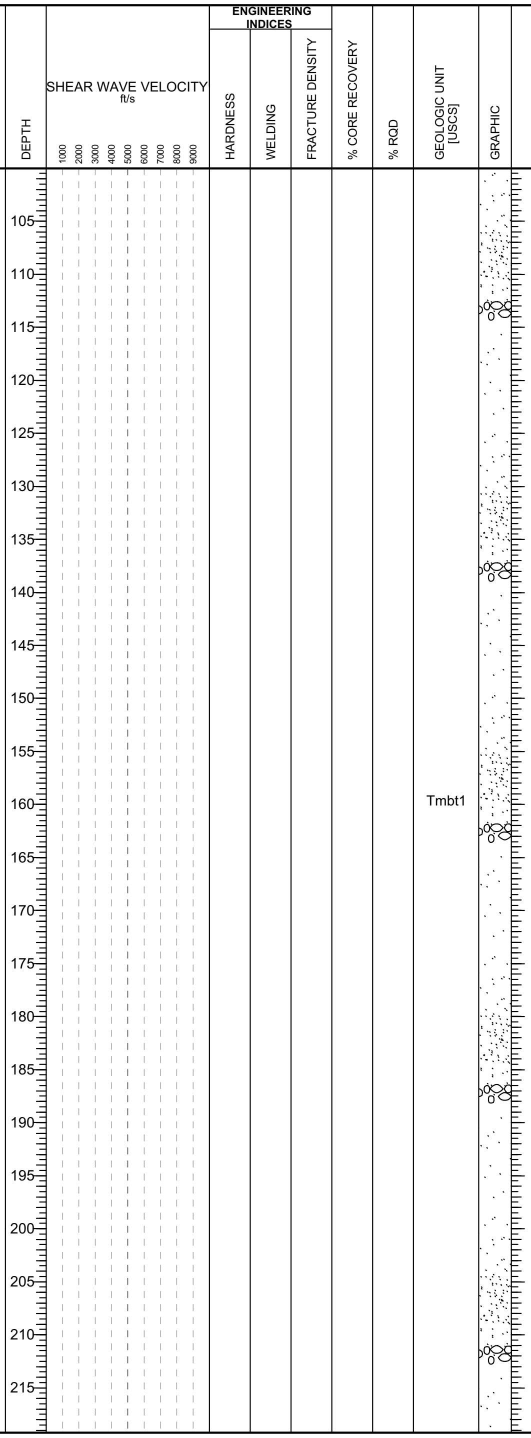
GEOLOGIC LOG OF DRILL HOLE UE-25 RF#22

SHEET 2 OF 6

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 7/25/2000 FINISHED: 8/15/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,206.2 E 570,793.48
TOTAL DEPTH: 540.6 ft
DEPTH TO BEDROCK: 80.0 ft

STATE: Nevada
GROUND ELEVATION: 3679.17
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown



CLASSIFICATION AND PHYSICAL CONDITION

530.0	90	R3

530.5 to 540.6 ft TIVA CANYON TUFF CRYSTAL POOR UPPER LITHOPHYSAL ZONE (Tpcpul)
Pyroclastic flow, densely welded, crystallized, medium gray with less than 5% pumice clasts up to 35 by 5 mm. No lithophysae are present in this core run, however contact is distinguished by the decrease in phenocrysts to, 2 to 3% sanidine and plagioclase with less than 1% biotite. Tuff has less than 1% dark-yellowish brown and light gray volcanic lithic fragments. Generally the rock is moderately hard (H4), moderately (W4) weathered, and moderately fractured (FD5).

Discontinuity Measurements:

Depth	Angle*	Roughness	Infilling
530.9	30	R4	
531.7	55	R4	
532.6	15	R3	
533.1	70	R4	vapor phase
534.4	75	R4	vapor phase
535.0	50	R4	
535.4	90	R4	vapor phase
535.6	85	R4	vapor phase and calcite
536.2	60	R3	
537.0	60	R2	rubble
537.5	52	R4	
537.7	48	R3	vapor phase
538.5	60	R3	vapor phase
538.9 - 540.6	breccia zone		

* Angles are measured from core axis and are plus or minus 5 degrees.

Figure 1.1-104. Geologic Log of Drill Hole UE-25 RF#22 (Sheet 2 of 6)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#22

SHEET 3 OF 6

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 7/25/2000 FINISHED: 8/15/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,206.2 E 570,793.48
TOTAL DEPTH: 540.6 ft
DEPTH TO BEDROCK: 80.0 ft

STATE: Nevada
GROUND ELEVATION: 3679.17
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

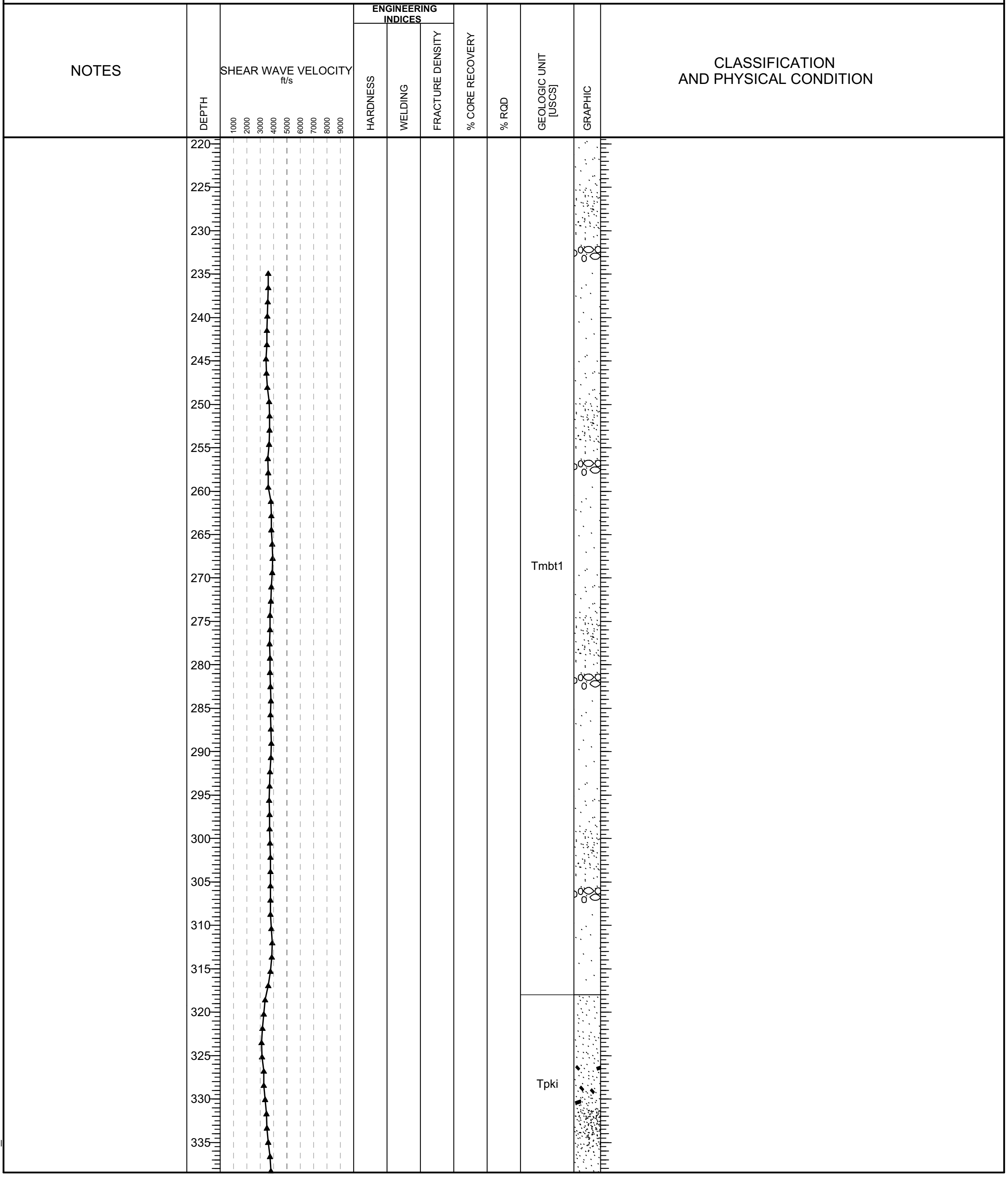


Figure 1.1-104. Geologic Log of Drill Hole UE-25 RF#22 (Sheet 3 of 6)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#22

SHEET 4 OF 6

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 7/25/2000 FINISHED: 8/15/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,206.2 E 570,793.48
TOTAL DEPTH: 540.6 ft
DEPTH TO BEDROCK: 80.0 ft

STATE: Nevada
GROUND ELEVATION: 3679.17
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

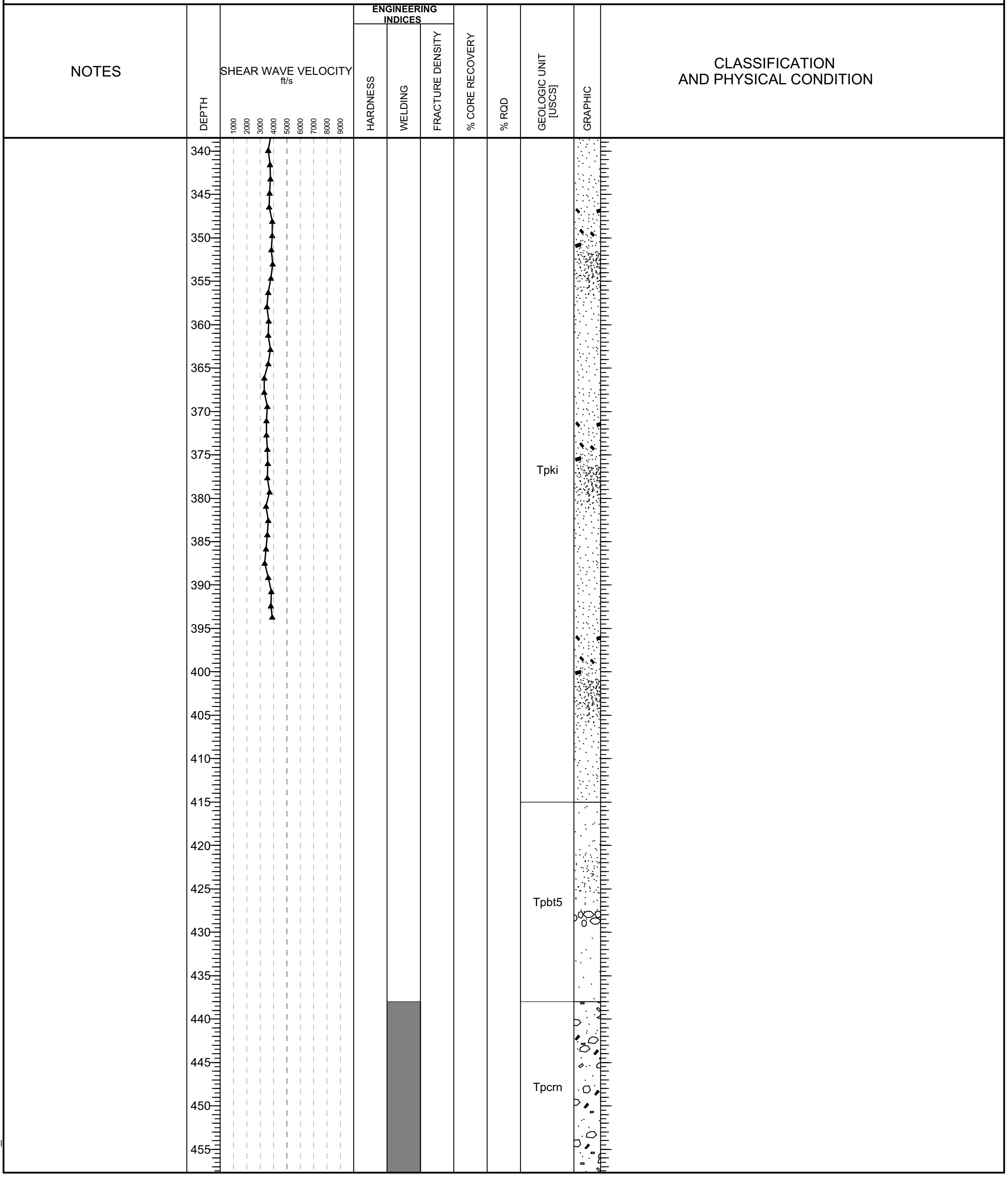


Figure 1.1-104. Geologic Log of Drill Hole UE-25 RF#22 (Sheet 4 of 6)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#22

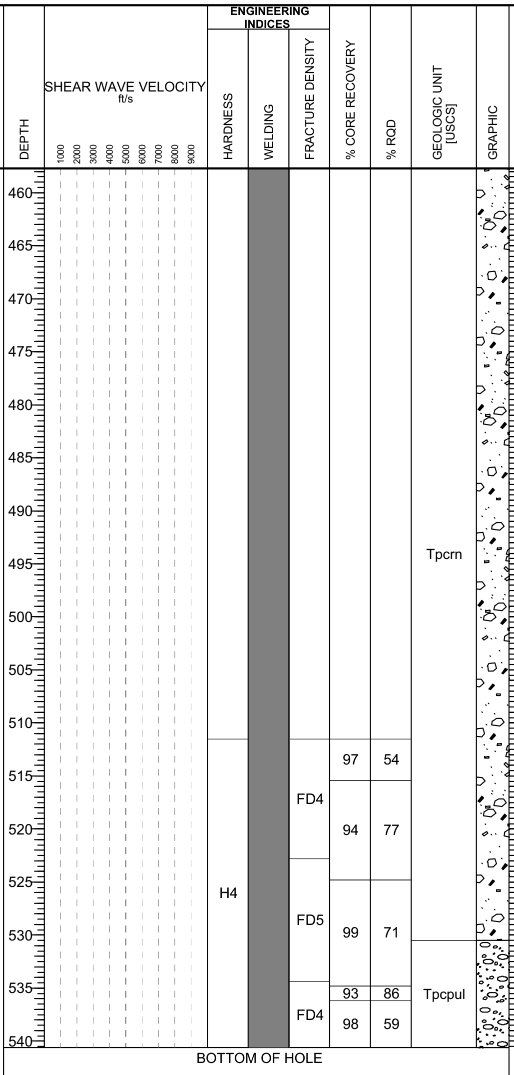
SHEET 5 OF 6

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 7/25/2000 FINISHED: 8/15/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,206.2 E 570,793.48
TOTAL DEPTH: 540.6 ft
DEPTH TO BEDROCK: 80.0 ft

STATE: Nevada
GROUND ELEVATION: 3679.17
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES



CLASSIFICATION AND PHYSICAL CONDITION

Begin core drilling at 511.5

Figure 1.1-104. Geologic Log of Drill Hole UE-25 RF#22 (Sheet 5 of 6)

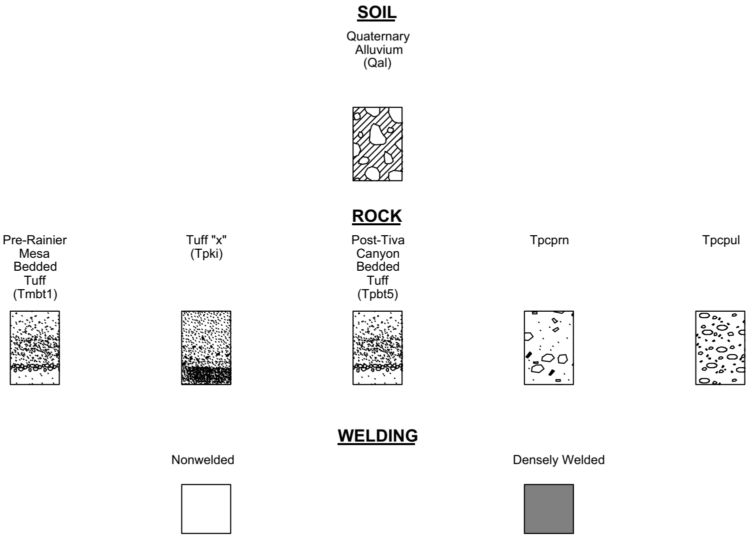
GEOLOGIC LOG OF DRILL HOLE UE-25 RF#22

SHEET 6 OF 6

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 7/25/2000 FINISHED: 8/15/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,206.2 E 570,793.48
TOTAL DEPTH: 540.6 ft
DEPTH TO BEDROCK: 80.0 ft

STATE: Nevada
GROUND ELEVATION: 3679.17
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown



HARDNESS

Alphanumeric descriptor	Descriptor	Criteria
H1	Extremely	Core, fragment, or exposure cannot be scratched with knife or sharp pick; can only be chipped with repeated heavy hammer blows.
H2	Very Hard	Cannot be scratched with knife or sharp pick. Core or fragment breaks with repeated heavy hammer blows.
H3	Hard	Can be scratched with knife or sharp pick with difficulty (heavy pressure). Heavy hammer blow required to break specimen.
H4	Moderately Hard	Can be scratched with knife or sharp pick with light pressure. Core or fragment breaks with moderate hammer blow.
H5	Moderately Soft	Can be grooved 1/16 in. (2mm) deep by sharp pick with moderate or heavy pressure. Core or fragment breaks with light hammer blow or heavy manual pressure.
H6	Soft	Can be grooved or gouged easily by knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
H7	Very Soft	Can be readily indented, grooved or gouged with fingernail, or carved with a knife. Breaks with light manual pressure.

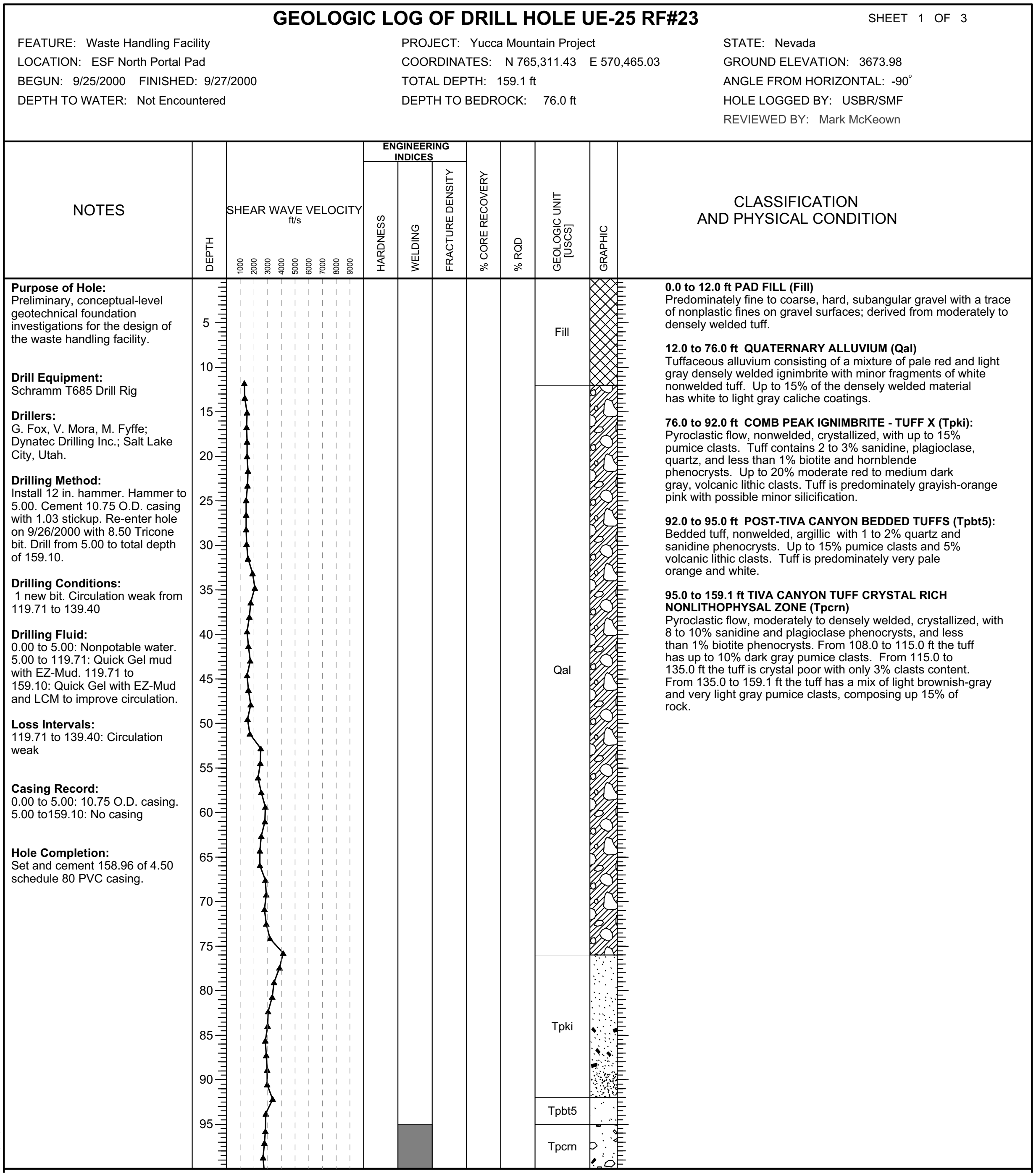
WEATHERING

Alphanumeric descriptor	Descriptor	General characteristics (strength, excavation, etc.)
W1	Fresh	Hammer rings when crystalline rocks are struck. Almost always rock excavation except for naturally weak or weakly cemented rocks such as siltstones or shales.
W2	Slightly weathered to fresh	
W3	Slightly weathered	Hammer rings when crystalline rocks are struck. Body of rock not weakened. With few exceptions, such as siltstones or shales, classified as rock excavation.
W4	Moderately to slightly weathered	
W5	Moderately weathered	Hammer does not ring when rock is struck. Body of rock is slightly weakened. Depending on fracturing, usually is rock excavation except in naturally weak rocks such as siltstones or shales.
W6	Intensely to moderately weathered	
W7	Intensely weathered	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened. Usually common excavation.
W8	Very intensely weathered	
W9	Decomposed	Can be granulated by hand. Always common excavation. Resistant minerals such as quartz may be present as "stringers" or "dikes."

FRACTURE DENSITY

Alphanumeric descriptor	Descriptor	Criteria (Excludes mechanical breaks)
FD0	Unfractured	No observed fractures.
FD1	Very slightly fractured	Core recovered mostly in lengths greater than 3 ft (1 m).
FD2	Slightly to very slightly fractured	
FD3	Slightly fractured	Core recovered mostly in lengths from 1 to 3 feet (300 to 1,000 mm) with few scattered lengths less than 1 ft (300 mm) or greater than 3 ft (1,000 mm).
FD4	Moderately to slightly fractured	
FD5	Moderately fractured	Core recovered mostly in lengths from 0.33 to 1.0 ft (100 to 300 mm) with most lengths about 0.67 ft (200 mm).
FD6	Moderately to intensely fractured	
FD7	Intensely fractured	Lengths average from 0.1 to 0.33 ft (30 to 100 mm) with fragmented intervals. Core recovered mostly in lengths less than 0.33 ft (100 mm).
FD8	Very intensely to intensely fractured	
FD9	Very intensely fractured	Core recovered mostly as chips and fragments with a few scattered short core lengths.

Figure 1.1-104. Geologic Log of Drill Hole UE-25 RF#22 (Sheet 6 of 6)



GEOLOGIC LOG OF DRILL HOLE UE-25 RF#23

SHEET 1 OF 3

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 9/25/2000 FINISHED: 9/27/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,311.43 E 570,465.03
TOTAL DEPTH: 159.1 ft
DEPTH TO BEDROCK: 76.0 ft

STATE: Nevada
GROUND ELEVATION: 3673.98
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES

Purpose of Hole:
Preliminary, conceptual-level geotechnical foundation investigations for the design of the waste handling facility.

Drill Equipment:
Schramm T685 Drill Rig

Drillers:
G. Fox, V. Mora, M. Fyffe; Dynatec Drilling Inc.; Salt Lake City, Utah.

Drilling Method:
Install 12 in. hammer. Hammer to 5.00. Cement 10.75 O.D. casing with 1.03 stickup. Re-enter hole on 9/26/2000 with 8.50 Tricone bit. Drill from 5.00 to total depth of 159.10.

Drilling Conditions:
1 new bit. Circulation weak from 119.71 to 139.40

Drilling Fluid:
0.00 to 5.00: Nonpotable water. 5.00 to 119.71: Quick Gel mud with EZ-Mud. 119.71 to 159.10: Quick Gel with EZ-Mud and LCM to improve circulation.

Loss Intervals:
119.71 to 139.40: Circulation weak

Casing Record:
0.00 to 5.00: 10.75 O.D. casing.
5.00 to159.10: No casing

Hole Completion:
Set and cement 158.96 of 4.50 schedule 80 PVC casing.

CLASSIFICATION AND PHYSICAL CONDITION

0.0 to 12.0 ft PAD FILL (Fill)
Predominately fine to coarse, hard, subangular gravel with a trace of nonplastic fines on gravel surfaces; derived from moderately to densely welded tuff.

12.0 to 76.0 ft QUATERNARY ALLUVIUM (Qal)
Tuffaceous alluvium consisting of a mixture of pale red and light gray densely welded ignimbrite with minor fragments of white nonwelded tuff. Up to 15% of the densely welded material has white to light gray caliche coatings.

76.0 to 92.0 ft COMB PEAK IGNIMBRITE - TUFF X (Tpki):
Pyroclastic flow, nonwelded, crystallized, with up to 15% pumice clasts. Tuff contains 2 to 3% sanidine, plagioclase, quartz, and less than 1% biotite and hornblende phenocrysts. Up to 20% moderate red to medium dark gray, volcanic lithic clasts. Tuff is predominately grayish-orange pink with possible minor silicification.

92.0 to 95.0 ft POST-TIVA CANYON BEDDED TUFFS (Tpbt5):
Bedded tuff, nonwelded, argillic with 1 to 2% quartz and sanidine phenocrysts. Up to 15% pumice clasts and 5% volcanic lithic clasts. Tuff is predominately very pale orange and white.

95.0 to 159.1 ft TIVA CANYON TUFF CRYSTAL RICH NONLITHOPHYSAL ZONE (Tpcrn)
Pyroclastic flow, moderately to densely welded, crystallized, with 8 to 10% sanidine and plagioclase phenocrysts, and less than 1% biotite phenocrysts. From 108.0 to 115.0 ft the tuff has up to 10% dark gray pumice clasts. From 115.0 to 135.0 ft the tuff is crystal poor with only 3% clasts content. From 135.0 to 159.1 ft the tuff has a mix of light brownish-gray and very light gray pumice clasts, composing up 15% of rock.

Figure 1.1-105. Geologic Log of Drill Hole UE-25 RF#23 (Sheet 1 of 3)

NOTE: Hole logged from cuttings. Shear Wave Velocity data from GeoVision suspension logging. Data acquired from downhole survey conducted after PVC casing installed.
RQD = rock quality designation.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#23

SHEET 2 OF 3

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 9/25/2000 FINISHED: 9/27/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,311.43 E 570,465.03
TOTAL DEPTH: 159.1 ft
DEPTH TO BEDROCK: 76.0 ft

STATE: Nevada
GROUND ELEVATION: 3673.98
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

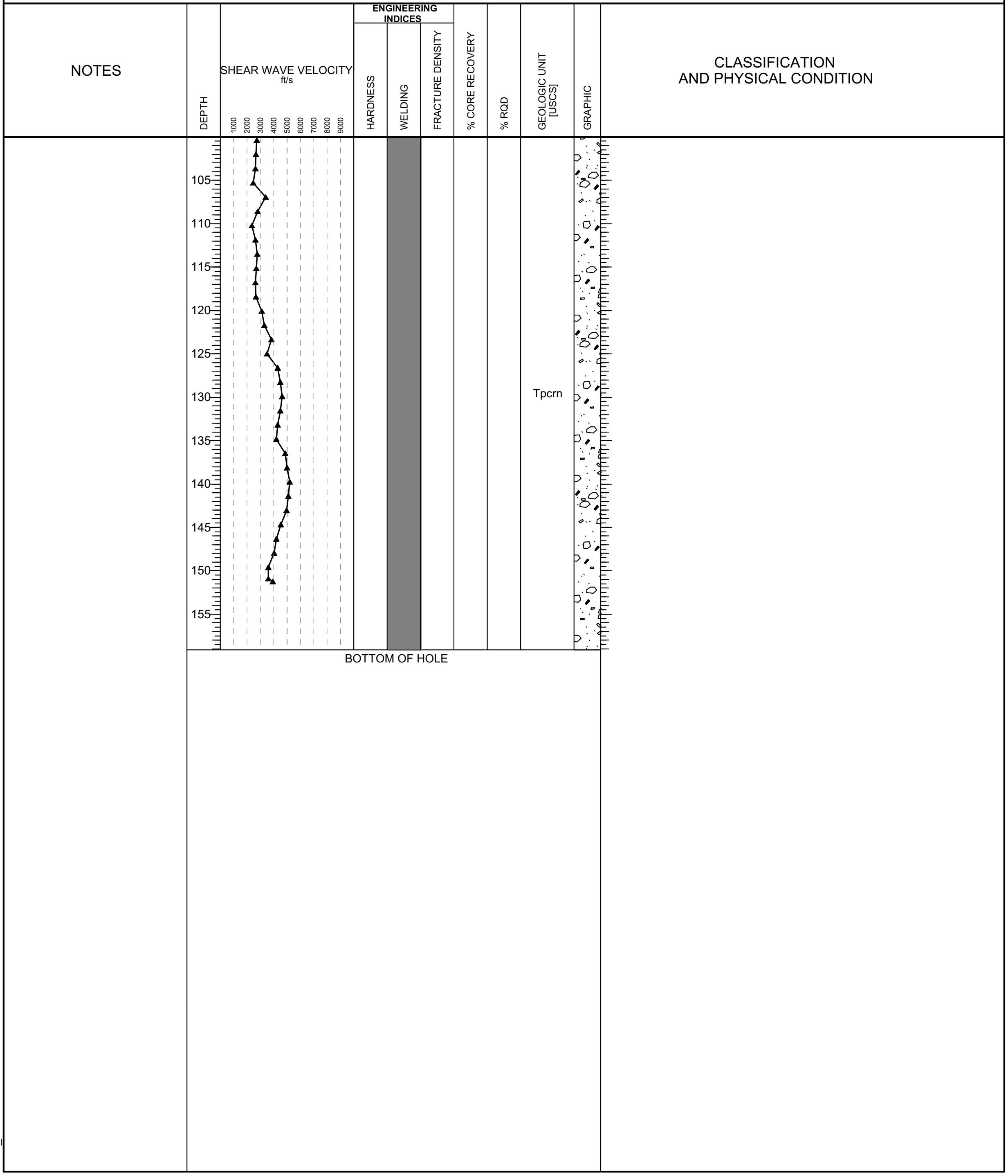


Figure 1.1-105. Geologic Log of Drill Hole UE-25 RF#23 (Sheet 2 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#23

SHEET 3 OF 3

FEATURE: Waste Handling Facility
PROJECT: Yucca Mountain Project
STATE: Nevada
LOCATION: ESF North Portal Pad
COORDINATES: N 765,311.43 E 570,465.03
GROUND ELEVATION: 3673.98
BEGUN: 9/25/2000 FINISHED: 9/27/2000
TOTAL DEPTH: 159.1 ft
ANGLE FROM HORIZONTAL: -90°
DEPTH TO WATER: Not Encountered
DEPTH TO BEDROCK: 76.0 ft
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

SOIL

Fill (made ground)	Quaternary Alluvium (Qal)
▩	▨

ROCK

Tuff "x" (Tpki)	Post-Tiva Canyon Bedded Tuff (Tpbt5)	Tpcprn
▓	▒	░

WELDING

Nonwelded	Densely Welded
☐	■

Figure 1.1-105. Geologic Log of Drill Hole UE-25 RF#23 (Sheet 3 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#24

SHEET 1 OF 4

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 8/15/2000 FINISHED: 8/23/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,344.31 E 570,542.26
TOTAL DEPTH: 268.0 ft
DEPTH TO BEDROCK: 30.0 ft

STATE: Nevada
GROUND ELEVATION: 3684.48
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES

Purpose of Hole:
Preliminary, conceptual-level geotechnical foundation investigations for the design of the waste handling facility.

Drill Equipment:
Schramm T685 Drill Rig

Drillers:
G. Fox, V. Mora, M. Fyffe; Dynatec Drilling Inc.; Salt Lake City, Utah.

Drilling Method:
Install 12 in. hammer. Hammer to 5.06. Cement 10.75 O.D. casing with 1.07 stickup. Re-enter hole on 8/17/2000 with 8.50 Tricone bit. Drill from 5.06 to total depth of 267.96.

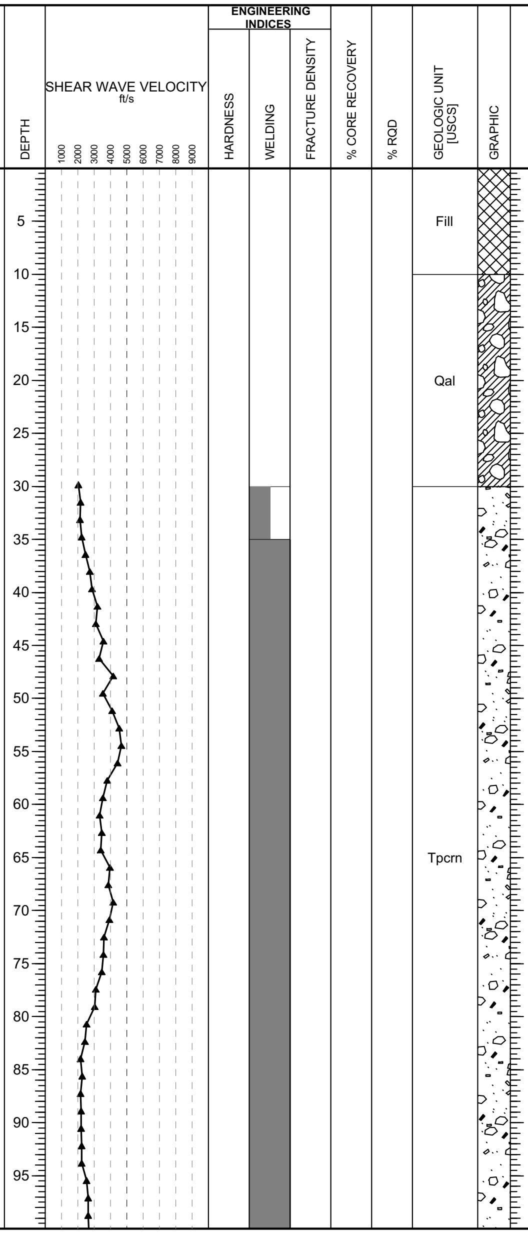
Drilling Conditions:
Lost circulation to weak circulation from 100.00 to 267.96. 233.00 to 236.00 very soft drilling. Smooth to rough drilling in some intervals.

Drilling Fluid:
0.00 to 5.06: Nonpotable water. 5.06 to 100.00: Quick Gel mud with EZ-Mud. 100.00 to 267.96: Quick Gel with EZ-Mud and LCM to re-establish circulation.

Loss Intervals:
100.00 to 267.96: Lost circulation to weak circulation.

Casing Record:
0.00 to 5.06: 10.75 O.D. casing.
5.06 to 267.96: No casing

Hole Completion:
Set and cement 266.05 of 4.50 schedule 80 PVC casing.



CLASSIFICATION AND PHYSICAL CONDITION

0.0 to 10.0 ft PAD FILL (Fill)
Predominately fine to coarse, hard, subangular gravel with a trace of nonplastic fines on gravel surfaces; derived from moderately to densely welded tuff.

10.0 to 30.0 ft QUATERNARY ALLUVIUM (Qal)
Tuffaceous alluvium consisting of a mixture of pale red and light gray densely welded ignimbrite with minor fragments of white nonwelded tuff. Up to 15% of the densely welded material has white to light gray caliche coatings.

30.0 to 110.0 ft TIVA CANYON TUFF CRYSTAL RICH NONLITHOPHYSAL ZONE (Tpcrn)
Pyroclastic flow, moderately to densely welded, crystallized, with 8 to 10% sanidine and plagioclase phenocrysts, and less than 1% biotite phenocrysts. From 44.0 to 57.0 ft the tuff is pumice poor with less than 1% clast content. From 57.0 to 93.0 ft the tuff has a mix of light brownish-gray and very light gray pumice clasts, composing up 15% of rock. Based on the occurrence of vapor phase mineralization fragments in the chips, there is a lithophysal bearing zone from 93.0 to 104.0 ft phenocryst content begins to decrease at 104.0 ft.

110.0 to 230.0 ft TIVA CANYON TUFF CRYSTAL POOR UPPER LITHOPHYSAL ZONE (Tpcpul)
Pyroclastic flow, densely welded, crystallized, vapor phase altered, light gray, with less than 1% sanidine, plagioclase, and biotite phenocrysts. Tuff has less than 1%, very light gray, pumice clasts and volcanic lithic fragments. Lithophysae are distinguished by vapor phase altered chips, indicating the edges of voids in the tuff.

230.0 to 268.0 ft TIVA CANYON TUFF CRYSTAL POOR MIDDLE NONLITHOPHYSAL ZONE (Tpcpmn)
Pyroclastic flow, densely welded, crystallized, pale red, with less than 1% sanidine, plagioclase, and biotite phenocrysts. Tuff has up to 1% pumice clasts and less than 1% volcanic lithic clasts.

Figure 1.1-106. Geologic Log of Drill Hole UE-25 RF#24 (Sheet 1 of 4)

NOTE: Hole logged from cuttings. Shear Wave Velocity data from GeoVision suspension logging. Data acquired from downhole survey conducted after PVC casing installed.
RQD = rock quality designation.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#24

SHEET 2 OF 4

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 8/15/2000 FINISHED: 8/23/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,344.31 E 570,542.26
TOTAL DEPTH: 268.0 ft
DEPTH TO BEDROCK: 30.0 ft

STATE: Nevada
GROUND ELEVATION: 3684.48
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

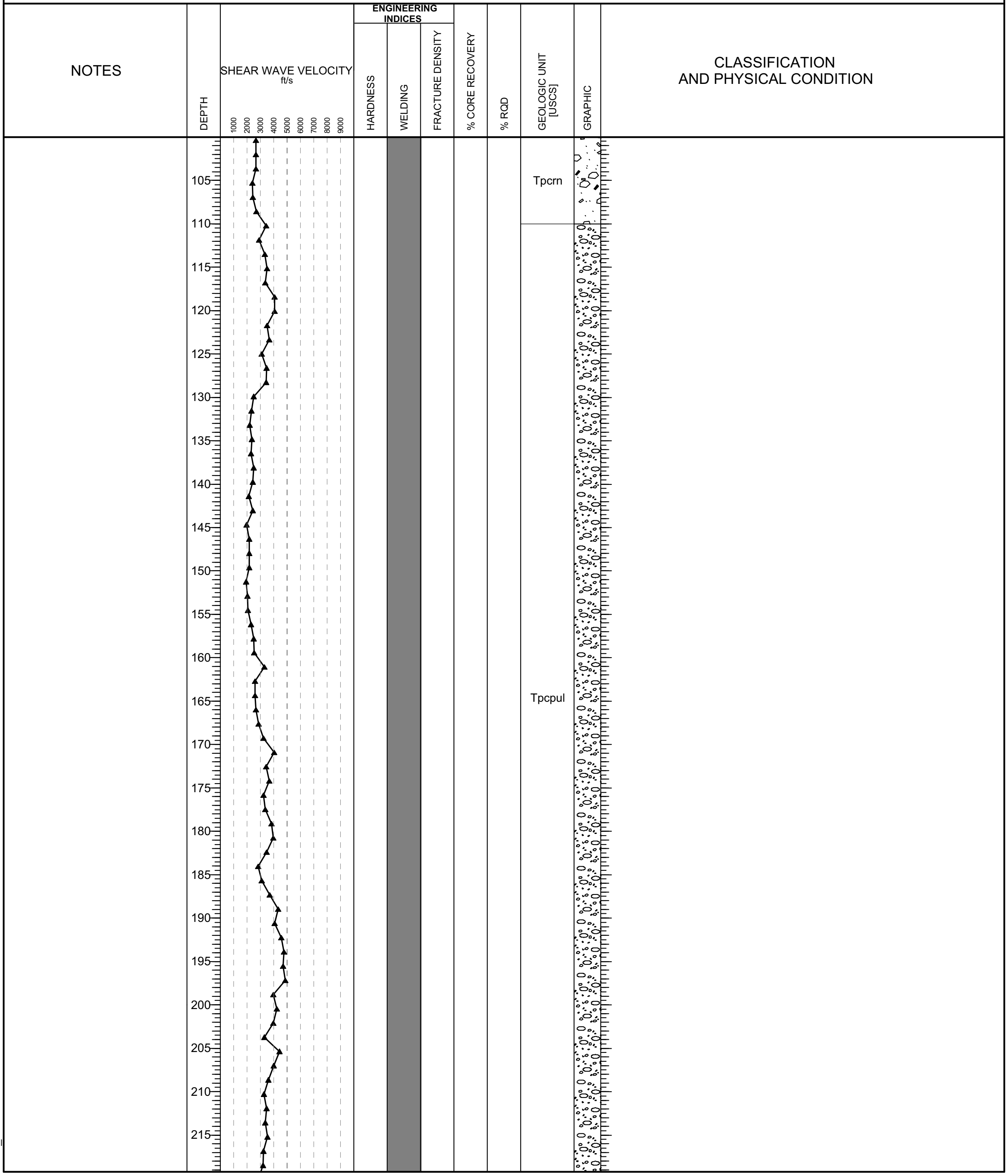


Figure 1.1-106. Geologic Log of Drill Hole UE-25 RF#24 (Sheet 2 of 4)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#24

SHEET 3 OF 4

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 8/15/2000 FINISHED: 8/23/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,344.31 E 570,542.26
TOTAL DEPTH: 268.0 ft
DEPTH TO BEDROCK: 30.0 ft

STATE: Nevada
GROUND ELEVATION: 3684.48
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

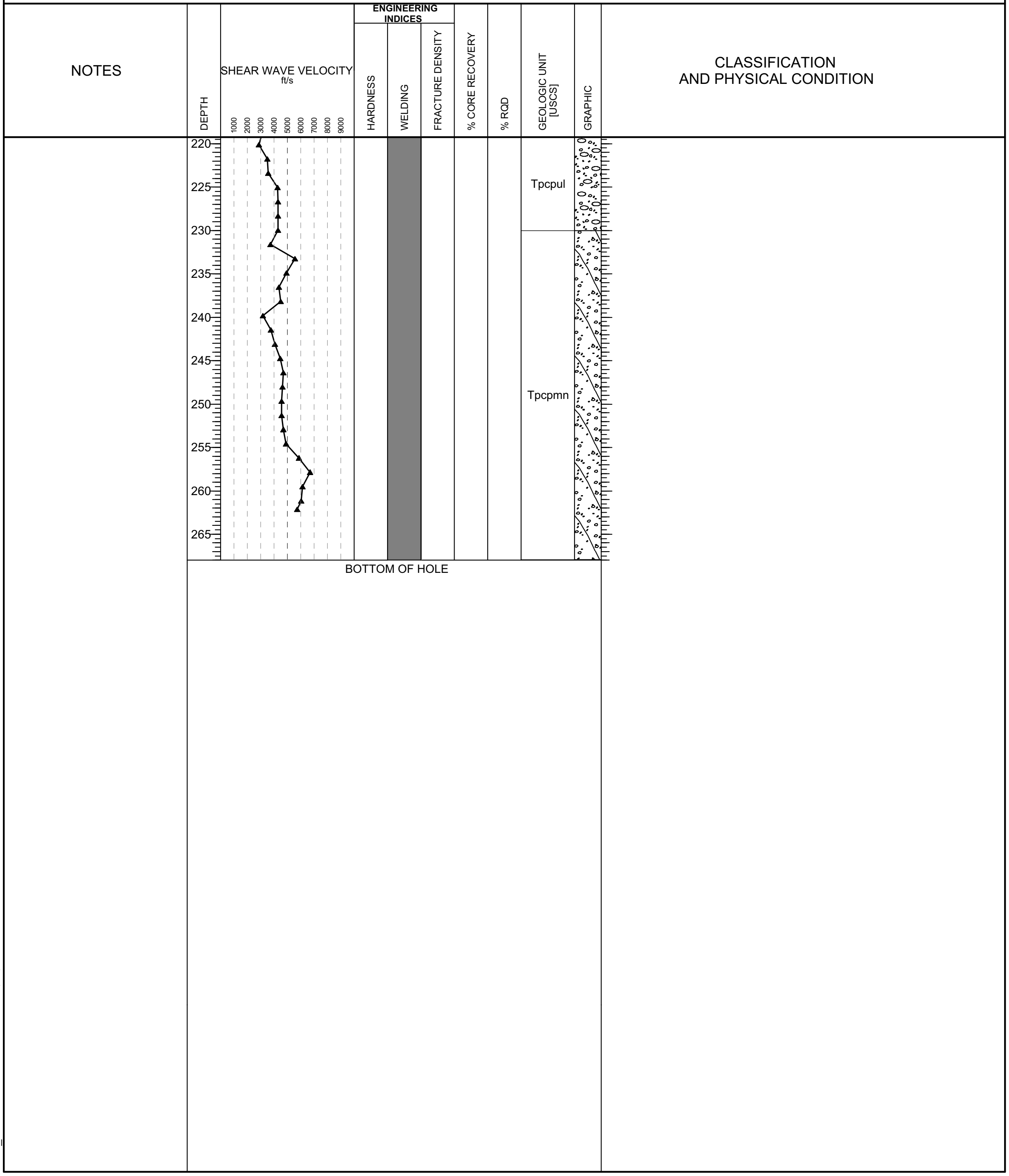


Figure 1.1-106. Geologic Log of Drill Hole UE-25 RF#24 (Sheet 3 of 4)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#24

SHEET 4 OF 4

FEATURE: Waste Handling Facility
PROJECT: Yucca Mountain Project
STATE: Nevada
LOCATION: ESF North Portal Pad
COORDINATES: N 766,344.31 E 570,542.26
GROUND ELEVATION: 3684.48
BEGUN: 8/15/2000 FINISHED: 8/23/2000
TOTAL DEPTH: 268.0 ft
ANGLE FROM HORIZONTAL: -90°
DEPTH TO WATER: Not Encountered
DEPTH TO BEDROCK: 30.0 ft
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

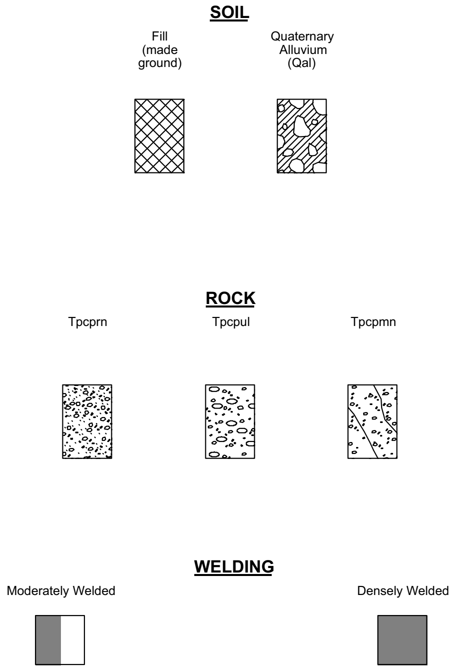
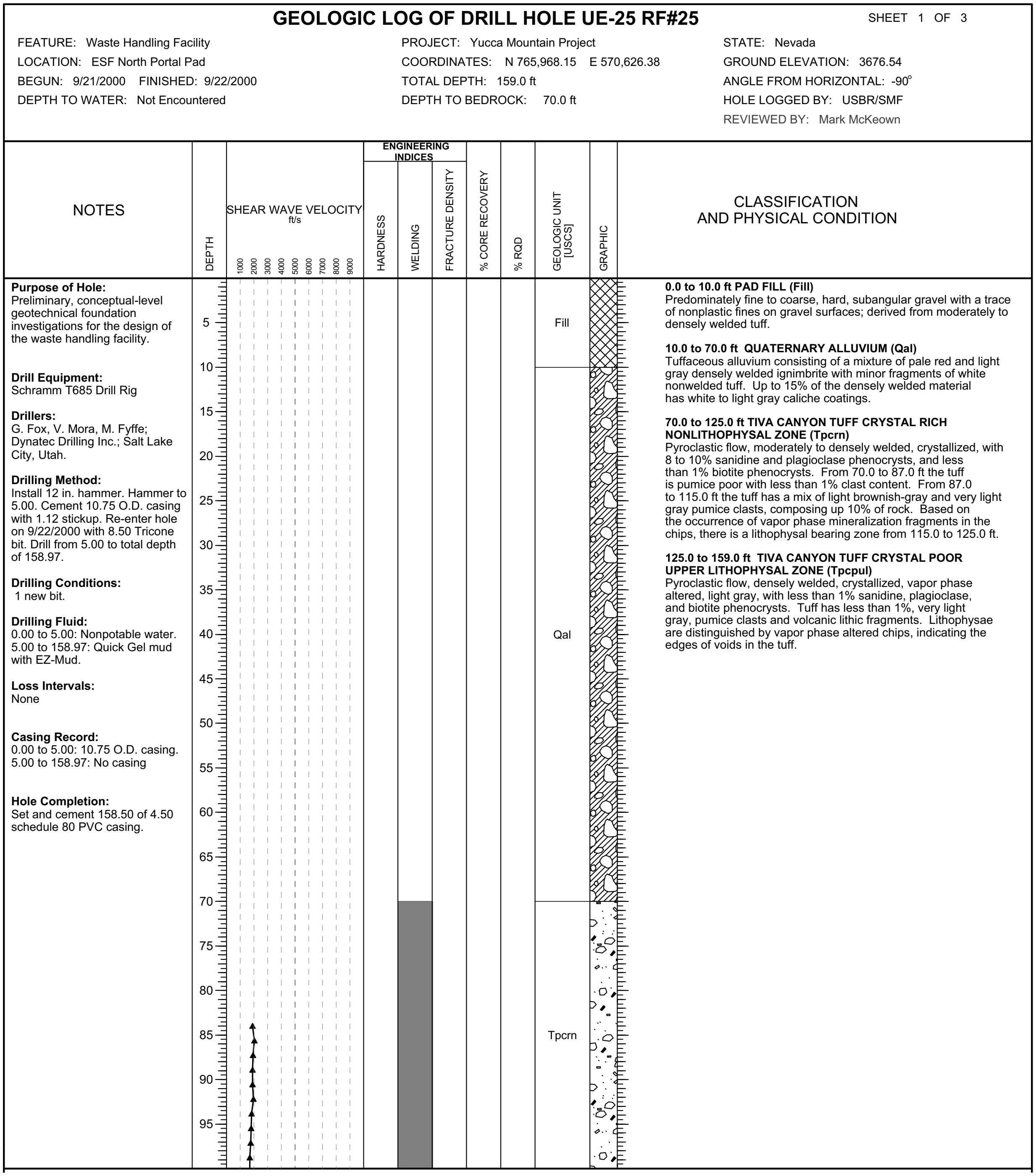


Figure 1.1-106. Geologic Log of Drill Hole UE-25 RF#24 (Sheet 4 of 4)



GEOLOGIC LOG OF DRILL HOLE UE-25 RF#25

SHEET 1 OF 3

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 9/21/2000 FINISHED: 9/22/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,968.15 E 570,626.38
TOTAL DEPTH: 159.0 ft
DEPTH TO BEDROCK: 70.0 ft

STATE: Nevada
GROUND ELEVATION: 3676.54
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES

Purpose of Hole:
Preliminary, conceptual-level geotechnical foundation investigations for the design of the waste handling facility.

Drill Equipment:
Schramm T685 Drill Rig

Drillers:
G. Fox, V. Mora, M. Fyffe; Dynatec Drilling Inc.; Salt Lake City, Utah.

Drilling Method:
Install 12 in. hammer. Hammer to 5.00. Cement 10.75 O.D. casing with 1.12 stickup. Re-enter hole on 9/22/2000 with 8.50 Tricone bit. Drill from 5.00 to total depth of 158.97.

Drilling Conditions:
1 new bit.

Drilling Fluid:
0.00 to 5.00: Nonpotable water.
5.00 to 158.97: Quick Gel mud with EZ-Mud.

Loss Intervals:
None

Casing Record:
0.00 to 5.00: 10.75 O.D. casing.
5.00 to 158.97: No casing

Hole Completion:
Set and cement 158.50 of 4.50 schedule 80 PVC casing.

CLASSIFICATION AND PHYSICAL CONDITION

0.0 to 10.0 ft PAD FILL (Fill)
Predominately fine to coarse, hard, subangular gravel with a trace of nonplastic fines on gravel surfaces; derived from moderately to densely welded tuff.

10.0 to 70.0 ft QUATERNARY ALLUVIUM (Qal)
Tuffaceous alluvium consisting of a mixture of pale red and light gray densely welded ignimbrite with minor fragments of white nonwelded tuff. Up to 15% of the densely welded material has white to light gray caliche coatings.

70.0 to 125.0 ft TIVA CANYON TUFF CRYSTAL RICH NONLITHOPHYSAL ZONE (Tpcrn)
Pyroclastic flow, moderately to densely welded, crystallized, with 8 to 10% sanidine and plagioclase phenocrysts, and less than 1% biotite phenocrysts. From 70.0 to 87.0 ft the tuff is pumice poor with less than 1% clast content. From 87.0 to 115.0 ft the tuff has a mix of light brownish-gray and very light gray pumice clasts, composing up 10% of rock. Based on the occurrence of vapor phase mineralization fragments in the chips, there is a lithophysal bearing zone from 115.0 to 125.0 ft.

125.0 to 159.0 ft TIVA CANYON TUFF CRYSTAL POOR UPPER LITHOPHYSAL ZONE (Tpcpul)
Pyroclastic flow, densely welded, crystallized, vapor phase altered, light gray, with less than 1% sanidine, plagioclase, and biotite phenocrysts. Tuff has less than 1%, very light gray, pumice clasts and volcanic lithic fragments. Lithophysae are distinguished by vapor phase altered chips, indicating the edges of voids in the tuff.

Figure 1.1-107. Geologic Log of Drill Hole UE-25 RF#25 (Sheet 1 of 3)

NOTE: Hole logged from cuttings. Shear Wave Velocity data from GeoVision suspension logging. Data acquired from downhole survey conducted after PVC casing installed.
RQD = rock quality designation.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#25

SHEET 2 OF 3

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 9/21/2000 FINISHED: 9/22/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,968.15 E 570,626.38
TOTAL DEPTH: 159.0 ft
DEPTH TO BEDROCK: 70.0 ft

STATE: Nevada
GROUND ELEVATION: 3676.54
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

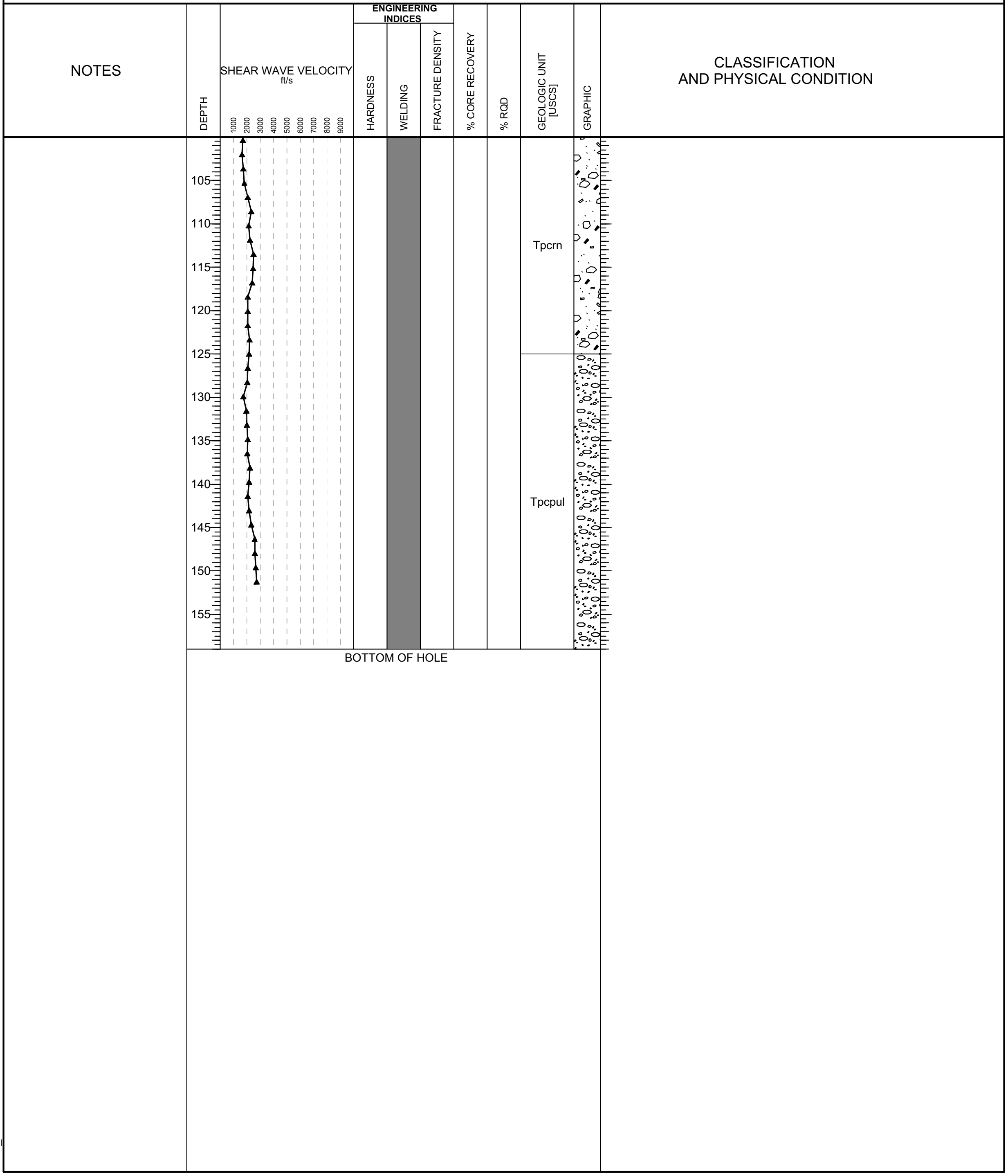


Figure 1.1-107. Geologic Log of Drill Hole UE-25 RF#25 (Sheet 2 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#25

SHEET 3 OF 3

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 9/21/2000 FINISHED: 9/22/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,968.15 E 570,626.38
TOTAL DEPTH: 159.0 ft
DEPTH TO BEDROCK: 70.0 ft

STATE: Nevada
GROUND ELEVATION: 3676.54
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

SOIL

Fill (made ground)	Quaternary Alluvium (Qal)
▦	▨

ROCK

Tpcprn	Tpcpul
▒	░

WELDING

Densely Welded
■

Figure 1.1-107. Geologic Log of Drill Hole UE-25 RF#25 (Sheet 3 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#26

SHEET 1 OF 4

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 6/26/2000 FINISHED: 7/25/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,247.95 E 570,579.71
TOTAL DEPTH: 264.9 ft
DEPTH TO BEDROCK: 85.0 ft

STATE: Nevada
GROUND ELEVATION: 3670.79
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES

Purpose of Hole:
Preliminary, conceptual-level geotechnical foundation investigations for the design of the waste handling facility.

Drill Equipment:
Schramm T685 Drill Rig

Drillers:
G. Fox, V. Mora, M. Fyffe; Dynatec Drilling Inc.; Salt Lake City, Utah.

Drilling Method:
Install 12 in. hammer. Hammer to 5.00. Cement 10.75 O.D. casing with 1.13 stickup. Re-enter hole on 7/7/2000 with 9 7/8 Tricone bit. Drill from 5.00 to depth of 39.39. Drill from 39.39 to total depth of 264.90 with 8.50 Tricone bit.

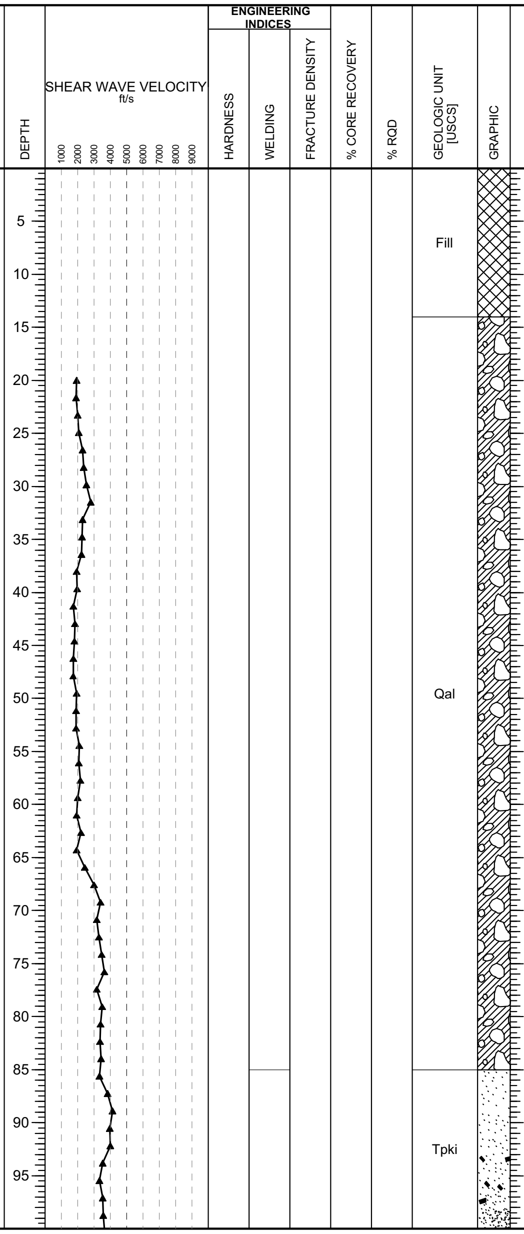
Drilling Conditions:
1 new bit. Loss circulation at 258.13.

Drilling Fluid:
0.00 to 5.00: Nonpotable water.
5.00 to total depth of 264.90: Hydro Gel mud with EZ-Mud and LCM to re-establish circulation.

Loss Intervals:
258.13

Casing Record:
0.00 to 5.00: 10.75 O.D. casing.
5.00 to 39.20: 9 casing.
39.20 to 264.90: No casing.

Hole Completion:
Set and cement 259.90 of 4.50 schedule 80 PVC casing.



CLASSIFICATION AND PHYSICAL CONDITION

0.0 to 14.0 ft PAD FILL (Fill)
Predominately fine to coarse, hard, subangular gravel with a trace of nonplastic fines on gravel surfaces; derived from moderately to densely welded tuff.

14.0 to 85.0 ft QUATERNARY ALLUVIUM (Qal)
Tuffaceous alluvium consisting of a mixture of pale red and light gray densely welded ignimbrite with minor fragments of white nonwelded tuff. Up to 15% of the densely welded material have white to light gray caliche coatings.

85.0 to 204.0 ft COMB PEAK IGNIMBRITE - TUFF X (Tpki):
Pyroclastic flow, nonwelded, crystallized, with up to 20% pumice clasts. Tuff contains 2 to 3% sanidine, plagioclase, quartz, and less than 1% biotite and hornblende phenocrysts. Up to 8% moderate red to medium dark gray, volcanic lithic clasts. Tuff is predominately grayish-orange pink with possible minor silicification.

204.0 to 211.0 ft POST-TIVA CANYON BEDDED TUFFS (Tpbt5):
Nonwelded, devitrified, reworked (?) Fallout tephra and pyroclastic flows separated by distinct paleosols. Bedded tuffs are very pale orange with 20 to 25% pumice clasts and up to 4%, pale red, volcanic lithic clasts. The tuff has up to 6% quartz, sanidine and lesser plagioclase, with less than 1% biotite and manganese oxides.

211.0 to 264.9 ft TIVA CANYON TUFF CRYSTAL RICH NONLITHOPHYSAL ZONE (Tpcrn)
Pyroclastic flow, moderately to densely welded, crystallized, with 8 to 10% sanidine and plagioclase phenocrysts, and less than 1% biotite phenocrysts. Possible vitrophyre from 211.0 to 220.0 ft. From 220.0 to 244.0 ft the tuff is pumice poor with up to 3% clast content. From 244.0 to 264.9 ft the tuff has a mix of light brownish-gray and very light gray pumice clasts, composing up 15% of rock.

Figure 1.1-108. Geologic Log of Drill Hole UE-25 RF#26 (Sheet 1 of 4)

NOTE: Hole logged from cuttings. Shear Wave Velocity data from GeoVision suspension logging. Data acquired from downhole survey conducted after PVC casing installed.
RQD = rock quality designation.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#26

SHEET 2 OF 4

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 6/26/2000 FINISHED: 7/25/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,247.95 E 570,579.71
TOTAL DEPTH: 264.9 ft
DEPTH TO BEDROCK: 85.0 ft

STATE: Nevada
GROUND ELEVATION: 3670.79
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

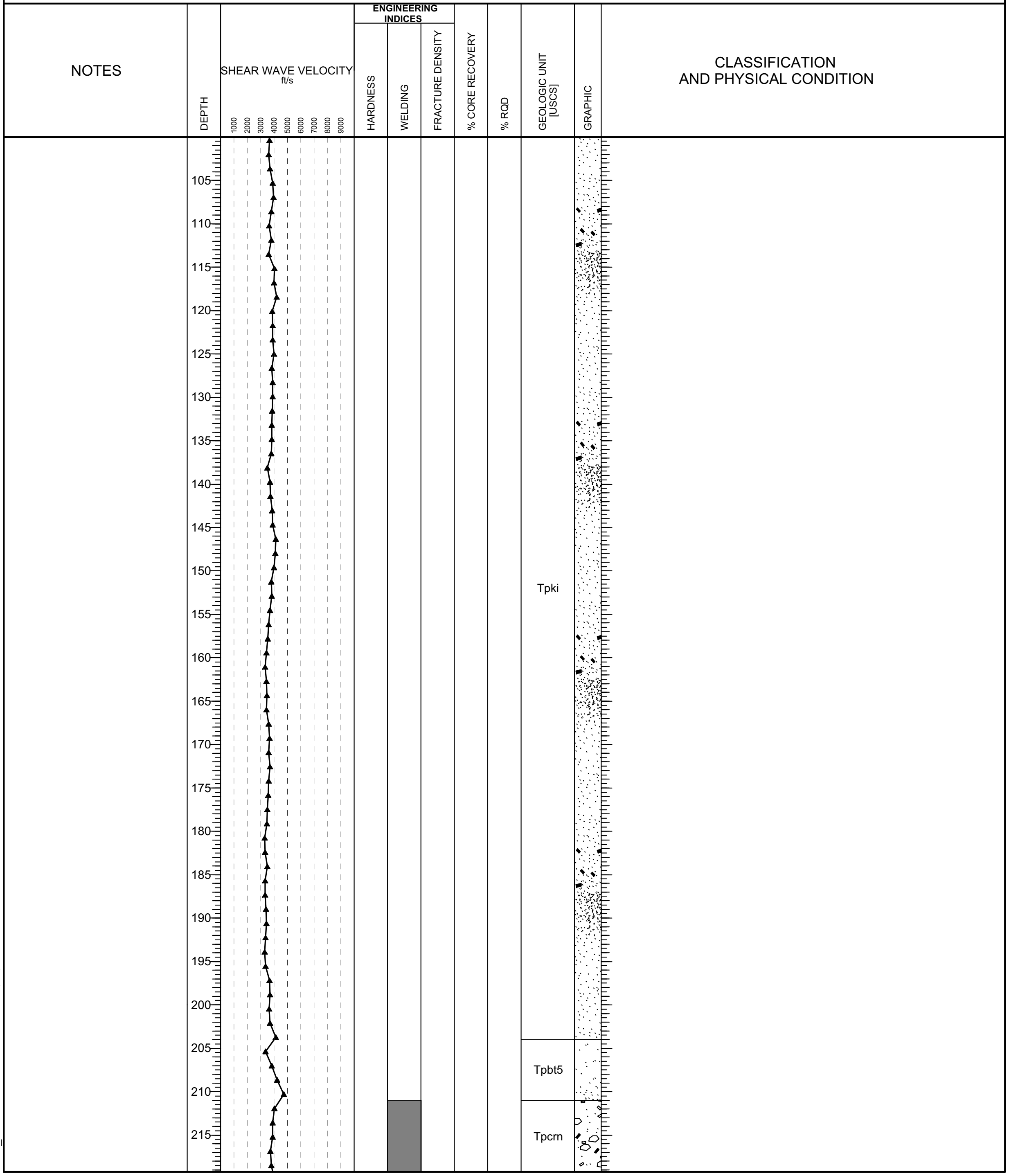


Figure 1.1-108. Geologic Log of Drill Hole UE-25 RF#26 (Sheet 2 of 4)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#26

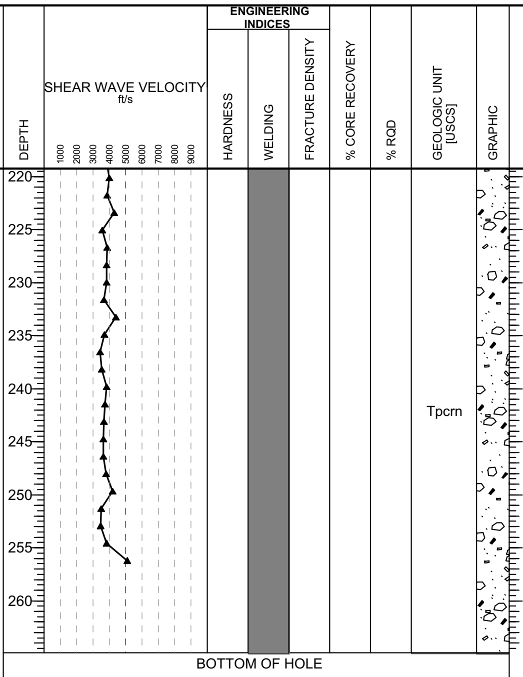
SHEET 3 OF 4

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 6/26/2000 FINISHED: 7/25/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,247.95 E 570,579.71
TOTAL DEPTH: 264.9 ft
DEPTH TO BEDROCK: 85.0 ft

STATE: Nevada
GROUND ELEVATION: 3670.79
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES



CLASSIFICATION AND PHYSICAL CONDITION

Figure 1.1-108. Geologic Log of Drill Hole UE-25 RF#26 (Sheet 3 of 4)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#26

SHEET 4 OF 4

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 6/26/2000 FINISHED: 7/25/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,247.95 E 570,579.71
TOTAL DEPTH: 264.9 ft
DEPTH TO BEDROCK: 85.0 ft

STATE: Nevada
GROUND ELEVATION: 3670.79
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

SOIL

- ▩ Fill (made ground)
- ▨ Quaternary Alluvium (Qal)

ROCK

- ▒ Tuff "x" (Tpki)
- ░ Post-Tiva Canyon Bedded Tuff (Tpbt5)
- ▓ Tpcprn

WELDING

- □ Nonwelded
- ■ Densely Welded

Figure 1.1-108. Geologic Log of Drill Hole UE-25 RF#26 (Sheet 4 of 4)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#28

SHEET 1 OF 2

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 8/24/2000 FINISHED: 8/25/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,510.21 E 570,104.87
TOTAL DEPTH: 99.8 ft
DEPTH TO BEDROCK: 15.0 ft

STATE: Nevada
GROUND ELEVATION: 3680.63
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES

Purpose of Hole:
Preliminary, conceptual-level geotechnical foundation investigations for the design of the waste handling facility.

Drill Equipment:
Schramm T685 Drill Rig

Drillers:
G. Fox, V. Mora, M. Fyffe; Dynatec Drilling Inc.; Salt Lake City, Utah.

Drilling Method:
Install 12 in. hammer. Hammer to 4.96. Cement 10.75 O.D. casing with 1.16 stickup. Re-enter hole on 8/25/2000 with 8.50 Tricone bit. Drill from 4.96 to total depth of 99.75.

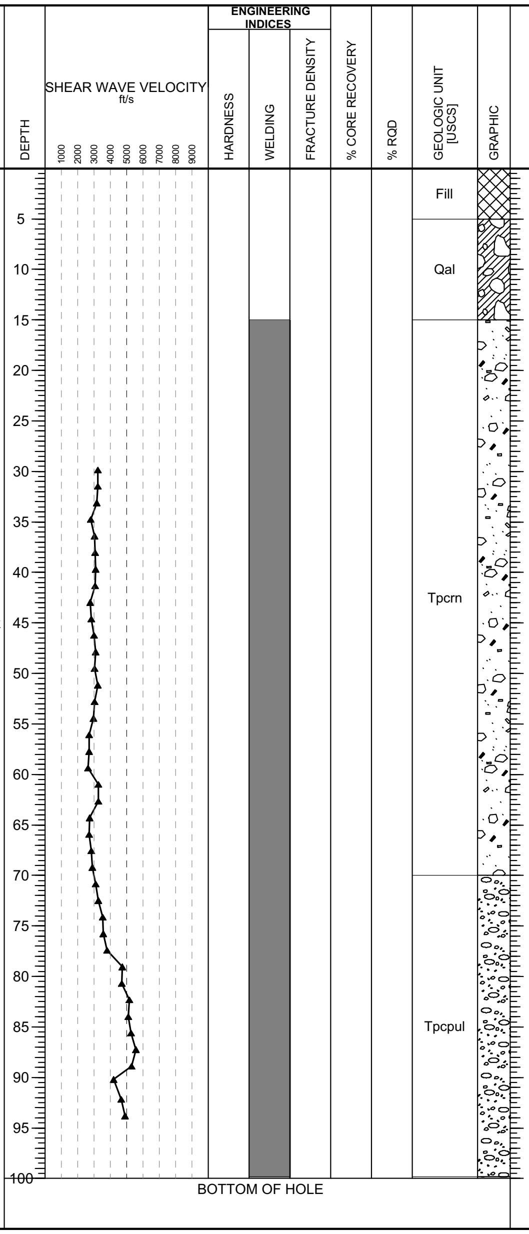
Drilling Conditions:
Smooth soft drilling to total depth of hole.

Drilling Fluid:
0.00 to 4.96: Nonpotable water. 4.96 to total depth of 99.75: Quick Gel mud with EZ-Mud.

Loss Intervals:
NA

Casing Record:
0.00 to 4.96: 10.75 O.D. casing. 4.96 to 99.75: No casing.

Hole Completion:
Set and cement 97.98 of 4.50 schedule 80 PVC casing.



CLASSIFICATION AND PHYSICAL CONDITION

0.0 to 5.0 ft PAD FILL (Fill)
Predominately fine to coarse, hard, subangular gravel with a trace of nonplastic fines on gravel surfaces; derived from moderately to densely welded tuff.

5.0 to 15.0 ft QUATERNARY ALLUVIUM (Qal)
Tuffaceous alluvium consisting of a mixture of pale red and light gray densely welded ignimbrite with minor fragments of white nonwelded tuff. Up to 15% of the densely welded material has white to light gray caliche coatings.

15.0 to 70.0 ft TIVA CANYON TUFF CRYSTAL RICH NONLITHOPHYSAL ZONE (Tpcrn)
Pyroclastic flow, moderately to densely welded, crystallized, with 8 to 10% sanidine and plagioclase phenocrysts, and less than 1% biotite phenocrysts. From 15.0 to 30.0 ft the tuff has a mix of light brownish-gray and very light gray pumice clasts, composing up 10% of rock. From 30.0 to 47.0 ft the presence of vapor phase mineral coatings on the chips indicate the presence lithophysal cavities. Phenocrysts content begins to decrease at 47.0 ft.

70.0 to 99.8 ft TIVA CANYON TUFF CRYSTAL POOR UPPER LITHOPHYSAL ZONE (Tpcpul)
Pyroclastic flow, densely welded, crystallized, vapor-phase altered, light gray, with 2 to 3% sanidine and plagioclase, and less than 1% biotite phenocrysts. Tuff has up to 5%, very light gray, pumice clasts. Lithophysae are distinguished by vapor-phase altered chips, indicating the edges of voids in the tuff.

Figure 1.1-109. Geologic Log of Drill Hole UE-25 RF#28 (Sheet 1 of 2)

NOTE: Hole logged from cuttings. Shear Wave Velocity data from GeoVision suspension logging. Data acquired from downhole survey conducted after PVC casing installed.
RQD = rock quality designation.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#28

SHEET 2 OF 2

FEATURE: Waste Handling Facility
PROJECT: Yucca Mountain Project
STATE: Nevada
LOCATION: ESF North Portal Pad
COORDINATES: N 765,510.21 E 570,104.87
GROUND ELEVATION: 3680.63
BEGUN: 8/24/2000 FINISHED: 8/25/2000
TOTAL DEPTH: 99.8 ft
ANGLE FROM HORIZONTAL: -90°
DEPTH TO WATER: Not Encountered
DEPTH TO BEDROCK: 15.0 ft
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

SOIL

Fill (made ground)	Quaternary Alluvium (Qal)
▩	▨

ROCK

Tpcprn	Tpcpul
░	░

WELDING

Densely Welded
■

Figure 1.1-109. Geologic Log of Drill Hole UE-25 RF#28 (Sheet 2 of 2)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#29

SHEET 1 OF 5

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 10/26/2000 FINISHED: 11/1/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,018.46 E 570,836.04
TOTAL DEPTH: 430.0 ft
DEPTH TO BEDROCK: 85.0 ft

STATE: Nevada
GROUND ELEVATION: 3672.71
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

NOTES

Purpose of Hole:
Preliminary, conceptual-level geotechnical foundation investigations for the design of the waste handling facility.

Drill Equipment:
Schramm T685 Drill Rig

Drillers:
G. Fox, V. Mora, M. Fyffe; Dynatec Drilling Inc.; Salt Lake City, Utah.

Drilling Method:
Install 12 in. hammer. Hammer to 4.50. Cement 10.75 O.D. casing with 1.51 stickup. Re-enter hole on 10/27/2000 with 8.50 Tricone bit. Drill from 4.50 to total depth of 429.92.

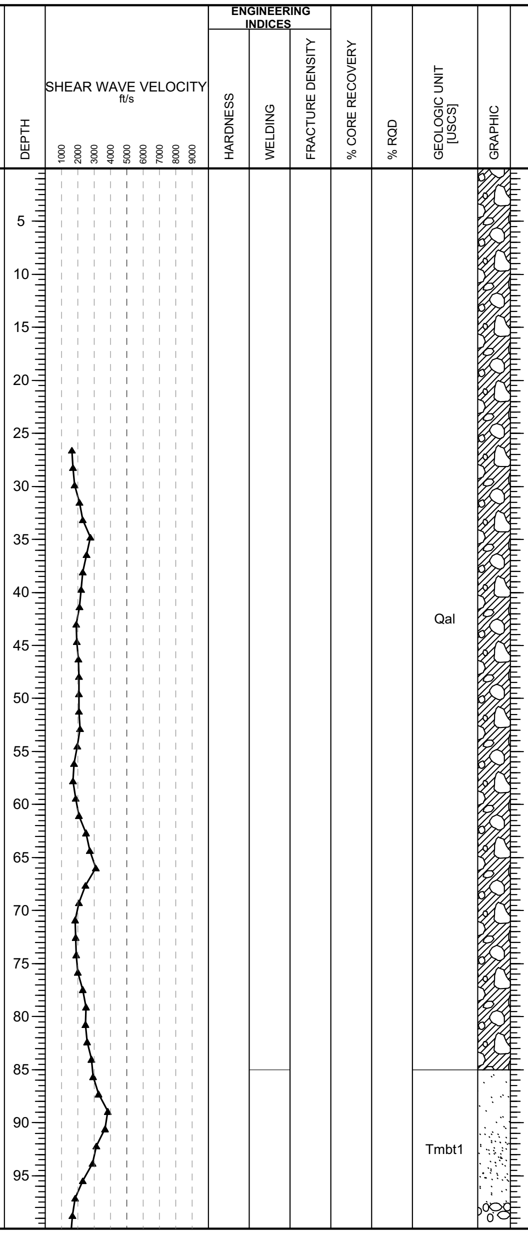
Drilling Conditions:
Smooth soft drilling to total depth of hole.

Drilling Fluid:
0.00 to 4.50: Nonpotable water.
4.50 to total depth of 429.92: Quick Gel mud with EZ-Mud.

Loss Intervals:
NA

Casing Record:
0.00 to 4.50: 10.75 O.D. casing.
4.50 to 429.92: No casing.

Hole Completion:
Set and cement 409.67 of 4.50 schedule 80 PVC casing.



CLASSIFICATION AND PHYSICAL CONDITION

0.0 to 85.0 ft QUATERNARY ALLUVIUM (Qal)
Tuffaceous alluvium consisting of a mixture of pale red and light gray densely welded ignimbrite with minor fragments of white nonwelded tuff. Up to 15% of the densely welded material have white to light gray caliche coatings.

85.0 to 280.0 ft BEDDED TUFF (Tmbt1)
Pre-Rainier Mesa Bedded Tuff composed of bedded and reworked tuff. Bedded tuff is nonwelded, argillic, with up to 10% quartz, plagioclase, and sanidine phenocrysts. Bedded tuff contains up to 10% argillically altered pumice clasts. Some beds have up to 15% volcanic lithic clasts. Tuff is predominately grayish-orange pink and drill-cutting returns are sand to silt sized.

280.0 to 370.0 ft COMB PEAK IGNIMBRITE - TUFF X (Tpki):
Pyroclastic flow, nonwelded, crystallized, with up to 15% pumice clasts. Tuff contains 2 to 3% sanidine, plagioclase, quartz, and less than 1% biotite and hornblende phenocrysts. Up to 15% moderate red to medium dark gray, volcanic lithic clasts. Tuff is predominately grayish-orange pink with possible minor silicification.

370.0 to 380.0 ft POST-TIVA CANYON BEDDED TUFFS (Tpbt5):
Nonwelded, devitrified, reworked (?) Fallout tephra and pyroclastic flows separated by distinct paleosols. Bedded tuffs are very pale orange with 20 to 25% pumice clasts and up to 4%, pale red, volcanic lithic clasts. The tuff has up to 6% quartz, sanidine and lesser plagioclase, with less than 1% biotite and manganese oxides.

380.0 to 430.0 ft TIVA CANYON TUFF CRYSTAL RICH NONLITHOPHYSAL ZONE (Tpcrn)
Pyroclastic flow, moderately to densely welded, crystallized, with 8 to 10% sanidine and plagioclase phenocrysts, and less than 1% biotite phenocrysts. Possible vitrophyre from 379.0 to 407.0 ft. From 407.0 to 427.0 ft the tuff is pumice poor with only 3% clasts content. From 427 to 429.9 ft the tuff has a mix of light brownish-gray and very light gray pumice clasts, composing up 12% of rock.

Figure 1.1-110. Geologic Log of Drill Hole UE-25 RF#29 (Sheet 1 of 5)

NOTE: Hole logged from cuttings. Shear Wave Velocity data from GeoVision suspension logging. Data acquired from downhole survey conducted after PVC casing installed.
RQD = rock quality designation.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#29

SHEET 2 OF 5

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 10/26/2000 FINISHED: 11/1/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,018.46 E 570,836.04
TOTAL DEPTH: 430.0 ft
DEPTH TO BEDROCK: 85.0 ft

STATE: Nevada
GROUND ELEVATION: 3672.71
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

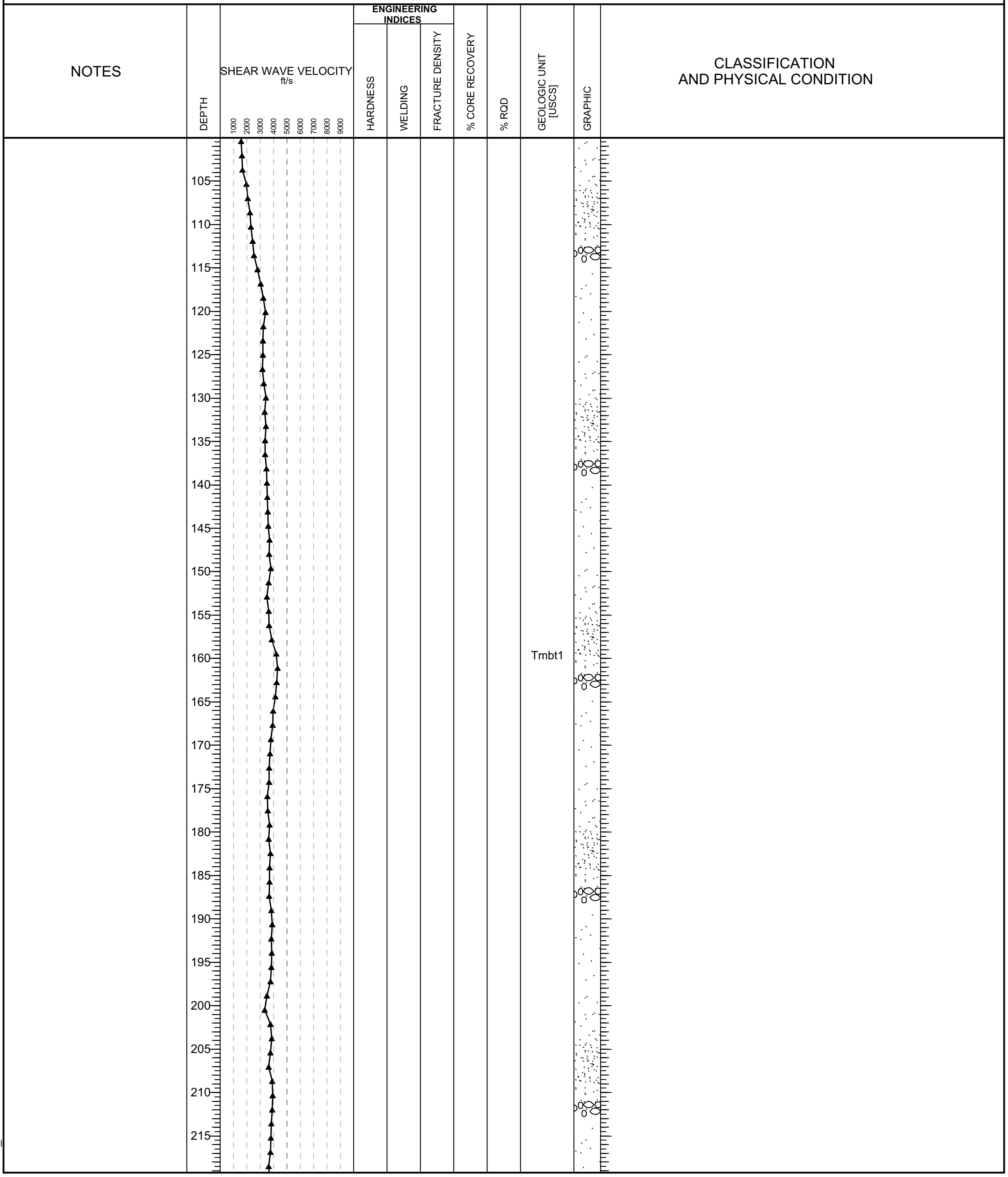


Figure 1.1-110. Geologic Log of Drill Hole UE-25 RF#29 (Sheet 2 of 5)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#29

SHEET 3 OF 5

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 10/26/2000 FINISHED: 11/1/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,018.46 E 570,836.04
TOTAL DEPTH: 430.0 ft
DEPTH TO BEDROCK: 85.0 ft

STATE: Nevada
GROUND ELEVATION: 3672.71
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

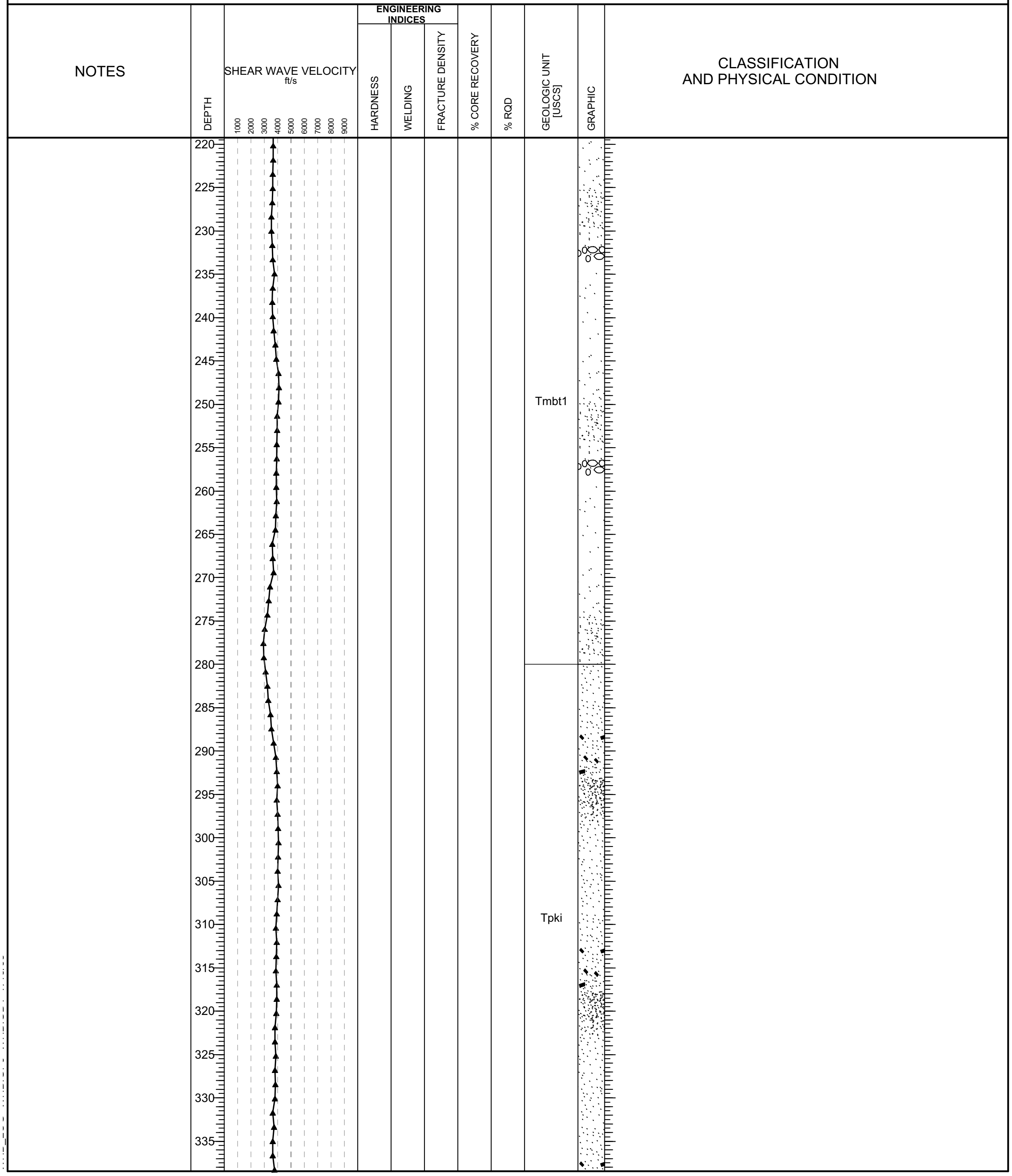


Figure 1.1-110. Geologic Log of Drill Hole UE-25 RF#29 (Sheet 3 of 5)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#29

SHEET 4 OF 5

FEATURE: Waste Handling Facility	PROJECT: Yucca Mountain Project	STATE: Nevada
LOCATION: ESF North Portal Pad	COORDINATES: N 766,018.46 E 570,836.04	GROUND ELEVATION: 3672.71
BEGUN: 10/26/2000 FINISHED: 11/1/2000	TOTAL DEPTH: 430.0 ft	ANGLE FROM HORIZONTAL: -90°
DEPTH TO WATER: Not Encountered	DEPTH TO BEDROCK: 85.0 ft	HOLE LOGGED BY: USBR/SMF
		REVIEWED BY: Mark McKeown

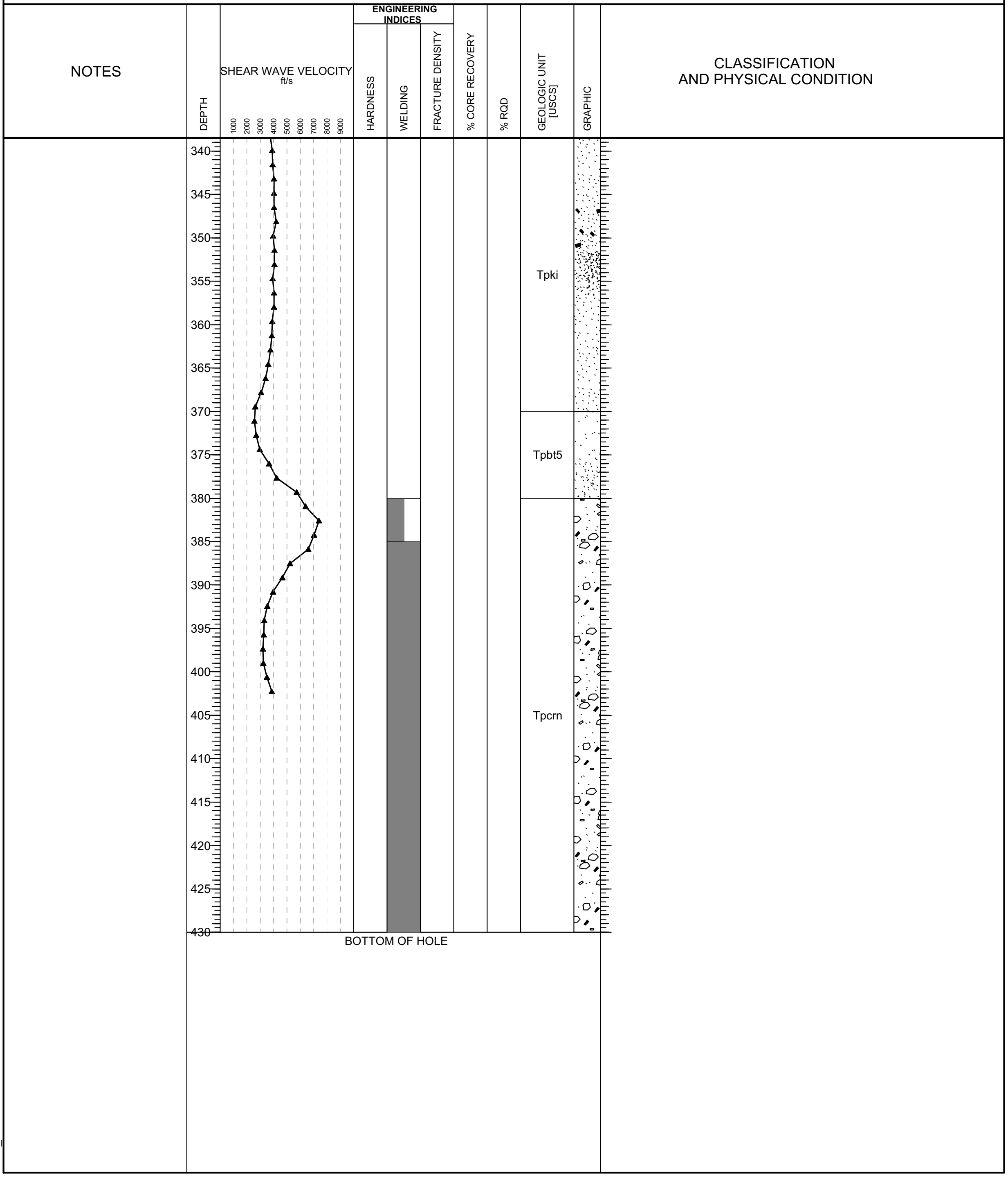


Figure 1.1-110. Geologic Log of Drill Hole UE-25 RF#29 (Sheet 4 of 5)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#29

SHEET 5 OF 5

FEATURE: Waste Handling Facility
LOCATION: ESF North Portal Pad
BEGUN: 10/26/2000 FINISHED: 11/1/2000
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,018.46 E 570,836.04
TOTAL DEPTH: 430.0 ft
DEPTH TO BEDROCK: 85.0 ft

STATE: Nevada
GROUND ELEVATION: 3672.71
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: USBR/SMF
REVIEWED BY: Mark McKeown

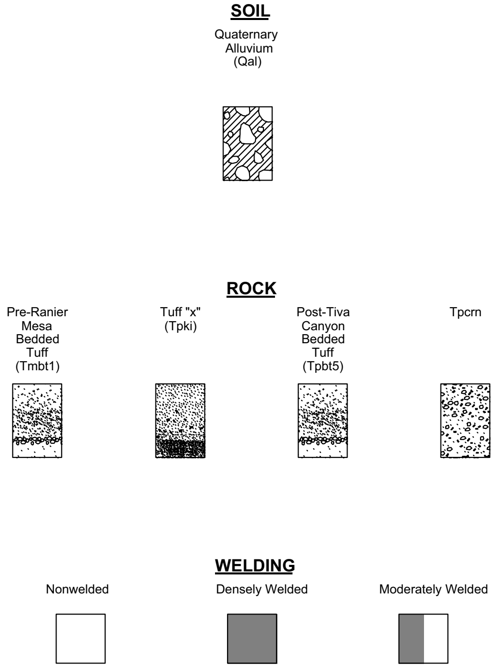


Figure 1.1-110. Geologic Log of Drill Hole UE-25 RF#29 (Sheet 5 of 5)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#42

SHEET 1 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 5/4/2005 FINISHED: 5/5/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 764,633.04 E 571,142
TOTAL DEPTH: 118.9 ft
DEPTH TO BEDROCK: 75.4 ft

STATE: Nevada
GROUND ELEVATION: 3634.87
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES | DEPTH | ENGINEERING INDICES: HARDNESS, WELDING, FRACTURE DENSITY | % CORE RECOVERY | % RQD | GEOLOGIC UNIT [USCS] | GRAPHIC | CLASSIFICATION AND PHYSICAL CONDITION

Purpose of Hole:
Repository Facilities Geotechnical Investigations

Drill Equipment:
GP24 300 RS (Sonic Drill Rig)
Flatbed combination water and pipe truck with boom for moving drill pipe and casing.

Driller:
Travis Ostergerg
Boart Longyear Drill Services

Drilling Method:
Rotosonic
Advance 8 in. casing as hole is cored 0.0 to 118.90 ft (TD). Drill string inside casing consists of 3½ in. single wall drill pipe with 6.163 in. Rotosonic Carbide button bit.

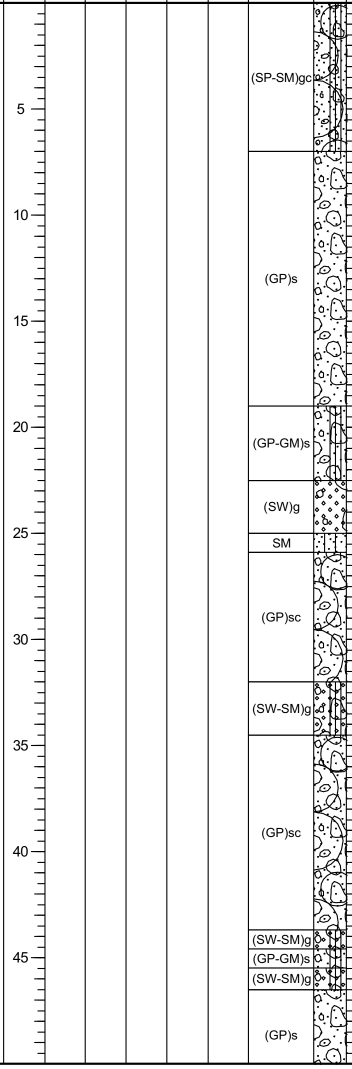
Drilling Conditions:
Not Reported

Drilling Fluid:
Small amounts of drilling additives were added to help in advancing casing.

Fluid Loss Interval:
NA

Casing Record:
8 in. casing from 0.0 to 118.9 ft (TD)

Hole Completion:
Back fill hole from 118.9 ft (TD) up to 0.0 ft (ground surface) with Bentonite Chips. Pull casing.



0.0 to 75.4 ft QUATERNARY ALLUVIUM (Qal):

0.0 to 7.0 ft POORLY GRADED SAND WITH SILT, GRAVEL AND COBBLES (SP-SM)gc: About 55% coarse to fine, subangular sand; about 30% coarse to fine, hard, subangular gravel; about 15% nonplastic fines with quick dilatancy and low toughness; trace of hard, subangular cobbles; maximum size 120 mm; dry, brown, no reaction with HCl. Organic material present.

7.0 to 19.0 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 55% coarse to fine, hard, subangular gravel; about 45% coarse to fine, subangular sand, coarse sand-size particles fractured with hammer blow; about 5% nonplastic fines; maximum size 75 mm; dry, pink, light brown, strong reaction with HCl.

19.0 to 22.5 ft POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)s: About 55% coarse to fine, hard, subangular gravel; about 35% coarse to fine, subangular sand; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 55 mm; dry, pinkish gray, strong reaction with HCl.

22.5 to 25.0 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 55% coarse to fine, angular to subangular sand; about 40% predominantly fine, hard, angular to subangular gravel; about 5% nonplastic fines; maximum size 25 mm; dry, gray, moderate reaction with HCl.

25.0 to 25.9 ft SILTY SAND (SM): About 70% coarse to fine, subangular to subrounded sand; about 30% nonplastic fines with quick dilatancy and low toughness; trace of predominantly fine, hard, subangular to subrounded gravel; maximum size 10 mm; dry, gray, strong reaction with HCl.

25.9 to 32.0 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, angular to subangular sand; trace of nonplastic fines; trace of hard, subangular to subrounded cobbles; maximum size 150 mm; dry, pink, strong reaction with HCl.

32.0 to 34.5 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 60% coarse to fine, subangular to subrounded sand; about 25% predominantly fine, hard, subangular gravel; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 45 mm; dry, gray, strong reaction with HCl.

34.5 to 43.7 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, angular to subrounded gravel; about 40% coarse to fine, angular to subangular sand; trace of nonplastic fines; trace of hard, subangular cobbles; maximum size 105 mm; dry, gray, strong reaction with HCl.

43.7 to 44.6 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 60% coarse to fine, angular to subangular sand; about 30% predominantly fine, hard, subangular to subrounded gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 25 mm; dry, pinkish gray, strong reaction with HCl.

44.6 to 45.5 ft POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)s: About 55% predominantly fine, hard, subangular gravel; about 35% coarse to fine, subangular sand; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 60 mm; dry, gray, strong reaction with HCl.

45.5 to 46.5 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 70%

Figure 1.1-111. Geologic Log of Drill Hole UE-25 RF#42 (Sheet 1 of 3)

NOTE: Descriptions of the material may not reflect in situ geologic conditions due to mechanical degradation of the sample by the Sonic drilling method; TD = total depth.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#42

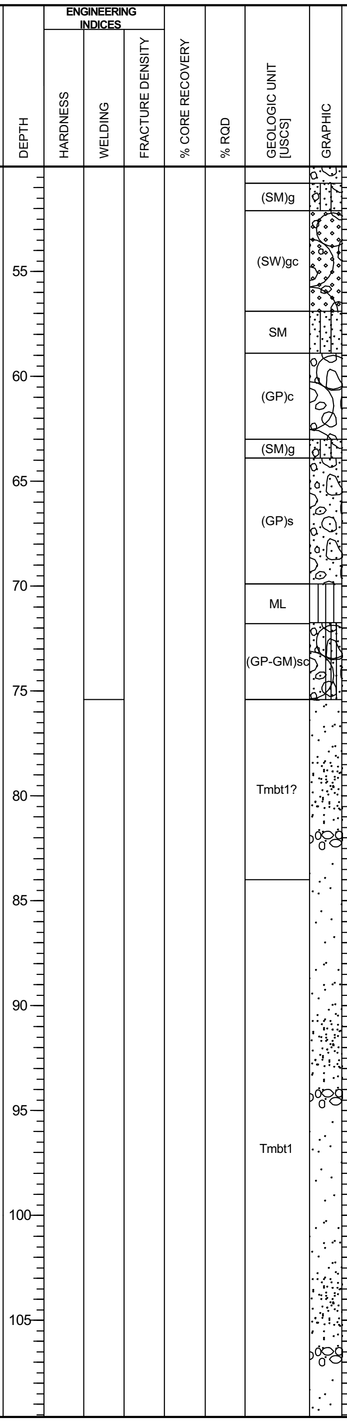
SHEET 2 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 5/4/2005 FINISHED: 5/5/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 764,633.04 E 571,142
TOTAL DEPTH: 118.9 ft
DEPTH TO BEDROCK: 75.4 ft

STATE: Nevada
GROUND ELEVATION: 3634.87
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES



CLASSIFICATION AND PHYSICAL CONDITION

coarse to fine, subangular sand; about 20% predominantly fine, hard, subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 10 mm; dry, pinkish gray, strong reaction with HCl.

46.5 to 50.8 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 60% coarse to fine, hard, angular gravel; about 35% coarse to fine, angular sand; about 5% nonplastic fines; maximum size 80 mm; dry, gray, no reaction with HCl.

50.8 to 52.1 ft SILTY SAND WITH GRAVEL (SM)g: About 55% coarse to fine, subangular sand; about 30% predominantly fine, hard, subangular gravel; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 20 mm; dry, gray, strong reaction with HCl.

52.1 to 56.9 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 65% coarse to fine, subangular sand; about 35% coarse to fine, hard, subangular gravel; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 100 mm; dry, pinkish gray, strong reaction with HCl.

56.9 to 58.9 ft SILTY SAND (SM): About 70% coarse to fine, subangular sand; about 30% nonplastic fines with quick dilatancy and low toughness; trace of predominantly fine, hard, subangular to subrounded gravel; maximum size 65 mm; dry, gray, strong reaction with HCl.

58.9 to 63.0 ft POORLY GRADED GRAVEL WITH COBBLES (GP)c: About 85% coarse to fine, hard, angular gravel; about 10% coarse to fine, angular sand; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 150 mm; dry, gray, strong reaction with HCl.

63.0 to 63.9 ft SILTY SAND WITH GRAVEL (SM)g. About 40% coarse to fine, subangular sand; about 30% predominantly fine, hard, subangular gravel; about 30% nonplastic fines with quick dilatancy and low toughness; maximum size 20 mm; dry, light gray, strong reaction with HCl.

63.9 to 69.9 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 65% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular to subangular sand; trace of nonplastic fines; maximum size 70 mm; dry, gray, strong reaction with HCl.

69.9 to 71.8 ft SANDY SILT (ML): About 55% nonplastic fines with quick dilatancy and low toughness; about 45% coarse to fine, subangular sand; trace of predominantly fine, hard, subangular gravel; maximum size 10 mm; dry, gray, strong reaction with HCl.

71.8 to 75.4 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc: About 65% coarse to fine, hard, angular to subangular gravel; about 25% coarse to fine, angular to subangular sand; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, subangular cobbles; maximum size 110 mm; dry, gray, strong reaction with HCl.

75.4 to 84.0 ft PRE-RAINIER MESA TUFF BEDDED TUFF? (Tmbt1): Bedded tuff, nonwelded, consists primarily of silt to fine sand size fragments of feldspar, pumice, glass shards, and crystallized welded tuff fragments in a calcite cemented volcanic ash matrix, very pale brown. Contains 2 to 5% pumice locally, 2 to 3% crystallized welded tuff fragments, 15 to 25% calcite fragments (strong reaction with HCl). From 75.4 to 79.0 ft is an incipient paleosol. From 82.0 to 83.0 ft are scattered cobble size clasts of crystallized welded tuff, caliche coated. This may be fill.

84.0 to 113.6 ft PRE-RAINIER MESA TUFF BEDDED TUFF (Tmbt1): Bedded tuff, nonwelded, partially clay altered, pink, with white calcite stringers. Contains 5 to 20% pumice, 1 to 4% lithic fragments composed of crystallized welded tuff, matrix is predominantly fine to medium sand size crystal fragments in calcite cemented volcanic ash, with 1 to 20% crystal fragments of quartz, sanidine and plagioclase, less than 1% biotite, less than 1% magnetite.

Tephra from 89.0 to 93.8 ft, nonwelded, composed of 50 to 60% altered pumice, 5 to 10% lithic fragments, 10 to 20% crystal fragments of quartz and altered feldspar, less than 1% biotite, and less than 1% magnetite, white.

Figure 1.1-111. Geologic Log of Drill Hole UE-25 RF#42 (Sheet 2 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#42

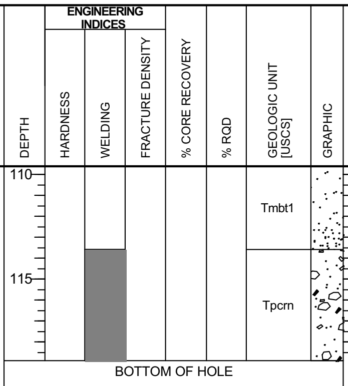
SHEET 3 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 5/4/2005 FINISHED: 5/5/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 764,633.04 E 571,142
TOTAL DEPTH: 118.9 ft
DEPTH TO BEDROCK: 75.4 ft

STATE: Nevada
GROUND ELEVATION: 3634.87
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

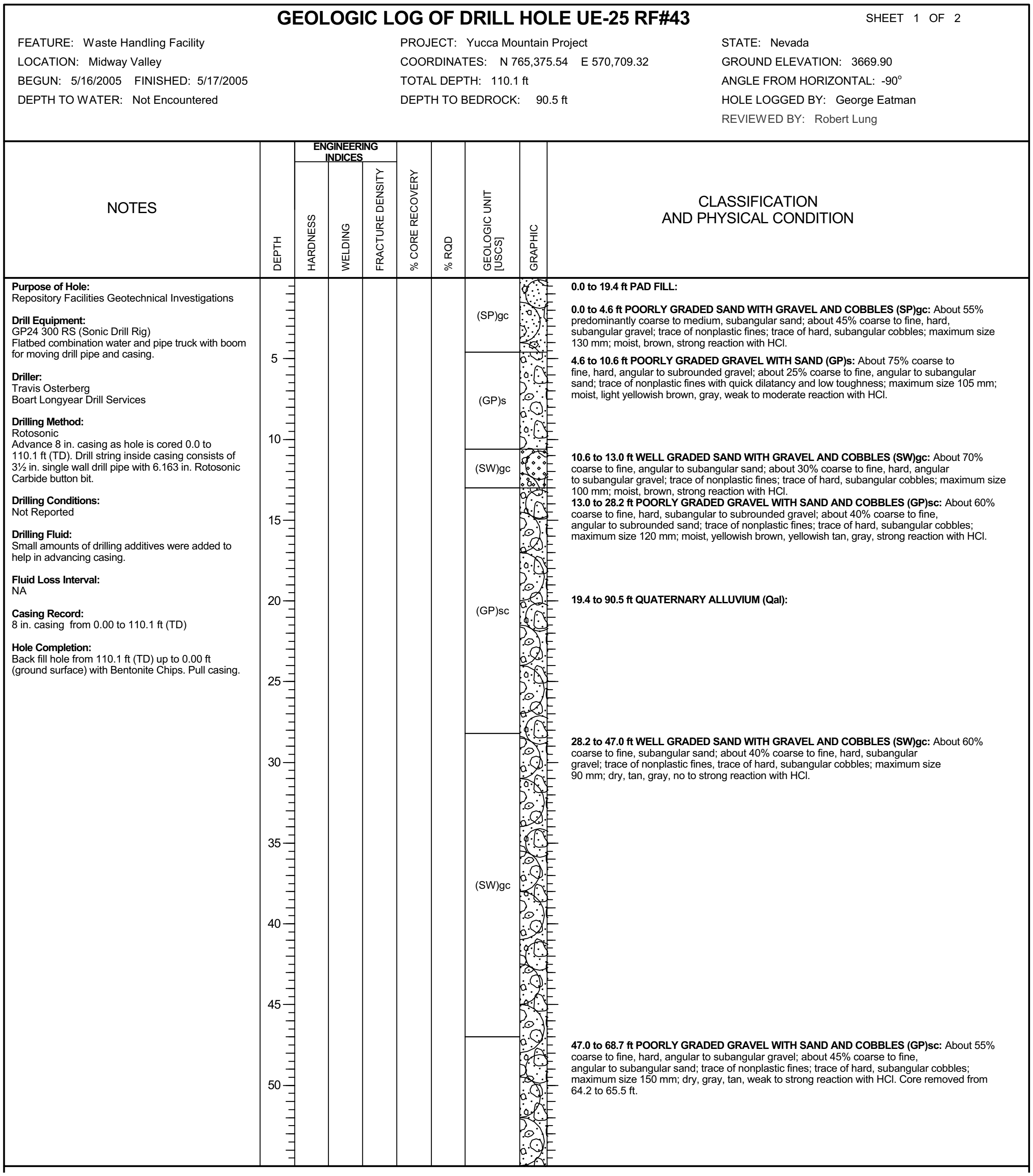
NOTES



CLASSIFICATION AND PHYSICAL CONDITION

113.6 to 118.9 ft TIVA CANYON TUFF CRYSTAL-RICH MEMBER NONLITHOPHYSAL ZONE (Tpcrn):
Pyroclastic flow, densely welded, crystallized, reddish gray, dark reddish-gray, reddish-black. Contains 5 to 25% pumice, 10 to 15% crystal fragments of sanidine and plagioclase, less than 1% biotite, and pyroxene.

Figure 1.1-111. Geologic Log of Drill Hole UE-25 RF#42 (Sheet 3 of 3)



GEOLOGIC LOG OF DRILL HOLE UE-25 RF#43

SHEET 1 OF 2

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 5/16/2005 FINISHED: 5/17/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,375.54 E 570,709.32
TOTAL DEPTH: 110.1 ft
DEPTH TO BEDROCK: 90.5 ft

STATE: Nevada
GROUND ELEVATION: 3669.90
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES

Purpose of Hole:
Repository Facilities Geotechnical Investigations

Drill Equipment:
GP24 300 RS (Sonic Drill Rig)
Flatbed combination water and pipe truck with boom for moving drill pipe and casing.

Driller:
Travis Osterberg
Boart Longyear Drill Services

Drilling Method:
Rotosonic
Advance 8 in. casing as hole is cored 0.0 to 110.1 ft (TD). Drill string inside casing consists of 3½ in. single wall drill pipe with 6.163 in. Rotosonic Carbide button bit.

Drilling Conditions:
Not Reported

Drilling Fluid:
Small amounts of drilling additives were added to help in advancing casing.

Fluid Loss Interval:
NA

Casing Record:
8 in. casing from 0.00 to 110.1 ft (TD)

Hole Completion:
Back fill hole from 110.1 ft (TD) up to 0.00 ft (ground surface) with Bentonite Chips. Pull casing.

CLASSIFICATION AND PHYSICAL CONDITION

0.0 to 19.4 ft PAD FILL:

0.0 to 4.6 ft POORLY GRADED SAND WITH GRAVEL AND COBBLES (SP)gc: About 55% predominantly coarse to medium, subangular sand; about 45% coarse to fine, hard, subangular gravel; trace of nonplastic fines; trace of hard, subangular cobbles; maximum size 130 mm; moist, brown, strong reaction with HCl.

4.6 to 10.6 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 75% coarse to fine, hard, angular to subrounded gravel; about 25% coarse to fine, angular to subangular sand; trace of nonplastic fines with quick dilatancy and low toughness; maximum size 105 mm; moist, light yellowish brown, gray, weak to moderate reaction with HCl.

10.6 to 13.0 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 70% coarse to fine, angular to subangular sand; about 30% coarse to fine, hard, angular to subangular gravel; trace of nonplastic fines; trace of hard, subangular cobbles; maximum size 100 mm; moist, brown, strong reaction with HCl.

13.0 to 28.2 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, subangular to subrounded gravel; about 40% coarse to fine, angular to subrounded sand; trace of nonplastic fines; trace of hard, subangular cobbles; maximum size 120 mm; moist, yellowish brown, yellowish tan, gray, strong reaction with HCl.

19.4 to 90.5 ft QUATERNARY ALLUVIUM (Qal):

28.2 to 47.0 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 60% coarse to fine, subangular sand; about 40% coarse to fine, hard, subangular gravel; trace of nonplastic fines, trace of hard, subangular cobbles; maximum size 90 mm; dry, tan, gray, no to strong reaction with HCl.

47.0 to 68.7 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% coarse to fine, hard, angular to subangular gravel; about 45% coarse to fine, angular to subangular sand; trace of nonplastic fines; trace of hard, subangular cobbles; maximum size 150 mm; dry, gray, tan, weak to strong reaction with HCl. Core removed from 64.2 to 65.5 ft.

Figure 1.1-112. Geologic Log of Drill Hole UE-25 RF#43 (Sheet 1 of 2)

NOTE: Descriptions of the material may not reflect in situ geologic conditions due to mechanical degradation of the sample by the Sonic drilling method; TD = total depth.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#43

SHEET 2 OF 2

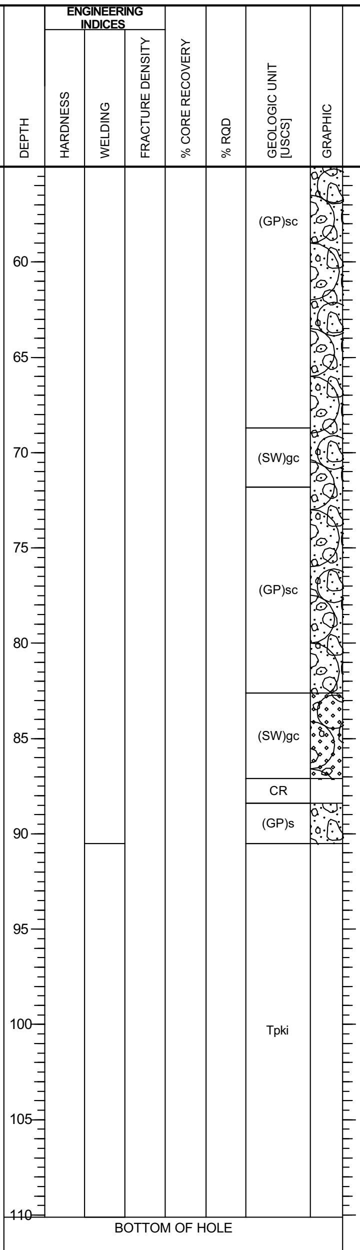
FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 5/16/2005 FINISHED: 5/17/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,375.54 E 570,709.32
TOTAL DEPTH: 110.1 ft
DEPTH TO BEDROCK: 90.5 ft

STATE: Nevada
GROUND ELEVATION: 3669.90
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES

CLASSIFICATION AND PHYSICAL CONDITION



68.7 to 71.8 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 60% coarse to fine, angular to subangular sand; about 40% coarse to fine, hard, subangular gravel; trace of nonplastic fines; trace of hard, subangular cobbles; maximum size 155 mm; dry, gray, strong reaction with HCl.

71.8 to 82.6 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% coarse to fine, hard, subangular gravel; about 45% coarse to fine, subangular sand; trace of nonplastic fines; trace of hard, subangular cobbles; maximum size 105 mm; dry, gray, strong reaction with HCl. Core removed from 75.4 to 76.7 ft.

82.6 to 87.1 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 60% coarse to fine, subangular sand; about 40% coarse to fine, angular to subangular gravel; trace of nonplastic fines; trace of subangular cobbles; maximum size 100 mm; dry, very pale brown, strong reaction with HCl.

87.1 to 88.4 ft CORE REMOVED

88.4 to 90.5 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 55% coarse to fine, angular to subangular gravel; about 45% coarse to fine, angular to subangular sand; trace of nonplastic fines; maximum size 60 mm; dry, light gray, strong reaction with HCl.

90.5 to 110.1 ft COMB PEAK IGNIMBRITE - TUFF "X" (Tpki):
Pyroclastic flow, nonwelded, crystallized to partially altered, primarily volcanic ash, locally caliche cemented, very pale brown, 1 to 20% pumice, 1 to 3% lithic fragments of crystallized moderately to densely welded tuff, less than 1% crystal fragments of sanidine and plagioclase, less than 1% biotite and pyroxene, slight to moderate reaction with HCl.

Figure 1.1-112. Geologic Log of Drill Hole UE-25 RF#43 (Sheet 2 of 2)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#44

SHEET 1 OF 3

FEATURE: Waste Handling Facility	PROJECT: Yucca Mountain Project	STATE: Nevada
LOCATION: Midway Valley	COORDINATES: N 765,418.81 E 570,828.46	GROUND ELEVATION: 3676.33
BEGUN: 5/18/2005 FINISHED: 5/23/2005	TOTAL DEPTH: 143.5 ft	ANGLE FROM HORIZONTAL: -90°
DEPTH TO WATER: Not Encountered	DEPTH TO BEDROCK: 108.0 ft	HOLE LOGGED BY: George Eatman
		REVIEWED BY: Robert Lung

NOTES	DEPTH	ENGINEERING INDICES HARDNESS	ENGINEERING INDICES WELDING	ENGINEERING INDICES FRACTURE DENSITY	% CORE RECOVERY	% RQD	GEOLOGIC UNIT [USCS]	GRAPHIC	CLASSIFICATION AND PHYSICAL CONDITION
Purpose of Hole: Repository Facilities Geotechnical Investigations **Drill Equipment:** GP24 300 RS (Sonic Drill Rig) Flatbed combination water and pipe truck with boom for moving drill pipe and casing. **Driller:** Travis Osterberg Boart Longyear Drill Services **Drilling Method:** Rotosonic Advance 8 in. casing as hole is cored 0.0 to 143.5 ft (TD). Drill string inside casing consists of 3½ in. single wall drill pipe with 6.163 in. Rotosonic Carbide buttonbit. **Drilling Conditions:** Not Reported **Drilling Fluid:** Small amounts of drilling additives were added to help in advancing casing. **Fluid Loss Interval:** NA **Casing Record:** 8 in. casing from 0.0 to 143.5 ft (TD) **Hole Completion:** Back fill hole from 143.5 ft (TD) up to 0.0 ft (ground surface) with Bentonite Chips. Pull casing.	5 10 15 20 25 30 35 40 45						(GP)sc (GP-GM)sc (SW)g (GP)sc		**0.0 to 26.8 ft PAD FILL:** **0.0 to 31.0 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc:** About 70% coarse to fine, hard, angular to subangular gravel; about 30% coarse to fine, angular sand; trace of nonplastic fines; dry, light gray, gray, pink, weak to strong reaction with HCl. TOTAL SAMPLE (BY VOLUME): About 5% hard, subangular cobbles; remainder minus 3 in.; maximum size 85 mm. **26.8 to 108.0 ft QUATERNARY ALLUVIUM (Qal):** **31.0 to 38.3 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc:** About 50% coarse to fine, hard, subangular gravel; about 40% coarse to fine, subangular sand; about 10% nonplastic fines with quick dilatancy and low toughness; dry, light brown, moderate reaction with HCl. Iron staining on gravel. TOTAL SAMPLE (BY VOLUME): About 5% hard, subangular cobbles; remainder minus 3 in.; maximum size 75 mm. **38.3 to 39.0 ft WELL GRADED SAND WITH GRAVEL (SW)g:** About 75% coarse to fine, angular to subangular sand; about 20% predominantly fine, hard, angular gravel; about 5% nonplastic fines; maximum size 25 mm; dry, light brown, strong reaction with HCl. Iron staining on gravel. **39.0 to 48.2 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc:** About 55% coarse to fine, hard, subangular gravel; about 40% coarse to fine, angular to subangular sand; about 5% nonplastic fines; dry, light gray and pink, no to strong reaction with HCl. TOTAL SAMPLE (BY VOLUME): About 10% hard, subangular cobbles; remainder minus 3 in.; maximum size 90 mm. **48.2 to 52.6 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g:** About 65% coarse to fine, angular to subangular sand; about 25% predominantly fine, hard,

Figure 1.1-113. Geologic Log of Drill Hole UE-25 RF#44 (Sheet 1 of 3)

NOTE: Descriptions of the material may not reflect in situ geologic conditions due to mechanical degradation of the sample by the Sonic drilling method; TD = total depth.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#44

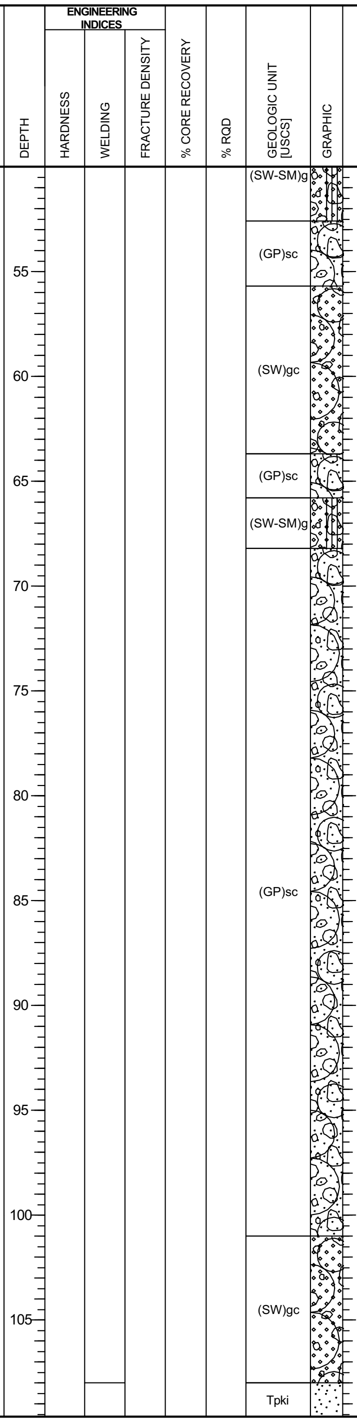
SHEET 2 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 5/18/2005 FINISHED: 5/23/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,418.81 E 570,828.46
TOTAL DEPTH: 143.5 ft
DEPTH TO BEDROCK: 108.0 ft

STATE: Nevada
GROUND ELEVATION: 3676.33
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES



CLASSIFICATION AND PHYSICAL CONDITION

angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 35 mm; dry, pinkish gray, weak reaction with HCl.

52.6 to 55.7 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% coarse to fine, hard, subangular gravel; about 45% coarse to fine, angular sand; trace of nonplastic fines; dry, pink, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 15% hard, subangular cobbles; remainder minus 3 in.; maximum size 120 mm.

55.7 to 63.7 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 50% coarse to fine, angular sand; about 45% coarse to fine, hard, angular gravel; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 80 mm; dry, pinkish gray, strong reaction with HCl.

63.7 to 66.1 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% predominantly fine, hard, angular gravel; about 40% coarse to fine, angular sand; trace of nonplastic fines; dry, light brown, moderate reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 10% hard, subangular cobbles; maximum size 110 mm; remainder minus 3 in.

66.1 to 68.2 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 55% coarse to fine, subangular sand; about 35% predominantly fine, hard, subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 35 mm; dry, pink, strong reaction with HCl.

68.2 to 101.0 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular to subangular sand; about 5% nonplastic fines; dry, pinkish white, strong reaction with HCl. Core removed from 98.2 to 99.4 ft.

TOTAL SAMPLE (BY VOLUME): About 10% hard, drilled and angular to subangular cobbles; maximum size 95 mm; remainder minus 3 in.

101.0 to 108.0 ft POORLY GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 65% coarse to fine, angular to subangular sand; about 35% coarse to fine, subangular gravel; trace of nonplastic fines; trace of subangular cobbles; maximum size 125 mm; dry, pink, strong reaction with HCl.

108.0 to 121.4 ft COMB PEAK IGNIMBRITE - TUFF "X" (Tpki): Pyroclastic flow, nonwelded, crystallized and partially silicified, white, 10 to 40% pumice,

Figure 1.1-113. Geologic Log of Drill Hole UE-25 RF#44 (Sheet 2 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#44

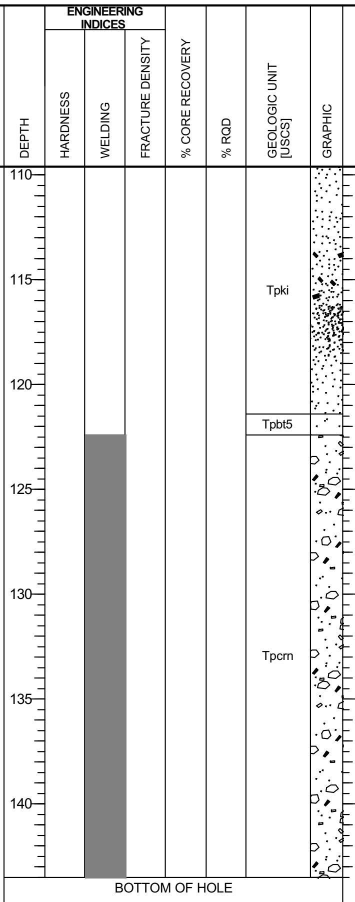
SHEET 3 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 5/18/2005 FINISHED: 5/23/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,418.81 E 570,828.46
TOTAL DEPTH: 143.5 ft
DEPTH TO BEDROCK: 108.0 ft

STATE: Nevada
GROUND ELEVATION: 3676.33
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES



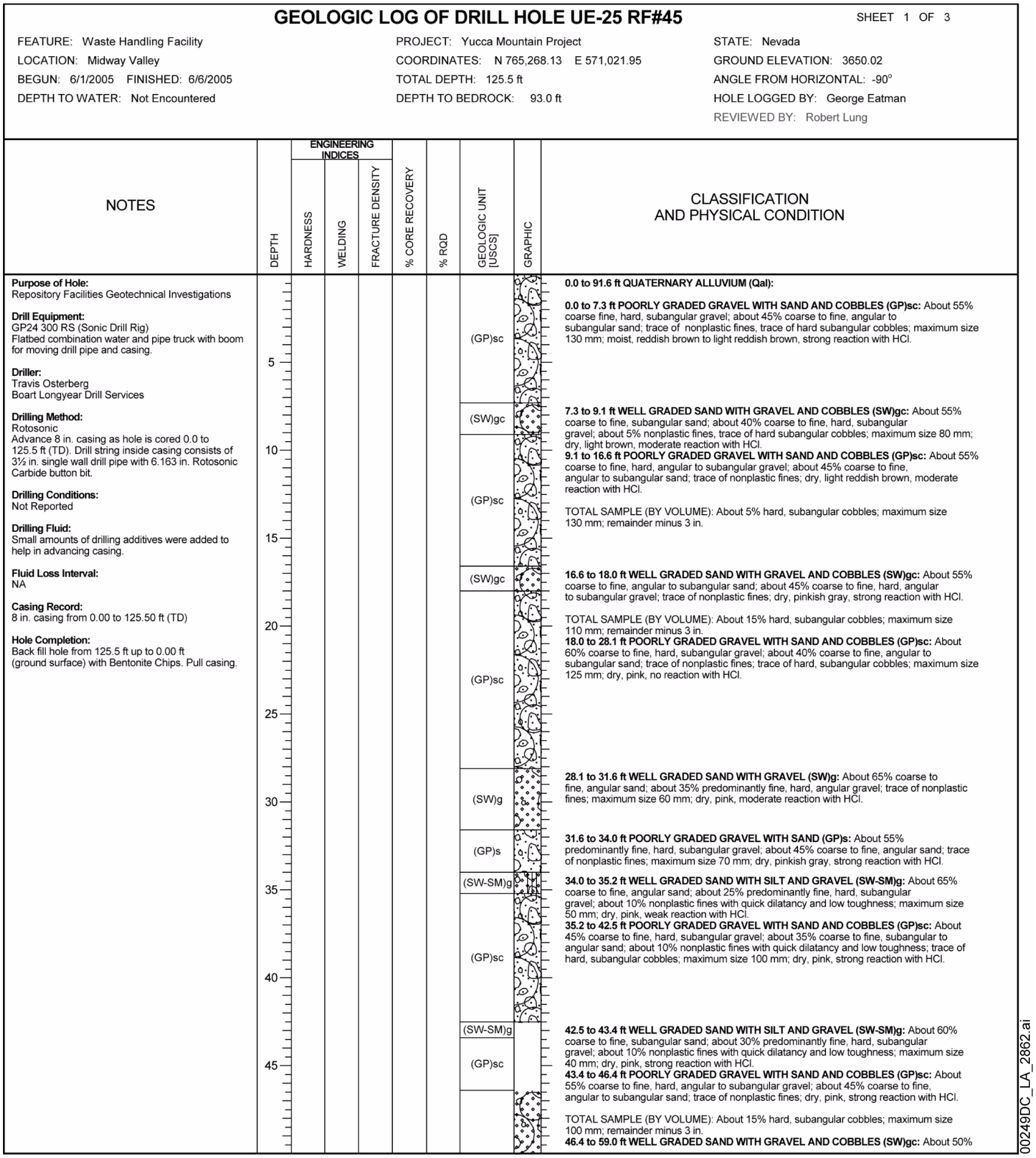
CLASSIFICATION
AND PHYSICAL CONDITION

locally 50 to 60% pumice, less than 1 to 5% lithic fragments of crystallized, densely welded tuff, less than 1 to 2% crystal fragments of sanidine, plagioclase and quartz, less than 1% biotite, and very minor hornblende, less than 1% scattered manganese oxides, scattered relict glass bubbles, slightly to moderately reactive with HCl (calcite veinlets).

121.4 to 122.4 ft POST-TIVA CANYON TUFF BEDDED TUFF (Tpbt5):
Bedded tuff, nonwelded, clay altered, light red with dark red mottling, 3 to 7% clay altered pumice, 10 to 20% lithic fragments of welded tuff, 1 to 2% crystal fragments of sanidine, plagioclase, and lesser quartz (less than 1%), less than 1% biotite, less than 1% magnetite. Scattered fragments of Tpcrn3 at base.

122.4 to 143.5 ft TIVA CANYON CRYSTAL RICH NONLITHOPHYSAL ZONE (Tpcrn):
Pyroclastic flow, moderately to densely welded, crystallized, pale red, pinkish gray, 5 to 20% pumice, less than 1% lithic fragments of welded tuff, 5 to 13% crystal fragments of sanidine and plagioclase, less than 1% biotite, hornblende, and pyroxene. Interval from 125.2 to 128.6 ft has fractures filled with pinkish-white tuffaceous sandstone with fine-grained densely welded and crystallized tuff as lithic clasts, and locally derived fragments of various sizes.

Figure 1.1-113. Geologic Log of Drill Hole UE-25 RF#44 (Sheet 3 of 3)



GEOLOGIC LOG OF DRILL HOLE UE-25 RF#45

SHEET 1 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 6/1/2005 FINISHED: 6/6/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,268.13 E 571,021.95
TOTAL DEPTH: 125.5 ft
DEPTH TO BEDROCK: 93.0 ft

STATE: Nevada
GROUND ELEVATION: 3650.02
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES

Purpose of Hole:
Repository Facilities Geotechnical Investigations

Drill Equipment:
GP24 300 RS (Sonic Drill Rig)
Flatbed combination water and pipe truck with boom for moving drill pipe and casing.

Driller:
Travis Osterberg
Boart Longyear Drill Services

Drilling Method:
Rotosonic
Advance 8 in. casing as hole is cored 0.0 to 125.5 ft (TD). Drill string inside casing consists of 3½ in. single wall drill pipe with 6.163 in. Rotosonic Carbide button bit.

Drilling Conditions:
Not Reported

Drilling Fluid:
Small amounts of drilling additives were added to help in advancing casing.

Fluid Loss Interval:
NA

Casing Record:
8 in. casing from 0.00 to 125.50 ft (TD)

Hole Completion:
Back fill hole from 125.5 ft up to 0.00 ft (ground surface) with Bentonite Chips. Pull casing.

CLASSIFICATION AND PHYSICAL CONDITION

0.0 to 91.6 ft QUATERNARY ALLUVIUM (Qal):

0.0 to 7.3 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% coarse fine, hard, subangular gravel; about 45% coarse to fine, angular to subangular sand; trace of nonplastic fines, trace of hard subangular cobbles; maximum size 130 mm; moist, reddish brown to light reddish brown, strong reaction with HCl.

7.3 to 9.1 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 55% coarse to fine, subangular sand; about 40% coarse to fine, hard, subangular gravel; about 5% nonplastic fines, trace of hard subangular cobbles; maximum size 80 mm; dry, light brown, moderate reaction with HCl.

9.1 to 16.6 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% coarse to fine, hard, angular to subangular gravel; about 45% coarse to fine, angular to subangular sand; trace of nonplastic fines; dry, light reddish brown, moderate reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 5% hard, subangular cobbles; maximum size 130 mm; remainder minus 3 in.

16.6 to 18.0 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 55% coarse to fine, angular to subangular sand; about 45% coarse to fine, hard, angular to subangular gravel; trace of nonplastic fines; dry, pinkish gray, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 15% hard, subangular cobbles; maximum size 110 mm; remainder minus 3 in.

18.0 to 28.1 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, subangular gravel; about 40% coarse to fine, angular to subangular sand; trace of nonplastic fines; trace of hard, subangular cobbles; maximum size 125 mm; dry, pink, no reaction with HCl.

28.1 to 31.6 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 65% coarse to fine, angular sand; about 35% predominantly fine, hard, angular gravel; trace of nonplastic fines; maximum size 60 mm; dry, pink, moderate reaction with HCl.

31.6 to 34.0 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 55% predominantly fine, hard, subangular gravel; about 45% coarse to fine, angular sand; trace of nonplastic fines; maximum size 70 mm; dry, pinkish gray, strong reaction with HCl.

34.0 to 35.2 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 65% coarse to fine, angular sand; about 25% predominantly fine, hard, subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 50 mm; dry, pink, weak reaction with HCl.

35.2 to 42.5 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 45% coarse to fine, hard, subangular gravel; about 35% coarse to fine, subangular to angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, subangular cobbles; maximum size 100 mm; dry, pink, strong reaction with HCl.

42.5 to 43.4 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 60% coarse to fine, subangular sand; about 30% predominantly fine, hard, subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 40 mm; dry, pink, strong reaction with HCl.

43.4 to 46.4 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% coarse to fine, hard, angular to subangular gravel; about 45% coarse to fine, angular to subangular sand; trace of nonplastic fines; dry, pink, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 15% hard, subangular cobbles; maximum size 100 mm; remainder minus 3 in.

46.4 to 59.0 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 50%

Figure 1.1-114. Geologic Log of Drill Hole UE-25 RF#45 (Sheet 1 of 3)

NOTE: Descriptions of the material may not reflect in situ geologic conditions due to mechanical degradation of the sample by the Sonic drilling method; TD = total depth.

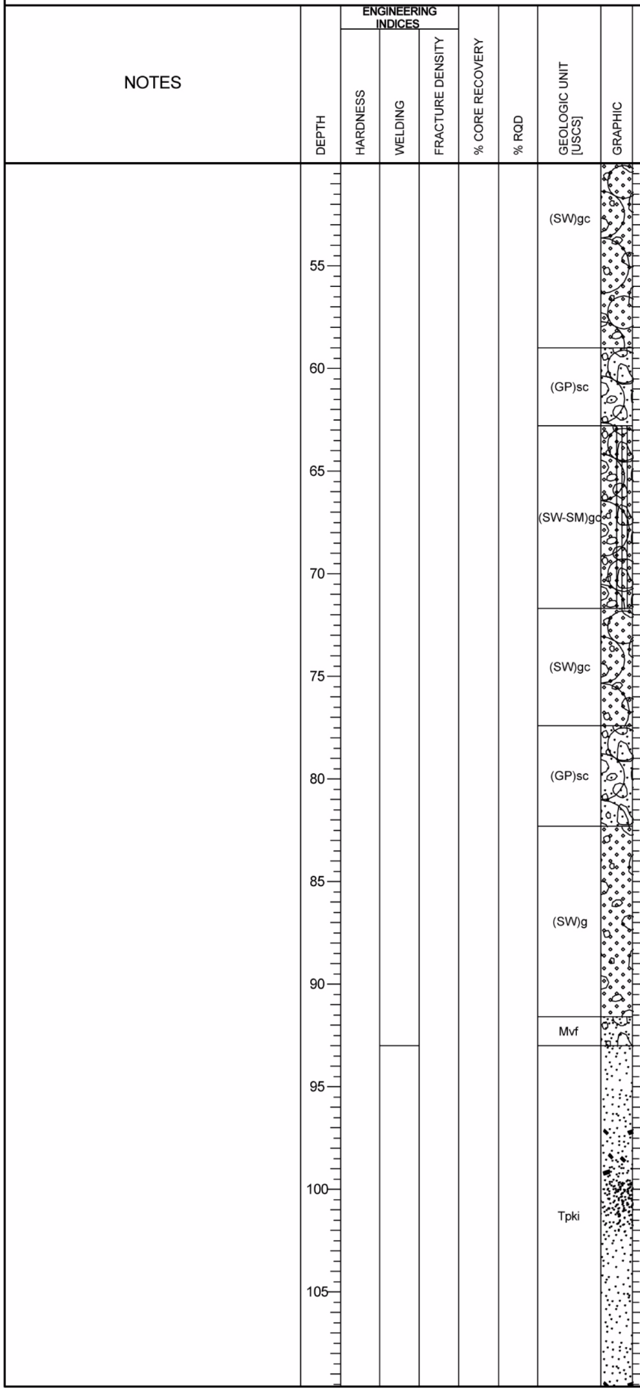
GEOLOGIC LOG OF DRILL HOLE UE-25 RF#45

SHEET 2 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 6/1/2005 FINISHED: 6/6/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,268.13 E 571,021.95
TOTAL DEPTH: 125.5 ft
DEPTH TO BEDROCK: 93.0 ft

STATE: Nevada
GROUND ELEVATION: 3650.02
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung



CLASSIFICATION AND PHYSICAL CONDITION

coarse to fine, angular to subangular sand; about 45% coarse to fine, hard, angular to subangular gravel; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 115 mm; dry, pink to pinkish gray, weak to strong reaction with HCl.

59.0 to 62.8 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 65% coarse to fine, hard, subangular gravel; about 35% coarse to fine, subangular sand; trace of nonplastic fines; trace of hard, subangular cobbles; maximum size 135 mm; dry, pink, strong reaction with HCl.

62.8 to 71.7 ft WELL GRADED SAND WITH SILT, GRAVEL AND COBBLES (SW-SM)gc: About 60% coarse to fine, angular to subangular sand; about 30% predominantly fine, angular to subangular gravel, gravel-size particles fractured with hammer blow; about 10% nonplastic fines with quick dilatancy and low toughness; dry, pink, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 10% hard, subangular and drilled cobbles; maximum size 150 mm; remainder minus 3 in.

71.7 to 77.4 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 55% coarse to fine, angular to subangular sand; about 40% predominantly fine, hard, angular to subangular gravel; about 5% nonplastic fines, dry, pinkish gray, weak reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 5% hard, subangular cobbles; maximum size 100 mm; remainder minus 3 in.

77.4 to 82.3 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 85% coarse to fine, hard, angular to subangular gravel; about 10% coarse to fine, subangular sand; about 5% nonplastic fines; dry, pinkish gray, strong reaction with HCl. Core removed from 78.9 to 80.6 ft.

TOTAL SAMPLE (BY VOLUME): About 15% hard, subangular cobbles; maximum size 220 mm; remainder minus 3 in.

82.3 to 91.6 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 60% coarse to fine, subangular sand; about 35% coarse to fine, hard, subangular gravel; about 5% nonplastic fines; maximum size 70 mm; dry, pink, strong reaction with HCl. Core removed from 90.6 to 91.6 ft.

91.6 to 93.0 ft MIOCENE(?) VALLEY FILL (Mvf):
Predominantly subrounded fragments of Tuff "X" and lesser crystallized welded tuff in a very fine to medium grained sand matrix of quartz, feldspar, and welded tuff, very pale brown. Generally no reaction with HCl. Scattered root casts.
93.0 to 125.5 ft COMB PEAK IGNIMBRITE - TUFF "X" (Tpki):
Pyroclastic flow, nonwelded, crystallized, white, 15 to 35% pumice, 1 to 10% lithic fragments of welded tuff, less than 1% crystal fragments of sanidine, plagioclase, biotite and hornblende.

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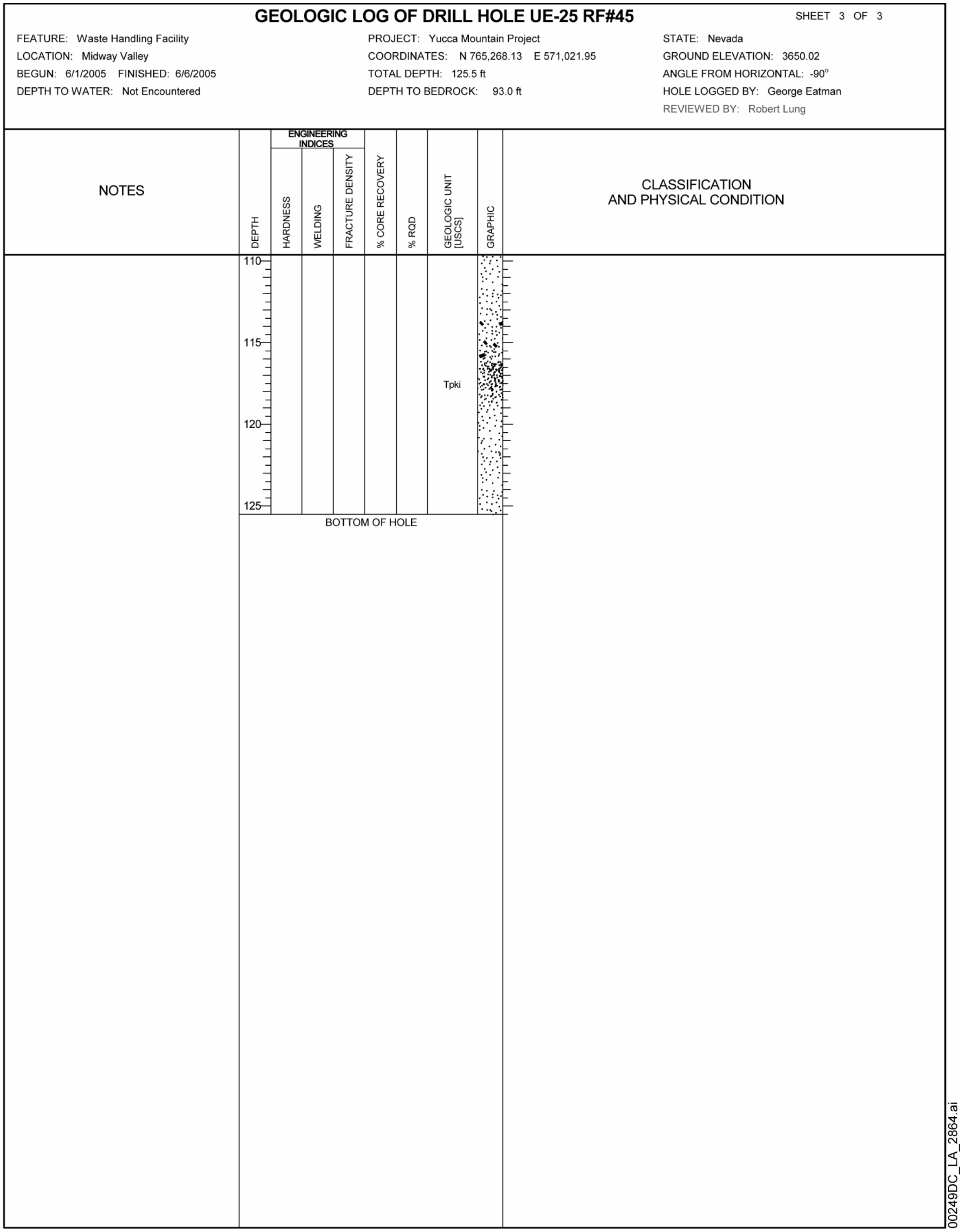
Figure 1.1-114. Geologic Log of Drill Hole UE-25 RF#45 (Sheet 2 of 3)



GEOLOGIC LOG OF DRILL HOLE UE-25 RF#45

SHEET 3 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 6/1/2005 FINISHED: 6/6/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,268.13 E 571,021.95
TOTAL DEPTH: 125.5 ft
DEPTH TO BEDROCK: 93.0 ft

STATE: Nevada
GROUND ELEVATION: 3650.02
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

Figure 1.1-114. Geologic Log of Drill Hole UE-25 RF#45 (Sheet 3 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#46

SHEET 1 OF 2

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 5/12/2005 FINISHED: 5/16/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 764,889.91 E 570,602.74
TOTAL DEPTH: 103.5 ft
DEPTH TO BEDROCK: 84.2 ft

STATE: Nevada
GROUND ELEVATION: 3669.22
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES

Purpose of Hole:
Repository Facilities Geotechnical Investigations

Drill Equipment:
GP24 300 RS (Sonic Drill Rig)
Flatbed combination water and pipe truck with boom for moving drill pipe and casing.

Driller:
Travis Osterberg
Boart Longyear Drill Services

Drilling Method:
Rotosonic
Advance 8 in. casing as hole is cored 0.0 to 103.5 ft (TD). Drill string inside casing consists of 3½ in. single wall drill pipe with 6.163 in. Rotosonic Carbide button bit.

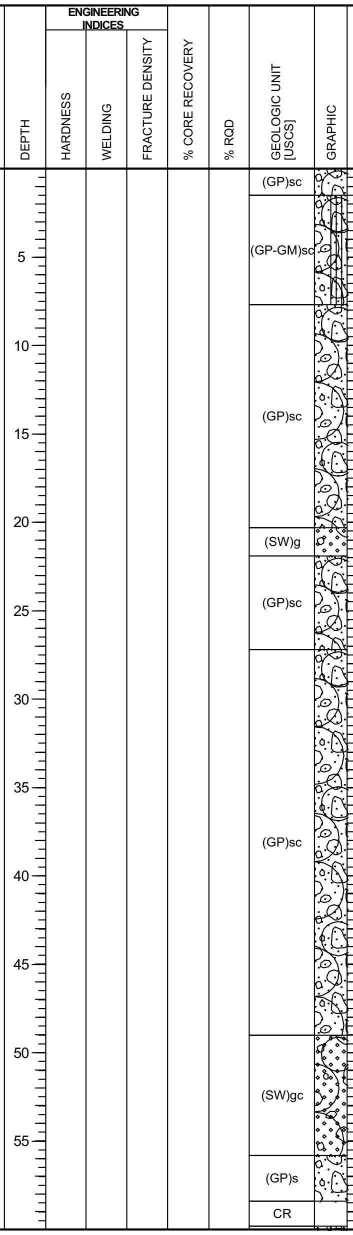
Drilling Conditions:
Not Reported

Drilling Fluid:
Small amounts of drilling additives were added to help in advancing casing.

Fluid Loss Interval:
NA

Casing Record:
8 in. casing from 0.00 to 103.5 ft (TD)

Hole Completion:
Back fill hole from 103.5 ft (TD) up to 0.0 ft (ground surface) with Bentonite Chips. Pull casing.



CLASSIFICATION
AND PHYSICAL CONDITION

0.0 to 27.2 ft PAD FILL

0.0 to 1.5 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% predominantly fine, hard, angular to subangular gravel; about 40% coarse to fine, subangular sand; about 5% nonplastic fines, trace of hard subangular cobbles; maximum size 110 mm; dry, gray, strong reaction with HCl. Pad fill.

1.5 to 7.7 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc: About 55% predominantly fine, hard, angular to subangular gravel; about 30% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness, trace of hard, subangular cobbles; maximum size 100 mm; dry, gray, no reaction with HCl. Pad fill.

7.7 to 20.3 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% predominantly fine, hard, angular to subangular gravel; about 40 to 45% coarse to fine, angular to subangular sand; trace to 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 90 mm; moist, light gray to light reddish brown, no to strong reaction with HCl. Pad fill.

20.3 to 21.9 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 70% coarse to fine, subangular sand; about 25% predominantly fine, hard, subangular gravel; about 5% nonplastic fines; maximum size 60 mm; moist, gray, no reaction with HCl. Pad fill.

21.9 to 27.2 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% coarse to fine, hard, subangular gravel; about 40% coarse to fine, angular to subangular sand; about 5% nonplastic fines; trace of hard subangular cobbles; maximum size 100 mm; moist, gray, no reaction with HCl. Pad fill.

27.2 to 84.2 ft QUATERNARY ALLUVIUM (Qal)

27.2 to 49.0 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% coarse to fine, hard, subangular, gravel; about 40% coarse to fine, angular to subangular sand; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 120 mm; moist, pink, light reddish brown, strong reaction with HCl.

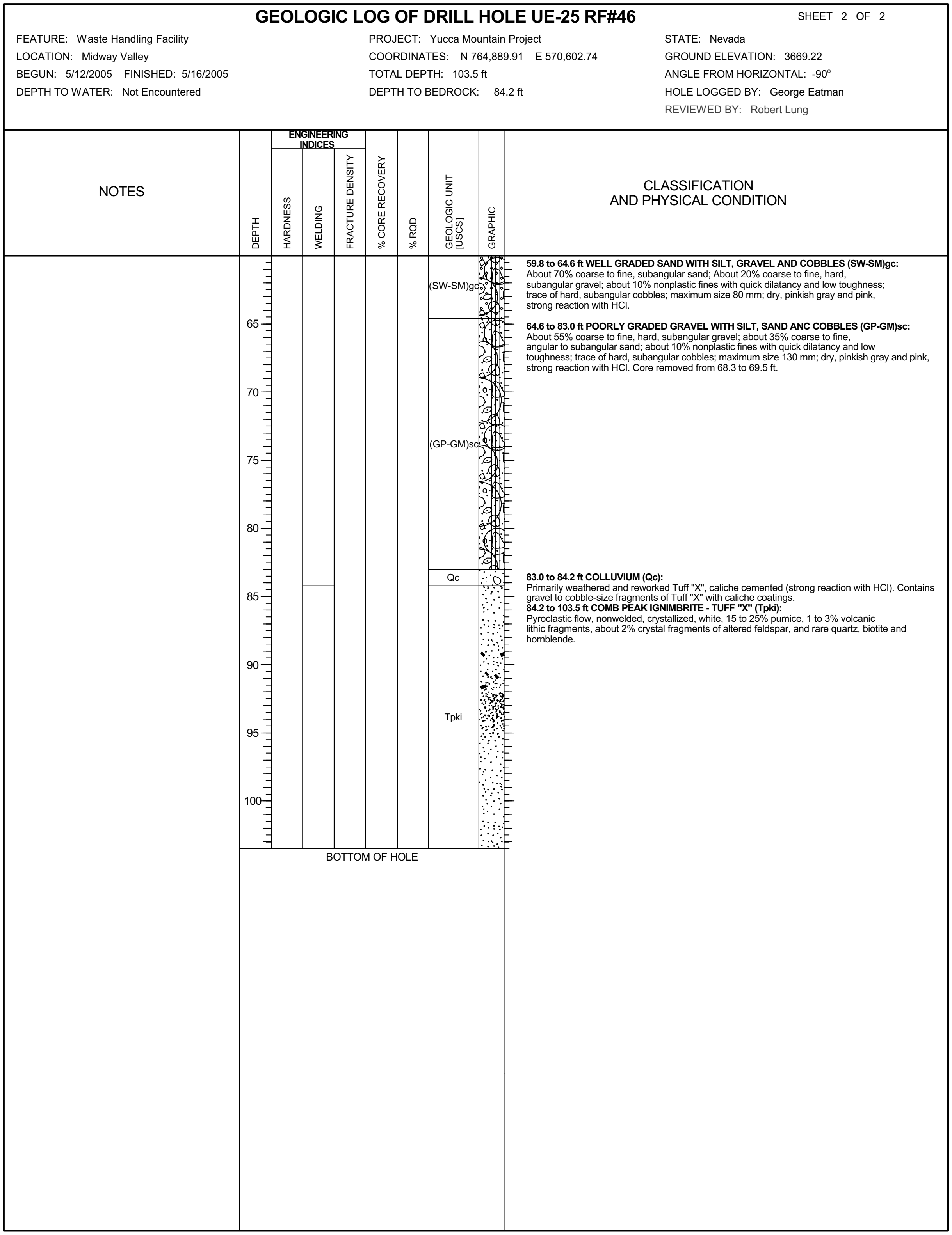
49.0 to 55.8 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 80% coarse to fine, angular to subangular sand; about 15% predominantly fine, hard, angular to subangular gravel; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 120 mm; dry, pink, no reaction with HCl.

55.8 to 58.4 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 65% predominantly fine, hard, angular gravel; about 35% coarse to fine, subangular sand; trace of nonplastic fines; maximum size 75 mm; dry, pink, strong reaction with HCl.

58.4 to 59.8 ft CORE REMOVED

Figure 1.1-115. Geologic Log of Drill Hole UE-25 RF#46 (Sheet 1 of 2)

NOTE: Descriptions of the material may not reflect in situ geologic conditions due to mechanical degradation of the sample by the Sonic drilling method; TD = total depth.



GEOLOGIC LOG OF DRILL HOLE UE-25 RF#46

SHEET 2 OF 2

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 5/12/2005 FINISHED: 5/16/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 764,889.91 E 570,602.74
TOTAL DEPTH: 103.5 ft
DEPTH TO BEDROCK: 84.2 ft

STATE: Nevada
GROUND ELEVATION: 3669.22
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

CLASSIFICATION AND PHYSICAL CONDITION

59.8 to 64.6 ft WELL GRADED SAND WITH SILT, GRAVEL AND COBBLES (SW-SM)gc:
About 70% coarse to fine, subangular sand; About 20% coarse to fine, hard, subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, subangular cobbles; maximum size 80 mm; dry, pinkish gray and pink, strong reaction with HCl.

64.6 to 83.0 ft POORLY GRADED GRAVEL WITH SILT, SAND ANC COBBLES (GP-GM)sc:
About 55% coarse to fine, hard, subangular gravel; about 35% coarse to fine, angular to subangular sand; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, subangular cobbles; maximum size 130 mm; dry, pinkish gray and pink, strong reaction with HCl. Core removed from 68.3 to 69.5 ft.

83.0 to 84.2 ft COLLUVIUM (Qc):
Primarily weathered and reworked Tuff "X", caliche cemented (strong reaction with HCl). Contains gravel to cobble-size fragments of Tuff "X" with caliche coatings.

84.2 to 103.5 ft COMB PEAK IGNIMBRITE - TUFF "X" (Tpki):
Pyroclastic flow, nonwelded, crystallized, white, 15 to 25% pumice, 1 to 3% volcanic lithic fragments, about 2% crystal fragments of altered feldspar, and rare quartz, biotite and hornblende.

Figure 1.1-115. Geologic Log of Drill Hole UE-25 RF#46 (Sheet 2 of 2)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#47

SHEET 1 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 7/12/2005 FINISHED: 7/13/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,746.68 E 571,076.62
TOTAL DEPTH: 122.3 ft
DEPTH TO BEDROCK: 97.0 ft

STATE: Nevada
GROUND ELEVATION: 3663.86
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES | DEPTH | ENGINEERING INDICES: HARDNESS, WELDING, FRACTURE DENSITY | % CORE RECOVERY | % RQD | GEOLOGIC UNIT [USCS] | GRAPHIC | CLASSIFICATION AND PHYSICAL CONDITION

Purpose of Hole:
Repository Facilities Geotechnical Investigations

Drill Equipment:
GP24 300 RS (Sonic Drill Rig)
Flatbed combination water and pipe truck with boom for moving drill pipe and casing.

Driller:
Travis Osterberg
Boart Longyear Drill Services

Drilling Method:
Rotosonic
Advance 8 in. casing as hole is cored 0.0 to 122.3 ft (TD). Drill string inside casing consists of 3½ in. singlewall drill pipe with 6.163 in. Rotosonic Carbide button bit.

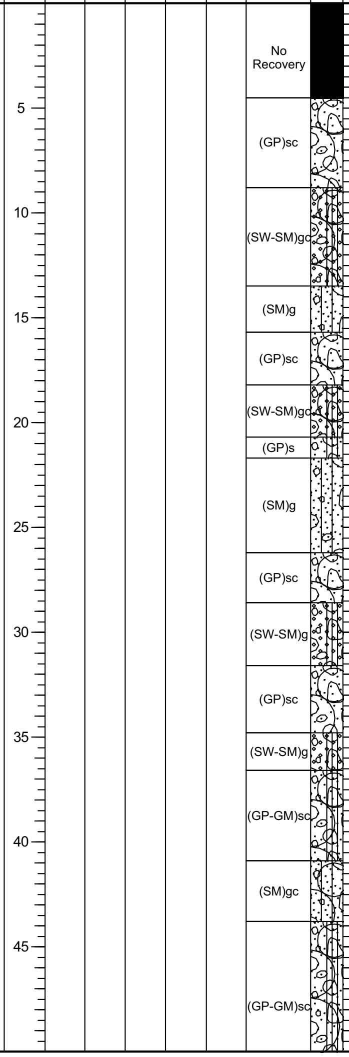
Drilling Conditions:
Not Reported

Drilling Fluid:
Small amounts of drilling additives were added to help in advancing casing.

Fluid Loss Interval:
NA

Casing Record:
8 in. casing from 0.0 to 122.3 ft (TD)

Hole Completion:
Back fill hole from 122.3 ft up to 0.0 ft (ground surface) with Bentonite Chips. Pull casing.



0.0 to 90.0 ft QUATERNARY ALLUVIUM (Qal)

0.0 to 4.5 ft NO CORE RECOVERED

4.5 to 8.8 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60 to 75% coarse to fine, hard, angular to subangular gravel; about 20 to 35% coarse to fine, angular sand; trace to 5% nonplastic fines; trace of hard subangular cobbles; maximum size 85 mm; dry, pink, weak to strong reaction with HCl. Caliche present.

8.8 to 13.5 ft WELL GRADED SAND WITH SILT, GRAVEL AND COBBLES (SW-SM)gc: About 55% coarse to fine, subangular sand; about 35% predominantly fine, hard, angular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; dry, pink, weak reaction with HCl. Caliche present.

TOTAL SAMPLE (BY VOLUME): About 10% hard, angular cobbles; maximum size 145 mm; remainder minus 3 in.

13.5 to 15.7 ft SILTY SAND WITH GRAVEL (SM)g: About 65% coarse to fine, angular to subangular sand; about 20% predominantly fine, hard, angular gravel; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 60 mm; dry, pink, strong reaction with HCl. Caliche present.

15.7 to 18.2 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% predominantly fine, hard, angular to subangular gravel; about 35% coarse to fine, subangular sand; about 5% nonplastic fines; trace of hard, drilled and subangular cobbles; maximum size 130 mm; dry, pinkish gray, strong reaction with HCl. Caliche present.

18.2 to 20.7 ft WELL GRADED SAND WITH SILT, GRAVEL AND COBBLES (SW-SM)gc: About 50% coarse to fine, angular to subangular sand; about 40% predominantly fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, subangular cobbles; maximum size 80 mm; dry, pinkish gray, strong reaction with HCl.

20.7 to 21.7 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 70% predominantly fine, hard, angular to subangular gravel; about 25% coarse to fine, angular sand; about 5% nonplastic fines; maximum size 60 mm; dry, pink, strong reaction with HCl.

21.7 to 26.2 ft SILTY SAND WITH GRAVEL (SM)g: About 45% coarse to fine, angular to subangular sand; about 40% predominantly fine, hard, subangular gravel; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 60 mm; dry, pinkish gray, strong reaction with HCl.

26.2 to 28.6 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% predominantly fine, hard, angular to subangular gravel; about 40% coarse to fine, angular to subangular sand; about 5% nonplastic fines; dry, pink, moderate reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 10% hard, drilled and subrounded cobbles; maximum size 110 mm; remainder minus 3 in.

28.6 to 31.6 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 50% coarse to fine, angular sand; about 40% predominantly fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 40 mm; dry, pink, no reaction with HCl.

31.6 to 34.8 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 65% predominantly coarse, hard, angular to subangular gravel; about 30% coarse to fine, angular sand; about 5% nonplastic fines; dry, pink, moderate reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 10% hard, subangular cobbles; maximum size 100 mm; remainder minus 3 in.

34.8 to 36.6 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 55% coarse to fine, angular to subangular sand; about 35% predominantly fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 65 mm; dry, pinkish gray, moderate reaction with HCl.

36.6 to 40.9 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc: About 50% predominantly fine, hard, angular to subangular gravel; about 40% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; dry, pinkish gray, weak reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 5% hard, subangular cobbles; maximum size 150 mm; remainder minus 3 in.

40.9 to 43.8 ft SILTY SAND WITH GRAVEL AND COBBLES (SM)gc: About 40% coarse to fine, angular sand; about 30% predominantly coarse, hard, angular to subangular gravel; about 30% nonplastic fines with quick dilatancy and low toughness; dry, light gray, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 15% hard, drilled and subangular cobbles; maximum size 130 mm; remainder minus 3 in.

43.8 to 51.9 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc: About 60% predominantly coarse, hard, angular gravel; about 30% coarse to fine,

Figure 1.1-116. Geologic Log of Drill Hole UE-25 RF#47 (Sheet 1 of 3)

NOTE: Descriptions of the material may not reflect in situ geologic conditions due to mechanical degradation of the sample by the Sonic drilling method; TD = total depth.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#47

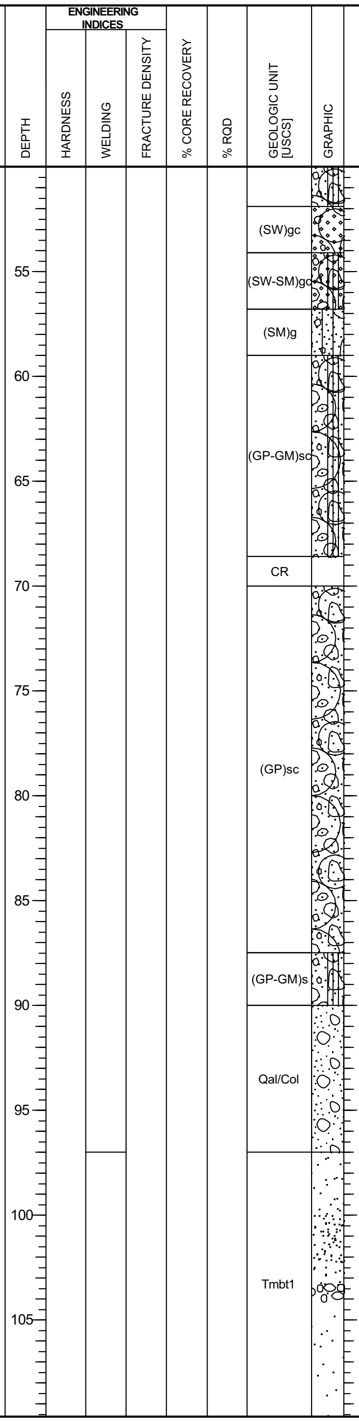
SHEET 2 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 7/12/2005 FINISHED: 7/13/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,746.68 E 571,076.62
TOTAL DEPTH: 122.3 ft
DEPTH TO BEDROCK: 97.0 ft

STATE: Nevada
GROUND ELEVATION: 3663.86
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES



CLASSIFICATION
AND PHYSICAL CONDITION

angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, subangular cobbles; maximum size 105 mm; dry, pinkish gray, strong reaction with HCl.

51.9 to 54.1 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 55% coarse to fine, angular sand; about 40% predominantly fine, hard, angular gravel; about 5% nonplastic fines; trace of hard, angular to subangular cobbles; maximum size 80 mm; dry, light reddish brown, moderate reaction with HCl.

54.1 to 56.8 ft WELL GRADED SAND WITH SILT, GRAVEL AND COBBLES (SW-SM)gc: About 55% coarse to fine, angular to subangular sand; about 35% predominantly coarse, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, drilled and angular to subangular cobbles; maximum size 85 mm; dry, pinkish gray, strong reaction with HCl.

56.8 to 59.0 ft SILTY SAND WITH GRAVEL (SM)g: About 65% coarse to fine, angular to subangular sand; about 20% predominantly fine, hard, angular gravel; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 20 mm; dry, pinkish gray, strong reaction with HCl.

59.0 to 68.6 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc: About 50% predominantly coarse, hard, angular gravel; about 40% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; dry, pinkish gray, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 5% hard, subangular cobbles; maximum size 120 mm; remainder minus 3 in.

68.6 to 70.0 ft CORE REMOVED

70.0 to 87.5 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 50 to 65% predominantly fine to predominantly coarse, hard, angular to subangular gravel; about 30 to 45% coarse to fine, angular to subangular sand; trace to 5% nonplastic fines; trace of hard, angular to subangular cobbles; maximum size 130 mm; dry, pink, no to strong reaction with HCl. Core removed from 81.6 to 83.0 ft.

87.5 to 90.0 ft POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)s: About 55% predominantly fine, hard, angular gravel; about 35% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 50 mm; dry, pinkish gray, moderate reaction with HCl.

90.0 to 97.0 ft ALLUVIUM/COLLUVIUM (Qal/Col):
Bedded, white, silt and very fine sand size fragments of welded tuff and lesser felsic crystals, caliche cemented (strong reaction with HCl), less than 10% densely welded tuff fragments up to 1 cm.

97.0 to 122.3 ft PRE-RAINIER MESA TUFF BEDDED TUFF (Tmbt1):
Bedded tuff, nonwelded, crystallized, slightly clay altered, white and pinkish white, calcite veinlets and fracture coatings near top of bed, 2 to 20% pumice, less than 1 to 15% lithic fragments of welded tuff or lava flow, less than 1 to 3% crystal fragments of sanidine, feldspar and quartz, less than 1% biotite.

Figure 1.1-116. Geologic Log of Drill Hole UE-25 RF#47 (Sheet 2 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#47

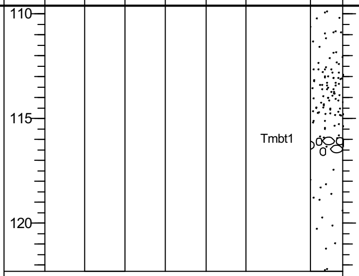
SHEET 3 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 7/12/2005 FINISHED: 7/13/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,746.68 E 571,076.62
TOTAL DEPTH: 122.3 ft
DEPTH TO BEDROCK: 97.0 ft

STATE: Nevada
GROUND ELEVATION: 3663.86
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES	DEPTH	ENGINEERING INDICES			% CORE RECOVERY	% RQD	GEOLOGIC UNIT [USCS]	GRAPHIC	CLASSIFICATION AND PHYSICAL CONDITION
		HARDNESS	WELDING	FRACTURE DENSITY					



BOTTOM OF HOLE

Figure 1.1-116. Geologic Log of Drill Hole UE-25 RF#47 (Sheet 3 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#48

SHEET 1 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 4/11/2005 FINISHED: 4/14/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,474.33 E 571,386.99
TOTAL DEPTH: 159.3 ft
DEPTH TO BEDROCK: 113.3 ft

STATE: Nevada
GROUND ELEVATION: 3653.64
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES | DEPTH | ENGINEERING INDICES: HARDNESS | WELDING | FRACTURE DENSITY | % CORE RECOVERY | % RQD | GEOLOGIC UNIT [USCS] | GRAPHIC | CLASSIFICATION AND PHYSICAL CONDITION

NOTES

Purpose of Hole:
Repository Facilities Geotechnical Investigations

Drill Equipment:
GP24 300 RS (Sonic Drill Rig)
Flatbed combination water and pipe truck with boom for moving drill pipe and casing.

Driller:
Travis Osterberg
Boart Longyear Drill Services

Drilling Method:
Rotosonic
Advance 8 in. casing as hole is cored 0.0 to 159.3 ft (TD). Drill string inside casing consists of 3½ in. single wall drill pipe with 6.163 in. Rotosonic Carbide button bit.

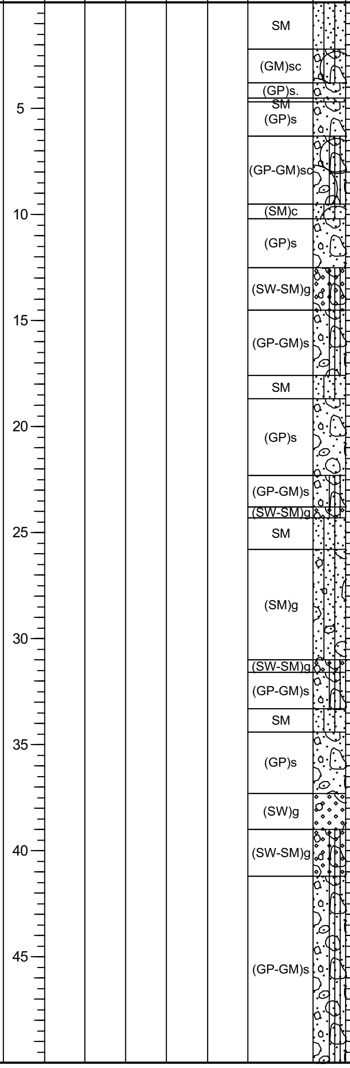
Drilling Conditions:
Not Reported

Drilling Fluid:
Small amounts of drilling additives were added to help in advancing casing.

Fluid Loss Interval:
NA

Casing Record:
8 in. casing from 0.0 to 159.3 ft (TD)

Hole Completion:
Back fill hole from 159.3 ft (TD) up to 0.0 ft (ground surface) with Bentonite Chips. Pull casing.



CLASSIFICATION AND PHYSICAL CONDITION

0.0 to 113.3 ft QUATERNARY ALLUVIUM (Qal)

0.0 to 2.2 ft SILTY SAND (SM): About 85% coarse to fine, subangular to subrounded sand; about 15% nonplastic fines with quick dilatancy and low toughness; trace of coarse to fine, hard, subangular to subrounded gravel; maximum size 75 mm; dry, brown, no reaction with HCl. Grass and roots present. Topsoil.
2.2 to 3.8 ft SILTY GRAVEL WITH SAND AND COBBLES (GM)sc: About 60% coarse to fine, hard, angular to subrounded gravel; about 25% coarse to fine, subangular to subrounded sand; about 15% nonplastic fines with quick dilatancy and low toughness; trace of hard, subrounded cobbles; maximum size 95 mm, dry, light tan, strong reaction with HCl.
3.8 to 4.5 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 55% coarse to fine, hard, angular gravel; about 40% coarse to fine, angular to subangular sand; about 5% nonplastic fines; maximum size 20 mm, dry, brown, moderate reaction with HCl. Grass and plant material present.
4.5 to 4.7 ft SILTY SAND (SM): About 85% coarse to fine, angular to subangular sand; about 15% nonplastic fines with quick dilatancy and low toughness; trace of predominantly fine, hard, angular gravel; maximum size 55 mm, dry, gray, strong reaction with HCl.
4.7 to 6.3 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 50% predominantly fine, hard, angular to subangular gravel; about 45% coarse to fine, angular to subangular sand; about 5% nonplastic fines; maximum size 75 mm, dry, light brown, strong reaction with HCl.
6.3 to 9.5 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc: About 65% predominantly fine, hard, angular gravel; about 25% coarse to fine, angular to subangular sand; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, subangular to subrounded cobbles; maximum size 100 mm, dry, light tan, strong reaction with HCl.
9.5 to 10.2 ft SILTY SAND WITH COBBLES (SM)c: About 70% coarse to fine, angular to subangular sand; about 30% nonplastic fines with quick dilatancy and low toughness; trace of predominantly fine, hard, angular to subangular gravel; trace of hard subangular to subrounded cobbles; maximum size 105 mm, dry, gray, strong reaction with HCl.
10.2 to 12.5 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 50% coarse to fine, hard, angular to subangular gravel; about 45% coarse to fine, subangular sand; about 5% nonplastic fines; maximum size 55 mm, dry, tan, strong reaction with HCl.
12.5 to 14.5 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 65% coarse to fine, angular to subangular sand; about 25% predominantly fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 45 mm, dry, gray, strong reaction with HCl.
14.5 to 17.6 ft POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)s: About 60% coarse to fine, hard, angular to subangular gravel; about 30% coarse to fine, angular to subangular sand; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 35 mm, dry, tan, strong reaction with HCl.
17.6 to 18.7 ft SILTY SAND (SM): About 80% coarse to fine, hard, subangular to subrounded sand; about 20% nonplastic fines with quick dilatancy and low toughness; trace of predominantly fine, hard, subangular gravel; maximum size 25 mm, dry, tan, strong reaction with HCl.
18.7 to 22.3 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 60% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular to subangular sand; about 5% nonplastic fines; maximum size 65 mm, dry, tan to light brown, strong reaction with HCl.
22.3 to 23.8 ft POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)s: About 70% coarse to fine, hard, angular gravel; about 20% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 70 mm, dry, gray, strong reaction with HCl.
23.8 to 24.3 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 65% coarse to fine, angular to subangular sand; about 25% predominantly fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 40 mm, dry, gray, strong reaction with HCl.
24.3 to 25.8 ft SILTY SAND (SM): About 85% coarse to fine, subangular to subrounded sand; about 15% nonplastic fines with quick dilatancy and low toughness; trace of predominantly fine, hard, subangular to subrounded gravel; maximum size 25 mm, dry, gray, strong reaction with HCl.
25.8 to 31.0 ft SILTY SAND WITH GRAVEL (SM)g: About 65% coarse to fine, angular to subrounded sand; about 20% predominantly fine, hard, angular gravel; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 70 mm, dry, tan, strong reaction with HCl.
31.0 to 31.6 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 70% predominantly fine, angular to subangular sand; about 20% coarse to fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 40 mm, dry, gray to tan, no reaction with HCl.
31.6 to 33.3 ft POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)s: About 50% coarse to fine, hard, angular gravel; about 40% coarse to fine, angular to subangular sand; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 25 mm, dry, gray to tan, no reaction with HCl.
33.3. to 34.4 ft SILTY SAND (SM): About 60% coarse to fine, hard, subangular sand; about 25% nonplastic fines with quick dilatancy and low toughness; about 10% predominantly fine, hard, subangular gravel; maximum size 60 mm, dry, gray, moderate reaction with HCl.
34.4 to 37.3 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 70% coarse to

Figure 1.1-117. Geologic Log of Drill Hole UE-25 RF#48 (Sheet 1 of 3)

NOTE: Descriptions of the material may not reflect in situ geologic conditions due to mechanical degradation of the sample by the Sonic drilling method; TD = total depth.

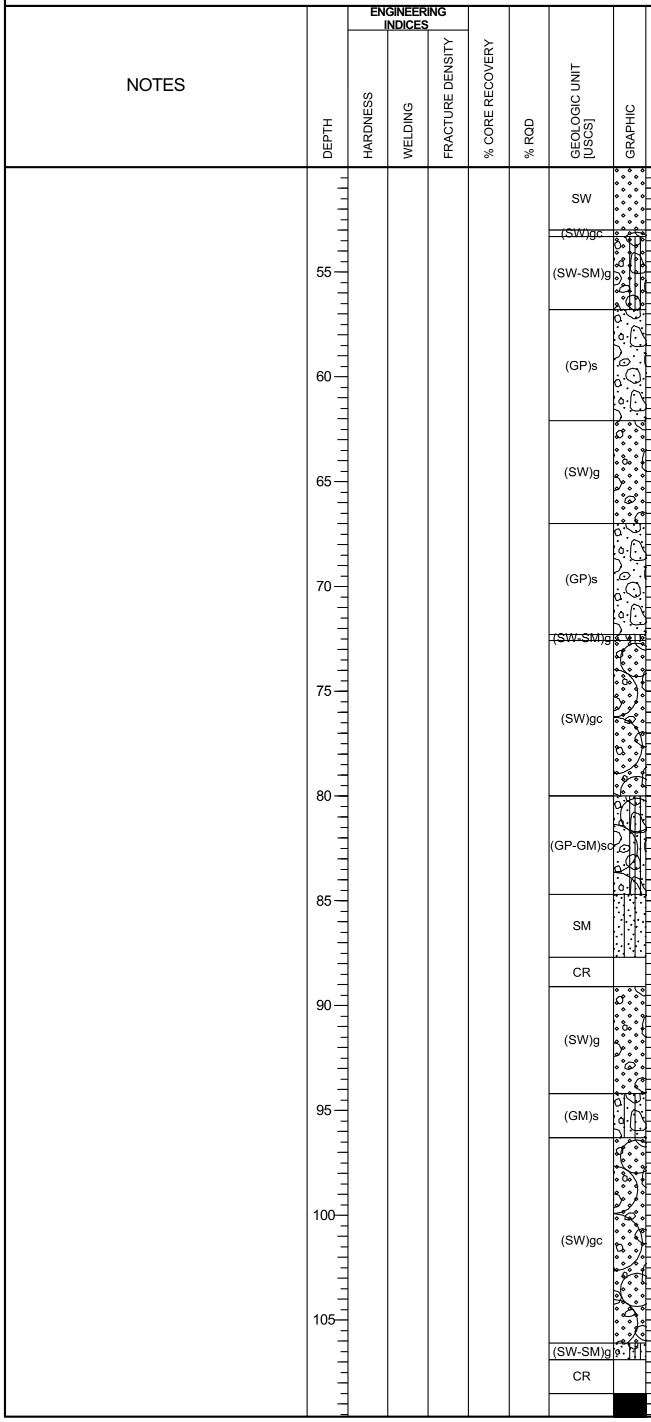
GEOLOGIC LOG OF DRILL HOLE UE-25 RF#48

SHEET 2 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 4/11/2005 FINISHED: 4/14/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,474.33 E 571,386.99
TOTAL DEPTH: 159.3 ft
DEPTH TO BEDROCK: 113.3 ft

STATE: Nevada
GROUND ELEVATION: 3653.64
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung



CLASSIFICATION AND PHYSICAL CONDITION

fine, hard, angular to subangular gravel; about 25% coarse to fine, angular to subangular sand; about 5% nonplastic fines; maximum size 60 mm, dry, gray, strong reaction with HCl.

37.3 to 39.0 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 65% coarse to fine, angular to subangular sand; about 35% coarse to fine, hard, angular to subangular gravel; trace of nonplastic fines; maximum size 45 mm, dry, light brown and tan, no to strong reaction with HCl.

39.0 to 41.2 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 65% coarse to fine, angular to subangular sand; about 25% predominantly fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 35 mm, dry, tan, strong reaction with HCl.

41.2 to 50.0 ft POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)s: About 55% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular to subangular sand; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 50 mm, dry, gray, strong reaction with HCl.

50.0 to 53.0 ft WELL GRADED SAND (SW): About 90% coarse to fine, angular to subangular sand; about 5% coarse to fine, hard, angular to subangular gravel; about 5% nonplastic fines; maximum size 130 mm, dry, tan, strong reaction with HCl.

53.0 to 53.3 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 55% coarse to fine, angular to subangular sand; about 40% predominantly fine, hard, angular gravel; about 5% nonplastic fines; trace of subangular to subrounded cobbles; maximum size 140 mm, dry, light gray, weak to moderate reaction with HCl.

53.3 to 56.8 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 60% coarse to fine, angular to subangular sand; about 30% coarse to fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 45 mm, dry, gray, strong reaction with HCl.

56.8 to 62.1 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 55% coarse to fine, hard, subangular to subrounded gravel; about 40% coarse to fine, subangular to subrounded sand; about 5% nonplastic fines; maximum size 60 mm, dry, tan, strong reaction with HCl.

62.1 to 67.0 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 70% coarse to fine, angular to subangular sand; about 15% coarse to fine, hard, angular to subangular gravel; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 25 mm, dry, gray, strong reaction with HCl.

67.0 to 72.3 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 55% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, angular to subangular sand; about 5% nonplastic fines; maximum size 55 mm, dry, tan, strong reaction with HCl.

72.3 to 72.6 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 70% coarse to fine, angular to subangular sand; about 20% predominantly fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 35 mm, dry, gray, strong reaction with HCl.

72.6 to 80.0 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 70% coarse to fine, angular to subangular sand; about 25% predominantly fine, hard, angular to subangular gravel; about 5% nonplastic fines; trace of hard, subangular to subrounded cobbles; maximum size 120 mm, dry, light brown, strong reaction with HCl.

80.0 to 84.7 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc. About 50% coarse to fine, hard, angular gravel; about 40% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, subangular to subrounded cobbles; maximum size 80 mm, dry, gray, strong reaction with HCl.

84.7 to 87.7 ft SILTY SAND (SM): About 75% coarse to fine, subangular to subrounded sand; about 25% nonplastic fines with quick dilatancy and low toughness; trace of predominantly fine, hard, subangular to subrounded gravel; maximum size 70 mm, dry, tan, strong reaction with HCl.

87.7 to 89.1 ft CORE REMOVED

89.1 to 94.2 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 50% coarse to fine, angular sand; about 45% coarse to fine, hard, angular gravel; about 5% nonplastic fines; maximum size 65 mm, dry, tan, strong reaction with HCl.

94.2 to 96.3 ft SILTY GRAVEL WITH SAND (GM)s: About 40% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular to subangular sand; about 25% nonplastic fines with quick dilatancy and low toughness; maximum size 50 mm, dry, gray, strong reaction with HCl.

96.3 to 106.1 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 70 to 80% coarse to fine, angular to subrounded sand; about 15 to 25% coarse to fine, hard, angular to subrounded gravel; about 5% nonplastic fines; trace of hard, drilled and angular cobbles; maximum size 140 mm, dry, tan and light tan, strong reaction with HCl. Core removed from 97.2 to 99.0 ft.

106.1 to 106.9 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 65% coarse to fine, subangular sand, coarse sand-size particles fractured with hammer blow; about 25% predominantly fine, hard, subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 15 mm; dry, gray, strong reaction with HCl.

106.9 to 108.5 ft CORE REMOVED

Figure 1.1-117. Geologic Log of Drill Hole UE-25 RF#48 (Sheet 2 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#48

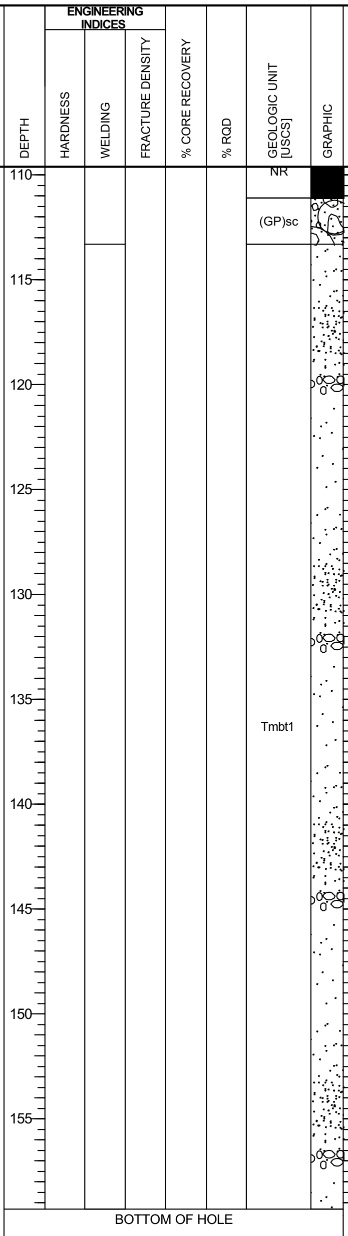
SHEET 3 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 4/11/2005 FINISHED: 4/14/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,474.33 E 571,386.99
TOTAL DEPTH: 159.3 ft
DEPTH TO BEDROCK: 113.3 ft

STATE: Nevada
GROUND ELEVATION: 3653.64
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES



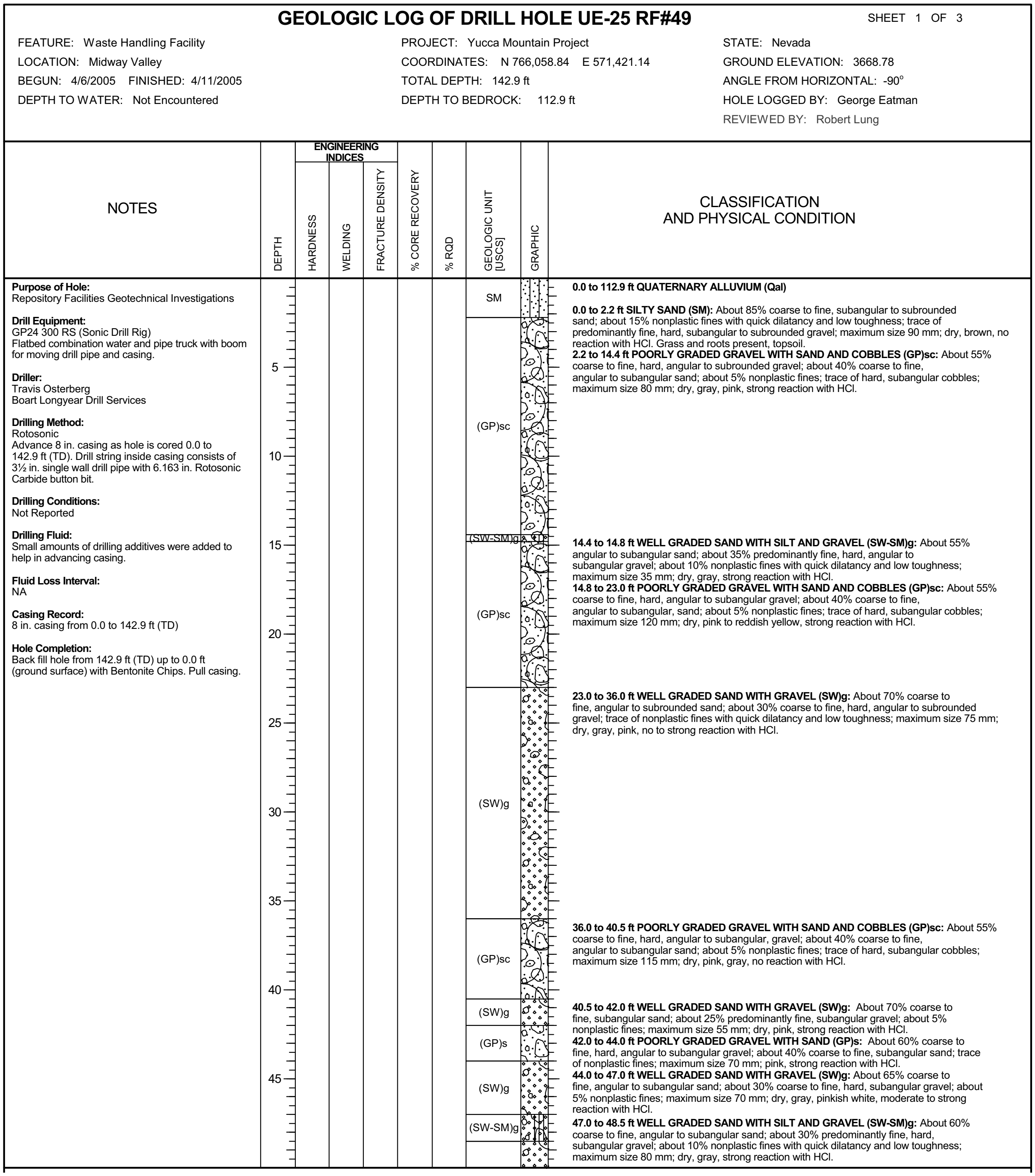
CLASSIFICATION
AND PHYSICAL CONDITION

108.5 to 111.1 ft NO RECOVERY INTERVAL

111.1 to 113.3 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, angular to subangular gravel; about 35% coarse to fine, angular to subangular sand; about 5% nonplastic fines; trace of angular cobbles; maximum size 95 mm; dry, light yellowish tan, strong reaction with HCl.

113.3 to 159.3 ft PRE-RAINIER MESA TUFF BEDDED TUFF (Tmbt1):
Pyroclastic flow(?) at the top of the unit, and bedded tuffs below, nonwelded, partially clay altered, 3 to 25% pumice, less than 1 to 10% lithic fragments of welded crystallized tuff, less than 1 to 6% crystal fragments of quartz, sanidine, and plagioclase, less than 1% biotite, lesser hornblende and altered pyroxene(?). Bedded tuff is reworked from 156.7 to 159.3 ft and consists predominantly of fine to very fine sand size fragments of quartz, feldspar, and crystallized welded tuff in a clay altered matrix, less than 1% crystal fragments of sanidine, plagioclase, biotite, hornblende(?), and magnetite.

Figure 1.1-117. Geologic Log of Drill Hole UE-25 RF#48 (Sheet 3 of 3)



GEOLOGIC LOG OF DRILL HOLE UE-25 RF#49

SHEET 1 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 4/6/2005 FINISHED: 4/11/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,058.84 E 571,421.14
TOTAL DEPTH: 142.9 ft
DEPTH TO BEDROCK: 112.9 ft

STATE: Nevada
GROUND ELEVATION: 3668.78
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES

Purpose of Hole:
Repository Facilities Geotechnical Investigations

Drill Equipment:
GP24 300 RS (Sonic Drill Rig)
Flatbed combination water and pipe truck with boom for moving drill pipe and casing.

Driller:
Travis Osterberg
Boart Longyear Drill Services

Drilling Method:
Rotosonic
Advance 8 in. casing as hole is cored 0.0 to 142.9 ft (TD). Drill string inside casing consists of 3½ in. single wall drill pipe with 6.163 in. Rotosonic Carbide button bit.

Drilling Conditions:
Not Reported

Drilling Fluid:
Small amounts of drilling additives were added to help in advancing casing.

Fluid Loss Interval:
NA

Casing Record:
8 in. casing from 0.0 to 142.9 ft (TD)

Hole Completion:
Back fill hole from 142.9 ft (TD) up to 0.0 ft (ground surface) with Bentonite Chips. Pull casing.

CLASSIFICATION AND PHYSICAL CONDITION

0.0 to 112.9 ft QUATERNARY ALLUVIUM (Qal)

0.0 to 2.2 ft SILTY SAND (SM): About 85% coarse to fine, subangular to subrounded sand; about 15% nonplastic fines with quick dilatancy and low toughness; trace of predominantly fine, hard, subangular to subrounded gravel; maximum size 90 mm; dry, brown, no reaction with HCl. Grass and roots present, topsoil.

2.2 to 14.4 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% coarse to fine, hard, angular to subrounded gravel; about 40% coarse to fine, angular to subangular sand; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 80 mm; dry, gray, pink, strong reaction with HCl.

14.4 to 14.8 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 55% angular to subangular sand; about 35% predominantly fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 35 mm; dry, gray, strong reaction with HCl.

14.8 to 23.0 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, angular to subangular, sand; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 120 mm; dry, pink to reddish yellow, strong reaction with HCl.

23.0 to 36.0 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 70% coarse to fine, angular to subrounded sand; about 30% coarse to fine, hard, angular to subrounded gravel; trace of nonplastic fines with quick dilatancy and low toughness; maximum size 75 mm; dry, gray, pink, no to strong reaction with HCl.

36.0 to 40.5 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% coarse to fine, hard, angular to subangular, gravel; about 40% coarse to fine, angular to subangular sand; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 115 mm; dry, pink, gray, no reaction with HCl.

40.5 to 42.0 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 70% coarse to fine, subangular sand; about 25% predominantly fine, subangular gravel; about 5% nonplastic fines; maximum size 55 mm; dry, pink, strong reaction with HCl.

42.0 to 44.0 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 60% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, subangular sand; trace of nonplastic fines; maximum size 70 mm; pink, strong reaction with HCl.

44.0 to 47.0 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 65% coarse to fine, angular to subangular sand; about 30% coarse to fine, hard, subangular gravel; about 5% nonplastic fines; maximum size 70 mm; dry, gray, pinkish white, moderate to strong reaction with HCl.

47.0 to 48.5 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 60% coarse to fine, angular to subangular sand; about 30% predominantly fine, hard, subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 80 mm; dry, gray, strong reaction with HCl.

Figure 1.1-118. Geologic Log of Drill Hole UE-25 RF#49 (Sheet 1 of 3)

NOTE: Descriptions of the material may not reflect in situ geologic conditions due to mechanical degradation of the sample by the Sonic drilling method; TD = total depth.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#49

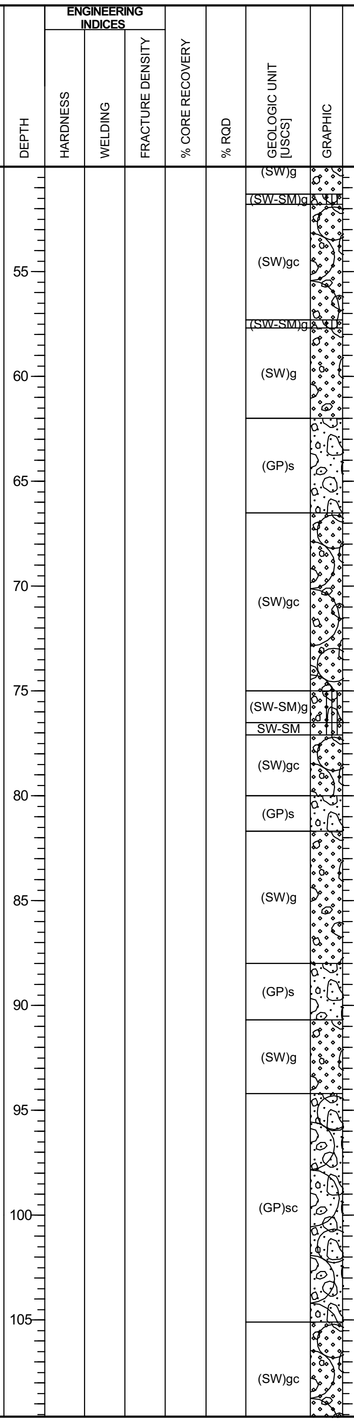
SHEET 2 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 4/6/2005 FINISHED: 4/11/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,058.84 E 571,421.14
TOTAL DEPTH: 142.9 ft
DEPTH TO BEDROCK: 112.9 ft

STATE: Nevada
GROUND ELEVATION: 3668.78
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES



CLASSIFICATION AND PHYSICAL CONDITION

48.5 to 51.3 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 70% coarse to fine, angular to subangular sand; about 25% coarse to fine, angular to subangular gravel; about 5% nonplastic fines; maximum size 85 mm; dry, gray, strong reaction with HCl.

51.3 to 51.8 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 70% coarse to fine, subangular to subrounded sand; about 20% predominantly fine, hard, subangular to subrounded gravel; about 10% nonplastic fines with low dry strength and quick dilatancy; maximum size 15 mm; dry, gray, strong reaction with HCl.

51.8 to 57.3 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 65% coarse to fine, subangular sand; about 30% coarse to fine, hard, subangular gravel; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 115 mm; dry, pink, gray, no to strong reaction with HCl.

57.3 to 57.7 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 60% coarse to fine, angular to subangular sand; about 30% predominantly fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 15 mm; dry, gray, strong reaction with HCl.

57.7 to 62.0 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 60% coarse to fine, angular to subangular sand; about 35% coarse to fine, hard, angular to subangular gravel; trace to 5% nonplastic fines; maximum size 115 mm; dry, pink, gray, strong reaction with HCl.

62.0 to 66.5 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 60% coarse to fine, hard, subangular gravel; about 40% coarse to fine, subangular sand; trace of nonplastic fines; maximum size 80 mm; dry, gray, moderate reaction with HCl.

66.5 to 75.0 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 60% coarse to fine, angular to subangular sand; about 35% coarse to fine, hard, angular to subangular gravel; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 95 mm; dry, pink, gray, no to strong reaction with HCl.

75.0 to 76.5 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 60% coarse to fine, subangular sand; about 30% predominantly fine, hard, subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 55 mm; dry, pink, moderate reaction with HCl.

76.5 to 77.1 ft WELL GRADED SAND WITH SILT (SW-SM): About 85% coarse to fine, subangular sand; about 5% predominantly fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 45 mm; dry, gray, strong reaction with HCl.

77.1 to 80.0 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 60% coarse to fine, angular to subangular sand; about 35% coarse to fine, hard, angular to subangular gravel; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 85 mm; dry, no to strong reaction with HCl.

80.0 to 81.7 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 55% coarse to fine, hard, subangular gravel; about 45% coarse to fine, subangular sand; trace of nonplastic fines; maximum size 90 mm; dry, pink, no reaction with HCl.

81.7 to 88.0 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 60% coarse to fine, angular to subangular sand; about 35% predominantly fine, hard, angular to subangular gravel; about 5% nonplastic fines; maximum size 65 mm; dry, pink, gray, no to weak reaction with HCl.

88.0 to 90.7 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 80% coarse to fine, hard, angular to subangular gravel; about 20% coarse to fine, angular to subangular sand; trace of nonplastic fines; maximum size 65 mm; dry, gray, weak reaction with HCl.

90.7 to 94.2 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 70% coarse to fine, subangular sand; about 25% predominantly fine, hard, angular to subangular gravel; about 5% nonplastic fines; maximum size 45 mm; dry, gray, moderate to strong reaction with HCl.

94.2 to 105.1 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% coarse to fine, hard, angular to subangular gravel; about 45% coarse to fine, angular to subangular sand; trace of nonplastic fines; trace of hard, subangular cobbles; maximum size 100 mm; dry, pink, pinkish white, strong reaction with HCl. Core removed from 95.1 to 96.7 ft.

105.1 to 110.5 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 70% coarse to fine, subangular sand; about 25% coarse to fine, hard, angular to subangular, gravel; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 90 mm; dry, gray, strong reaction with HCl. Core removed from 106.6 to 108.3 ft.

Figure 1.1-118. Geologic Log of Drill Hole UE-25 RF#49 (Sheet 2 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#49

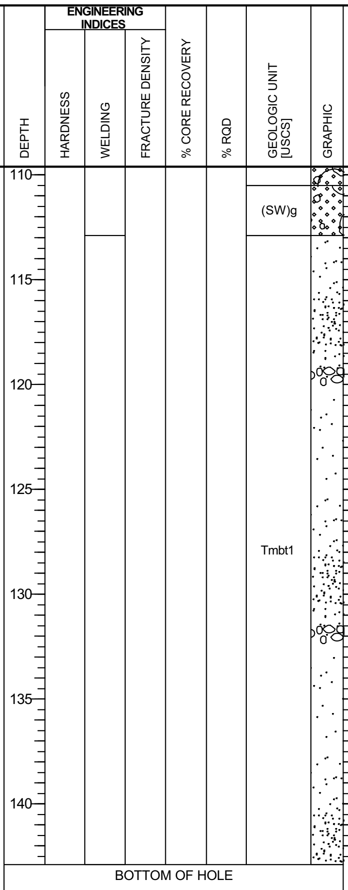
SHEET 3 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 4/6/2005 FINISHED: 4/11/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,058.84 E 571,421.14
TOTAL DEPTH: 142.9 ft
DEPTH TO BEDROCK: 112.9 ft

STATE: Nevada
GROUND ELEVATION: 3668.78
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES



CLASSIFICATION AND PHYSICAL CONDITION

110.5 to 112.9 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 60% coarse to fine, angular to subangular sand; about 35% coarse to fine, hard, angular to subangular gravel; about 5% nonplastic fines; maximum size 100 mm; dry, gray, strong reaction with HCl.

112.9 to 142.9 ft PRE-RAINIER MESA TUFF BEDDED TUFF (Tmbt1): Bedded tuffs interbedded with tephras.

The bedded tuff is nonwelded, poorly consolidated, locally cemented, white, light gray, composed of ash and very fine to medium sand size crystal fragments, 5 to 15% pumice (locally 25%), rare to 1% volcanic lithic fragments. Portions of the bedded tuff is probably reworked.

The tephra is nonwelded, vitric, poorly consolidated, locally altered, locally cemented, white, 20 to 98% pumice, rare to 15% lithic fragments, less than 1% to abundant vitric shards and fragments, 1 to 2% crystal fragments of quartz and sanidine, rare biotite.

Figure 1.1-118. Geologic Log of Drill Hole UE-25 RF#49 (Sheet 3 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#50

SHEET 1 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 4/14/2005 FINISHED: 4/19/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,785. E 571,698.02
TOTAL DEPTH: 155.5 ft
DEPTH TO BEDROCK: 123.2 ft

STATE: Nevada
GROUND ELEVATION: 3656.26
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES | DEPTH | ENGINEERING INDICES: HARDNESS, WELDING, FRACTURE DENSITY | % CORE RECOVERY | % RQD | GEOLOGIC UNIT [USCS] | GRAPHIC | CLASSIFICATION AND PHYSICAL CONDITION

Purpose of Hole:
Repository Facilities Geotechnical Investigations

Drill Equipment:
GP24 300 RS (Sonic Drill Rig)
Flatbed combination water and pipe truck with boom for moving drill pipe and casing.

Driller:
Travis Osterberg
Boart Longyear Drill Services

Drilling Method:
Rotosonic
Advance 8 in. casing as hole is cored 0.0 to 103.5 ft (TD). Drill string inside casing consists of 3½ in. single wall drill pipe with 6.163 in. Rotosonic Carbide button bit.

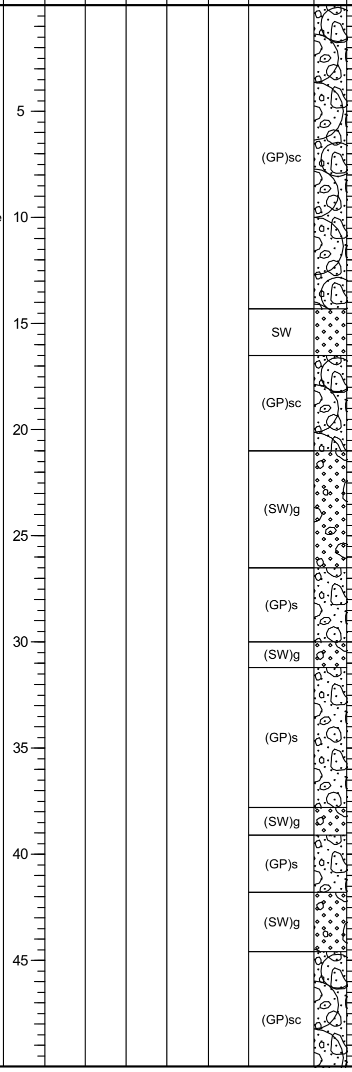
Drilling Conditions:
Not Reported

Drilling Fluid:
Small amounts of drilling additives were added to help in advancing casing.

Fluid Loss Interval:
NA

Casing Record:
8 in. casing from 0.0 to 155.5 ft (TD)

Hole Completion:
Back fill hole from 155.5 ft (TD) up to 0.0 ft (ground surface) with Bentonite Chips. Pull casing.



0.0 to 123.2 ft QUATERNARY ALLUVIUM (Qal)

0.0 to 14.3 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 65% coarse to fine, hard, angular to subrounded gravel; about 30% coarse to fine, angular to subrounded sand; about 5% nonplastic fines; trace of hard drilled cobbles; maximum size 150 mm; moist, reddish brown, light reddish brown, light gray, moderate to mostly strong reaction with HCl. Some organic materials present near the top.

14.3 to 16.5 ft WELL GRADED SAND (SW): About 90% coarse to fine, angular to subangular sand; about 10% predominantly fine, hard, subangular gravel; trace of nonplastic fines; maximum size 30 mm; moist, pink, strong reaction with HCl.

16.5 to 21.0 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 80% coarse to fine, hard, angular gravel; about 20% coarse to fine, angular to subangular sand; trace of nonplastic fines; moist, reddish brown, moderate reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 10% hard, drilled cobbles; maximum size 130 mm; remainder minus 3 in.

21.0 to 26.5 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 60% coarse to fine, angular to subangular sand; about 40% predominantly fine, hard, angular to subangular gravel; trace of nonplastic fines; maximum size 40 mm; moist, reddish brown, light gray, no to strong reaction with HCl.

26.5 to 30.0 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 55% predominantly fine, hard, angular to subangular gravel; about 45% coarse to fine, angular to subangular sand; trace of nonplastic fines; maximum size 50 mm; moist, light reddish brown, no reaction with HCl.

30.0 to 31.2 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 55% coarse to fine, angular to subangular sand; about 45% predominantly fine, hard, angular to subangular gravel; trace of nonplastic fines; maximum size 65 mm; moist, light reddish brown, no reaction with HCl.

31.2 to 37.8 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 60% predominantly fine, hard, angular to subangular gravel; about 40% coarse to fine, angular to subangular sand; trace of nonplastic fines; maximum size 50 mm; moist, reddish brown, weak reaction with HCl.

37.8 to 39.1 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 55% coarse to fine, subangular to subrounded sand; about 45% predominantly fine, hard, angular to subangular gravel; trace of nonplastic fines; maximum size 70 mm; moist, light reddish brown, pink, strong reaction with HCl.

39.1 to 41.8 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 65% coarse to fine, hard, angular to subrounded gravel; about 30% coarse to fine, subangular to subrounded sand; about 5% nonplastic fines; maximum size 70 mm; dry to moist, pink, light gray, light reddish brown, strong reaction with HCl.

41.8 to 44.6 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 55% coarse to fine, angular to subangular sand; about 40% coarse to fine, hard, angular to subangular gravel; about 5% nonplastic fines; maximum size 45 mm; moist, light gray, pink, no to strong reaction with HCl.

44.6 to 51.0 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular to subangular sand; about 5% nonplastic fines; moist, pink, light reddish brown, light gray, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 10% hard, subangular to subrounded cobbles; maximum size 85 mm; remainder minus 3 in.

Figure 1.1-119. Geologic Log of Drill Hole UE-25 RF#50 (Sheet 1 of 3)

NOTE: Descriptions of the material may not reflect in situ geologic conditions due to mechanical degradation of the sample by the Sonic drilling method; TD = total depth.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#50

SHEET 2 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 4/14/2005 FINISHED: 4/19/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,785. E 571,698.02
TOTAL DEPTH: 155.5 ft
DEPTH TO BEDROCK: 123.2 ft

STATE: Nevada
GROUND ELEVATION: 3656.26
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES

DEPTH

ENGINEERING INDICES: HARDNESS, WELDING, FRACTURE DENSITY

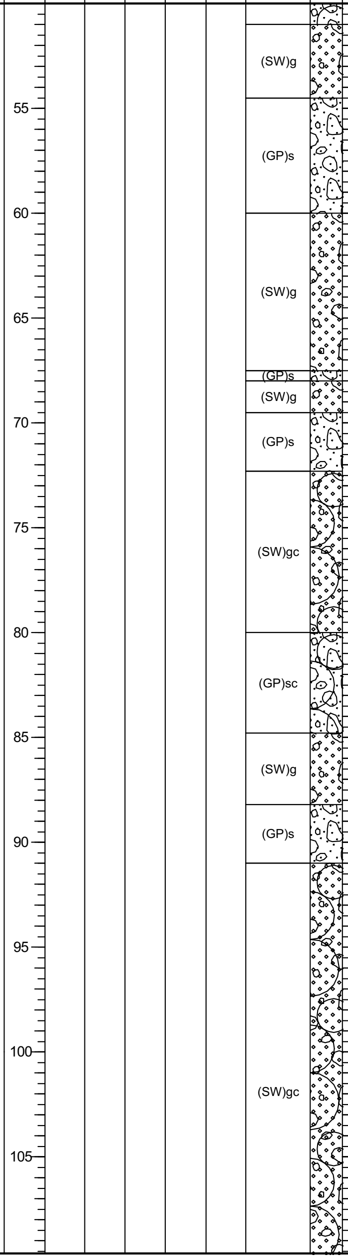
% CORE RECOVERY

% RQD

GEOLOGIC UNIT [USCS]

GRAPHIC

CLASSIFICATION AND PHYSICAL CONDITION



51.0 to 54.5 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 70% coarse to fine, angular to subangular sand; about 30% predominantly fine, hard, angular to subangular gravel; trace of nonplastic fines; maximum size 25 mm; moist, pinkish gray, light reddish brown, strong reaction with HCl.

54.5 to 60.0 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 55% coarse to fine, hard, subangular gravel; about 45% coarse to fine, subangular to subrounded sand; trace of nonplastic fines; maximum size 45 mm; moist, pinkish gray, strong reaction with HCl.

60.0 to 67.5 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 70% coarse to fine, angular to subangular sand; about 25% predominantly fine, hard, angular to subangular gravel; trace to 5% nonplastic fines; maximum size 40 mm; moist, light gray, pink, pinkish gray, strong reaction with HCl.

67.5 to 68.0 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 60% coarse to fine, hard, angular gravel; about 35%, coarse to fine, angular to subangular sand; about 5% nonplastic fines; maximum size 65 mm; moist, light gray, strong reaction with HCl.
68.0 to 69.5 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 55% coarse to fine, angular to subangular sand; about 40% predominantly fine, hard, angular gravel; about 5% nonplastic fines; maximum size 30 mm; moist, light gray, strong reaction with HCl.
69.5 to 72.3 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 55% predominantly fine, hard, angular gravel; about 40% coarse to fine, angular to subangular sand; about 5% nonplastic fines; maximum size 60 mm; moist, light gray, strong reaction with HCl.
72.3 to 80.0 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 70% coarse to fine, angular to subrounded sand; about 25% predominantly fine, hard, angular to subangular gravel; about 5% nonplastic fines; moist, pinkish gray, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 10% hard, subangular cobbles; maximum size 120 mm; remainder minus 3 in.

80.0 to 84.8 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% predominantly fine, hard, angular to subangular gravel; about 40% coarse to fine, angular to subangular sand; trace of nonplastic fines; moist, pink, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 10% hard, subangular cobbles; maximum size 85 mm; remainder minus 3 in.

84.8 to 88.2 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 80% coarse to fine, angular to subangular sand; about 15% predominantly fine, hard, angular to subangular gravel; about 5% nonplastic fines; maximum size 25 mm; moist, pink, light gray, strong reaction with HCl.

88.2 to 91.0 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 60% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, angular to subangular sand; trace of nonplastic fines; maximum size 45 mm; moist, pink, light gray, strong reaction with HCl.

91.0 to 112.8 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 65% coarse to fine, angular to subangular sand; about 30% coarse to fine, hard, angular to subangular gravel; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 120 mm; moist, pinkish gray, pink, light gray, weak to strong reaction with HCl. Core removed from 91.6 to 93.1 ft, and from 105.4 to 107.2 ft.

Figure 1.1-119. Geologic Log of Drill Hole UE-25 RF#50 (Sheet 2 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#50

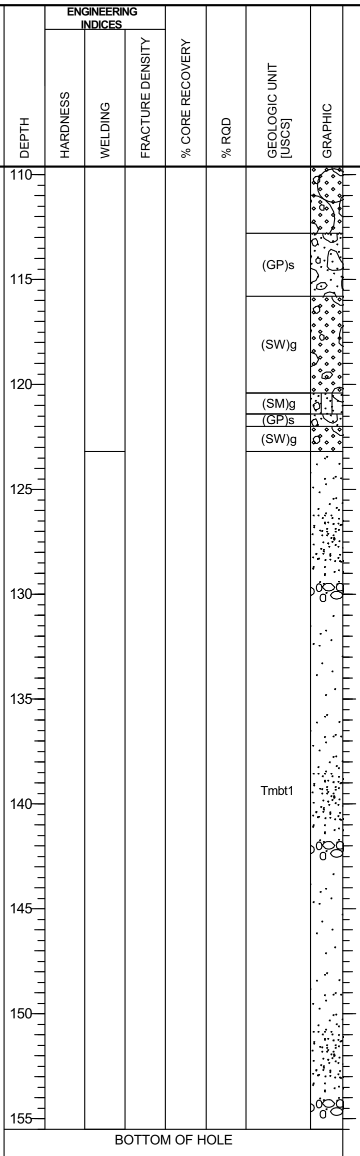
SHEET 3 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 4/14/2005 FINISHED: 4/19/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,785. E 571,698.02
TOTAL DEPTH: 155.5 ft
DEPTH TO BEDROCK: 123.2 ft

STATE: Nevada
GROUND ELEVATION: 3656.26
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES



CLASSIFICATION
AND PHYSICAL CONDITION

112.8 to 115.8 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 60% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, angular to subangular sand; trace of nonplastic fines; maximum size 80 mm; moist, pink, strong reaction with HCl.

115.8 to 120.4 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 70% coarse to fine, angular to subangular sand; about 25% coarse to fine, hard, angular to subangular gravel; about 5% nonplastic fines; maximum size 50 mm; moist, gray, strong reaction with HCl. Core removed from 116.5 to 118.2 ft.

120.4 to 121.4 ft SILTY SAND WITH GRAVEL (SM)g: About 45% coarse to fine, angular to subangular sand; about 40% coarse to fine, hard, angular to subangular gravel; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 45 mm; moist, light gray, strong reaction with HCl.
121.4 TO 122.0 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 70% coarse to fine, hard, angular gravel; about 30% coarse to fine, angular to subangular sand; trace of nonplastic fines; maximum size 90 mm; moist, gray, strong reaction with HCl.
122.0 to 123.2 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 65% coarse to fine, angular to subangular sand; about 30% coarse to fine, hard, angular to subangular gravel; about 5% nonplastic fines; maximum size 30 mm; moist, pink, gray, strong reaction with HCl.
123.2 to 155.5 ft PRE-RAINIER MESA TUFF BEDDED TUFF (Tmbt1):
Bedded tuffs with tephras.

The bedded tuff is nonwelded, partially consolidated, vitric, with zones of intense clay alteration, very pale brown and white, 10 to 40% pumice, 3 to 50% crystal fragments of quartz and sanidine.

The tephra is nonwelded, poorly to partially consolidated, vitric, with some possibly reworked zones, very friable locally, light brown, pale brown, pink, and white, 2 to 40% pumice, ash with less than 1 to 10% felsic crystal fragments, less than 1% and locally absent volcanic lithic fragments, less than 1% or 10 to 15% locally of volcanic glass fragments.

Figure 1.1-119. Geologic Log of Drill Hole UE-25 RF#50 (Sheet 3 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#51

SHEET 1 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 3/29/2005 FINISHED: 3/31/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,313.71 E 571,672.09
TOTAL DEPTH: 156.7 ft
DEPTH TO BEDROCK: 128.4 ft

STATE: Nevada
GROUND ELEVATION: 3671.96
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES	DEPTH	ENGINEERING INDICES			% CORE RECOVERY	% RQD	GEOLOGIC UNIT [USCS]	GRAPHIC	CLASSIFICATION AND PHYSICAL CONDITION
		HARDNESS	WELDING	FRACTURE DENSITY					
Purpose of Hole: Repository Facilities Geotechnical Investigations **Drill Equipment:** GP24 300 RS (Sonic Drill Rig) Flatbed combination water and pipe truck with boom for moving drill pipe and casing. **Driller:** Travis Osterberg Boart Longyear Drill Services **Drilling Method:** Rotosonic Advance 8 in. casing as hole is cored 0.0 to 156.7 ft (TD). Drill string inside casing consists of 3½ in. single wall drill pipe with 6.163 in. Rotosonic Carbide button bit. **Drilling Conditions:** Not Reported Drilling Fluid: Small amounts of drilling additives were added to help in advancing casing. Fluid Loss Interval: NA Casing Record: 8 in. casing from 0.0 to 156.7 ft (TD) Hole Completion: Back fill hole from 156.7 ft (TD) up to 0.0 ft (ground surface) with Bentonite Chips. Pull casing.	5 10 15 20 25						(GM)sc		**0.0 to 128.4 ft QUATERNARY ALLUVIUM (Qal)** **0.0 to 26.6 ft SILTY GRAVEL WITH SAND AND COBBLES (GM)sc:** About 50% coarse to fine, hard, angular to subrounded gravel; about 35% coarse to fine, angular to subrounded sand; about 15% nonplastic fines with quick dilatancy and low toughness, trace of hard, subangular to subrounded cobbles; maximum size 110 mm; dry, light reddish brown, pink, no reaction with HCl near top of hole, to strong reaction with depth.
							SM		**26.6 to 26.9 ft SILTY SAND (SM):** About 55% coarse to fine, subangular to subrounded sand; about 40% nonplastic fines with quick dilatancy and low toughness; about 5% predominantly fine, hard, subangular to subrounded gravel; maximum size 60 mm; dry, light gray, strong reaction with HCl.
	30 35						(GP)sc		**26.9 to 39.4 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc:** About 65% coarse to fine, hard, angular to subrounded gravel; about 35% coarse to fine, angular to subrounded sand; trace of nonplastic fines; trace of hard, subrounded cobbles; maximum size 80 mm, dry, pink, no reaction with HCl.
	40						(SW-SM)g		**39.4 to 42.6 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g:** About 70% coarse to fine, subangular to subrounded sand; about 20% coarse to fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 30 mm, dry, pink, no reaction with HCl.
	45						(GP-GM)sc		**42.6 to 46.0 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc:** About 50% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, subangular to subrounded sand; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, subrounded cobbles; maximum size 80 mm; dry, pink, no reaction with HCl.
							(GM)s		**46.0 to 50.0 ft SILTY GRAVEL WITH SAND (GM)s:** About 45% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, subangular to subrounded sand; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 30 mm, dry, pink, strong reaction with HCl.

Figure 1.1-120. Geologic Log of Drill Hole UE-25 RF#51 (Sheet 1 of 3)

NOTE: Descriptions of the material may not reflect in situ geologic conditions due to mechanical degradation of the sample by the Sonic drilling method; TD = total depth.

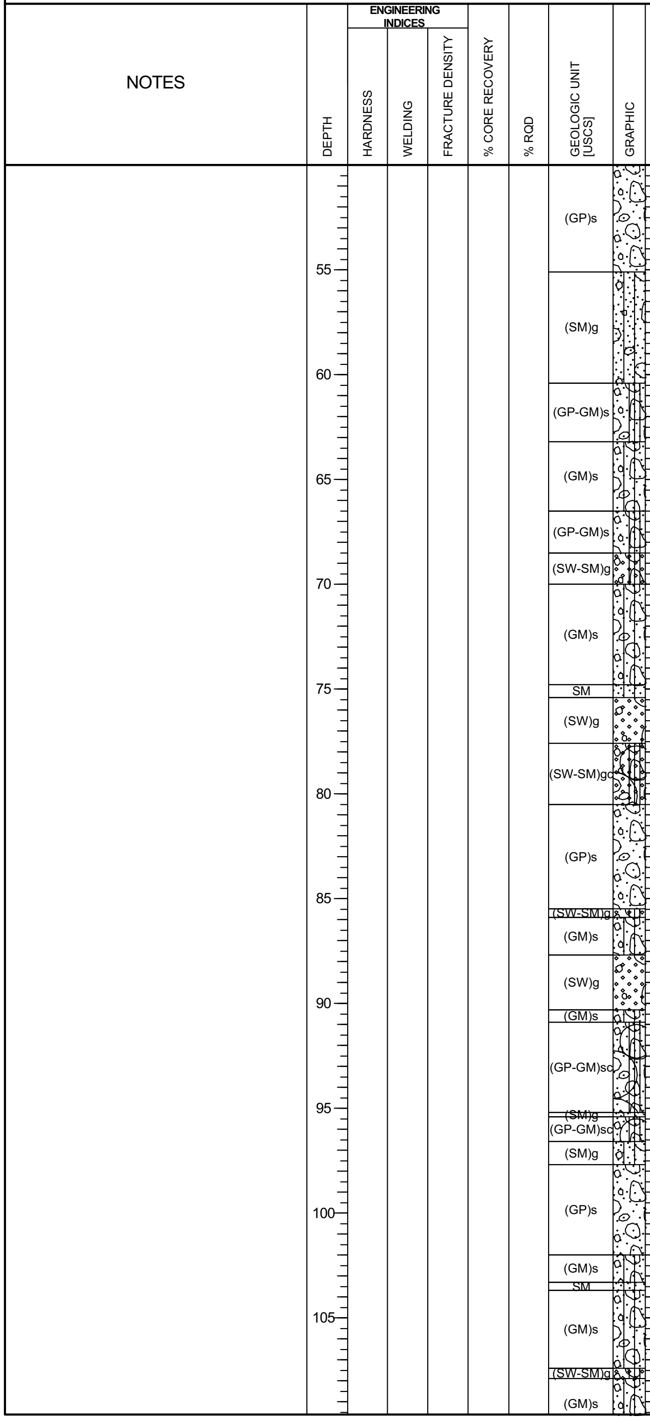
GEOLOGIC LOG OF DRILL HOLE UE-25 RF#51

SHEET 2 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 3/29/2005 FINISHED: 3/31/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,313.71 E 571,672.09
TOTAL DEPTH: 156.7 ft
DEPTH TO BEDROCK: 128.4 ft

STATE: Nevada
GROUND ELEVATION: 3671.96
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung



CLASSIFICATION AND PHYSICAL CONDITION

50.0 to 55.1 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 65% coarse to fine, hard, angular gravel; about 30% coarse to fine, subangular to subrounded sand; about 5% nonplastic fines; maximum size 75 mm; dry, pink, strong reaction with HCl.

55.1 to 60.4 ft SILTY SAND WITH GRAVEL (SM)g: About 50% coarse to fine, angular to subrounded sand; about 35% predominantly fine, hard, angular to subangular gravel; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 65 mm; dry, pink, strong reaction with HCl.

60.4 to 63.2 ft POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)s: About 60% coarse to fine, hard, subangular to subrounded gravel; about 30% coarse to fine, subangular to subrounded sand; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 85 mm, dry, pink, strong reaction with HCl.

63.2 to 66.5 ft SILTY GRAVEL WITH SAND (GM)s: About 60% coarse to fine, hard, angular to subangular gravel; about 25% coarse to fine, subangular to subrounded sand; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 70 mm; dry, pink, strong reaction with HCl.

66.5 to 68.5 ft POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)s: About 50% predominantly fine, hard, angular to subangular gravel; about 40% coarse to fine, angular to subrounded sand; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 65 mm; dry, pink, strong reaction with HCl.

68.5 to 70.0 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 70% coarse to fine, subangular to subrounded sand; about 20% coarse to fine, hard, subangular to subrounded gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 90 mm; dry, pink, strong reaction with HCl.

70.0 to 74.8 ft SILTY GRAVEL WITH SAND (GM)s: About 45% coarse to fine, hard, subangular to subrounded gravel; about 35% coarse to fine, subangular to subrounded sand; about 20% nonplastic fines with quick dilatancy and low toughness; maximum size 40 mm; dry, pinkish gray, strong reaction with HCl.

74.8 to 75.4 ft SILTY SAND (SM): About 75% coarse to fine, subangular to subrounded sand; about 25% nonplastic fines with quick dilatancy and low toughness; trace of predominantly fine, hard, subangular gravel; maximum size 60 mm; dry, light gray, strong reaction with HCl.

75.4 to 77.6 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 65% coarse to fine, subangular to subrounded sand; about 30% coarse to fine, hard, angular to subrounded gravel; about 5% nonplastic fines; maximum size 85 mm; dry, pink, strong reaction with HCl.

77.6 to 80.5 ft WELL GRADED SAND WITH SILT, GRAVEL AND COBBLES (SW-SM)gc: About 60% coarse to fine, angular to subrounded sand; about 30% coarse to fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, subrounded cobbles; maximum size 115 mm; dry, pink, strong reaction with HCl.

80.5 to 85.5 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 55% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, subangular to subrounded sand; about 5% nonplastic fines; maximum size 130 mm; dry, pink, light reddish brown, no reaction with HCl.

85.5 to 85.9 ft POORLY GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 50% coarse to fine, subangular to subrounded sand; about 25% predominantly fine, hard, angular to subangular gravel; about 25% nonplastic fines with quick dilatancy and low toughness; maximum size 35 mm; dry, pinkish gray, strong reaction with HCl.

85.9 to 87.7 ft SILTY GRAVEL WITH SAND (GM)s: About 40% predominantly fine, hard, angular to subangular gravel; about 35% coarse to fine, angular to subangular sand; about 25% nonplastic fines with quick dilatancy and low toughness; maximum size 60 mm; dry, pinkish gray, strong reaction with HCl.

87.7 to 90.3 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 75% coarse to fine, subangular to subrounded sand; about 20% predominantly fine, hard, angular to subangular gravel; about 5% nonplastic fines; maximum size 60 mm; dry, light gray, strong reaction with HCl.

90.3 to 90.9 ft SILTY GRAVEL WITH SAND (GM)s: About 70% coarse to fine, hard, angular to subangular gravel; about 15% coarse to fine, subangular to subrounded sand; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 50 mm; dry, light gray, strong reaction with HCl.

90.9 to 95.2 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc: About 50% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, angular to subangular sand; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, subrounded cobbles; maximum size 85 mm; dry, pinkish gray, strong reaction with HCl.

95.2 to 95.4 ft SILTY SAND WITH GRAVEL (SM)g: About 60% coarse to fine, angular to subangular sand; about 25% predominantly fine, hard, angular to subangular gravel; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 35 mm; dry, light gray, strong reaction with HCl.

95.4 to 96.6 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc: About 60% coarse to fine, hard, angular to subangular gravel; about 30% coarse to fine, angular to subangular sand; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, subangular cobbles; maximum size 80 mm; dry, pink, strong reaction with HCl.

96.6 to 97.7 ft SILTY SAND WITH GRAVEL (SM)g: About 50% coarse to fine, angular to subangular sand; about 25% coarse to fine, hard, subangular gravel; about 25% nonplastic fines with quick dilatancy and low toughness; maximum size 50 mm; dry, light gray, strong reaction with HCl.

97.7 to 102.0 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 55% coarse to fine, hard, angular to subrounded gravel; about 45% coarse to fine, angular to subangular sand; trace of nonplastic fines; maximum size 105 mm; dry, pinkish gray, strong reaction with HCl.

Figure 1.1-120. Geologic Log of Drill Hole UE-25 RF#51 (Sheet 2 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#51

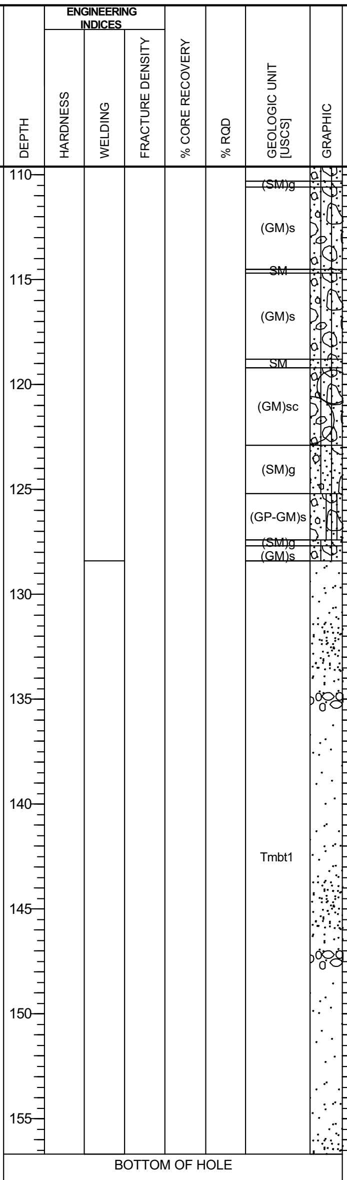
SHEET 3 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 3/29/2005 FINISHED: 3/31/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,313.71 E 571,672.09
TOTAL DEPTH: 156.7 ft
DEPTH TO BEDROCK: 128.4 ft

STATE: Nevada
GROUND ELEVATION: 3671.96
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES



CLASSIFICATION AND PHYSICAL CONDITION

Core removed from 100.4 to 101.4 ft.
102.0 to 103.3 ft SILTY GRAVEL WITH SAND (GM)s: About 40% predominantly fine, hard, angular to subangular gravel; about 30% nonplastic fines with quick dilatancy and low toughness; about 20% coarse to fine, angular to subangular sand; maximum size 60 mm; dry, pinkish gray, strong reaction with HCl.
103.3 to 103.7 ft SILTY SAND (SM): About 60% coarse to fine, subangular to subrounded sand; about 40% nonplastic fines with quick dilatancy and low toughness; trace of predominantly fine, hard, subangular gravel; maximum size 15 mm; dry, light gray, strong reaction with HCl.
103.7 to 107.4 ft SILTY GRAVEL WITH SAND (GM)s: About 55% coarse to fine, hard, angular to subangular gravel; about 30% coarse to fine, angular to subangular sand; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 80 mm; dry, pink, strong reaction with HCl.
107.4 to 107.9 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 60% coarse to fine, angular to subangular sand; about 30% predominantly fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 30 mm; dry, pink, strong reaction with HCl.
107.9 to 110.3 ft SILTY GRAVEL WITH SAND (GM)s: About 45% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, subangular to subrounded sand; about 20% nonplastic fines with quick dilatancy and low toughness; maximum size 65 mm; dry, light gray, strong reaction with HCl.
110.3 to 110.6 ft SILTY SAND WITH GRAVEL (SM)g: About 65% coarse to fine, angular to subangular sand; about 20% predominantly fine, hard, angular to subangular gravel; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 125 mm; dry, light gray, strong reaction with HCl.
110.6 to 114.5 ft SILTY GRAVEL WITH SAND (GM)s: About 45% coarse to fine, hard, angular gravel; about 40% coarse to fine, angular to subangular sand; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 60 mm; dry, pinkish gray, strong reaction with HCl. Core removed from 111.5 to 112.3 ft.
114.5 to 114.7 ft SILTY SAND (SM): About 80% coarse to fine, subangular to subrounded sand; about 20% nonplastic fines with quick dilatancy and low toughness; trace of predominantly fine, hard, angular to subangular gravel; maximum size 15 mm; dry, light gray, strong reaction with HCl.
114.7 to 118.8 ft SILTY GRAVEL WITH SAND (GM)s: About 55% coarse to fine, hard, angular to subangular gravel; about 30% coarse to fine, angular to subangular sand; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 40 mm; dry, pink, strong reaction with HCl.
118.8 to 119.2 ft SILTY SAND (SM): About 65% coarse to fine, subangular to subrounded sand; about 35% nonplastic fines with quick dilatancy and low toughness; trace of predominantly fine, hard, angular to subangular gravel; maximum size 25 mm; dry, light gray, strong reaction with HCl.
119.2 to 122.9 ft SILTY GRAVEL WITH SAND AND COBBLES (GM)sc: About 50% coarse to fine, hard, angular gravel; about 30% coarse to fine, angular sand; about 20% nonplastic fines with quick dilatancy and low toughness; trace of hard, subangular cobbles; maximum size 85 mm; dry, pinkish gray, strong reaction with HCl. Core removed from 121.1 to 121.7 ft.
122.9 to 125.2 ft SILTY SAND WITH GRAVEL (SM)g: About 35% coarse to fine, subangular to subrounded sand; about 35% nonplastic fines with quick dilatancy and low toughness; about 30% coarse to fine, hard, subangular to subrounded gravel; maximum size 50 mm; dry, light gray, strong reaction with HCl.
125.2 to 127.4 ft POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)s: About 65% coarse to fine, hard, angular to subangular gravel; about 25% coarse to fine, subangular to subrounded sand; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 55 mm; dry, pinkish gray, strong reaction with HCl.
127.4 to 127.7 ft SILTY SAND WITH GRAVEL (SM)g: About 60% coarse to fine, angular to subangular sand; about 25% predominantly fine, hard, angular gravel; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 25 mm; dry, light gray, strong reaction with HCl.
127.7 to 128.4 ft SILTY GRAVEL WITH SAND (GM)s: About 45% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular to subangular sand; about 20% nonplastic fines with quick dilatancy and low toughness; maximum size 45 mm; dry, pink, strong reaction with HCl.
128.4 to 156.7 ft PRE-RAINIER MESA TUFF BEDDED TUFF (Tmbt1):

128.4 to 129.9 ft: Bedded tuff, nonwelded, pinkish white, consists primarily of silt to very fine sand size fragments of quartz, feldspar, and crystallized welded tuff in a calcite cemented as matrix, 1 to 2% pumice, 1 to 2% lithic fragments of crystallized welded tuff.

129.9 to 153.6 ft: Ignimbrite, nonwelded, vitric, bedded, white, 10 to 15% pumice, 1% lithic fragments of crystallized welded tuff, 15% crystal fragments of sanidine, plagioclase and quartz, less than 1% biotite and magnetite. There is a paleosol at the base of the unit, from 153.4 to 153.6 ft.

153.6 to 156.7 ft: Bedded/reworked tuff, nonwelded, crystallized, pink, 10 to 15% pumice, 5 to 10% crystal fragments of quartz and feldspar, less than 1% of biotite and hornblende, less than 1% lithics.

Figure 1.1-120. Geologic Log of Drill Hole UE-25 RF#51 (Sheet 3 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#52

SHEET 1 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 3/31/2005 FINISHED: 4/5/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,557.02 E 571,914.65
TOTAL DEPTH: 184.7 ft
DEPTH TO BEDROCK: 164.7 ft

STATE: Nevada
GROUND ELEVATION: 3672.37
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES

Purpose of Hole:
Repository Facilities Geotechnical Investigations

Drill Equipment:
GP24 300 RS (Sonic Drill Rig)
Flatbed combination water and pipe truck with boom for moving drill pipe and casing.

Driller:
Travis Osterberg
Boart Longyear Drill Services

Drilling Method:
Rotosonic
Advance 8 in. casing as hole is cored 0.0 to 184.7 ft (TD). Drill string inside casing consists of 3½ in. single wall drill pipe with 6.163 in. Rotosonic Carbide button bit.

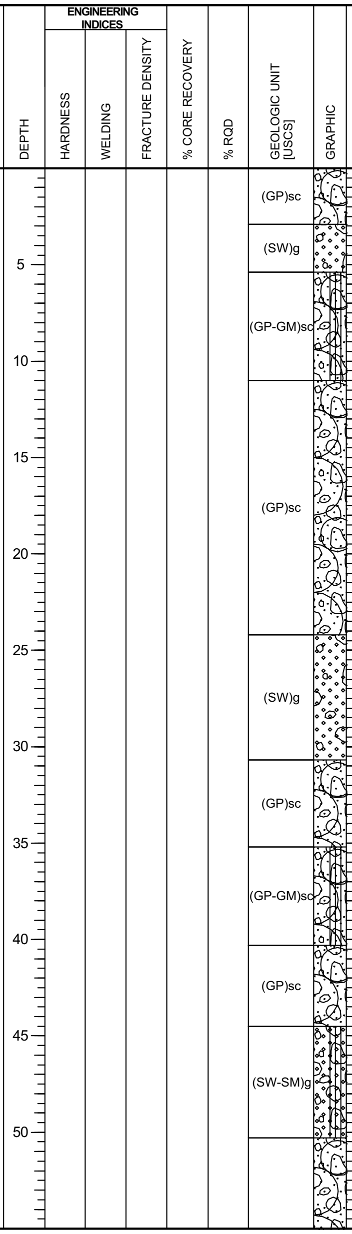
Drilling Conditions:
Not Reported

Drilling Fluid:
Small amounts of drilling additives were added to help in advancing casing.

Fluid Loss Interval:
NA

Casing Record:
8 in. casing from 0.00 to 184.7 ft (TD)

Hole Completion:
Back fill hole from 184.7 ft (TD) up to 0.0 ft (ground surface) with Bentonite Chips. Pull casing.



CLASSIFICATION
AND PHYSICAL CONDITION

0.0 to 164.7 ft QUATERNARY ALLUVIUM (Qal)

0.0 to 2.9 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% coarse to fine, angular to subangular gravel; about 45% coarse to fine, angular to subangular sand; trace of nonplastic fines; dry, reddish brown, moderate reaction with HCl. Topsoil with organic material.

TOTAL SAMPLE (BY VOLUME): About 20% hard, subangular cobbles; maximum size 115 mm; remainder minus 3 in.

2.9 to 5.4 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 55% coarse to fine, subangular sand; about 45% predominantly fine, hard, subangular gravel; trace of nonplastic fines; maximum size 65 mm; dry, light reddish brown, moderate reaction with HCl. Some organic material present.

5.4 to 11.0 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc: About 50% coarse to fine, hard, angular gravel; about 40% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, subangular cobbles; maximum size 110 mm; dry, pink, weak reaction with HCl.

11.0 to 24.2 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular to subangular sand; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 130 mm; dry, light reddish brown, pink, no reaction with HCl.

24.2 to 30.7 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 80% coarse to fine, angular sand; about 20% predominantly fine, hard, angular gravel; trace of nonplastic fines; maximum size 50 mm; dry, pink, no reaction with HCl.

30.7 to 35.2 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 65% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular sand; trace of nonplastic fines; trace of hard, subangular cobbles; maximum size 120 mm; dry, light reddish brown, no reaction with HCl.

35.2 to 40.3 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc: About 60% coarse to fine, hard, angular gravel; about 30% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, subangular cobbles; maximum size 110 mm; dry, pinkish gray, no reaction with HCl.

40.3 to 44.5 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 65% coarse to fine, hard, angular gravel; about 35% coarse to fine, angular sand; trace of nonplastic fines; dry, pink, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 5% hard, subrounded cobbles; maximum size 150 mm; remainder minus 3 in.

44.5 to 50.3 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 65% coarse to fine, angular sand; about 25% predominantly fine, hard, angular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 55 mm; dry, pinkish gray, moderate reaction with HCl.

50.3 to 61.6 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 65% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular to subangular sand; trace of nonplastic fines; trace of hard, subangular cobbles; maximum size 170 mm; dry, light reddish brown, pink, weak to strong reaction with HCl.

Figure 1.1-121. Geologic Log of Drill Hole UE-25 RF#52 (Sheet 1 of 3)

NOTE: Descriptions of the material may not reflect in situ geologic conditions due to mechanical degradation of the sample by the Sonic drilling method; TD = total depth.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#52

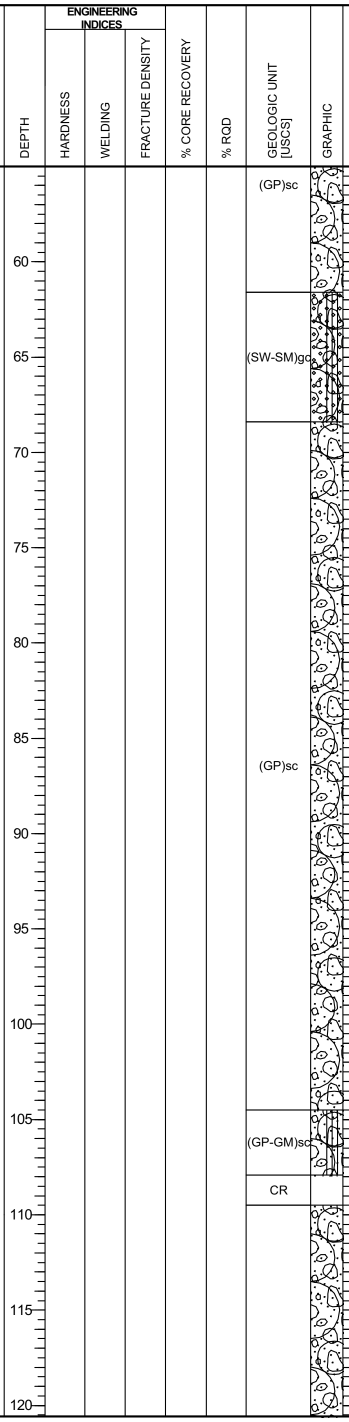
SHEET 2 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 3/31/2005 FINISHED: 4/5/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,557.02 E 571,914.65
TOTAL DEPTH: 184.7 ft
DEPTH TO BEDROCK: 164.7 ft

STATE: Nevada
GROUND ELEVATION: 3672.37
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES



CLASSIFICATION
AND PHYSICAL CONDITION

61.6 to 68.4 ft WELL GRADED SAND WITH SILT, GRAVEL AND COBBLES (SW-SM)gc: About 50% coarse to fine, angular to subangular sand; about 40% predominantly fine, hard, angular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, subangular cobbles; maximum size 150 mm; dry, pinkish gray, no reaction with HCl.

68.4 to 104.5 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 65% coarse to fine, hard, angular to subangular gravel; about 30% coarse to fine, angular to subangular sand; about 5% nonplastic fines; dry, pink, pinkish gray, weak to strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 5% hard, subangular cobbles; maximum size 150 mm; remainder minus 3 in.

104.5 to 107.9 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc: About 50% predominantly coarse, hard, angular gravel; about 40% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; dry, pinkish gray, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 25% hard, subangular cobbles; maximum size 100 mm; remainder minus 3 in.
107.9 to 109.5 ft CORE REMOVED

109.5 to 148.2 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 70% coarse to fine, hard, angular to subangular gravel; about 30% coarse to fine, angular to subangular sand; trace of nonplastic fines; dry, pink, pinkish gray, light gray, no to strong reaction with HCl. Core removed from 115.7 to 117.7 ft, 128.7 to 130.1 ft, and 136.7 to 138.0 ft.

TOTAL SAMPLE (BY VOLUME): About 10% hard, angular to subangular cobbles; maximum size 170 mm; remainder minus 3 in.

Figure 1.1-121. Geologic Log of Drill Hole UE-25 RF#52 (Sheet 2 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#52

SHEET 3 OF 3

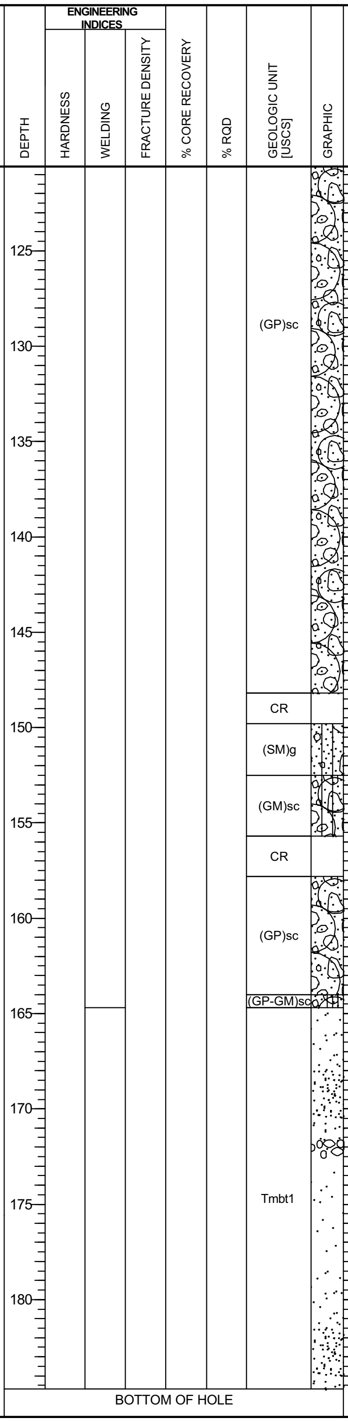
FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 3/31/2005 FINISHED: 4/5/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,557.02 E 571,914.65
TOTAL DEPTH: 184.7 ft
DEPTH TO BEDROCK: 164.7 ft

STATE: Nevada
GROUND ELEVATION: 3672.37
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES

CLASSIFICATION AND PHYSICAL CONDITION



148.2 to 149.8 ft CORE REMOVED

149.8 to 152.5 ft SILTY SAND WITH GRAVEL (SM)g: About 45% coarse to fine, angular sand; about 40% coarse to fine, hard, subangular gravel; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 70 mm; dry, pink, no reaction with HCl.

152.5 to 155.7 ft SILTY GRAVEL WITH SAND AND COBBLES (GM)sc: About 50% coarse to fine, hard, angular gravel; about 35% coarse to fine, angular sand; about 15% nonplastic fines with quick dilatancy and low toughness; dry, pink, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 5% hard, subangular cobbles; maximum size 120 mm; remainder minus 3 in.

155.7 to 157.8 ft CORE REMOVED

157.8 to 164.0 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 75% coarse to fine, hard, angular gravel; about 20% coarse to fine, angular sand; about 5% nonplastic fines; dry, pinkish gray, light reddish brown, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 10% hard, subangular cobbles; maximum size 170 mm; remainder minus 3 in.

164.0 to 164.7 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc: About 50% predominantly fine, hard, angular gravel; about 40% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; dry, pink, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 40% hard, subangular cobbles; maximum size 140 mm; remainder minus 3 in.

164.7 to 184.7 ft PRE-RAINIER MESA TUFF BEDDED TUFF (Tmbt1): Tephra and bedded tuff.

164.7 to 174.6 ft: Tephra, nonwelded, bedded, poorly lithified (almost completely disaggregated by drilling), vitric, white, 10 to 30% pumice, rare lithic fragments of volcanic rock, 5 to 15% and locally 40% crystal fragments of sanidine and quartz, less than 1% biotite. At the top of the unit, from 164.7 to 164.8 ft may be a paleosol, very pale brown.

174.6 to 176.7 ft: Bedded tuff, aeolian(?), fine grained, crystal-lithic siltstone, with very fine crystal fragments and glass shards. May be an incipient paleosol.

176.7 to 178.2 ft: Sample removed.

178.2 to 184.7 ft: Tephra, nonwelded, bedded, reworked, pale brown to very pale brown, 5 to 10% pumice, rare lithic fragments of crystallized tuff or obsidian, 4 to 7% crystal fragments of quartz and sanidine, less than 1% biotite; lithified/cemented nodules of the tephra (up to 2 cm) occur throughout.

Figure 1.1-121. Geologic Log of Drill Hole UE-25 RF#52 (Sheet 3 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#53

SHEET 1 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 4/20/2005 FINISHED: 4/25/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,039.7 E 571,947.85
TOTAL DEPTH: 160.6 ft
DEPTH TO BEDROCK: 138.2 ft

STATE: Nevada
GROUND ELEVATION: 3661.30
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES

Purpose of Hole:
Repository Facilities Geotechnical Investigations

Drill Equipment:
GP24 300 RS (Sonic Drill Rig)
Flatbed combination water and pipe truck with boom for moving drill pipe and casing.

Driller:
Travis Osterberg
Boart Longyear Drill Services

Drilling Method:
Rotosonic
Advance 8 in. casing as hole is cored 0.0 to 160.6 ft (TD). Drill string inside casing consists of 3½ in. single wall drill pipe with 6.163 in. Rotosonic Carbide button bit.

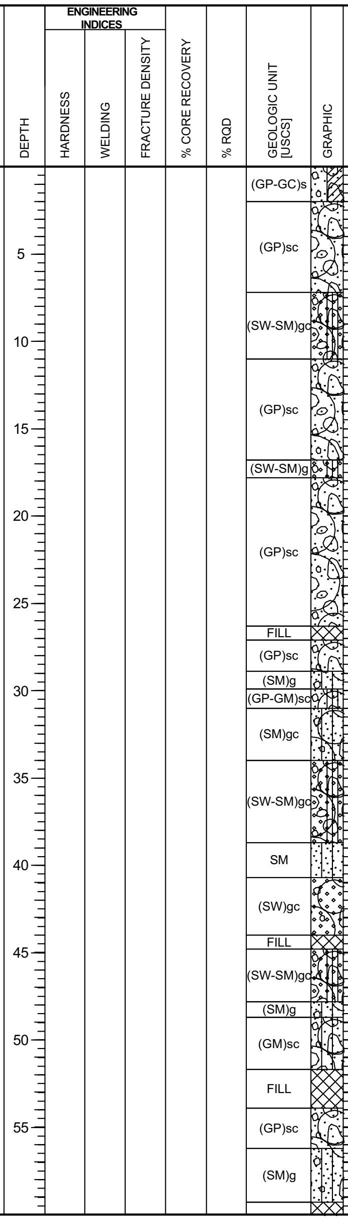
Drilling Conditions:
Not Reported

Drilling Fluid:
Small amounts of drilling additives were added to help in advancing casing.

Fluid Loss Interval:
NA

Casing Record:
8 in. casing from 0.0 to 160.6 ft (TD)

Hole Completion:
Back fill hole from 160.6 ft (TD) up to 0.0 ft (ground surface) with Bentonite Chips. Pull casing.



CLASSIFICATION AND PHYSICAL CONDITION

0.0 to 137.6 ft QUATERNARY ALLUVIUM (Qal)

0.0 to 2.0 ft POORLY GRADED GRAVEL WITH CLAY AND SAND (GP-GC)s: About 50% coarse to fine, hard, subangular gravel; about 40% coarse to fine, angular sand; about 10% fines of low plasticity, with slow dilatancy and medium toughness; maximum size 70 mm; dry, light reddish brown, no reaction with HCl. Topsoil with organic material.
2.0 to 7.2 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 65% coarse to fine, hard, subangular gravel; about 35% coarse to fine, subangular sand; trace of nonplastic fines; trace of hard, subangular cobbles; maximum size 110 mm; dry, pinkish gray, strong reaction with HCl.
7.2 to 11.0 ft WELL GRADED SAND WITH SILT, GRAVEL AND COBBLES (SW-SM)gc: About 55% coarse to fine, angular sand; about 35% coarse to fine, hard, angular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, subangular cobbles; maximum size 110 mm; dry, pink, strong reaction with HCl.

11.0 to 16.8 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 65% coarse to fine, hard, angular gravel; about 35% coarse to fine, angular sand; trace of nonplastic fines; dry, light reddish brown, no reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 5% hard, subangular cobbles; maximum size 90 mm; remainder minus 3 in.

16.8 to 17.8 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 65% coarse to fine, subangular sand; about 25% predominantly fine, hard, subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 50 mm; dry, pink, weak reaction with HCl.
17.8 to 26.3 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, angular sand; trace of nonplastic fines; dry, pink, weak reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 10% hard, subangular cobbles; maximum size 135 mm; remainder minus 3 in.

26.3 to 27.1 ft FILL
27.1 to 28.9 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, subangular gravel; about 35% coarse to fine, angular sand; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 95 mm; dry, pinkish gray, no reaction with HCl.
28.9 to 29.9 ft SILTY SAND WITH GRAVEL (SM)g: About 65% coarse to fine, angular sand; about 20% coarse to fine, hard, angular to subangular gravel; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 30 mm; dry, pinkish gray, no reaction with HCl.
29.9 to 31.0 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc: About 55% coarse to fine, hard, angular gravel; about 35% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, subangular cobbles; maximum size 100 mm; dry, pink, strong reaction with HCl.
31.0 to 34.0 ft SILTY SAND WITH GRAVEL AND COBBLES (SM)gc: About 50% coarse to fine, angular to subangular sand; about 35% coarse to fine, hard, angular to subangular gravel; about 15% nonplastic fines with quick dilatancy and low toughness; trace of hard, subangular cobbles; maximum size 95 mm; dry, light reddish brown, strong reaction with HCl.
34.0 to 38.7 ft WELL GRADED SAND WITH SILT, GRAVEL AND COBBLES (SW-SM)gc: About 55% coarse to fine, angular sand; about 35% coarse to fine, hard, angular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; dry, pinkish gray, no reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 5% hard, subangular cobbles; maximum size 120 mm; remainder minus 3 in.
38.7 to 40.7 ft SILTY SAND (SM): About 75% coarse to fine, angular sand; about 15% nonplastic fines with quick dilatancy and low toughness; about 10% coarse to fine, hard, angular to subangular gravel; maximum size 70 mm; dry, pink, no reaction with HCl.
40.7 to 44.0 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 50% coarse to fine, angular sand; about 45% coarse to fine, hard, angular gravel; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 120 mm; dry, light reddish brown, no reaction with HCl.
44.0 to 44.8 ft FILL
44.8 to 47.8 ft WELL GRADED SAND WITH SILT, GRAVEL AND COBBLES (SW-SM)gc: About 55% coarse to fine, angular sand; about 35% coarse to fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; dry, pinkish gray, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 5% hard, subangular cobbles; maximum size 120 mm; remainder minus 3 in.
47.8 to 48.7 ft SILTY SAND WITH GRAVEL (SM)g: About 60% coarse to fine, angular to subangular sand; about 25% nonplastic fines with quick dilatancy and low toughness; about 15% predominantly fine, hard, angular gravel; maximum size 35 mm; dry, pinkish gray, weak reaction with HCl.

Figure 1.1-122. Geologic Log of Drill Hole UE-25 RF#53 (Sheet 1 of 3)

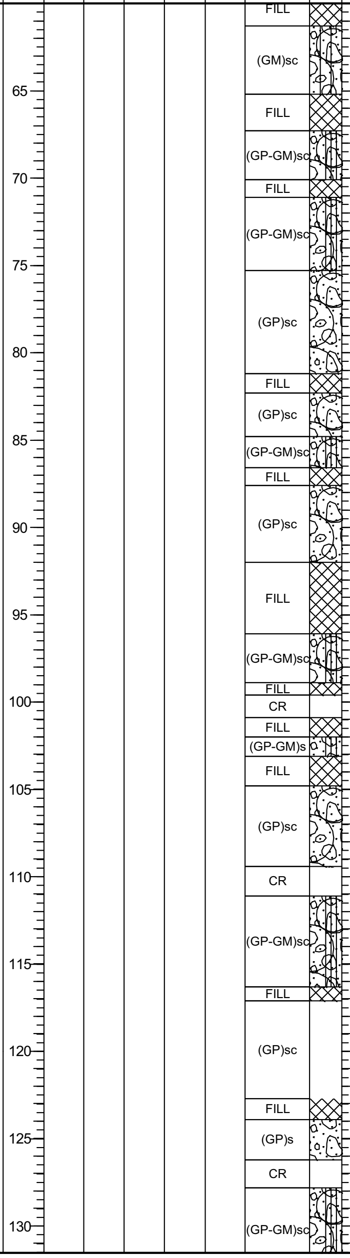
NOTE: Descriptions of the material may not reflect in situ geologic conditions due to mechanical degradation of the sample by the Sonic drilling method; TD = total depth.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#53

SHEET 2 OF 3

FEATURE: Waste Handling Facility	PROJECT: Yucca Mountain Project	STATE: Nevada
LOCATION: Midway Valley	COORDINATES: N 766,039.7 E 571,947.85	GROUND ELEVATION: 3661.30
BEGUN: 4/20/2005 FINISHED: 4/25/2005	TOTAL DEPTH: 160.6 ft	ANGLE FROM HORIZONTAL: -90°
DEPTH TO WATER: Not Encountered	DEPTH TO BEDROCK: 138.2 ft	HOLE LOGGED BY: George Eatman
		REVIEWED BY: Robert Lung

NOTES	DEPTH	ENGINEERING INDICES HARDNESS	 WELDING	 FRACTURE DENSITY	% CORE RECOVERY	% RQD	GEOLOGIC UNIT [USCS]	GRAPHIC	CLASSIFICATION AND PHYSICAL CONDITION



48.7 to 51.7 ft SILTY GRAVEL WITH SAND AND COBBLES (GM)sc: About 55% coarse to fine, hard, angular to subangular gravel; about 30% coarse to fine, angular sand; about 15% nonplastic fines with quick dilatancy and low toughness; trace of hard, subangular cobbles; maximum size 115 mm; dry, light reddish brown, no reaction with HCl.
51.7 to 53.9 ft FILL
53.9 to 56.2 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular sand; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 95 mm; dry, pink, no reaction with HCl.
56.2 to 59.3 ft SILTY SAND WITH GRAVEL (SM)g: About 50% coarse to fine, angular sand; about 35% coarse to fine, hard, angular gravel; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 70 mm; dry, pink, no reaction with HCl.
59.3 to 61.3 ft FILL
61.3 to 65.2 ft SILTY GRAVEL WITH SAND AND COBBLES (GM)sc: About 50% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular sand; about 15% nonplastic fines with quick dilatancy and low toughness; dry, pinkish gray, weak reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 20% hard, subangular cobbles; maximum size 180 mm; remainder minus 3 in.
65.2 to 67.3 ft FILL
67.3 to 70.1 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc: About 50% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; dry, light reddish brown, no to strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 20% hard, drilled cobbles; maximum size 175 mm; remainder minus 3 in.
70.1 to 71.1 ft FILL
71.1 to 75.3 ft: POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc. About 60% predominantly fine to coarse to fine, hard, angular to subangular gravel; about 30% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; dry, light gray, pinkish gray, no to strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 15% hard, drilled and subangular cobbles; maximum size 150 mm; remainder minus 3 in.
75.3 to 81.2 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 65% coarse to fine, hard, angular to subangular gravel; about 30% coarse to fine, subangular sand; about 5% nonplastic fines; dry, pinkish gray, no reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 10% hard, drilled and subangular cobbles; maximum size 110 mm; remainder minus 3 in.
81.2 to 82.3 ft FILL
82.3 to 84.8 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 65% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular sand; trace of nonplastic fines; dry, pinkish gray, moderate reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 20% hard, drilled and subangular cobbles; maximum size 130 mm; remainder minus 3 in.
84.8 to 86.6 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc: About 50% coarse to fine, hard, subangular gravel; about 40% coarse to fine, subangular sand; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, subangular cobbles; maximum size 130 mm; dry, pinkish gray, strong reaction with HCl.
86.6 to 87.6 ft FILL
87.6 to 92.0 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, very angular sand; about 5% nonplastic fines; dry, pink, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 5% hard, subangular cobbles; maximum size 95 mm; remainder minus 3 in.
92.0 to 96.1 ft FILL
96.1 to 98.9 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc: About 55% coarse to fine, hard, angular gravel; about 25% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; dry, pinkish gray, moderate reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 10% hard, subangular cobbles; maximum size 130 mm; remainder minus 3 in.
98.9 to 99.6 ft FILL
99.6 to 100.9 ft CORE REMOVED
100.9 to 102.0 ft FILL
102.0 to 103.1 ft POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)s: About 55% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular to subangular sand; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 50 mm; dry, pink, no reaction with HCl.
103.1 to 104.8 ft FILL
104.8 to 109.4 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 65% coarse to fine, hard, angular to subangular gravel; about 30% coarse to fine, angular sand; about 5% nonplastic fines; dry, pink, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 15% hard, drilled and subangular cobbles; maximum size 150 mm; remainder minus 3 in.
109.4 to 111.1 ft CORE REMOVED
111.1 to 116.3 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc: About 60% coarse to fine, hard, angular to subangular gravel; about 30% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; dry, pinkish gray, moderate reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 30% hard, drilled cobbles; maximum size 210 mm; remainder minus 3 in.
116.3 to 117.1 ft FILL
117.1 to 122.7 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% coarse to fine, hard, angular gravel; about 40% coarse to fine, angular sand;

Figure 1.1-122. Geologic Log of Drill Hole UE-25 RF#53 (Sheet 2 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#53

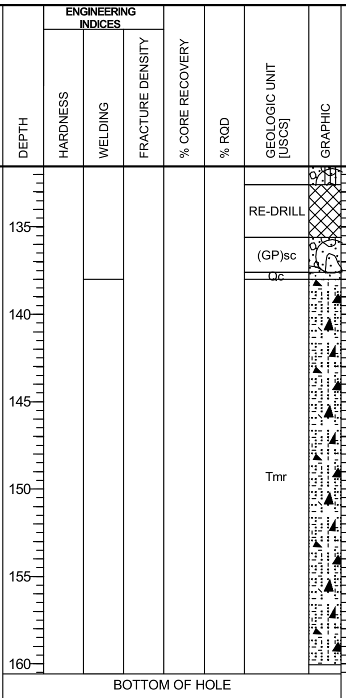
SHEET 3 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 4/20/2005 FINISHED: 4/25/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,039.7 E 571,947.85
TOTAL DEPTH: 160.6 ft
DEPTH TO BEDROCK: 138.2 ft

STATE: Nevada
GROUND ELEVATION: 3661.30
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES



CLASSIFICATION
AND PHYSICAL CONDITION

about 5% nonplastic fines; trace of hard, subrounded cobbles; maximum size 85 mm; dry, pinkish gray, strong reaction with HCl.

122.7 to 123.9 ft FILL

123.9 to 126.2 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 65% coarse to fine, hard, subangular gravel; about 30% coarse to fine, angular sand; about 5% nonplastic fines; maximum size 60 mm; dry, pinkish gray, strong reaction with HCl.

126.2 to 127.8 ft CORE REMOVED

127.8 to 132.6 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc: About 60% coarse to fine, hard, angular to subangular gravel; about 30% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness, dry, pinkish gray, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 10% hard, drilled and subangular cobbles; maximum size 165 mm; remainder minus 3 in.

132.6 to 135.6 ft RE-DRILL

135.6 to 137.6 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% coarse to fine to predominantly coarse, hard, angular to subangular gravel; about 40% coarse to fine, angular to subangular sand; about 5% nonplastic fines; dry, pink, pinkish gray, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 10% hard, drilled and angular cobbles; maximum size 130 mm; remainder minus 3 in.

137.6 to 138.0 ft COLLUVIUM (Qc):
Caliche cemented ash, generally consists of fine to medium sand size fragments of quartz, feldspar, and welded tuff in a caliche/ash matrix, white to pinkish white, with white caliche stringers, less than 1% biotite and magnetite.

138.2 to 160.6 ft RAINIER MESA TUFF (Tmr):
Volcanic tuff, nonwelded, vitric, poorly consolidated (broken by drilling process into sand size fragments), white, 20 to 35% pumice, 1% lithic fragments of welded tuff, 10 to 20% crystal fragments of sanidine, plagioclase and quartz, less than 1% biotite. Caliche cemented at top of unit from 138.0 to 139.0 ft, strong reaction with HCl.

Figure 1.1-122. Geologic Log of Drill Hole UE-25 RF#53 (Sheet 3 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#54

SHEET 1 OF 4

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 4/25/2005 FINISHED: 4/27/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,278.9 E 572,190.12
TOTAL DEPTH: 196.7 ft
DEPTH TO BEDROCK: 183.0 ft

STATE: Nevada
GROUND ELEVATION: 3661.64
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES

Purpose of Hole:
Repository Facilities Geotechnical Investigations

Drill Equipment:
GP24 300 RS (Sonic Drill Rig)
Flatbed combination water and pipe truck with boom for moving drill pipe and casing.

Driller:
Travis Osterberg
Boart Longyear Drill Services

Drilling Method:
Rotosonic
Advance 8 in. casing as hole is cored 0.0 to 196.7 ft (TD). Drill string inside casing consists of 3½ in. single wall drill pipe with 6.163 in. Rotosonic Carbide button bit.

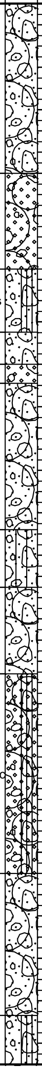
Drilling Conditions:
Not Reported

Drilling Fluid:
Small amounts of drilling additives were added to help in advancing casing.

Fluid Loss Interval:
NA

Casing Record:
8 in. casing from 0.0 to 196.7 ft (TD)

Hole Completion:
Back fill hole from 196.7 ft (TD) up to 0.0 ft (ground surface) with Bentonite Chips. Pull casing.



DEPTH	ENGINEERING INDICES			% CORE RECOVERY	% RQD	GEOLOGIC UNIT [USCS]	CLASSIFICATION AND PHYSICAL CONDITION
	HARDNESS	WELDING	FRACTURE DENSITY				
							0.0 to 183.0 ft QUATERNARY ALLUVIUM (Qal)
5						(GP)sc	**0.0 to 8.0 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc:** About 65% coarse to fine, hard, subangular to subrounded gravel; about 35% coarse to fine, angular to subangular sand; about 5% nonplastic fines; trace of hard, drilled and subangular cobbles; maximum size 115 mm; moist near surface to dry at depth, strong brown to light yellowish brown, strong reaction with HCl.
10						(SW)gc	**8.0 to 12.5 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc:** About 50% coarse to fine, angular to subangular sand; about 45% coarse to fine, hard, subangular gravel; about 5% nonplastic fines with no dry strength and quick dilatancy; trace of hard, subrounded cobbles; maximum size 125 mm, dry, light brownish gray, no reaction with HCl.
15						(GP-GM)s	**12.5 to 15.5 ft POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)s:** About 50% predominantly fine, hard, subangular gravel; about 40% coarse to fine, subangular sand; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 65 mm, dry, yellow, no reaction with HCl.
						(GP)s	**15.5 to 17.0 ft POORLY GRADED GRAVEL WITH SAND (GP)s:** About 65% coarse to fine, hard, subangular to subrounded gravel; about 35% coarse to fine, angular to subangular sand; trace of nonplastic fines; maximum size 75 mm; dry, very pale brown, moderate reaction with HCl.
						(SW)g	**17.0 to 17.9 ft WELL GRADED SAND WITH GRAVEL (SW)g:** About 65% coarse to fine, angular sand; about 30% predominantly fine, hard, subangular gravel; about 5% nonplastic fines; maximum size 35 mm; dry, very pale brown, moderate reaction with HCl.
20						(GP)sc	**17.9 to 24.8 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc:** About 55% coarse to fine, hard, subangular gravel; about 35% coarse to fine, subangular sand; trace of nonplastic fines; trace of hard, subangular cobbles; maximum size 105 mm; dry, very pale brown, moderate reaction with HCl.
25						(GM)s	**24.8 to 27.5 ft SILTY GRAVEL WITH SAND (GM)s:** About 45% predominantly fine, hard, subangular gravel; about 40% coarse to fine, subangular sand; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 50 mm; dry, light gray, strong reaction with HCl.
30						(GP)sc	**27.5 to 31.6 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc:** About 50% coarse to fine, hard, angular to subangular gravel; about 45% coarse to fine, subangular sand; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 100 mm; dry, very pale brown, no reaction with HCl.
35 40						(SW-SM)gc	**31.6 to 41.0 ft WELL GRADED SAND WITH SILT, GRAVEL AND COBBLES (SW-SM)gc:** About 60% coarse to fine, angular to subangular sand; about 25% coarse to fine, hard, angular to subangular gravel; about 15% nonplastic fines with quick dilatancy and low toughness; trace of hard, subangular cobbles; maximum size 110 mm; dry, white, light gray, pale brown, and light olive gray, no to strong reaction with HCl.
45						(GP)sc	**41.0 to 47.7 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc:** About 50% coarse to fine, hard, angular to subangular gravel; about 45% coarse to fine, angular to subangular sand; about 5% nonplastic fines; trace of hard, drilled and subangular cobbles; maximum size 140 mm; dry, pale yellow, no to weak reaction with HCl.
							47.7 to 52.2 ft POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)s: About 55% coarse to fine, hard, subangular gravel; about 35% coarse to fine, subangular sand; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 50 mm;

Figure 1.1-123. Geologic Log of Drill Hole UE-25 RF#54 (Sheet 1 of 4)

NOTE: Descriptions of the material may not reflect in situ geologic conditions due to mechanical degradation of the sample by the Sonic drilling method; TD = total depth.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#54

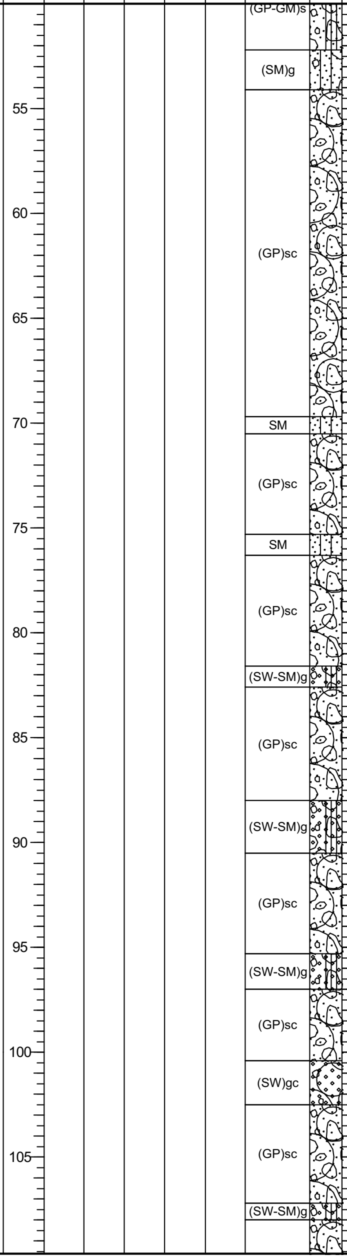
SHEET 2 OF 4

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 4/25/2005 FINISHED: 4/27/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,278.9 E 572,190.12
TOTAL DEPTH: 196.7 ft
DEPTH TO BEDROCK: 183.0 ft

STATE: Nevada
GROUND ELEVATION: 3661.64
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES | DEPTH | ENGINEERING INDICES: HARDNESS, WELDING, FRACTURE DENSITY | % CORE RECOVERY | % RQD | GEOLOGIC UNIT [USCS] | GRAPHIC | CLASSIFICATION AND PHYSICAL CONDITION



dry, pale yellow, strong reaction with HCl.

52.2 to 54.1 ft SILTY SAND WITH GRAVEL (SM)g: About 60% coarse to fine, angular to subangular sand; about 20% predominantly fine, hard, subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 50 mm; dry, light brownish gray, strong reaction with HCl.

54.1 to 69.7 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, angular to subangular sand; trace of nonplastic fines; trace of hard, drilled and subangular to subrounded cobbles; maximum size 120 mm; dry, light gray and pale yellow, weak to strong reaction with HCl.

69.7 to 70.5 ft SILTY SAND (SM): About 70% coarse to fine, subangular sand; about 20% nonplastic fines with quick dilatancy and low toughness; about 10% predominantly fine, hard, angular to subangular gravel; maximum size 20 mm; dry, light gray, strong reaction with HCl.

70.5 to 75.3 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 70% coarse to fine, hard, subangular gravel; about 30% coarse to fine, subangular sand; trace of nonplastic fines; trace of hard, subangular cobbles; maximum size 100 mm; dry, light olive gray, strong reaction with HCl.

75.3 to 76.3 ft SILTY SAND (SM): About 80% coarse to fine, angular to subangular sand; about 15% nonplastic fines with quick dilatancy and low toughness; about 5% predominantly fine, hard, angular to subangular gravel; maximum size 45 mm; dry, light brownish gray, strong reaction with HCl.

76.3 to 81.6 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% coarse to fine, hard, subangular gravel; about 40% coarse to fine, subangular sand; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 130 mm; dry, pale yellow, moderate reaction with HCl.

81.6 to 82.6 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 70% coarse to fine, subangular sand; about 20% predominantly fine, hard, subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 20 mm; dry, pinkish gray, strong reaction with HCl.

82.6 to 88.0 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 70% coarse to fine, hard, subangular gravel; about 30% coarse to fine, subangular sand; trace of nonplastic fines; trace of hard, subangular cobbles; maximum size 150 mm; dry, pinkish gray, moderate reaction with HCl.

88.0 to 90.5 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 70% coarse to fine, subangular sand; about 20% predominantly fine, hard, subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 45 mm; dry, pinkish gray, moderate reaction with HCl.

90.5 to 95.3 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 70% coarse to fine, hard, angular to subangular gravel; about 25% coarse to fine, angular to subangular sand; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 130 mm; dry, pink and light gray, no to strong reaction with HCl.

95.3 to 97.0 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 50% coarse to fine, subangular sand; about 40% predominantly fine, hard, subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 60 mm; dry, pinkish gray, moderate reaction with HCl.

97.0 to 100.4 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, subangular gravel; about 35% coarse to fine, subangular sand; about 5% nonplastic fines; trace of hard, angular cobbles; maximum size 120 mm; dry, pink, strong reaction with HCl.

100.4 to 102.5 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 55% coarse to fine, subangular sand; about 35% coarse to fine, hard, subangular gravel; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 85 mm; dry, pinkish gray, strong reaction with HCl.

102.5 to 107.2 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 75% coarse to fine, hard, angular to subangular gravel; about 25% coarse to fine, subangular sand; trace of nonplastic fines; trace of hard, subangular cobbles; maximum size 120 mm; dry, pink, strong reaction with HCl.

107.2 to 108.0 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 70% coarse to fine, subangular sand; about 20% predominantly fine, hard, subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size

Figure 1.1-123. Geologic Log of Drill Hole UE-25 RF#54 (Sheet 2 of 4)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#54

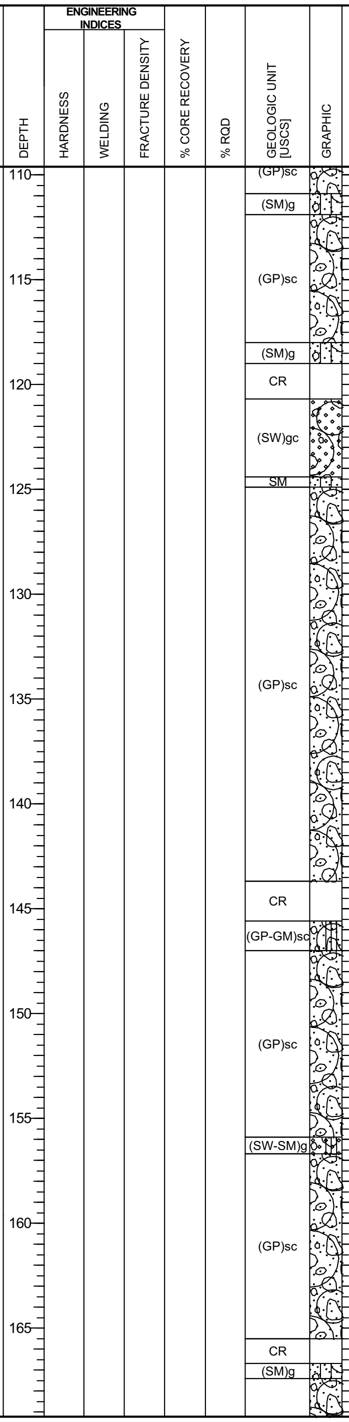
SHEET 3 OF 4

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 4/25/2005 FINISHED: 4/27/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,278.9 E 572,190.12
TOTAL DEPTH: 196.7 ft
DEPTH TO BEDROCK: 183.0 ft

STATE: Nevada
GROUND ELEVATION: 3661.64
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES



CLASSIFICATION AND PHYSICAL CONDITION

30 mm; dry, pinkish gray, strong reaction with HCl.

108.0 to 110.9 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 85% coarse to fine, hard, angular to subangular gravel; about 15% coarse to fine, subangular sand; trace of nonplastic fines; dry, pinkish gray, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 20% hard, drilled, and subangular to subrounded cobbles; maximum size 150 mm; remainder minus 3 in.

110.9 to 111.9 ft SILTY SAND WITH GRAVEL (SM)g: About 60% coarse to fine, subangular sand; about 25% predominantly fine, hard, subangular gravel; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 50 mm; dry, pinkish gray, strong reaction with HCl.

111.9 to 118.0 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular to subangular sand; about 5% nonplastic fines; dry, pinkish gray, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 5% hard, subangular cobbles; maximum size 140 mm; remainder minus 3 in.

118.0 to 119.0 ft SILTY SAND WITH GRAVEL (SM)g: About 60% coarse to fine, angular to subangular sand; about 20% predominantly fine, hard, angular to subangular gravel; about 20% nonplastic fines with quick dilatancy and low toughness; maximum size 110 mm; dry, light gray, moderate reaction with HCl.

119.0 to 120.7 ft CORE REMOVED

120.7 to 124.4 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 55% coarse to fine, angular to subangular sand; about 45% coarse to fine, hard, angular to subangular gravel; trace of nonplastic fines; trace of hard, drilled and subangular cobbles; maximum size 150 mm; dry, light brown, strong reaction with HCl.

124.4 to 124.9 ft SILTY SAND (SM): About 75% coarse to fine, subangular sand; about 15% nonplastic fines with quick dilatancy and low toughness; about 10% predominantly fine, hard, angular to subangular gravel; maximum size 85 mm; dry, light gray, strong reaction with HCl.

124.9 to 143.7 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, angular to subangular sand; trace of nonplastic fines; dry, light brown to pinkish gray, weak reaction with HCl. Core removed from 128.0 to 129.3 ft.

TOTAL SAMPLE (BY VOLUME): About 15% hard, drilled and subangular cobbles; maximum size 150 mm; remainder minus 3 in.

143.7 to 145.6 ft CORE REMOVED

145.6 to 147.0 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc: About 50% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, angular to subangular sand; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, subangular cobbles; maximum size 140 mm; dry, pink, strong reaction with HCl.

147.0 to 155.9 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular to subangular sand; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 110 mm; dry, light brown, no reaction with HCl. Core removed from 153.1 to 154.2 ft.

155.9 to 156.7 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 65% coarse to fine, angular to subangular sand; about 25% predominantly fine, hard, subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 60 mm; dry, pinkish gray, no reaction with HCl.

156.7 to 165.5 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 65% coarse to fine, hard, angular to subangular gravel; about 25 to 30% coarse to fine, angular to subangular sand; about 5% nonplastic fines; dry, pink, weak to strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 45% hard, drilled and subangular cobbles; maximum size 150 mm; remainder minus 3 in.

165.5 to 166.7 ft CORE REMOVED

166.7 to 167.4 ft SILTY SAND WITH GRAVEL (SM)g: About 65% coarse to fine, angular to subangular sand; about 20% predominantly fine, hard, angular to subangular gravel; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size

Figure 1.1-123. Geologic Log of Drill Hole UE-25 RF#54 (Sheet 3 of 4)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#54

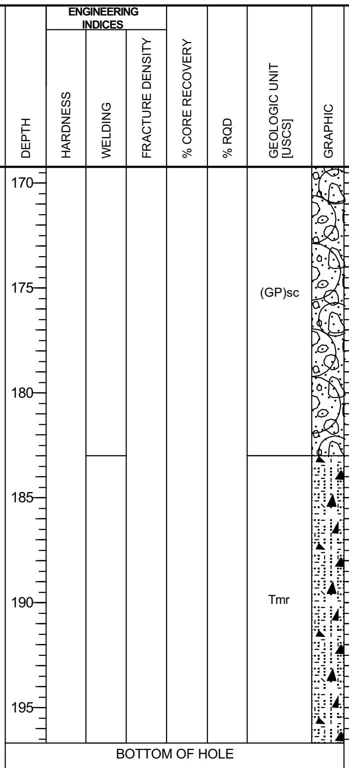
SHEET 4 OF 4

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 4/25/2005 FINISHED: 4/27/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 766,278.9 E 572,190.12
TOTAL DEPTH: 196.7 ft
DEPTH TO BEDROCK: 183.0 ft

STATE: Nevada
GROUND ELEVATION: 3661.64
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES



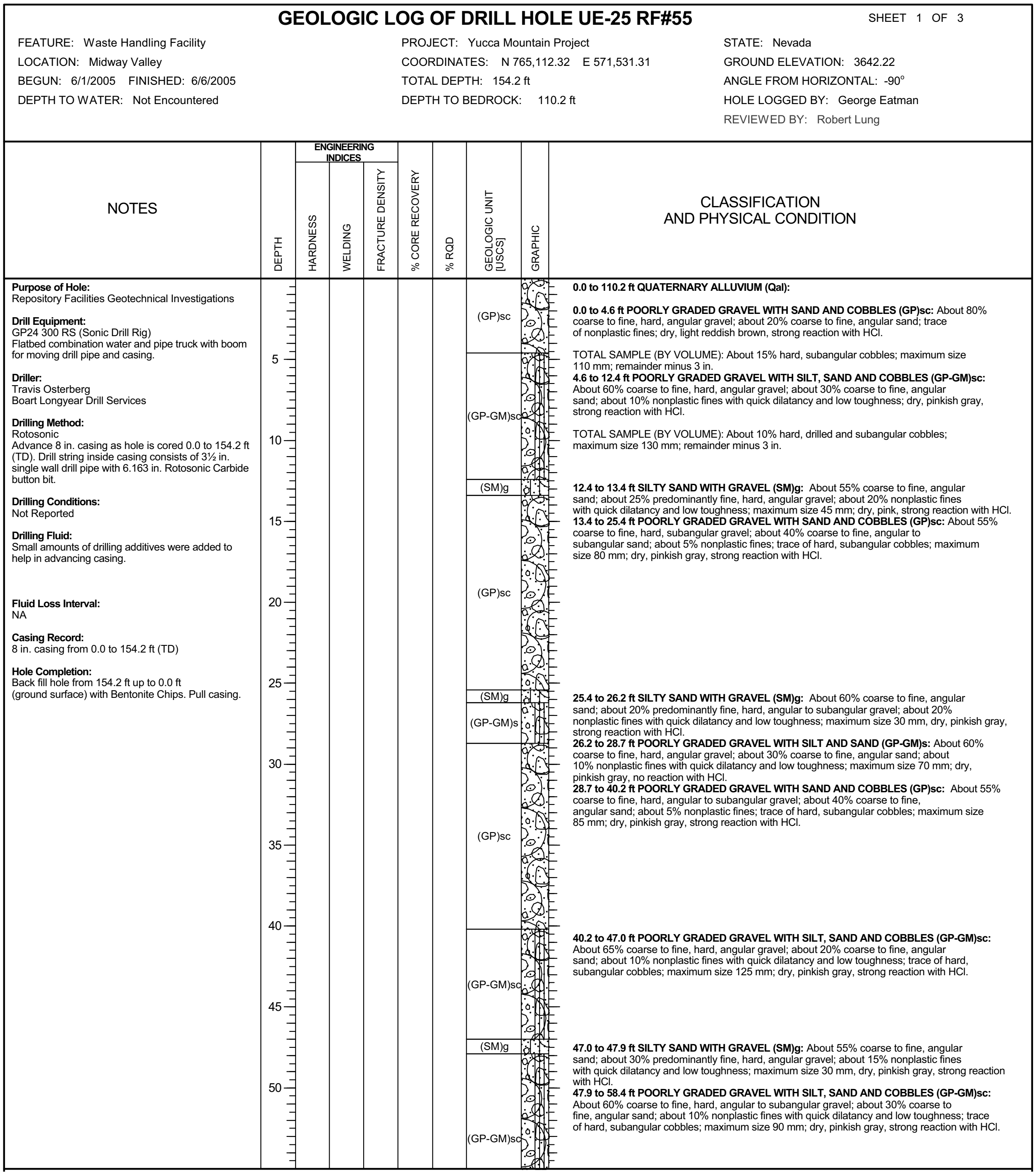
CLASSIFICATION AND PHYSICAL CONDITION

15 mm; dry, pinkish gray, strong reaction with HCl.
167.4 to 183.0 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 65% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular to subangular sand; about 5% nonplastic fines; dry, pink, moderate to strong reaction with HCl. Core removed 175.2 to 177.1 ft.

TOTAL SAMPLE (BY VOLUME): About 25% hard, drilled and subangular cobbles; maximum size 200 mm; remainder minus 3 in.

183.0 to 196.7 ft RAINIER MESA TUFF (Tmr):
Ignimbrite, nonwelded, poorly consolidated, partially crystallized, white, 20 to 30% pumice, 2 to 3% lithic fragments of welded tuff, 10 to 20% crystal fragments of quartz, sanidine, and plagioclase, less than 1% biotite.

Figure 1.1-123. Geologic Log of Drill Hole UE-25 RF#54 (Sheet 4 of 4)



GEOLOGIC LOG OF DRILL HOLE UE-25 RF#55

SHEET 1 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 6/1/2005 FINISHED: 6/6/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,112.32 E 571,531.31
TOTAL DEPTH: 154.2 ft
DEPTH TO BEDROCK: 110.2 ft

STATE: Nevada
GROUND ELEVATION: 3642.22
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES

Purpose of Hole:
Repository Facilities Geotechnical Investigations

Drill Equipment:
GP24 300 RS (Sonic Drill Rig)
Flatbed combination water and pipe truck with boom for moving drill pipe and casing.

Driller:
Travis Osterberg
Boart Longyear Drill Services

Drilling Method:
Rotosonic
Advance 8 in. casing as hole is cored 0.0 to 154.2 ft (TD). Drill string inside casing consists of 3½ in. single wall drill pipe with 6.163 in. Rotosonic Carbide button bit.

Drilling Conditions:
Not Reported

Drilling Fluid:
Small amounts of drilling additives were added to help in advancing casing.

Fluid Loss Interval:
NA

Casing Record:
8 in. casing from 0.0 to 154.2 ft (TD)

Hole Completion:
Back fill hole from 154.2 ft up to 0.0 ft (ground surface) with Bentonite Chips. Pull casing.

CLASSIFICATION AND PHYSICAL CONDITION

0.0 to 110.2 ft QUATERNARY ALLUVIUM (Qal):

0.0 to 4.6 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 80% coarse to fine, hard, angular gravel; about 20% coarse to fine, angular sand; trace of nonplastic fines; dry, light reddish brown, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 15% hard, subangular cobbles; maximum size 110 mm; remainder minus 3 in.

4.6 to 12.4 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc: About 60% coarse to fine, hard, angular gravel; about 30% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; dry, pinkish gray, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 10% hard, drilled and subangular cobbles; maximum size 130 mm; remainder minus 3 in.

12.4 to 13.4 ft SILTY SAND WITH GRAVEL (SM)g: About 55% coarse to fine, angular sand; about 25% predominantly fine, hard, angular gravel; about 20% nonplastic fines with quick dilatancy and low toughness; maximum size 45 mm; dry, pink, strong reaction with HCl.

13.4 to 25.4 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% coarse to fine, hard, subangular gravel; about 40% coarse to fine, angular to subangular sand; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 80 mm; dry, pinkish gray, strong reaction with HCl.

25.4 to 26.2 ft SILTY SAND WITH GRAVEL (SM)g: About 60% coarse to fine, angular sand; about 20% predominantly fine, hard, angular to subangular gravel; about 20% nonplastic fines with quick dilatancy and low toughness; maximum size 30 mm, dry, pinkish gray, strong reaction with HCl.

26.2 to 28.7 ft POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)s: About 60% coarse to fine, hard, angular gravel; about 30% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 70 mm; dry, pinkish gray, no reaction with HCl.

28.7 to 40.2 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, angular sand; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 85 mm; dry, pinkish gray, strong reaction with HCl.

40.2 to 47.0 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc: About 65% coarse to fine, hard, angular gravel; about 20% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, subangular cobbles; maximum size 125 mm; dry, pinkish gray, strong reaction with HCl.

47.0 to 47.9 ft SILTY SAND WITH GRAVEL (SM)g: About 55% coarse to fine, angular sand; about 30% predominantly fine, hard, angular gravel; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 30 mm, dry, pinkish gray, strong reaction with HCl.

47.9 to 58.4 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc: About 60% coarse to fine, hard, angular to subangular gravel; about 30% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, subangular cobbles; maximum size 90 mm; dry, pinkish gray, strong reaction with HCl.

Figure 1.1-124. Geologic Log of Drill Hole UE-25 RF#55 (Sheet 1 of 3)

NOTE: Descriptions of the material may not reflect in situ geologic conditions due to mechanical degradation of the sample by the Sonic drilling method; TD = total depth.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#55

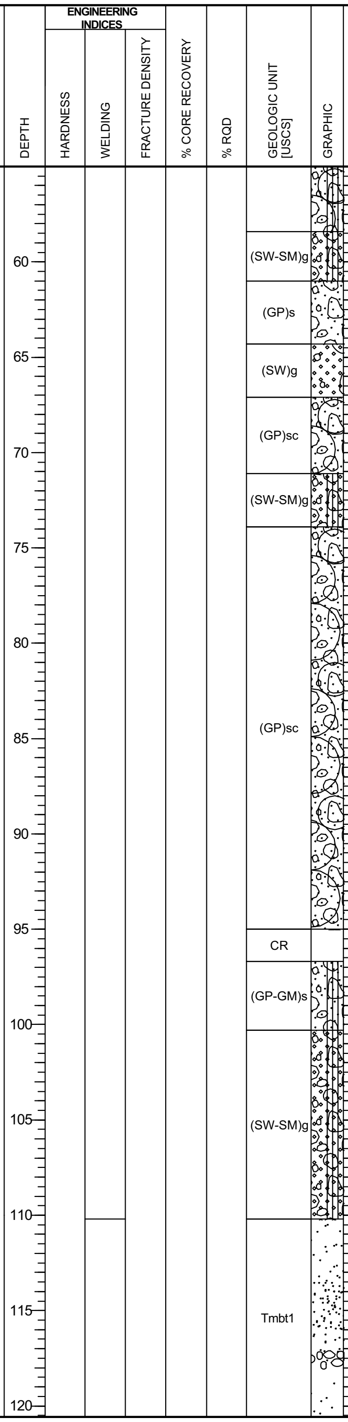
SHEET 2 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 6/1/2005 FINISHED: 6/6/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,112.32 E 571,531.31
TOTAL DEPTH: 154.2 ft
DEPTH TO BEDROCK: 110.2 ft

STATE: Nevada
GROUND ELEVATION: 3642.22
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES



CLASSIFICATION AND PHYSICAL CONDITION

58.4 to 61.0 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 50% coarse to fine, angular to subangular sand; about 40% coarse to fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness, maximum size 65 mm, dry, pink, strong reaction with HCl.

61.0 to 64.3 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 65% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular sand; trace of nonplastic fines; maximum size 55 mm; dry, pink, strong reaction with HCl.

64.3 to 67.1 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 55% coarse to fine, angular sand; about 40% coarse to fine, hard, angular to subangular gravel; about 5% nonplastic fines; maximum size 65 mm; dry, strong reaction with HCl.

67.1 to 71.1 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 65% coarse to fine, hard, angular to subangular gravel; about 30% coarse to fine, angular sand; about 5% nonplastic fines; dry, pink, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 5% hard, drilled and subangular cobbles; maximum size 125 mm; remainder minus 3 in.

71.1 to 73.9 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 50% coarse to fine, angular sand; about 40% coarse to fine, hard, angular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 60 mm; dry, pinkish gray, strong reaction with HCl.

73.9 to 95.0 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, angular sand; trace of nonplastic fines; trace of hard, drilled and subangular cobbles; maximum size 125 mm; dry, pink, pinkish gray, strong reaction with HCl. Core removed from 82.3 to 83.7 ft.

95.0 to 96.7 ft CORE REMOVED

96.7 to 100.3 ft POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)s: About 50% coarse to fine, hard, subangular gravel; about 35% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 65 mm; dry, pink, strong reaction with HCl.

100.3 to 110.2 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 50% coarse to fine, angular sand; about 40% coarse to fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 30 mm; dry, pink, strong reaction with HCl. Core removed from 106.3 to 108.0 ft.

110.2 to 144.4 ft PRE-RAINIER MESA TUFF BEDDED TUFF (Tmbt1):
Bedded tuff, nonwelded, locally altered, locally reworked, crystallized, white, pinkish white, pink, very pale brown, 2 to 15% pumice,1 to 15% lithic fragments of crystallized welded tuff, 2 to 25% crystal fragments of quartz, sanidine, plagioclase, less than 1% biotite, hornblende, and magnetite, calcite veinlets locally, weak to strong reaction with HCl. Interval from 110.0 to 113.0 ft consists of calcite cemented ash and 5 to 20% silt to very fine sand size fragments of quartz, feldspar, and crystallized welded tuff, with less than 1% pumice and less than 1% lithic fragments.

Figure 1.1-124. Geologic Log of Drill Hole UE-25 RF#55 (Sheet 2 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#55

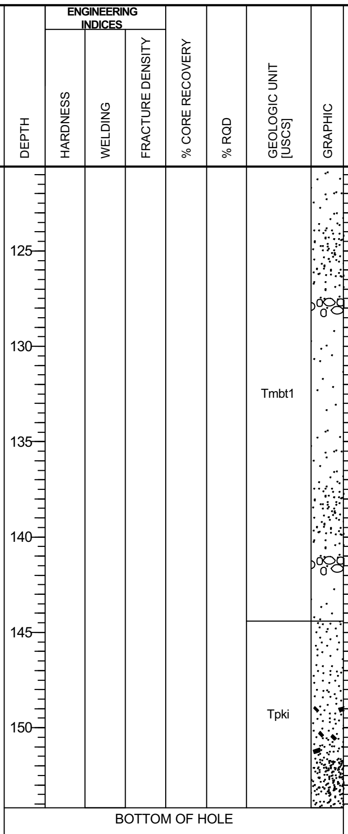
SHEET 3 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 6/1/2005 FINISHED: 6/6/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,112.32 E 571,531.31
TOTAL DEPTH: 154.2 ft
DEPTH TO BEDROCK: 110.2 ft

STATE: Nevada
GROUND ELEVATION: 3642.22
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES



CLASSIFICATION AND PHYSICAL CONDITION

144.4 to 154.2 ft COMB PEAK IGNIMBRITE - TUFF "X" (Tpki):
Pyroclastic flow, nonwelded, crystallized below 146.4 ft, white, 20 to 25% pumice, 2 to 3% lithic fragments of crystallized welded tuff, 1% crystal fragments of sanidine and plagioclase, less than 1% of biotite and magnetite.

Figure 1.1-124. Geologic Log of Drill Hole UE-25 RF#55 (Sheet 3 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#56

SHEET 1 OF 5

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 6/6/2005 FINISHED: 7/7/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,439.36 E 571,857.22
TOTAL DEPTH: 416.9 ft
DEPTH TO BEDROCK: 129.9 ft

STATE: Nevada
GROUND ELEVATION: 3646.81
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES

Purpose of Hole:
Repository Facilities Geotechnical Investigations

Drill Equipment:
GP24 300 RS (Sonic Drill Rig)
Flatbed combination water and pipe truck with boom for moving drill pipe and casing.

Driller:
Travis Osterberg
Boart Longyear Drill Services

Drilling Method:
Rotosonic
Advance 8 in. casing as hole is cored 0.0 to 337.4 ft. Drill string inside casing consists of 3½ in. single wall drill pipe with 6.163 in. Rotosonic Carbide button bit to 337.4 ft. Change over to 4 in. coring system with 4.56 in. Rotosonic Carbide button bit. Advance 6 in. casing as hole is cored from 337.4 to 416.9 ft (TD).

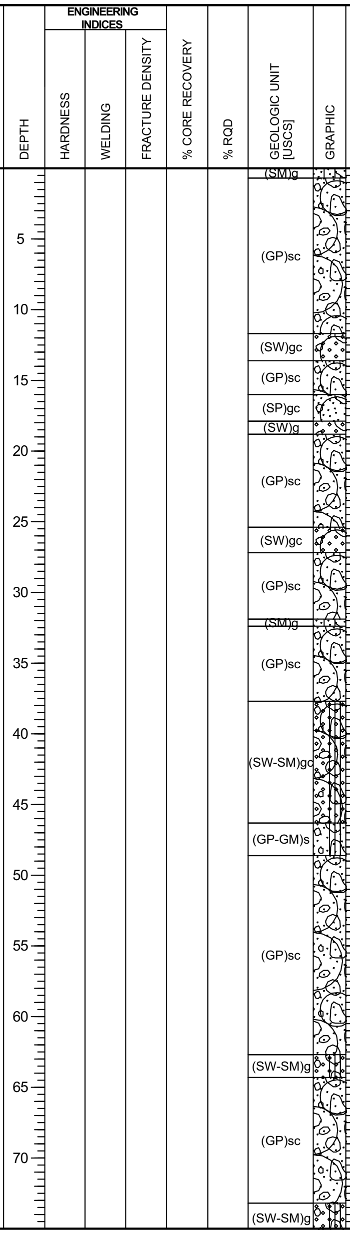
Drilling Conditions:
Not Reported

Drilling Fluid:
Small amounts of drilling additives were added to help in advancing casing.

Fluid Loss Interval:
NA

Casing Record:
8 in. casing from 0.0 to 337.4 ft.
6 in. casing from 337.4 to 416.9 ft (TD).

Hole Completion:
Back fill hole from 416.9 ft up to 0.0 ft
(ground surface) with Bentonite Chips. Pull casing.



CLASSIFICATION
AND PHYSICAL CONDITION

0.0 to 129.7 ft: QUATERNARY ALLUVIUM (Qal).

0.0 to 0.7 ft SILTY SAND WITH GRAVEL (SM)g: About 40% coarse to fine, subangular sand; about 30% coarse to fine, hard, subangular gravel; about 30% nonplastic fines with quick dilatancy and low toughness; maximum size 50 mm; dry, light reddish brown, weak reaction with HCl.
0.7 to 11.7 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, angular to subangular sand; about 5% nonplastic fines; dry, light reddish brown, reddish yellow, moderate reaction with HCl. Appears iron stained.

TOTAL SAMPLE (BY VOLUME): About 5% hard, drilled and subangular cobbles; maximum size 120 mm; remainder minus 3 in.
11.7 to 13.6 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 60% coarse to fine, angular sand; about 40% coarse to fine, hard, angular to subangular gravel; trace of nonplastic fines; trace of hard, subangular cobbles; maximum size 130 mm; dry, light reddish brown, weak reaction with HCl.
13.6 to 16.0 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 50% coarse to fine, hard, angular gravel; about 45% coarse to fine, angular to subangular sand; about 5% nonplastic fines; dry, pink, moderate reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 10% hard, drilled and subangular cobbles; maximum size 140 mm; remainder minus 3 in.
16.0 to 17.9 ft POORLY GRADED SAND WITH GRAVEL AND COBBLES (SP)gc: About 55% coarse to fine, subangular sand; about 40% coarse to fine, hard, angular to subangular gravel; about 5% nonplastic fines; dry, pink, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 20% hard, drilled and subangular cobbles; maximum size 175 mm; remainder minus 3 in.
17.9 to 18.8 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 60% coarse to fine, angular sand; about 35% predominantly fine, hard, angular to subangular gravel; about 5% nonplastic fines; maximum size 60 mm; dry, pinkish gray, strong reaction with HCl.
18.8 to 25.4 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, subangular gravel; about 40% coarse to fine, angular to subangular sand; trace of nonplastic fines; dry, pinkish gray, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 20% hard, drilled and subangular cobbles; maximum size 120 mm; remainder minus 3 in.
25.4 to 27.2 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 55% coarse to fine, angular sand; about 40% coarse to fine, hard, angular gravel; about 5% nonplastic fines; dry, pink, moderate reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 30% hard, drilled and subangular cobbles; maximum size 120 mm; remainder minus 3 in.
27.2 to 31.9 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 50% coarse to fine, hard, angular gravel; about 45% coarse to fine, angular sand; about 5% nonplastic fines; dry, pinkish gray, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 5% hard, drilled and subangular cobbles; maximum size 120 mm; remainder minus 3 in.
31.9 to 32.4 ft SILTY SAND WITH GRAVEL (SM)g: About 45% coarse to fine, angular sand; about 35% predominantly fine, hard, angular gravel; about 20% nonplastic fines with quick dilatancy and low toughness; maximum size 40 mm; dry, pinkish gray, strong reaction with HCl.
32.4 to 37.7 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 65% coarse to fine, hard, angular to subangular gravel; about 30% coarse to fine, angular sand; trace to 5% nonplastic fines; dry, light reddish brown, pinkish gray, no to strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 5% hard, drilled and subangular cobbles; maximum size 130 mm; remainder minus 3 in.
37.7 to 46.3 ft WELL GRADED SAND WITH SILT, GRAVEL AND COBBLES (SW-SM)gc: About 50% coarse to fine, angular to subangular sand; about 40% coarse to fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; dry, pink, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 10% hard, subangular cobbles; maximum size 125 mm; remainder minus 3 in.
46.3 to 48.6 ft POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)s: About 50% coarse to fine, hard, subangular gravel; about 40% coarse to fine, angular to subangular sand; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 90 mm; dry, pinkish gray, strong reaction with HCl.
48.6 to 62.7 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, angular to subangular sand; trace to 5% nonplastic fines; trace of hard, drilled and subangular cobbles; maximum size 120 mm; dry, pink, weak to strong reaction with HCl.
62.7 to 64.3 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 60% coarse to fine, angular to subangular sand; about 30% coarse to fine, hard, angular

Figure 1.1-125. Geologic Log of Drill Hole UE-25 RF#56 (Sheet 1 of 5)

NOTE: Descriptions of the material may not reflect in situ geologic conditions due to mechanical degradation of the sample by the Sonic drilling method; TD = total depth.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#56

SHEET 2 OF 5

FEATURE: Waste Handling Facility	PROJECT: Yucca Mountain Project	STATE: Nevada
LOCATION: Midway Valley	COORDINATES: N 765,439.36 E 571,857.22	GROUND ELEVATION: 3646.81
BEGUN: 6/6/2005 FINISHED: 7/7/2005	TOTAL DEPTH: 416.9 ft	ANGLE FROM HORIZONTAL: -90°
DEPTH TO WATER: Not Encountered	DEPTH TO BEDROCK: 129.9 ft	HOLE LOGGED BY: George Eatman
		REVIEWED BY: Robert Lung

NOTES

DEPTH

ENGINEERING INDICES: HARDNESS, WELDING, FRACTURE DENSITY

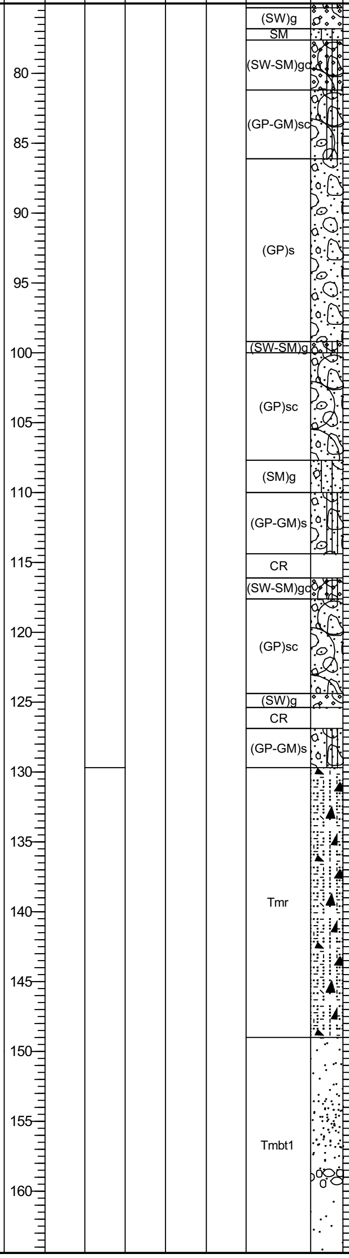
% CORE RECOVERY

% RQD

GEOLOGIC UNIT [USCS]

GRAPHIC

CLASSIFICATION AND PHYSICAL CONDITION



to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 90 mm; dry, pink, strong reaction with HCl.

64.3 to 73.2 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 65% coarse to fine, hard, angular to subangular gravel; about 30% coarse to fine, angular sand; about 5% nonplastic fines; dry, pink, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 10% hard, drilled and subangular cobbles; maximum size 120 mm; remainder minus 3 in.

73.2 to 75.3 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 60% coarse to fine, angular sand; about 30% predominantly fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 55 mm; dry, pink, no reaction with HCl.

75.3 to 76.8 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 50% coarse to fine, subangular sand; about 45% coarse to fine, hard, angular to subangular gravel; about 5% nonplastic fines; maximum size 75 mm; dry, pinkish gray, weak reaction with HCl.

76.8 to 77.6 ft SILTY SAND (SM): About 60% coarse to fine, angular to subangular sand; about 30% nonplastic fines with quick dilatancy and low toughness; about 10% predominantly fine, hard, angular to subangular gravel; maximum size 25 mm; dry, light gray, moderate reaction with HCl.

77.6 to 81.2 ft WELL GRADED SAND WITH SILT, GRAVEL AND COBBLES (SW-SM)gc: About 50% coarse to fine, angular to subangular sand; about 40% coarse to fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; dry, pinkish gray, moderate reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 5% hard, drilled and subangular cobbles; maximum size 120 mm; remainder minus 3 in.

81.2 to 86.1 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc: About 50% coarse to fine, hard, angular gravel; about 40% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness, trace of hard, drilled and subangular cobbles; maximum size 120 mm; dry, pinkish gray, moderate reaction with HCl.

86.1 to 99.2 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 60% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular to subangular sand; about 5% nonplastic fines; maximum size 100 mm; dry, pink, pinkish gray, moderate to strong reaction with HCl. Core removed from 92.7 to 94.3 ft.

99.2 to 99.8 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 60% coarse to fine, angular sand; about 30% predominantly fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 45 mm; dry, pink, moderate reaction with HCl.

99.8 to 107.7 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular to subangular sand; trace to 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 100 mm; dry, pink, pinkish gray, strong reaction with HCl. Core removed from 104.9 to 106.3 ft.

107.7 to 110.0 ft SILTY SAND WITH GRAVEL (SM)g: About 60% coarse to fine, angular to subangular sand; about 25% predominantly fine, hard, angular to subangular gravel; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 80 mm; dry, pink, strong reaction with HCl.

110.0 to 114.4 ft POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)s: About 50% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, angular to subangular sand; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 90 mm; dry, light gray, pink, strong reaction with HCl.

114.4 to 116.1 ft CORE REMOVED

116.1 to 117.6 ft WELL GRADED SAND WITH SILT, GRAVEL AND COBBLES (SW-SM)gc: About 50% coarse to fine, angular to subangular sand; about 40% coarse to fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; dry, pinkish gray, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 20% hard, drilled and subangular cobbles; maximum size 140 mm; remainder minus 3 in.

117.6 to 124.4 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 70% coarse to fine, hard, angular to subangular gravel; about 25% coarse to fine, angular to subangular sand; about 5% nonplastic fines; dry, pinkish gray, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 10% hard, drilled and subangular cobbles; maximum size 125 mm; remainder minus 3 in.

124.4 to 125.4 ft WELL GRADED SAND WITH GRAVEL (SW)g: About 55% coarse to fine, angular to subangular sand; about 40% predominantly fine, hard, subangular gravel; about 5% nonplastic fines; maximum size 95 mm; dry, pink, strong reaction with HCl.

125.4 to 126.9 ft CORE REMOVED

126.9 to 129.7 ft POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)s: About 50% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, subangular sand; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 50 mm; dry, pink, strong reaction with HCl.

129.7 to 149.0 ft: RAINIER MESA TUFF (Tmr):
Tephra and bedded tuff, nonwelded, vitric, locally altered, locally poorly consolidated, pinkish white, 10 to 20% pumice, less than 1% densely welded and crystallized lithic fragments, 10 to 20% crystal fragments of quartz, plagioclase and sanidine, less than 1% biotite.

149.0 to 226.0 ft: PRE-RAINIER MESA TUFF BEDDED TUFF (Tmbt1):
Interbedded ignimbrite, bedded tuff and fallout tephra.

The ignimbrite is nonwelded, bedded, vitric, locally clay altered, pink, white, 15 to 40% pumice, 1 to 3% lithic fragments of welded tuff, less than 1 to 2% glass fragments, 5 to 7% crystal fragments of quartz, sanidine and plagioclase, less than 1% biotite.

The fallout tephra is nonwelded, primarily fine grained ash and locally coarse grained lithic and crystal rich ash, locally zeolitized, pinkish white.

The bedded tuff is nonwelded, vitric, locally partially crystallized, locally altered and locally zeolitized, locally poorly consolidated, locally reworked, light gray, very pale brown, white and pink, 3 to 30% pumice, less than 1 to 15% lithic fragments of welded tuff, 5 to 15% crystal fragments of quartz, sanidine, and plagioclase.

Figure 1.1-125. Geologic Log of Drill Hole UE-25 RF#56 (Sheet 2 of 5)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#56

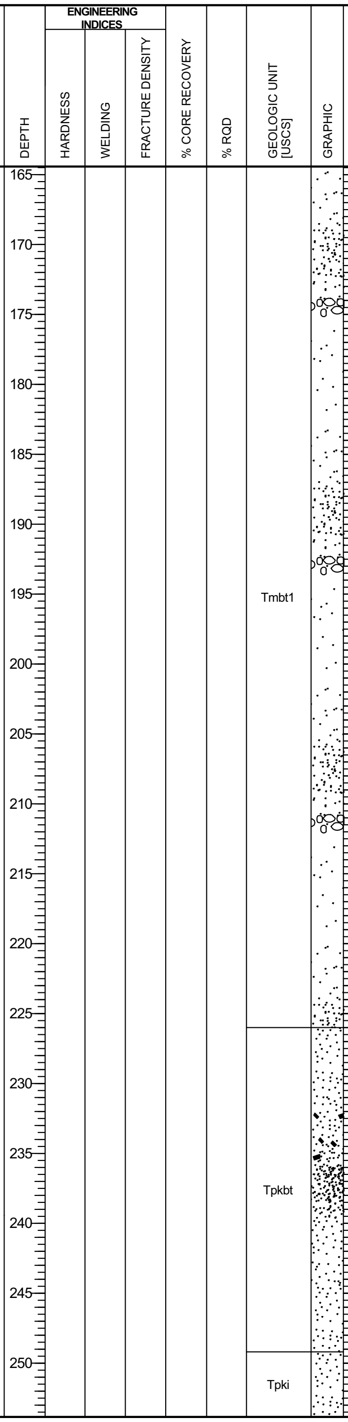
SHEET 3 OF 5

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 6/6/2005 FINISHED: 7/7/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,439.36 E 571,857.22
TOTAL DEPTH: 416.9 ft
DEPTH TO BEDROCK: 129.9 ft

STATE: Nevada
GROUND ELEVATION: 3646.81
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES



CLASSIFICATION AND PHYSICAL CONDITION

226.0 to 249.2 ft: POST TUFF "X" BEDDED TUFF (Tpkbt):
Bedded tuff, nonwelded, clay altered, pink, very pale brown, 3 to 20% pumice, 2 to 5% lithic fragments of welded tuff, quartz absent. From 226.0 to 228.5 ft may be an incipient paleosol.

249.2 to 392.7 ft: COMB PEAK IGNIMBRITE - TUFF "X" (Tpki):

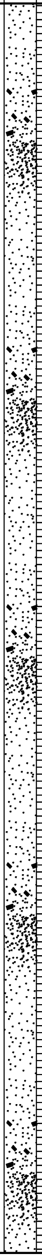
249.2 to 255.6 ft: Ignimbrite, nonwelded, vitric, slightly altered, pink, 3 to 5% pumice. This is the upper nonwelded vitric zone of Tpki.

Figure 1.1-125. Geologic Log of Drill Hole UE-25 RF#56 (Sheet 3 of 5)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#56

SHEET 4 OF 5

FEATURE: Waste Handling Facility	PROJECT: Yucca Mountain Project	STATE: Nevada
LOCATION: Midway Valley	COORDINATES: N 765,439.36 E 571,857.22	GROUND ELEVATION: 3646.81
BEGUN: 6/6/2005 FINISHED: 7/7/2005	TOTAL DEPTH: 416.9 ft	ANGLE FROM HORIZONTAL: -90°
DEPTH TO WATER: Not Encountered	DEPTH TO BEDROCK: 129.9 ft	HOLE LOGGED BY: George Eatman
		REVIEWED BY: Robert Lung



NOTES	DEPTH	ENGINEERING INDICES HARDNESS	WELDING	FRACTURE DENSITY	% CORE RECOVERY	% RQD	GEOLOGIC UNIT [USCS]	GRAPHIC	CLASSIFICATION AND PHYSICAL CONDITION
	255								255.6 to 392.7 ft: Pyroclastic flow, nonwelded, crystallized, locally altered, white, pinkish white and pale brown, 15 to 30% pumice, 2 to 5% lithic fragments of welded tuff, 1 to 2% crystal fragments of quartz and feldspar, less than 1% of biotite, hornblende and magnetite.
	260								
	265								
	270								
	275								
	280								
	285								
	290								
	295						Tpki		
	300								
	305								
	310								
	315								
	320								
	325								
	330								
	335								
	340								

Figure 1.1-125. Geologic Log of Drill Hole UE-25 RF#56 (Sheet 4 of 5)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#56

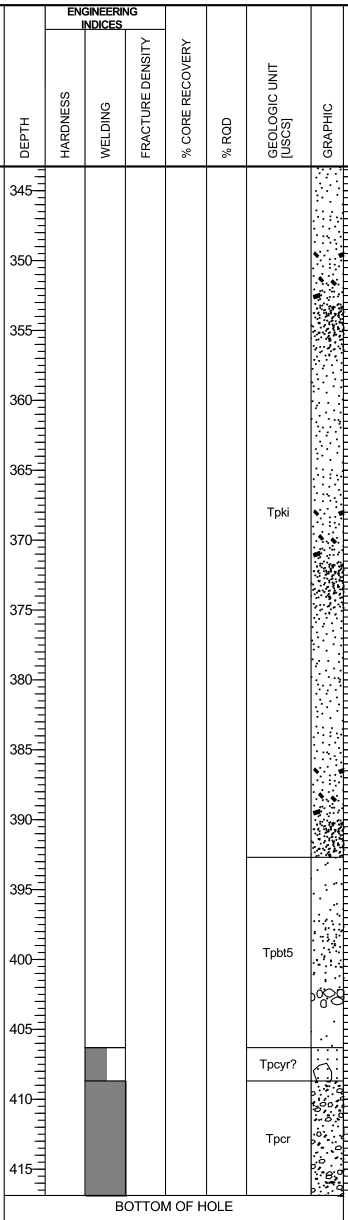
SHEET 5 OF 5

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 6/6/2005 FINISHED: 7/7/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 765,439.36 E 571,857.22
TOTAL DEPTH: 416.9 ft
DEPTH TO BEDROCK: 129.9 ft

STATE: Nevada
GROUND ELEVATION: 3646.81
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES



CLASSIFICATION AND PHYSICAL CONDITION

392.7 to 406.3 ft: POST-TIVA CANYON TUFF BEDDED TUFF (Tpbt5):
Bedded tuff, nonwelded, partially reworked, partially clay altered, pink, white, very pale brown, 2 to 30% pumice, 1 to 3% lithic fragments of welded tuff, 2 to 6% crystal fragments of quartz, sanidine and plagioclase, less than 1 to 1% biotite, pyroxene and magnetite.

406.3 to 408.7 ft: TUFF OF PINYON PASS (Tpcyr?):
Pyroclastic flow, partially welded, crystallized, pale red, 10 to 15% pumice, less than 1% lithic fragments of welded tuff, 1% crystal fragments of plagioclase, sanidine and quartz, less than 1 to 2% biotite and pyroxene.

408.7 to 416.9 ft: TIVA CANYON TUFF CRYSTAL-RICH MEMBER (Tpcr):
Pyroclastic flow, densely welded, vitric to crystallized, weak red, pale red, very dark gray, 5 to 20% pumice, less than 1% lithic fragments of welded tuff, 7 to 15% crystal fragments of plagioclase and sanidine, less than 1 to 1% biotite and pyroxene.

Figure 1.1-125. Geologic Log of Drill Hole UE-25 RF#56 (Sheet 5 of 5)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#58

SHEET 1 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: FINISHED: 5/11/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 763,061.43 E 571,072.57
TOTAL DEPTH: 150.7 ft
DEPTH TO BEDROCK: 134.2 ft

STATE: Nevada
GROUND ELEVATION: 3667.70
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES

Purpose of Hole:
Repository Facilities Geotechnical Investigations

Drill Equipment:
GP24 300 RS (Sonic Drill Rig)
Flatbed combination water and pipe truck with boom for moving drill pipe and casing.

Driller:
Travis Osterberg
Boart Longyear Drill Services

Drilling Method:
Rotosonic
Advance 8 in. casing as hole is cored 0.0 to 150.7 ft (TD). Drill string inside casing consists of 3½ in. single wall drill pipe with 6.163 in. Rotosonic Carbide button bit.

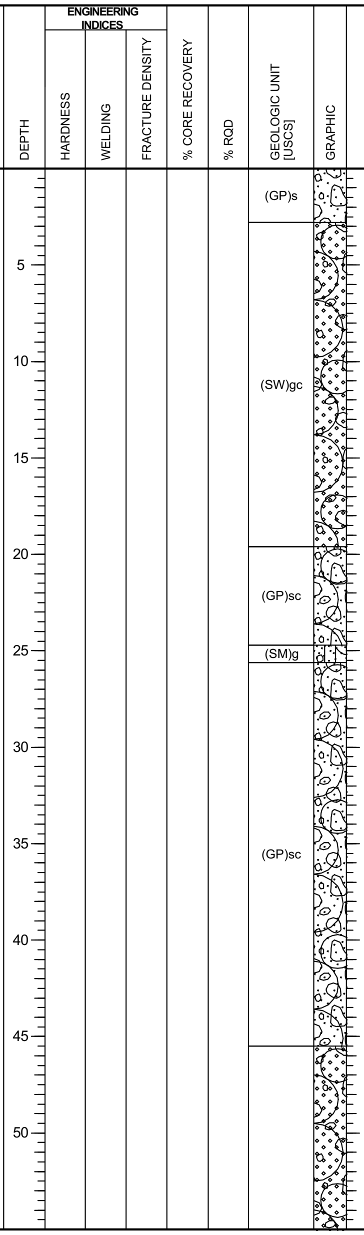
Drilling Conditions:

Drilling Fluid:
Small amounts of drilling additives were added to help in advancing casing.

Fluid Loss Interval:
NA

Casing Record:
8 in. casing from 0.0 to 150.7 ft (TD)

Hole Completion:
Back fill hole from 150.7 ft (TD) up to 0.0 ft (ground surface) with Bentonite Chips. Pull casing.



CLASSIFICATION AND PHYSICAL CONDITION

0.0 to 134.2 ft QUATERNARY ALLUVIUM (Qal)

0.0 to 2.8 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 55% coarse to fine, hard, subangular to subrounded gravel; about 45% coarse to fine, subangular to subrounded sand; trace of nonplastic fines; maximum size 115 mm; moist, brown, strong reaction with HCl. Topsoil.

2.8 to 19.6 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 65% coarse to fine, angular to subangular sand; about 30% coarse to fine, hard, angular to subangular gravel; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 125 mm; dry to moist, light brown, gray, strong reaction with HCl.

19.6 to 24.7 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% coarse to fine, hard, subangular to subrounded gravel; about 45% coarse to fine, angular to subangular sand; trace of nonplastic fines; trace of hard, subangular cobbles; maximum size 170 mm; dry, light brown, strong reaction with HCl.

24.7 to 25.6 ft SILTY SAND WITH GRAVEL (SM)g: About 65% coarse to fine, subangular sand; about 20% nonplastic fines with quick dilatancy and low toughness; about 15% predominantly fine, hard, angular to subangular gravel; maximum size 70 mm; dry, gray, strong reaction with HCl.

25.6 to 45.5 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, angular to subangular sand; trace to 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 130 mm; dry, light brown, gray, strong reaction with HCl.

45.5 to 80.6 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 60% coarse to fine, angular to subangular sand; about 40% coarse to fine, hard, angular to subangular gravel; trace of nonplastic fines; trace of hard, subangular cobbles; maximum size 130 mm; dry, light brown, gray, tan, no to strong reaction with HCl.

Figure 1.1-126. Geologic Log of Drill Hole UE-25 RF#58 (Sheet 1 of 3)

NOTE: Descriptions of the material may not reflect in situ geologic conditions due to mechanical degradation of the sample by the Sonic drilling method; TD = total depth.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#58

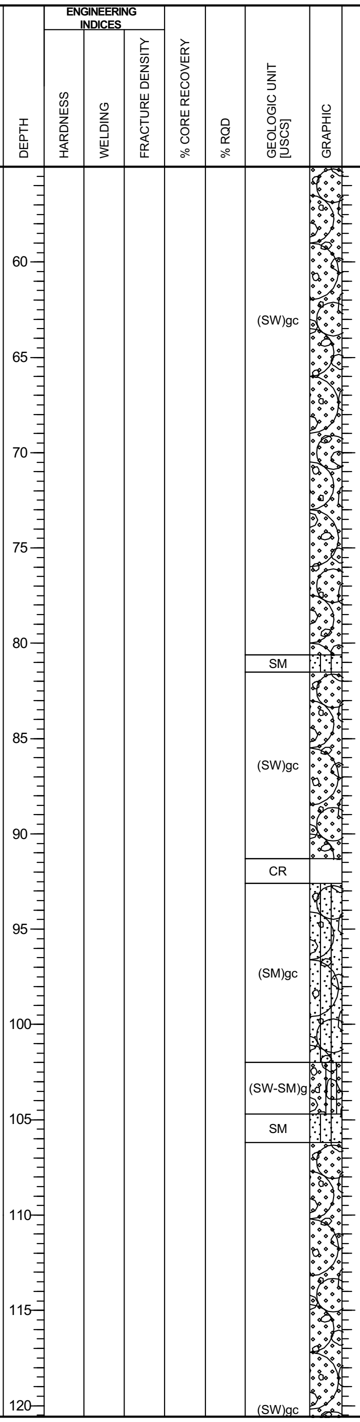
SHEET 2 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: FINISHED: 5/11/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 763,061.43 E 571,072.57
TOTAL DEPTH: 150.7 ft
DEPTH TO BEDROCK: 134.2 ft

STATE: Nevada
GROUND ELEVATION: 3667.70
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES



CLASSIFICATION
AND PHYSICAL CONDITION

80.6 to 81.5 ft SILTY SAND (SM): About 70% coarse to fine, subangular sand; about 20% nonplastic fines with quick dilatancy and low toughness; about 10% predominantly fine, hard, angular to subangular gravel; maximum size 50 mm; dry, strong reaction with HCl.
81.5 to 91.3 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 70% coarse to fine, angular to subangular sand; about 30% coarse to fine, hard, angular to subangular gravel; trace of nonplastic fines; trace of hard, subangular cobbles; maximum size 120 mm; dry, gray, strong reaction with HCl.

91.3 to 92.6 ft CORE REMOVED

92.6 to 102.0 ft SILTY SAND WITH GRAVEL AND COBBLES (SM)gc: About 50% coarse to fine, subangular sand; about 35% coarse to fine, hard, subangular gravel; about 15% nonplastic fines with quick dilatancy and low toughness; trace of hard, subangular cobbles; maximum size 110 mm; dry, gray, strong reaction with HCl.

102.0 to 104.7 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 60% coarse to fine, subangular sand; about 30% coarse to fine, hard, subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 95 mm; dry, gray, strong reaction with HCl.
104.7 to 106.2 ft SILTY SAND (SM): About 75% coarse to fine, subangular sand; about 15% nonplastic fines with quick dilatancy and low toughness; about 10% predominantly fine, hard, subangular gravel; maximum size 60 mm; dry, gray, strong reaction with HCl.
106.2 to 134.2 ft POORLY GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 60% coarse to fine, angular to subangular sand; about 35% coarse to fine, hard, subangular gravel; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 190 mm; dry, pink, gray, strong reaction with HCl. Core removed from 106.8 to 108.1 ft, 118.4 to 119.7 ft, and 130.6 to 132.2 ft.

Figure 1.1-126. Geologic Log of Drill Hole UE-25 RF#58 (Sheet 2 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#58

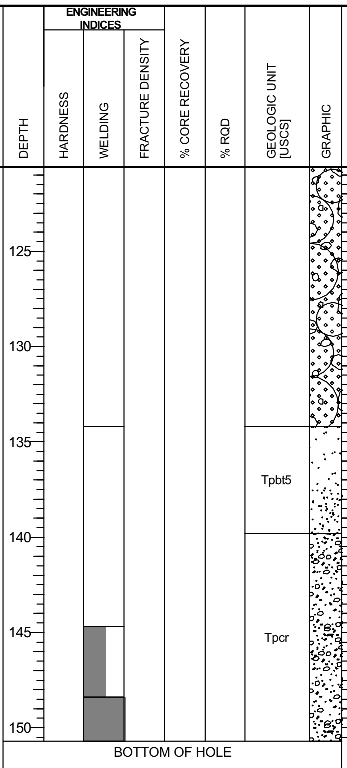
SHEET 3 OF 3

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: FINISHED: 5/11/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 763,061.43 E 571,072.57
TOTAL DEPTH: 150.7 ft
DEPTH TO BEDROCK: 134.2 ft

STATE: Nevada
GROUND ELEVATION: 3667.70
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES



CLASSIFICATION
AND PHYSICAL CONDITION

134.2 to 139.8 ft POST TIVA CANYON TUFF BEDDED TUFF (Tpbt5):
Tephra and fallout tephra, reworked, partially vitric, predominantly clay altered ash, white, 1 to 5% pumice increasing with depth to partly pumice supported, less than 1% volcanic lithic fragments, less than 1 to 10% phenocrysts of sanidine and quartz, less than 1% hornblende, and biotite.

139.8 to 150.7 ft TIVA CANYON CRYSTAL-RICH MEMBER (Tpcr):
Pyroclastic flow, variably vitric and crystallized, nonwelded at the top increasing to densely welded at depth, locally silicified or clay altered, white to very pale brown, light gray to weak red, black, 5 to 20% pumice, less than 1 to 5% lithic fragments of volcanic tuff, lithics absent locally at depth, 2 to 12% crystal fragments of sanidine and plagioclase, less than 1% biotite, pyroxene and hornblende. Minor fractures with calcite and zeolite/clay filling increasing with depth.

Figure 1.1-126. Geologic Log of Drill Hole UE-25 RF#58 (Sheet 3 of 3)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#59

SHEET 1 OF 4

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 5/25/2005 FINISHED: 5/31/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 762,347.29 E 571,406.69
TOTAL DEPTH: 179.0 ft
DEPTH TO BEDROCK: 155.3 ft

STATE: Nevada
GROUND ELEVATION: 3664.55
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES	DEPTH	ENGINEERING INDICES HARDNESS	WELDING	FRACTURE DENSITY	% CORE RECOVERY	% RQD	GEOLOGIC UNIT [USCS]	GRAPHIC	CLASSIFICATION AND PHYSICAL CONDITION
	0.0–8.6						(GP)sc		
	8.6–12.0						(SW-SM)gc		
	12.0–31.9						(GP)sc		
	31.9–34.8						(SW)g		
	34.8–45.5						(GP)sc		
	45.5–						(SW)gc		

Purpose of Hole:
Repository Facilities Geotechnical Investigations

Drill Equipment:
GP24 200 RS (Sonic Drill Rig)
Flatbed combination water and pipe truck with boom for moving drill pipe and casing.

Driller:
Dale
Boart Longyear Drill Services

Drilling Method:
Rotosonic
Advance 8 in. casing as hole is cored 0.0 to 179.0 ft (TD). Drill string inside casing consists of 3½ in. single wall drill pipe with 6.163 in. Rotosonic Carbide button bit.

Drilling Conditions:

Drilling Fluid:
Small amounts of drilling additives were added to help in advancing casing.

Fluid Loss Interval:
NA

Casing Record:
8 in. casing from 0.0 to 179.0 ft (TD)

Hole Completion:
Back fill hole from 179.0 ft (TD) up to 0.0 ft (ground surface) with Bentonite Chips. Pull casing

0.0 to 154.8 ft QUATERNARY ALLUVIUM (Qal)

0.0 to 8.6 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% coarse to fine, hard, subangular gravel; about 40% coarse to fine, angular sand; trace to 5% nonplastic fines; trace of hard, drilled and angular to subangular cobbles; maximum size 130 mm; dry, reddish brown, light reddish brown, weak to moderate reaction with HCl.

8.6 to 12.0 ft WELL GRADED SAND WITH SILT, GRAVEL AND COBBLES (SW-SM)gc: About 55% coarse to fine, subangular sand; about 35% coarse to fine, hard, subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; dry, reddish yellow, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 5% hard, drilled and subangular cobbles; maximum size 170 mm; remainder minus 3 in.

12.0 to 31.9 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular to subangular sand; trace to 5% nonplastic fines; dry, pink, light reddish brown, moderate to strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 5% hard, subangular cobbles; maximum size 145 mm; remainder minus 3 in.

31.9 to 34.8 ft WELL GRADED SAND WITH GRAVEL (SW)g: **About 50% coarse to fine, angular sand; about 45% coarse to fine, hard, subangular gravel; about 5% nonplastic fines; maximum size 60 mm; dry, pink, strong reaction with HCl.**

34.8 to 45.5 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular sand; about 5% nonplastic fines; trace of hard, subangular cobbles maximum size 120 mm; dry, pink, strong reaction with HCl.

45.5 to 52.5 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 50% coarse to fine, angular sand; about 45% coarse to fine, hard, subangular gravel; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 95 mm; dry, pink, no reaction with HCl.

Figure 1.1-127. Geologic Log of Drill Hole UE-25 RF#59 (Sheet 1 of 4)

NOTE: Descriptions of the material may not reflect in situ geologic conditions due to mechanical degradation of the sample by the Sonic drilling method; TD = total depth.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#59

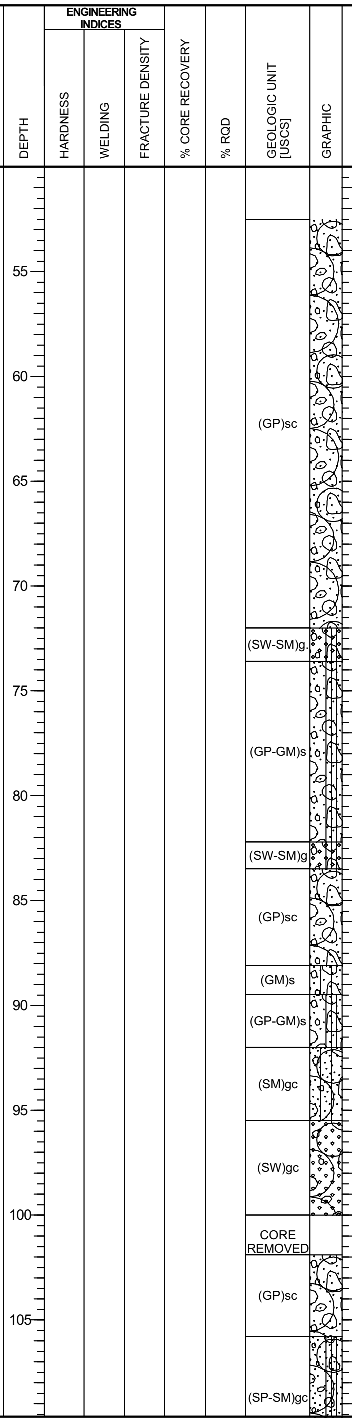
SHEET 2 OF 4

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 5/25/2005 FINISHED: 5/31/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 762,347.29 E 571,406.69
TOTAL DEPTH: 179.0 ft
DEPTH TO BEDROCK: 155.3 ft

STATE: Nevada
GROUND ELEVATION: 3664.55
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES



CLASSIFICATION AND PHYSICAL CONDITION

52.5 to 72.0 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 65% coarse to fine, hard, angular to subangular gravel; about 30% coarse to fine; angular sand; trace to 5% nonplastic fines; dry, pink, pinkish gray, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 10% hard, subangular cobbles; maximum size 120 mm; remainder minus 3 in.

72.0 to 73.6 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 50% coarse to fine, angular sand; about 40% coarse to fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 40 mm; dry, pinkish gray, strong reaction with HCl.

73.6 to 82.2 ft POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)s: About 60% coarse to fine, hard, angular to subangular gravel; about 30% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 70 mm; dry, pinkish gray, strong reaction with HCl.

82.2 to 83.5 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 60% coarse to fine, angular sand; about 30% coarse to fine, hard, angular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 30 mm; dry, pinkish gray, moderate reaction with HCl.

83.5 to 88.1 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, angular gravel; about 40% coarse to fine, angular sand; trace of nonplastic fines; trace of hard, subangular cobbles; maximum size 105 mm; dry, light reddish brown, moderate reaction with HCl.

88.1 to 89.5 ft SILTY GRAVEL WITH SAND (GM)s: About 45% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, angular sand; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 25 mm; dry, pinkish gray, strong reaction with HCl.

89.5 to 92.0 ft POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)s: About 50% coarse to fine, hard, angular gravel; about 40% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 70 mm; dry, pinkish gray, moderate reaction with HCl.

92.0 to 95.5 ft SILTY SAND WITH GRAVEL AND COBBLES (SM)gc: About 45% coarse to fine, angular to subangular sand; about 40% coarse to fine, hard, angular to subangular gravel; about 15% nonplastic fines with quick dilatancy and low toughness; dry, pinkish gray, moderate to strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 10% hard, drilled, and angular to subangular cobbles; maximum size 150 mm; remainder minus 3 in.

95.5 to 100.0 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 55% coarse to fine, angular sand; about 40% coarse to fine, hard, angular to subangular gravel; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 120 mm; dry, pink, weak to moderate reaction with HCl.

100.0 to 101.9 ft CORE REMOVED

101.9 to 105.8 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, angular sand; about 5% nonplastic fines; dry, pink, weak to moderate reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 10% hard, drilled and subangular cobbles; maximum size 120 mm; remainder minus 3 in.

105.8 to 111.6 ft POORLY GRADED SAND WITH SILT, GRAVEL AND COBBLES (SP-SM)gc: About 60% coarse to medium, angular sand; about 25% predominantly fine, hard, angular to subangular gravel; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 190 mm; dry, light gray, moderate reaction with HCl.

Figure 1.1-127. Geologic Log of Drill Hole UE-25 RF#59 (Sheet 2 of 4)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#59

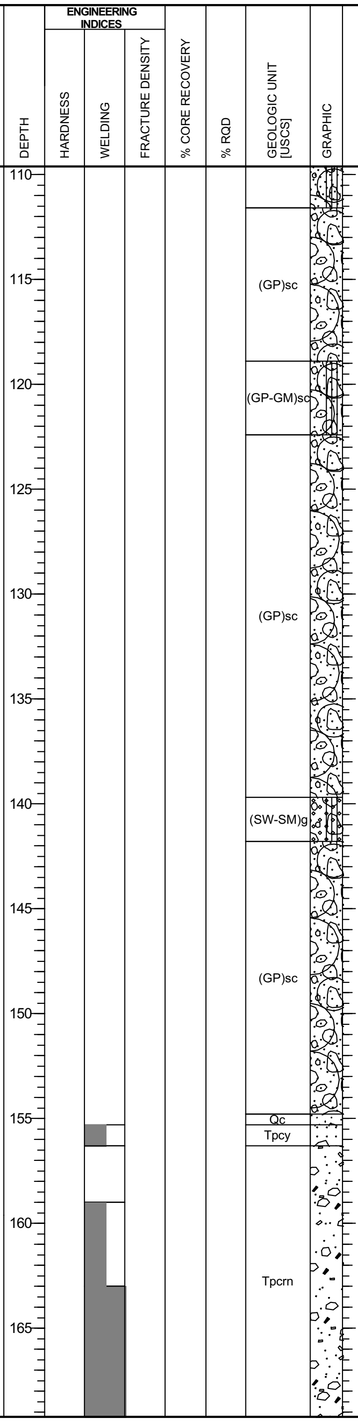
SHEET 3 OF 4

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 5/25/2005 FINISHED: 5/31/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 762,347.29 E 571,406.69
TOTAL DEPTH: 179.0 ft
DEPTH TO BEDROCK: 155.3 ft

STATE: Nevada
GROUND ELEVATION: 3664.55
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES



CLASSIFICATION AND PHYSICAL CONDITION

TOTAL SAMPLE (BY VOLUME): About 45% hard, drilled cobbles; maximum size 190 mm; remainder minus 3 in.

111.6 to 118.9 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 65% coarse to fine, hard, angular to subangular gravel; about 30% coarse to fine, angular sand; about 5% nonplastic fines; trace of hard, angular to subangular cobbles; maximum size 105 mm; dry, pink, pinkish gray, strong reaction with HCl. Core removed from 113.1 to 115.1 ft.

118.9 to 122.4 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc: About 55% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular sand; about 10% nonplastic fines with low dry strength, quick dilatancy and low toughness; trace of hard, angular to subangular cobbles; maximum size 115 mm; dry, pink, strong reaction with HCl.

122.4 to 139.7 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, angular sand; about 5% nonplastic fines; dry, pink, pinkish gray, no to strong reaction with HCl. Core removed from 131.9 to 133.5 ft.

TOTAL SAMPLE (BY VOLUME): About 5% hard, drilled and angular to subangular cobbles; maximum size 175 mm; remainder minus 3 in.

139.7 to 141.8 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 50% coarse to fine, angular sand; about 40% coarse to fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 40 mm; dry, pinkish gray, strong reaction with HCl.

141.8 to 154.8 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular sand; about 5% nonplastic fines; trace of hard, angular to subangular cobbles; maximum size 120 mm; dry, pink, strong reaction with HCl. Core removed from 145.4 to 147.4 ft.

154.8 to 155.3 ft COLLUVIUM (Qc):
Colluvium consists of welded tuff fragments (red), gravel to cobble size in a caliche matrix (very pale brown).

155.3 to 156.3 ft TUFF OF PINYON PASS (Tpcy):
Pyroclastic flow, partially to moderately welded, crystallized, dusky red, 1 to 2% pumice, 5 to 15% lithic fragments of moderately welded tuff, 5% crystal fragments of sanidine and lesser plagioclase, 1% biotite and lesser hornblende and pyroxene.

156.3 to 179.0 ft TIVA CANYON TUFF CRYSTAL-RICH NONLITHOPHYSAL ZONE (Tpcrn):
Pyroclastic flow, nonwelded near top increasing to densely welded with depth, mostly crystallized, but vitric locally, very pale brown, pink, reddish brown, and very dark gray, pumice 2 to 15%, less than 1% lithic fragments of crystallized welded tuff near top of unit and absent at depth, 3 to 14% crystal fragments of sanidine and plagioclase, less than 1 to 2% biotite, pyroxene, hornblende, and magnetite.

Figure 1.1-127. Geologic Log of Drill Hole UE-25 RF#59 (Sheet 3 of 4)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#59

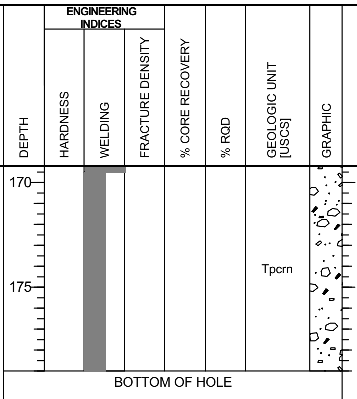
SHEET 4 OF 4

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 5/25/2005 FINISHED: 5/31/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 762,347.29 E 571,406.69
TOTAL DEPTH: 179.0 ft
DEPTH TO BEDROCK: 155.3 ft

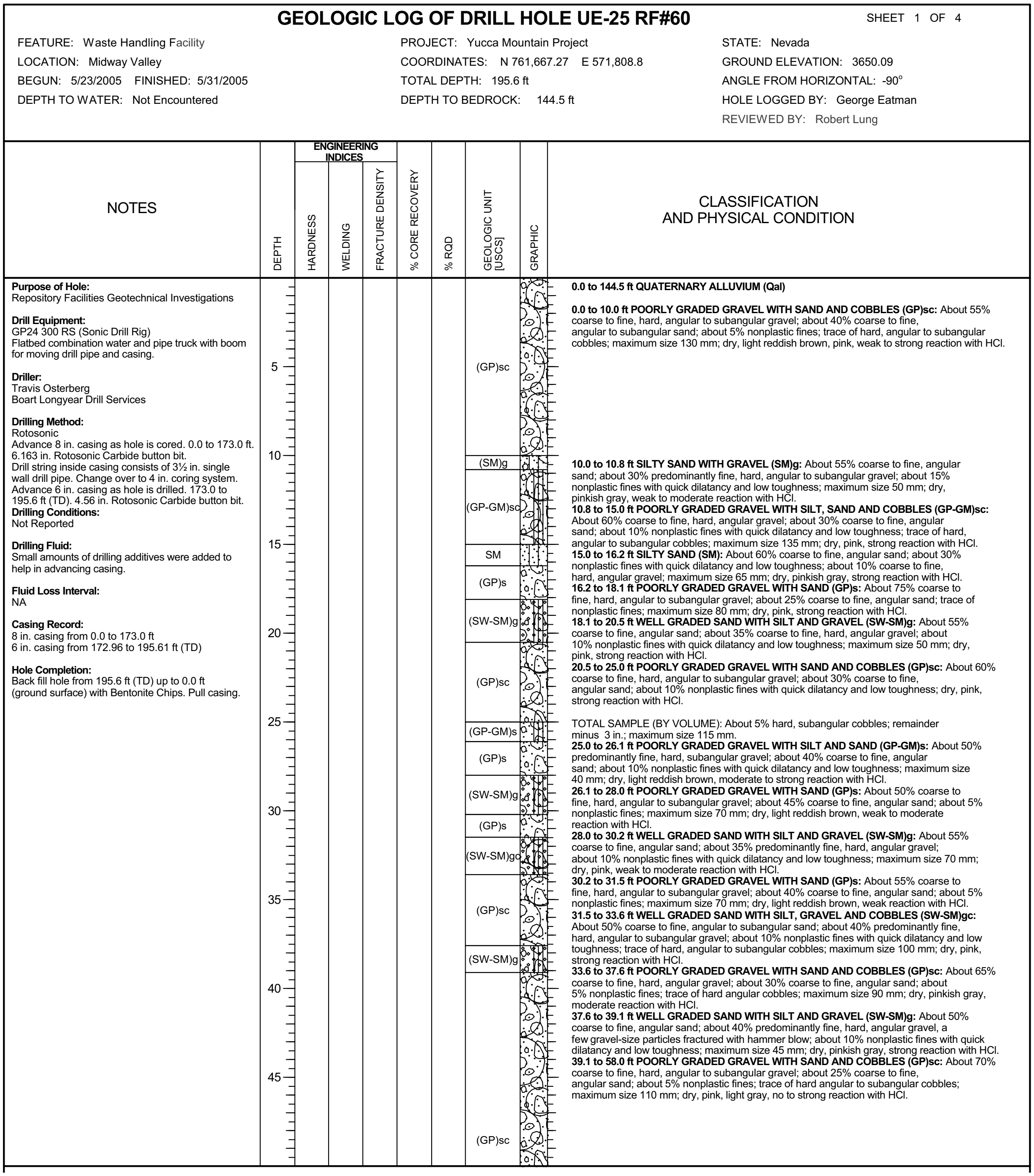
STATE: Nevada
GROUND ELEVATION: 3664.55
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES



CLASSIFICATION AND PHYSICAL CONDITION

Figure 1.1-127. Geologic Log of Drill Hole UE-25 RF#59 (Sheet 4 of 4)



GEOLOGIC LOG OF DRILL HOLE UE-25 RF#60 SHEET 1 OF 4

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 5/23/2005 FINISHED: 5/31/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 761,667.27 E 571,808.8
TOTAL DEPTH: 195.6 ft
DEPTH TO BEDROCK: 144.5 ft

STATE: Nevada
GROUND ELEVATION: 3650.09
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES

Purpose of Hole:
Repository Facilities Geotechnical Investigations

Drill Equipment:
GP24 300 RS (Sonic Drill Rig)
Flatbed combination water and pipe truck with boom for moving drill pipe and casing.

Driller:
Travis Osterberg
Boart Longyear Drill Services

Drilling Method:
Rotosonic
Advance 8 in. casing as hole is cored. 0.0 to 173.0 ft. 6.163 in. Rotosonic Carbide button bit.
Drill string inside casing consists of 3½ in. single wall drill pipe. Change over to 4 in. coring system. Advance 6 in. casing as hole is drilled. 173.0 to 195.6 ft (TD). 4.56 in. Rotosonic Carbide button bit.

Drilling Conditions:
Not Reported

Drilling Fluid:
Small amounts of drilling additives were added to help in advancing casing.

Fluid Loss Interval:
NA

Casing Record:
8 in. casing from 0.0 to 173.0 ft
6 in. casing from 172.96 to 195.61 ft (TD)

Hole Completion:
Back fill hole from 195.6 ft (TD) up to 0.0 ft (ground surface) with Bentonite Chips. Pull casing.

CLASSIFICATION AND PHYSICAL CONDITION

0.0 to 144.5 ft QUATERNARY ALLUVIUM (Qal)

0.0 to 10.0 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, angular to subangular sand; about 5% nonplastic fines; trace of hard, angular to subangular cobbles; maximum size 130 mm; dry, light reddish brown, pink, weak to strong reaction with HCl.

10.0 to 10.8 ft SILTY SAND WITH GRAVEL (SM)g: About 55% coarse to fine, angular sand; about 30% predominantly fine, hard, angular to subangular gravel; about 15% nonplastic fines with quick dilatancy and low toughness; maximum size 50 mm; dry, pinkish gray, weak to moderate reaction with HCl.

10.8 to 15.0 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc: About 60% coarse to fine, hard, angular gravel; about 30% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, angular to subangular cobbles; maximum size 135 mm; dry, pink, strong reaction with HCl.

15.0 to 16.2 ft SILTY SAND (SM): About 60% coarse to fine, angular sand; about 30% nonplastic fines with quick dilatancy and low toughness; about 10% coarse to fine, hard, angular gravel; maximum size 65 mm; dry, pinkish gray, strong reaction with HCl.

16.2 to 18.1 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 75% coarse to fine, hard, angular to subangular gravel; about 25% coarse to fine, angular sand; trace of nonplastic fines; maximum size 80 mm; dry, pink, strong reaction with HCl.

18.1 to 20.5 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 55% coarse to fine, angular sand; about 35% coarse to fine, hard, angular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 50 mm; dry, pink, strong reaction with HCl.

20.5 to 25.0 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, angular to subangular gravel; about 30% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; dry, pink, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 5% hard, subangular cobbles; remainder minus 3 in.; maximum size 115 mm.

25.0 to 26.1 ft POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)s: About 50% predominantly fine, hard, subangular gravel; about 40% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 40 mm; dry, light reddish brown, moderate to strong reaction with HCl.

26.1 to 28.0 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 50% coarse to fine, hard, angular to subangular gravel; about 45% coarse to fine, angular sand; about 5% nonplastic fines; maximum size 70 mm; dry, light reddish brown, weak to moderate reaction with HCl.

28.0 to 30.2 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 55% coarse to fine, angular sand; about 35% predominantly fine, hard, angular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 70 mm; dry, pink, weak to moderate reaction with HCl.

30.2 to 31.5 ft POORLY GRADED GRAVEL WITH SAND (GP)s: About 55% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, angular sand; about 5% nonplastic fines; maximum size 70 mm; dry, light reddish brown, weak reaction with HCl.

31.5 to 33.6 ft WELL GRADED SAND WITH SILT, GRAVEL AND COBBLES (SW-SM)gc: About 50% coarse to fine, angular to subangular sand; about 40% predominantly fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, angular to subangular cobbles; maximum size 100 mm; dry, pink, strong reaction with HCl.

33.6 to 37.6 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 65% coarse to fine, hard, angular gravel; about 30% coarse to fine, angular sand; about 5% nonplastic fines; trace of hard angular cobbles; maximum size 90 mm; dry, pinkish gray, moderate reaction with HCl.

37.6 to 39.1 ft WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)g: About 50% coarse to fine, angular sand; about 40% predominantly fine, hard, angular gravel, a few gravel-size particles fractured with hammer blow; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 45 mm; dry, pinkish gray, strong reaction with HCl.

39.1 to 58.0 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 70% coarse to fine, hard, angular to subangular gravel; about 25% coarse to fine, angular sand; about 5% nonplastic fines; trace of hard angular to subangular cobbles; maximum size 110 mm; dry, pink, light gray, no to strong reaction with HCl.

Figure 1.1-128. Geologic Log of Drill Hole UE-25 RF#60 (Sheet 1 of 4)

NOTE: Descriptions of the material may not reflect in situ geologic conditions due to mechanical degradation of the sample by the Sonic drilling method; TD = total depth.

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#60

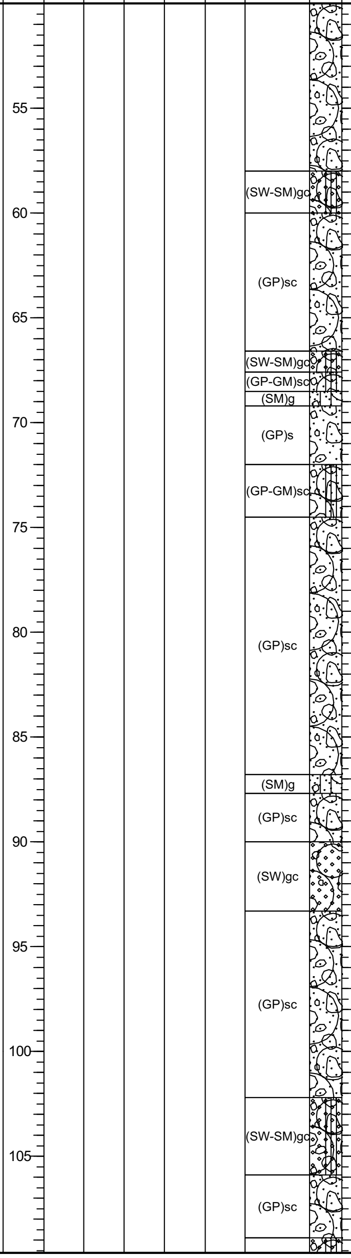
SHEET 2 OF 4

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 5/23/2005 FINISHED: 5/31/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 761,667.27 E 571,808.8
TOTAL DEPTH: 195.6 ft
DEPTH TO BEDROCK: 144.5 ft

STATE: Nevada
GROUND ELEVATION: 3650.09
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES	DEPTH	ENGINEERING INDICES			% CORE RECOVERY	% RQD	GEOLOGIC UNIT [USCS]	GRAPHIC	CLASSIFICATION AND PHYSICAL CONDITION
		HARDNESS	WELDING	FRACTURE DENSITY					



58.0 to 60.0 ft WELL GRADED SAND WITH SILT, GRAVEL AND COBBLES (SW-SM)gc: About 55% coarse to fine, angular sand; about 35% coarse to fine, hard, angular to subrounded gravel; about 10% nonplastic fines with quick dilatancy and low toughness; dry, pink, weak to moderate reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 15% hard, angular to subangular cobbles; remainder minus 3 in.; maximum size 80 mm.
60.0 to 66.6 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 55% coarse to fine, hard, angular to subangular gravel; about 40% coarse to fine, angular sand; about 5% nonplastic fines; dry, pinkish gray, strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 5% hard, angular to subangular cobbles; remainder minus 3 in.; maximum size 120 mm.

66.6 to 67.6 ft WELL GRADED SAND WITH SILT, GRAVEL AND COBBLES (SW-SM)gc: About 60% coarse to fine, angular sand; about 30% predominantly fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; dry, pink, weak reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 5% hard, subangular cobbles; remainder minus 3 in.; maximum size 105 mm.
67.6 to 68.5 ft POORLY GRADED GRAVEL WITH SILT, SAND, AND COBBLES (GP-GM)sc: About 55% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; dry, pink, no to weak reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 5% hard, subangular cobbles; remainder minus 3 in.; maximum size 80 mm.
68.5 to 69.2 ft SILTY SAND WITH GRAVEL (SM)g: About 55% coarse to fine, angular sand; about 30% nonplastic fines with quick dilatancy and low toughness; about 15% predominantly fine, hard, angular to subangular gravel; maximum size 35 mm; dry, pinkish gray, moderate to strong reaction with HCl.
69.2 to 72.0 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)s: About 60% coarse fine, hard, angular to subangular gravel; about 35% coarse to fine angular sand; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 85 mm; dry, pink, strong reaction with HCl.
72.0 to 74.5 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc: About 60% coarse to fine, hard, angular to subangular gravel; about 30% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, subangular cobbles; maximum size 100 mm; dry, pinkish gray, strong reaction with HCl.
74.5 to 86.8 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular to subangular sand; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 110 mm; dry, pink, moderate to strong reaction with HCl.

86.8 to 87.7 ft SILTY SAND WITH GRAVEL (SM)g: About 50% coarse to fine, angular sand; about 35% nonplastic fines with quick dilatancy and low toughness; about 15% predominantly fine, hard, angular gravel; maximum size 50 mm; dry, light gray, strong reaction with HCl.
87.7 to 90.0 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular to subangular sand; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 80 mm; dry, pinkish gray, strong reaction with HCl.
90.0 to 93.3 ft WELL GRADED SAND WITH GRAVEL AND COBBLES (SW)gc: About 55% coarse to fine, angular sand; about 40% coarse to fine, hard, angular to subangular gravel; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 130 mm; dry, pinkish gray, strong reaction with HCl.
93.3 to 102.2 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular sand; about 5% nonplastic fines; dry, pink, pinkish gray, weak to strong reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 10% hard, drilled and subangular cobbles; remainder minus 3 in.; maximum size 160 mm.

102.2 to 105.9 ft WELL GRADED SAND WITH SILT, GRAVEL AND COBBLES (SW-SM)gc: About 55% coarse to fine, angular sand; about 35% coarse to fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low dry strength; dry, pink, moderate reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 10% hard, drilled and subangular cobbles; remainder minus 3 in.; maximum size 120 mm.
105.9 to 108.9 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 70% coarse to fine, hard, angular to subangular gravel; about 25% coarse to fine, angular sand; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 105 mm; dry, pink, strong reaction with HCl.

Figure 1.1-128. Geologic Log of Drill Hole UE-25 RF#60 (Sheet 2 of 4)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#60

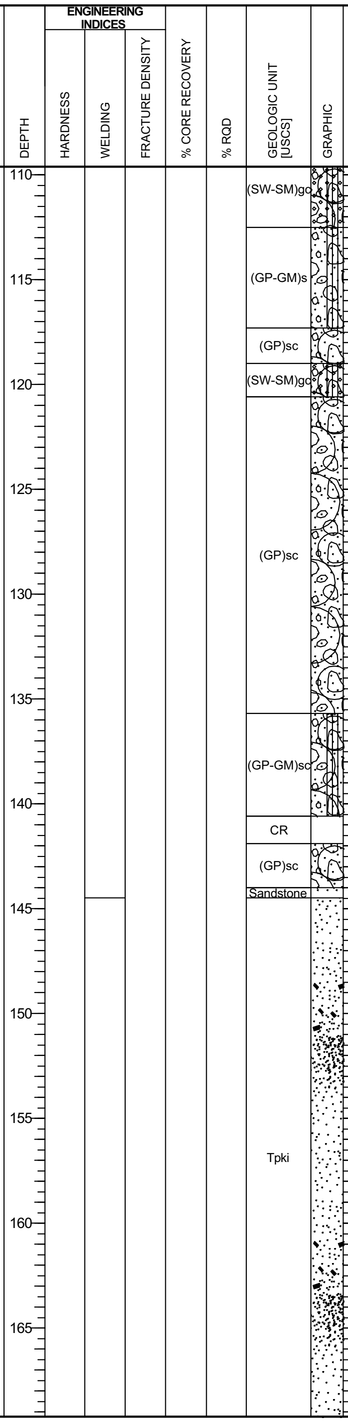
SHEET 3 OF 4

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 5/23/2005 FINISHED: 5/31/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 761,667.27 E 571,808.8
TOTAL DEPTH: 195.6 ft
DEPTH TO BEDROCK: 144.5 ft

STATE: Nevada
GROUND ELEVATION: 3650.09
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES



CLASSIFICATION
AND PHYSICAL CONDITION

108.9 to 112.5 ft WELL GRADED SAND WITH SILT, GRAVEL AND COBBLES (SW-SM)gc: About 50% coarse to fine, angular sand; about 40% coarse to fine, hard, angular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, angular to subangular cobbles; maximum size 100 mm; dry, pinkish gray, strong reaction with HCl.

112.5 to 117.3 ft POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)s: About 50% coarse to fine, hard, angular gravel; about 40% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; maximum size 70 mm; dry, pinkish gray, no reaction with HCl.

117.3 to 119.0 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular to subangular sand; about 5% nonplastic fines; dry, pinkish gray, no to weak reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 20% hard, drilled and subangular cobbles; remainder minus 3 in.; maximum size 130 mm.
119.0 to 120.6 ft WELL GRADED SAND WITH SILT, GRAVEL AND COBBLES (SW-SM)gc: About 50% coarse to fine, angular sand; about 40% coarse to fine, hard, angular to subangular gravel; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, subangular cobbles; maximum size 100 mm; dry, pink, strong reaction with HCl.
120.6 to 135.7 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 60% coarse to fine, hard, angular to subangular gravel; about 35% coarse to fine, angular sand; about 5% nonplastic fines; dry, pink, pinkish gray, no to moderate reaction with HCl.

TOTAL SAMPLE (BY VOLUME): About 10% hard, drilled and angular to subangular cobbles; remainder minus 3 in.; maximum size 150 mm.

135.7 to 140.6 ft POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM)sc: About 50% coarse to fine, hard, angular gravel; about 40% coarse to fine, angular sand; about 10% nonplastic fines with quick dilatancy and low toughness; trace of hard, subangular cobbles; maximum size 120 mm; dry, pink, no reaction with HCl.

140.6 to 141.9 ft CORE REMOVED

141.9 to 144.0 ft POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP)sc: About 65% coarse to fine, hard, angular to subangular gravel; about 30% coarse to fine, angular sand; about 5% nonplastic fines; trace of hard, subangular cobbles; maximum size 100 mm; dry, pinkish gray, strong reaction with HCl.
144.0 to 144.5 ft SANDSTONE:
Sandstone, fine grained, very dark gray.
144.5 to 176.1 ft. COMB PEAK IGNIMBRITE - TUFF "X" (Tpki):
Ignimbrite, nonwelded, partially clay altered, white, 25 to 60% pumice, 2 to 7% and locally greater than 10% volcanic lithic fragments, about 3% crystal fragments of sanidine and biotite with rare magnetite.

Figure 1.1-128. Geologic Log of Drill Hole UE-25 RF#60 (Sheet 3 of 4)

GEOLOGIC LOG OF DRILL HOLE UE-25 RF#60

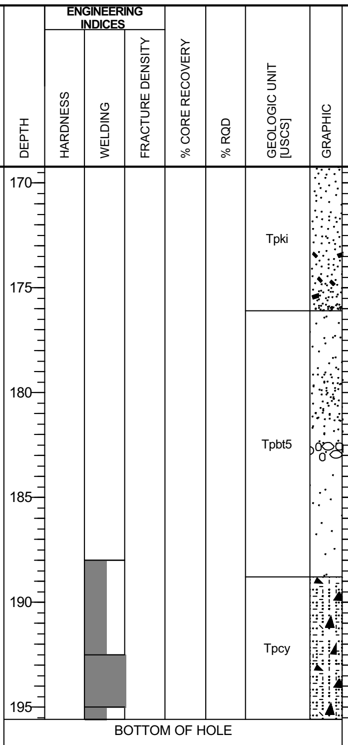
SHEET 4 OF 4

FEATURE: Waste Handling Facility
LOCATION: Midway Valley
BEGUN: 5/23/2005 FINISHED: 5/31/2005
DEPTH TO WATER: Not Encountered

PROJECT: Yucca Mountain Project
COORDINATES: N 761,667.27 E 571,808.8
TOTAL DEPTH: 195.6 ft
DEPTH TO BEDROCK: 144.5 ft

STATE: Nevada
GROUND ELEVATION: 3650.09
ANGLE FROM HORIZONTAL: -90°
HOLE LOGGED BY: George Eatman
REVIEWED BY: Robert Lung

NOTES



CLASSIFICATION AND PHYSICAL CONDITION

176.1 to 188.8 ft POST-TIVA CANYON TUFF BEDDED TUFF (Tpbt5):
Bedded tuff, tephra and ignimbrite.

176.1 to179.7 ft: Bedded tuff, nonwelded, reworked, moderately indurated, pink, predominantly fine sand size felsic crystal fragments and tuff fragments, 3 to 15% pumice.

179.7 to 184.3 ft: Tephra, nonwelded, partially clay altered, vitric, very pale brown, 20% pumice, 5% crystal fragments of biotite and sanidine with rare magnetite.

184.3 to 187.0 ft: Ignimbrite, nonwelded, moderately indurated, clay altered, reddish-yellow, pumice obscured or absent, 3% crystal fragments of biotite, less than 1% crystal fragments of sanidine and other minerals, 2% lithic fragments.

187.0 to 188.8 ft: Sample removed at drill site, contact with underlying Tpcy contained within sample interval.

188.8 to 195.6 ft TUFF OF PINYON PASS (Tpcy):
Ignimbrite, partially to densely welded, pink, gray, black, 5 to 10% pumice, less than 1% volcanic lithic fragments, 5 to 10% crystal fragments of sanidine and biotite with minor pyroxene.

Figure 1.1-128. Geologic Log of Drill Hole UE-25 RF#60 (Sheet 4 of 4)

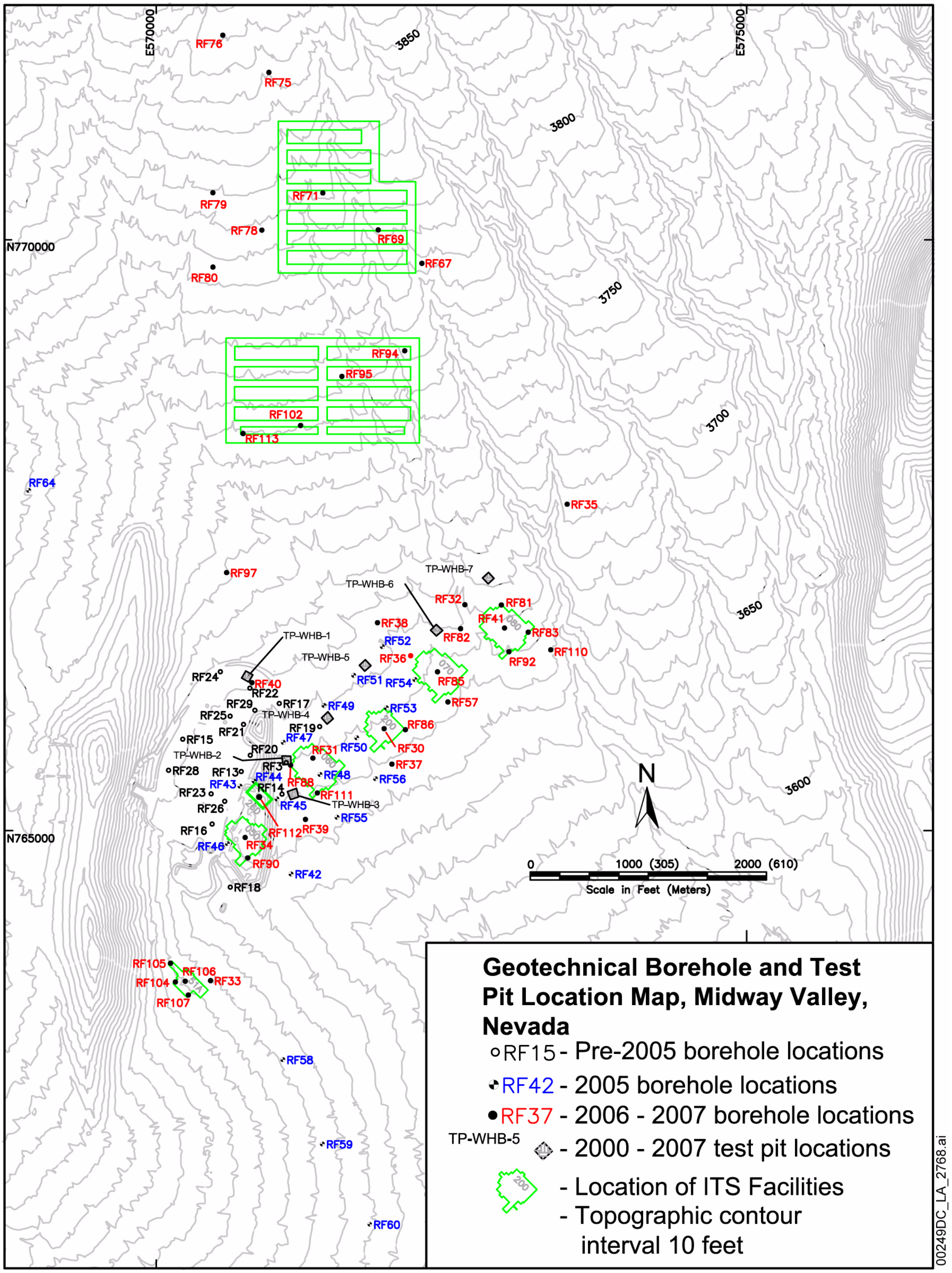


Figure 1.1-129. Repository Facilities Borehole and Test Pit Locations

Source: Buesch and Lung 2008, Figure 1.

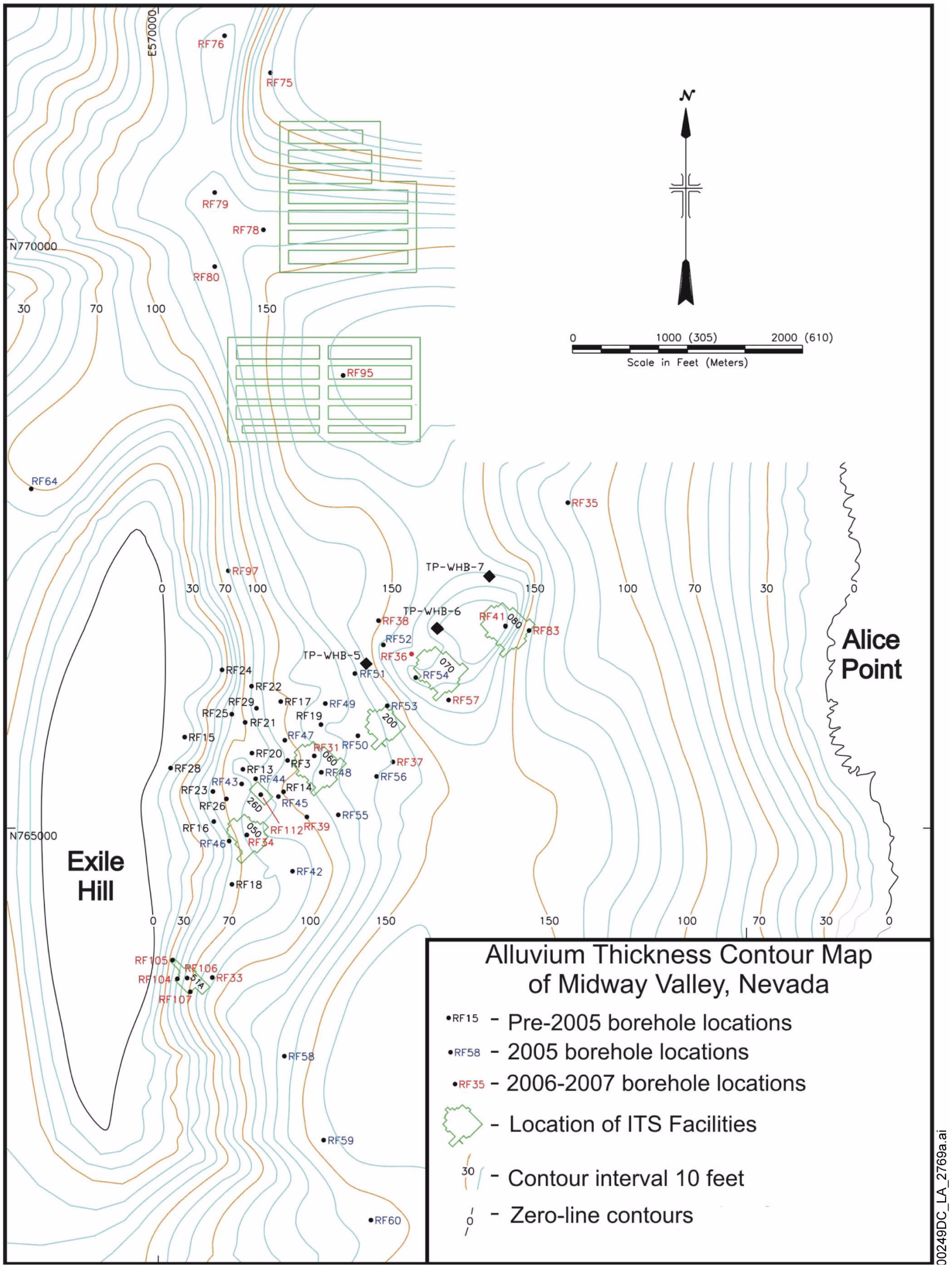


Figure 1.1-130. Alluvium Thickness Contour Map of Midway Valley

NOTE: Not all boreholes from the 2006-2007 drilling program are shown. Figure only shows the 2006-2007 boreholes used to construct the alluvium thickness contour map.

Source: SNL 2008a, Figure 6.2-4.

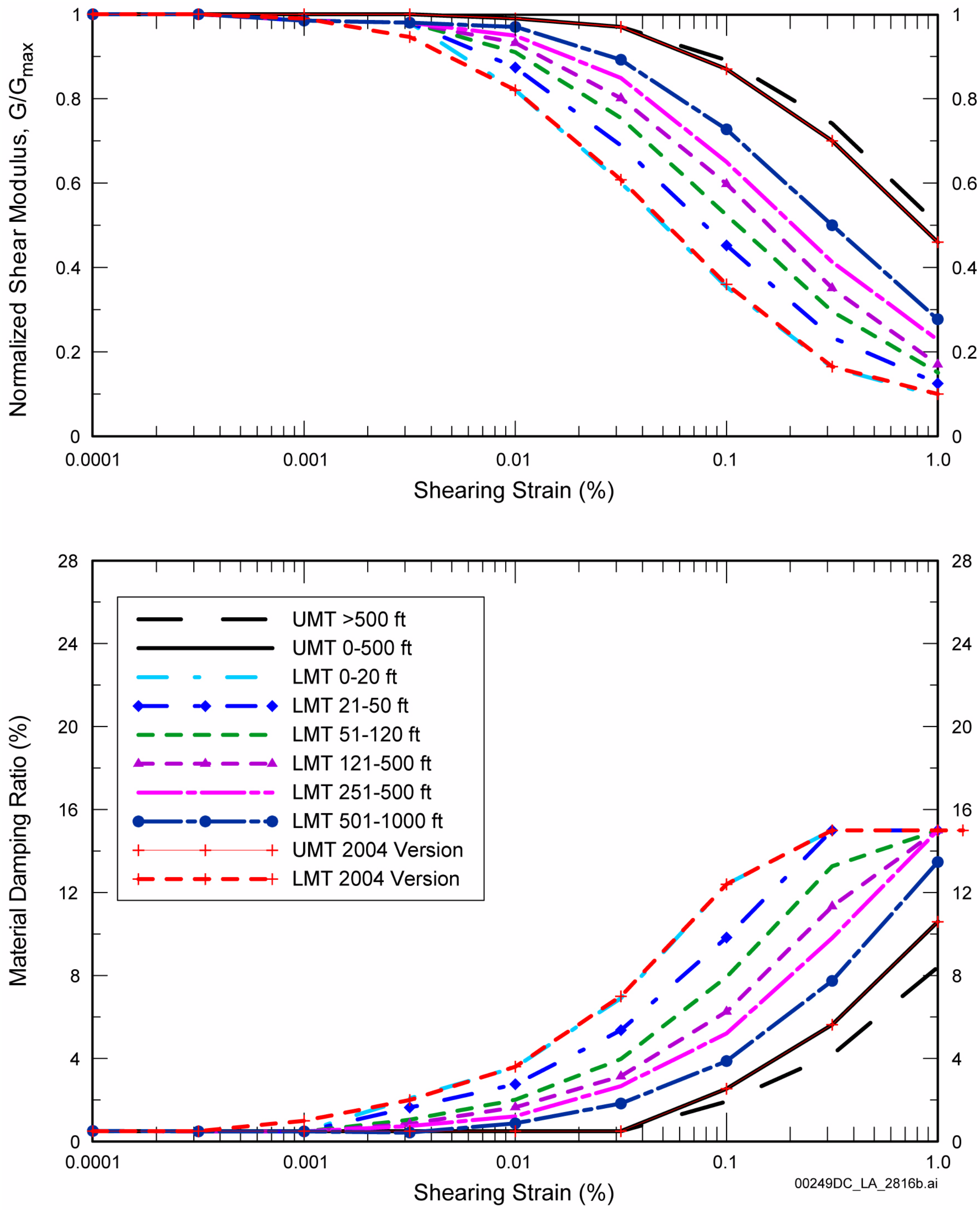


Figure 1.1-131. Comparison of Original and Updated Shear Modulus and Hysteretic Damping Curves for Tuff

NOTE: LMT = lower mean tuff; UMT = upper mean tuff.

Source: BSC 2008c, Figure 6.4.4-10.

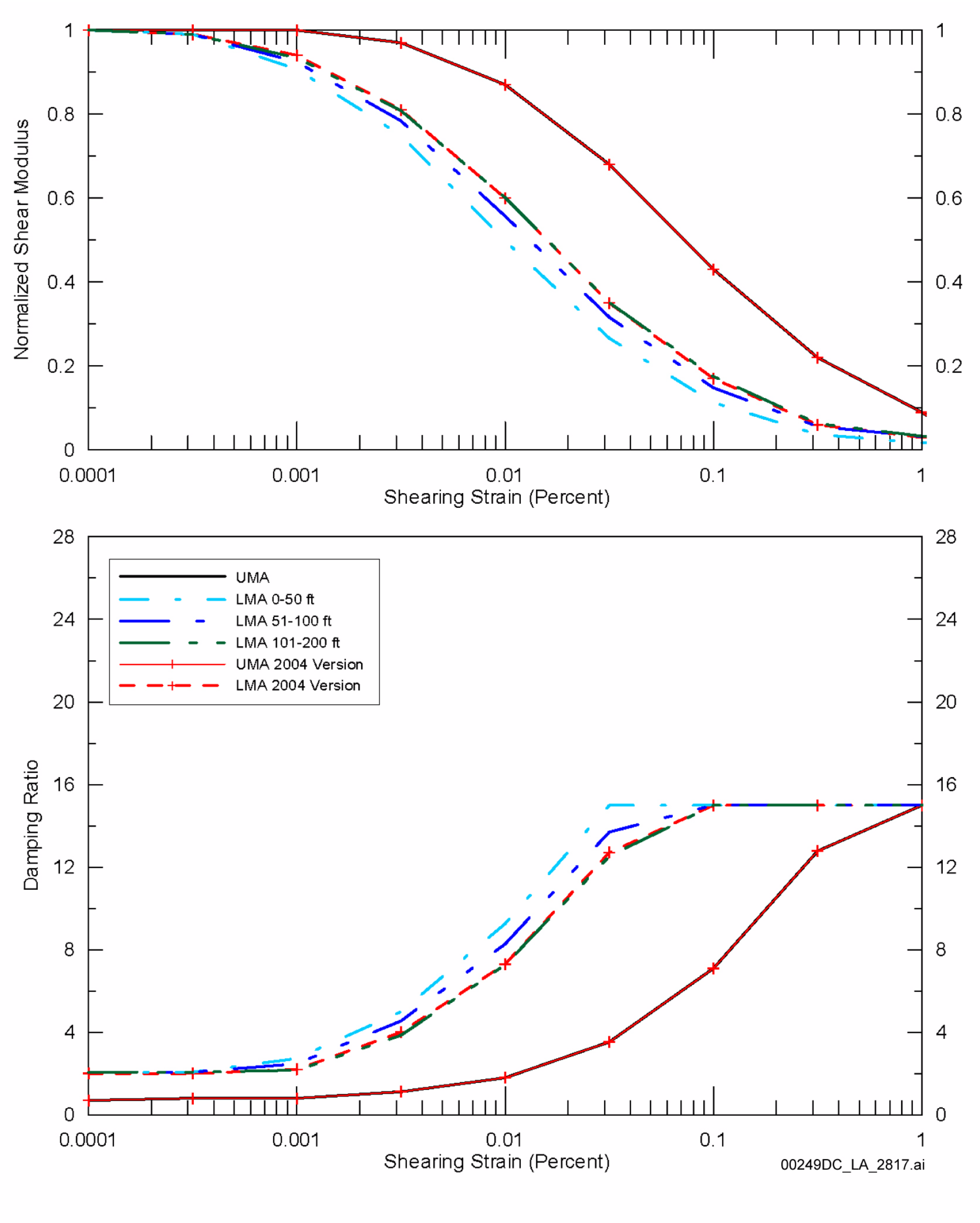


Figure 1.1-132. Comparison of Original and Updated Shear Modulus and Hysteretic Damping Curves for Surface GROA Alluvium

NOTE: LMA = lower mean alluvium; UMA = upper mean alluvium.

Source: BSC 2008c, Figure 6.4.4-19.

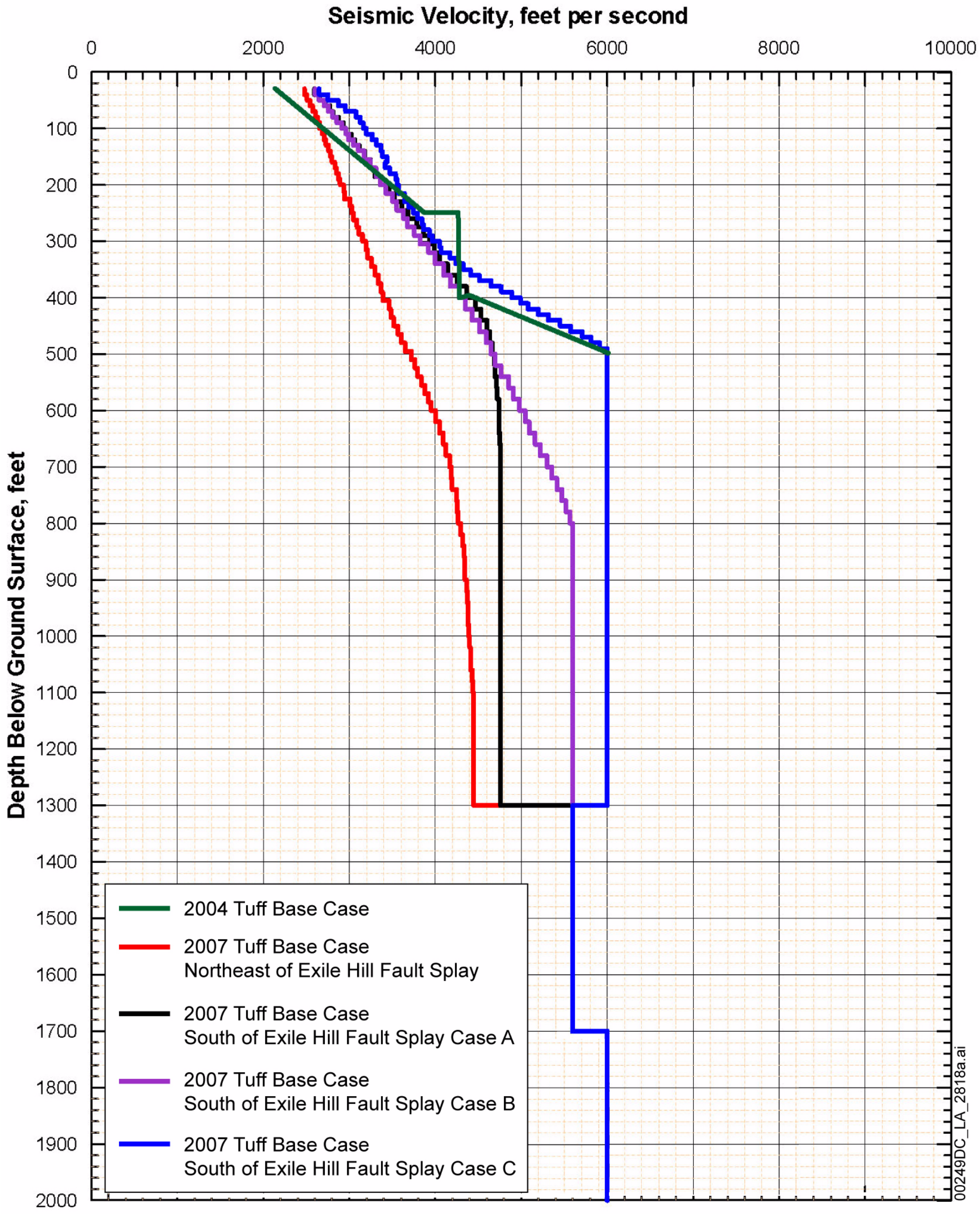


Figure 1.1-133. 2004 and 2007 Smoothed Surface GROA Base Case V_S Profiles for Tuff

NOTE: Below 1,300 ft all three South of Exile Hill Fault Splay Base Case profiles are shown in blue.

Source: BSC 2008c, Figure 6.4.2-94.

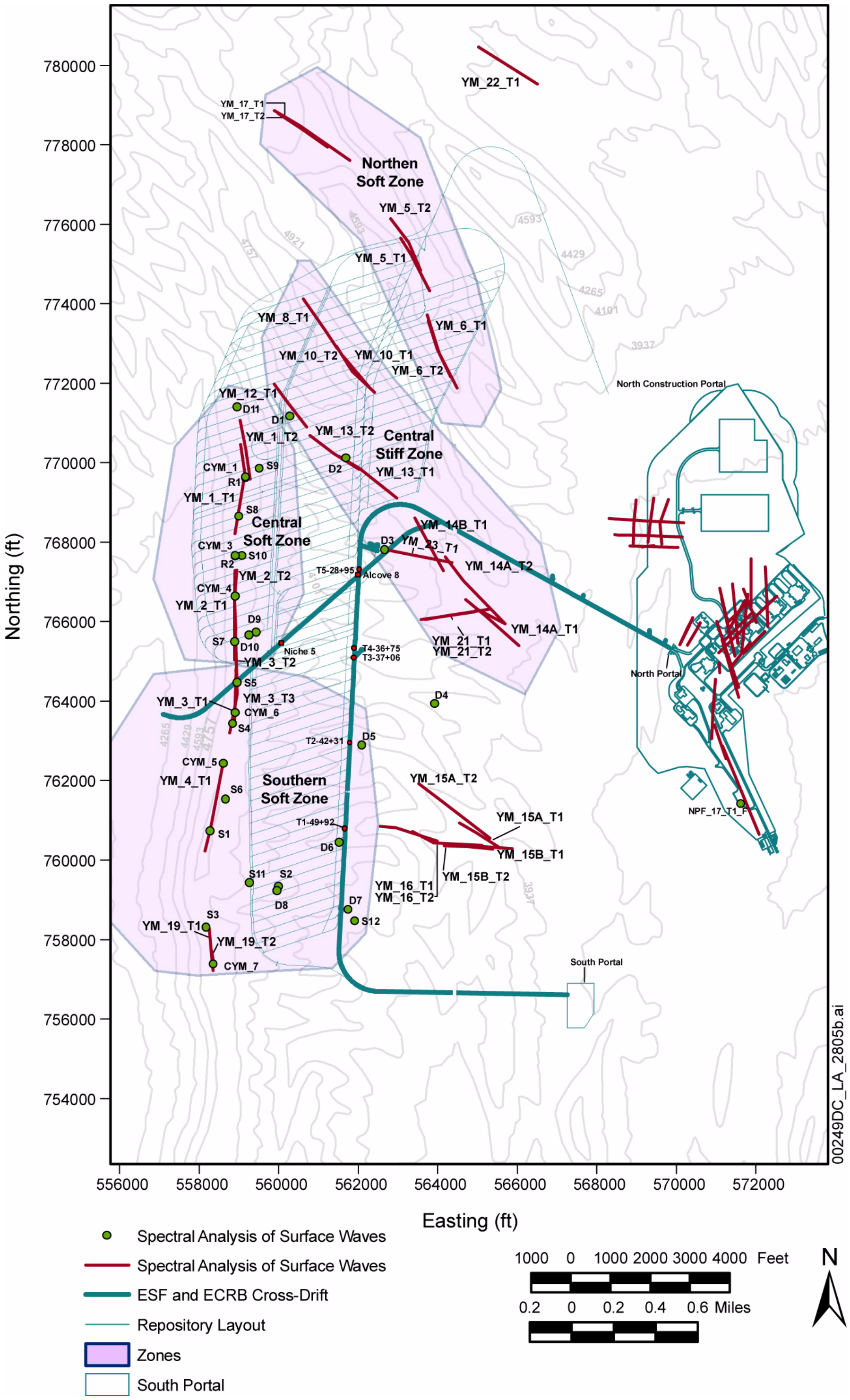


Figure 1.1-134. Spectral Analysis of Surface Waves Surveys in the Vicinity of the Repository Block

NOTE: Nevada State Plane coordinates.

Source: BSC 2008c, Figure 6.4.2-6.

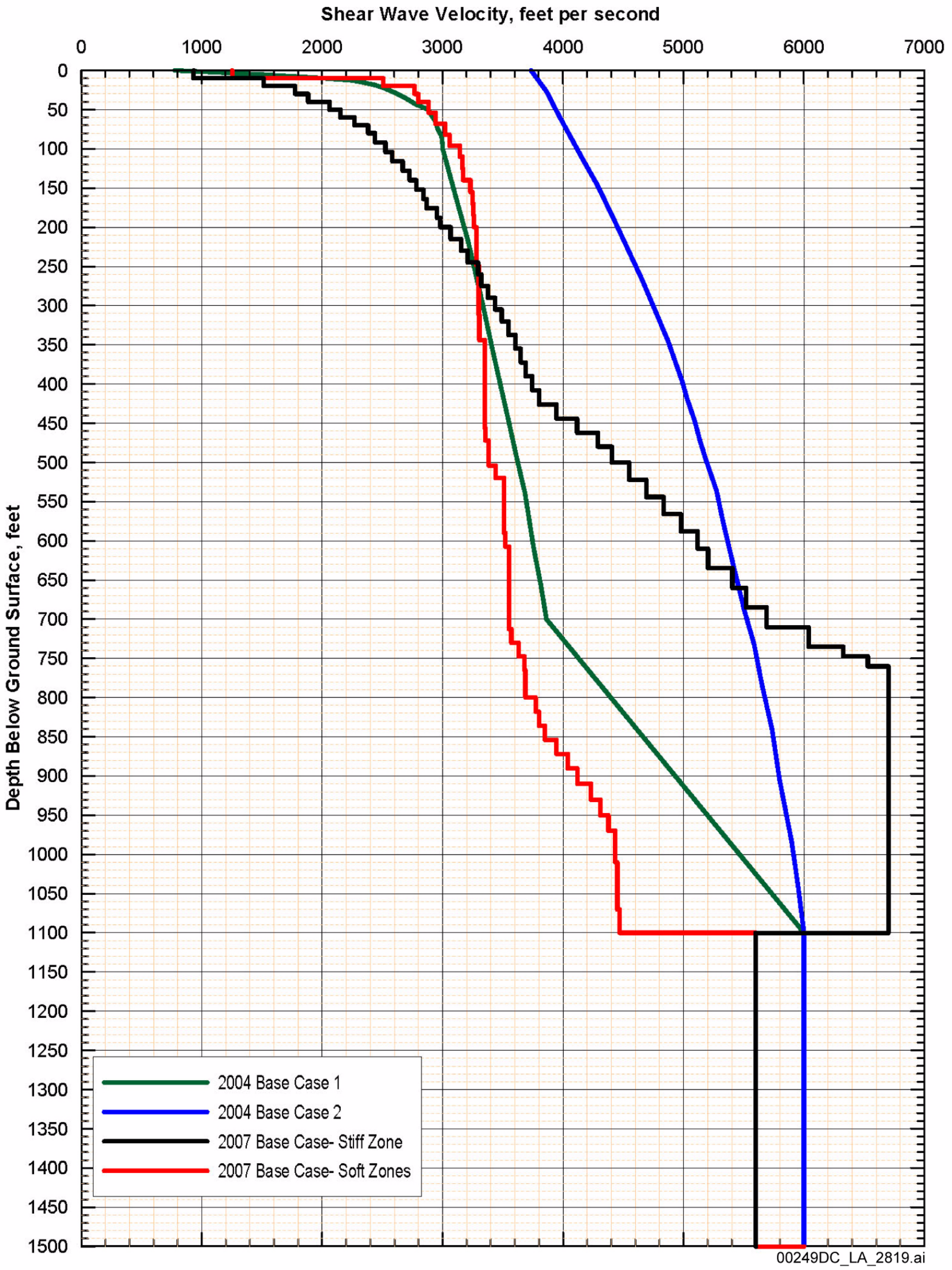


Figure 1.1-135. Comparison of 2004 and 2007 Smoothed Repository Block Base Case V_S Profiles

Source: BSC 2008c, Figure 6.4.2-93.

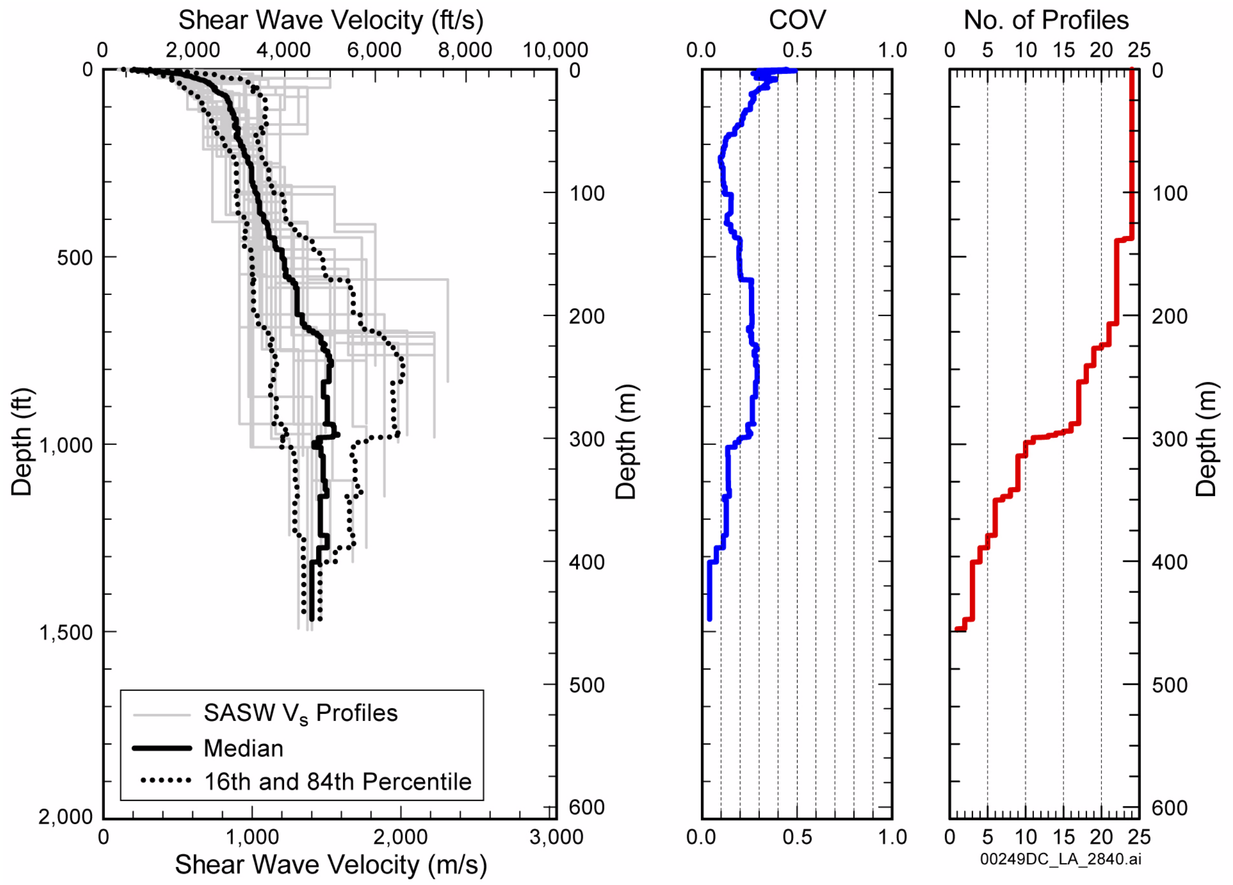


Figure 1.1-136. Individual Profiles and Statistical Analysis of 24 Spectral Analysis of Surface Wave Tests Performed Around the Mountain Area

Source: SNL 2008a, Figure 6.3-2.

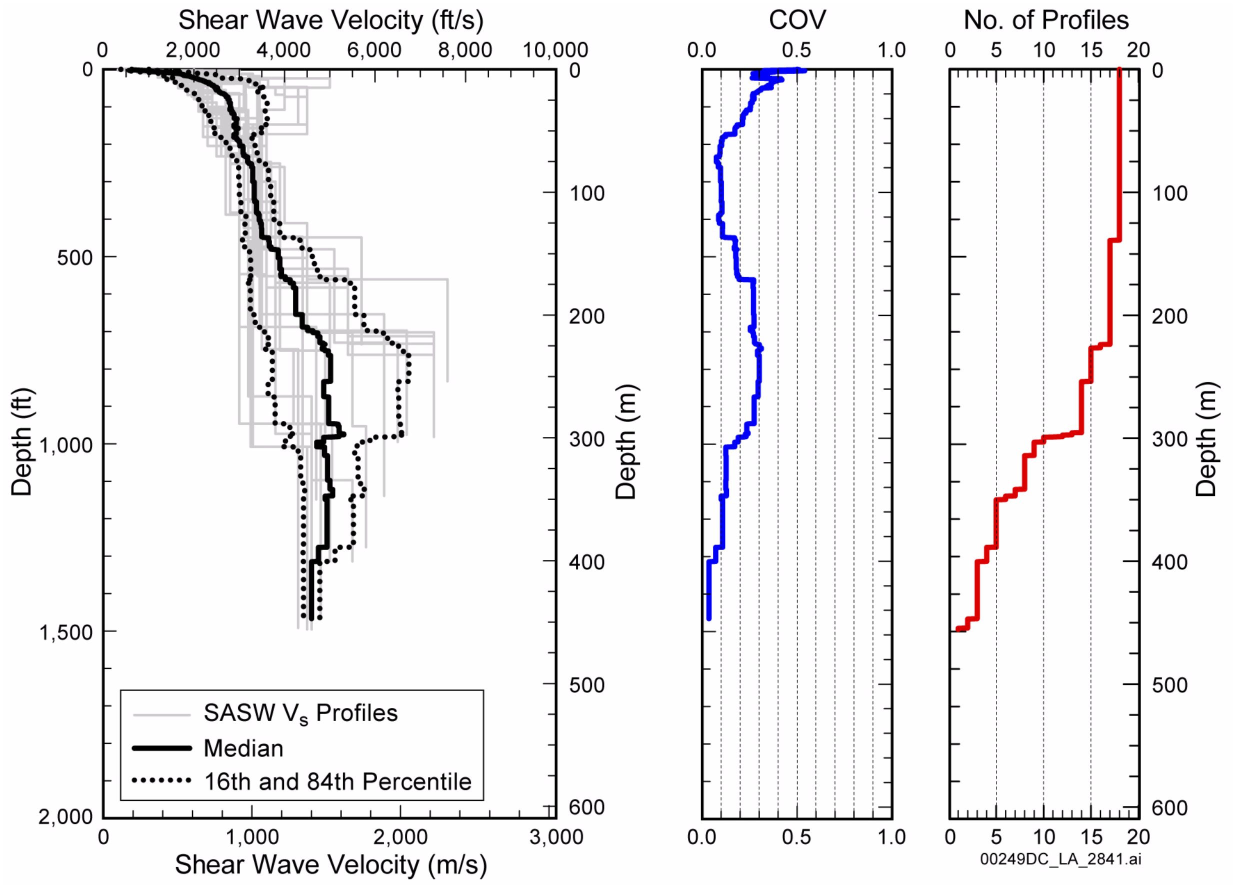


Figure 1.1-137. Individual Profiles and Statistical Analysis of 18 Spectral Analysis of Surface Wave Tests Performed Around the Mountain Area

Source: SNL 2008a, Figure 6.3-3.

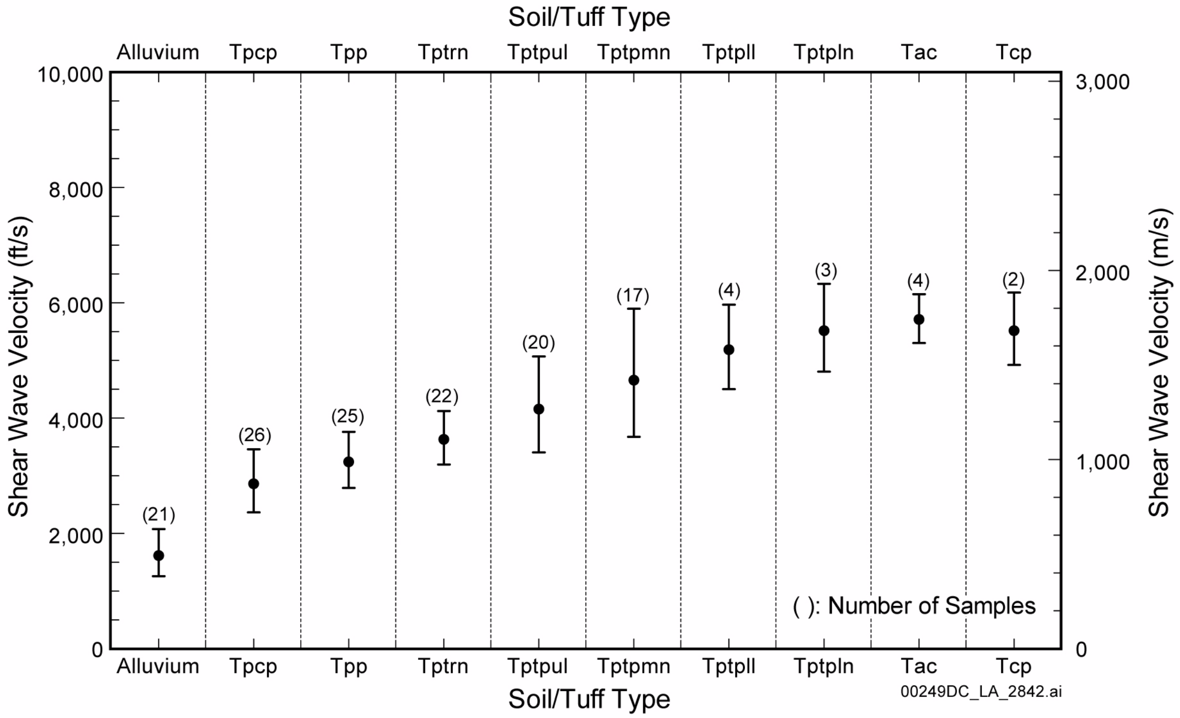


Figure 1.1-138. Distribution of V_S Velocities from Spectral Analysis of Surface Wave Testing by Geologic Unit

Source: SNL 2008a, Figure 6.3-9.

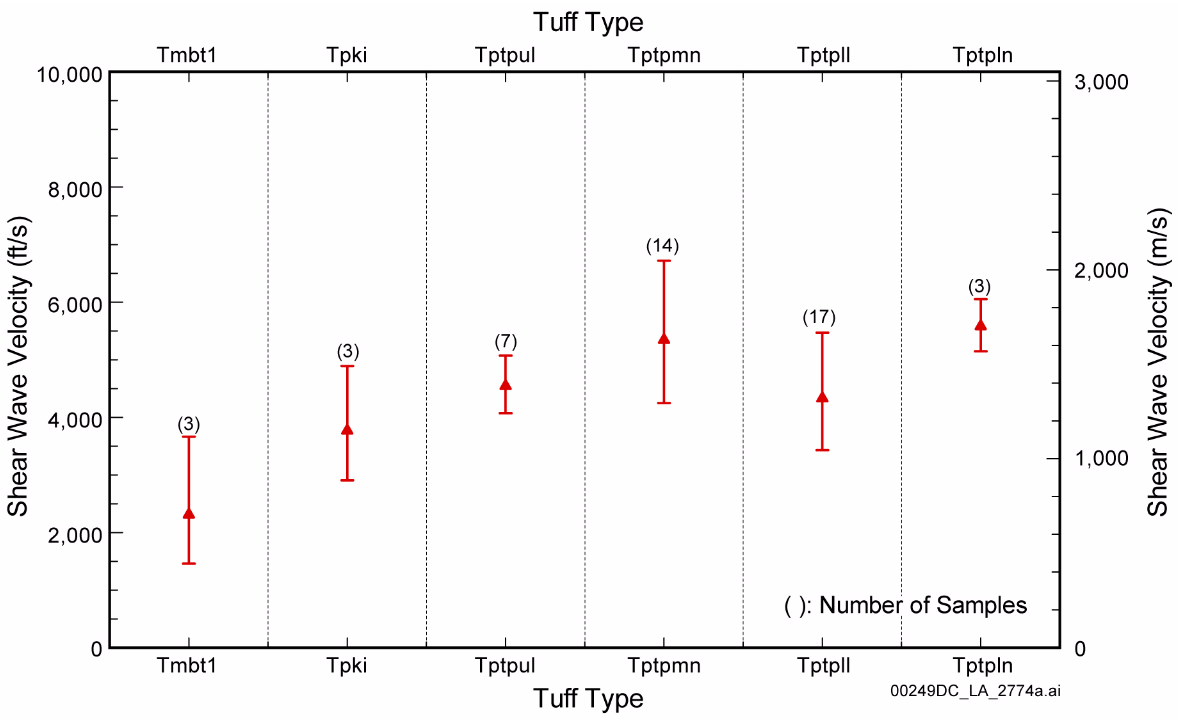


Figure 1.1-139. Distribution of Spectral Analysis Of Surface Wave Velocities by Underground Geologic Units

Source: SNL 2008a, Figure 6.4-14.

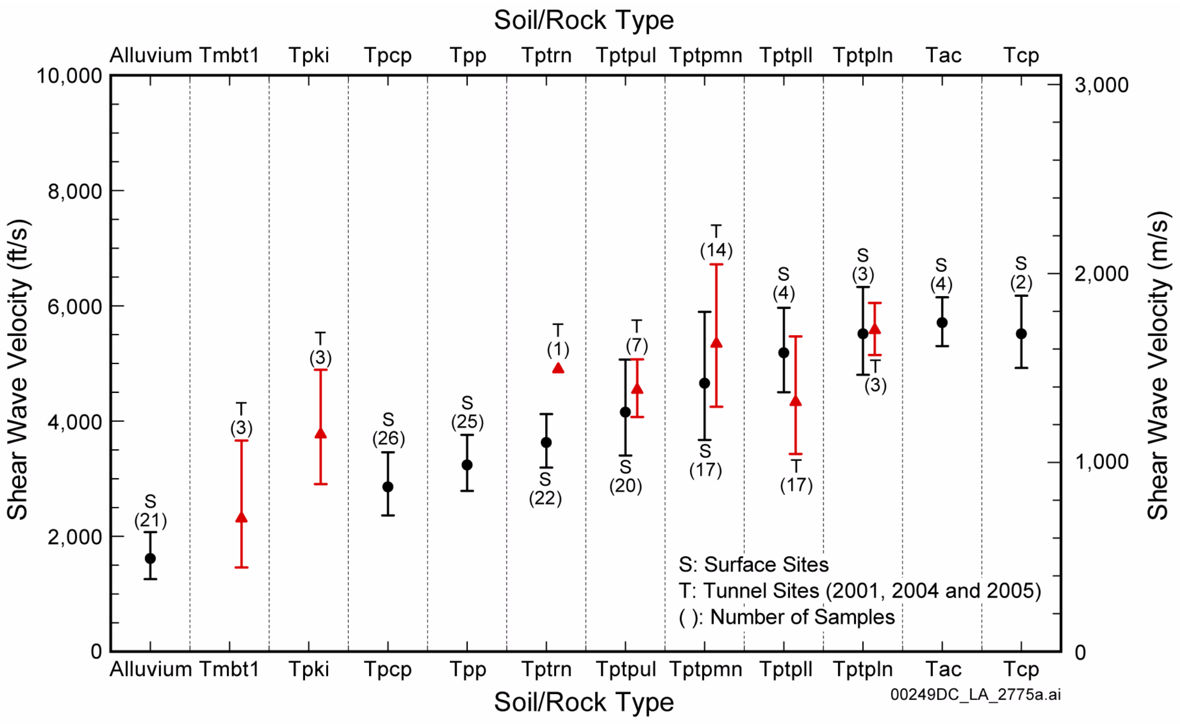
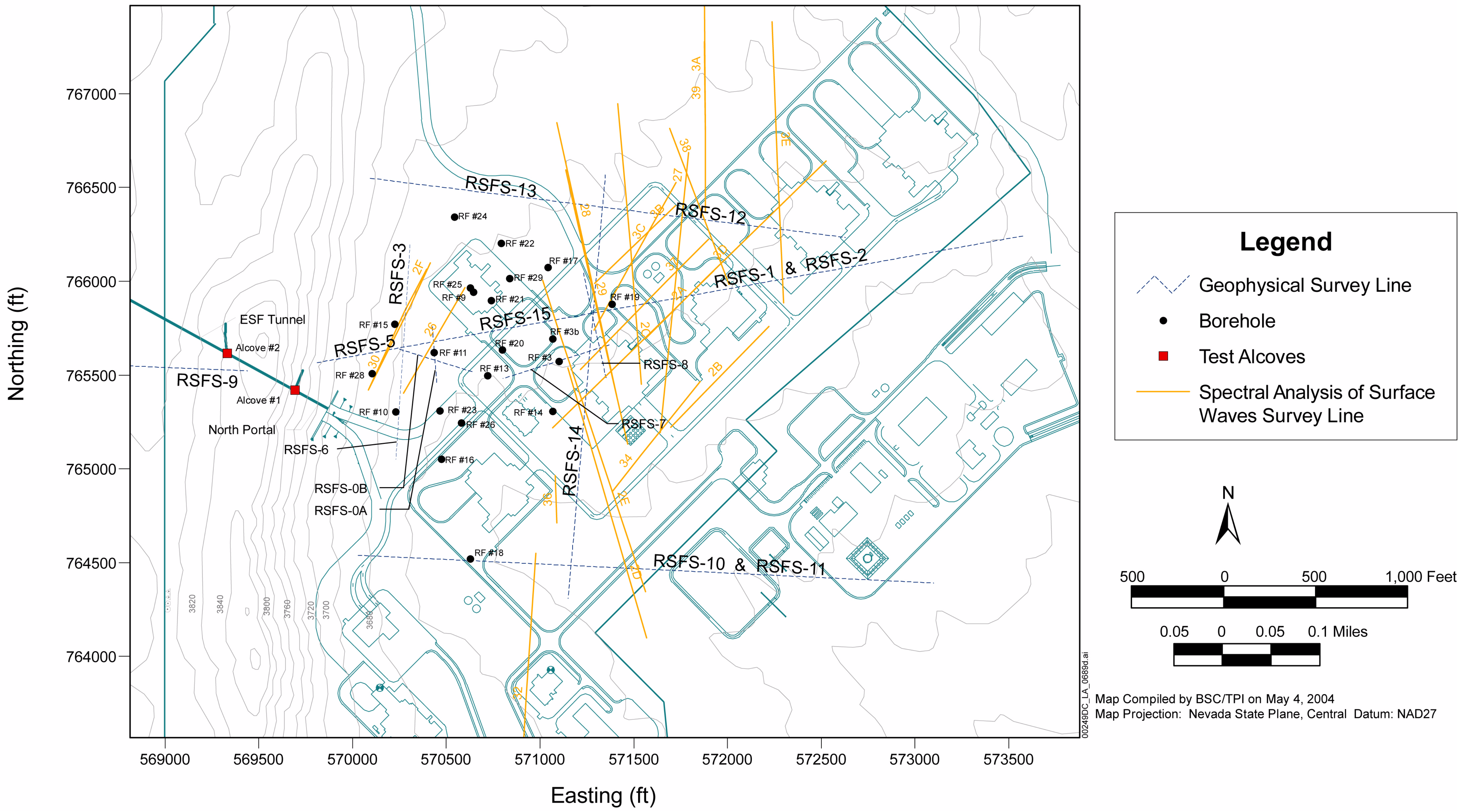


Figure 1.1-140. Comparison of V_S Ranges between Surface and Tunnel Spectral Analysis of Surface Wave Test Sites Based on Geologic Units

Source: SNL 2008a, Figure 6.4-18.



Map Compiled by BSC/TPI on May 4, 2004
Map Projection: Nevada State Plane, Central Datum: NAD27

Source: BSC 2002b, Figure 43; Charles B. Reynolds & Associates 1985, Enclosure 1.

Figure 1.1-141. Location of Pre-2004 Geophysical Surveys Relative to the Surface Geologic Repository Operations Area

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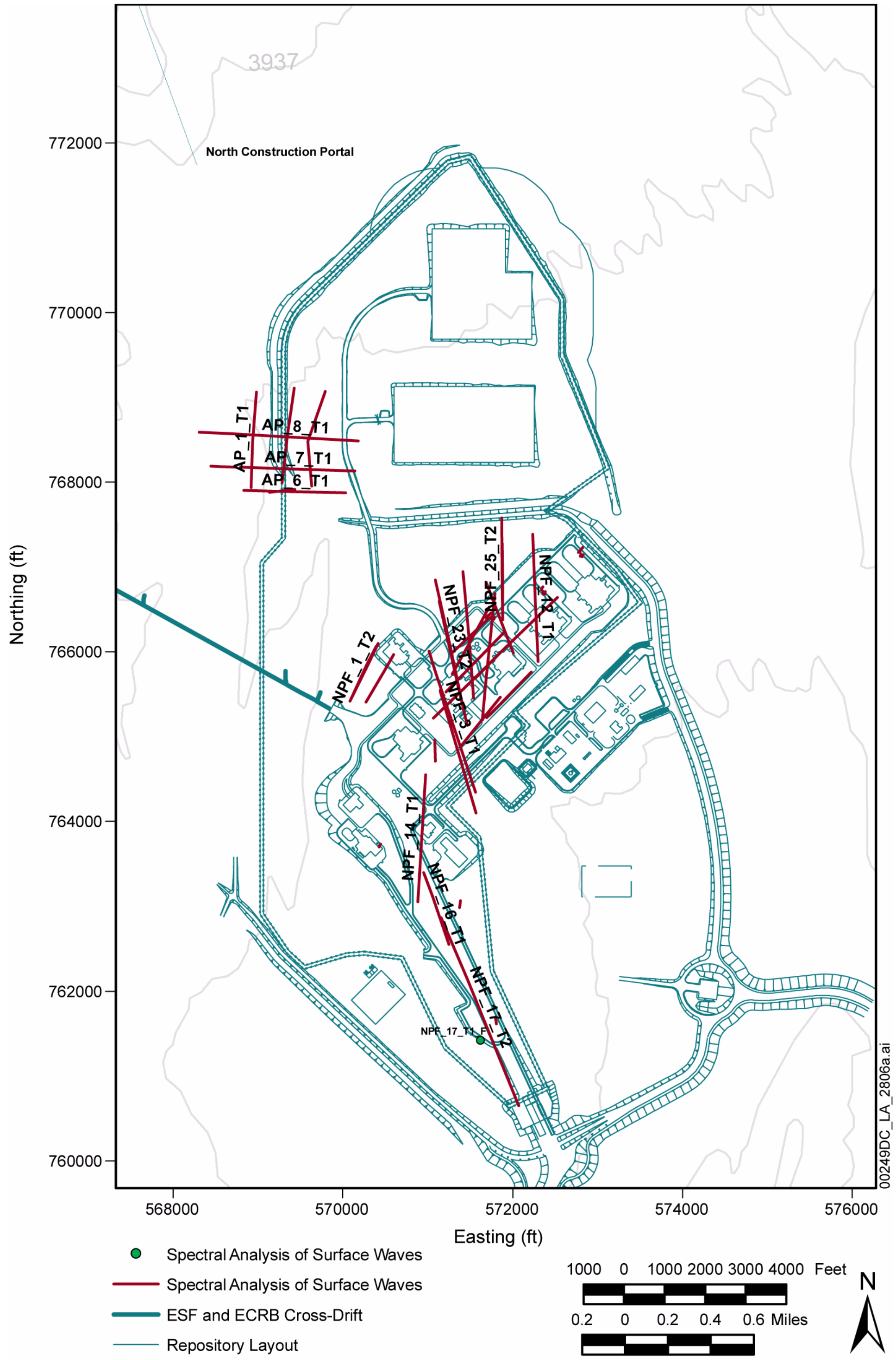

Figure 1.1-142. Spectral Analysis of Surface Waves Testing in the Vicinity of the Surface GROA in 2004 and 2005

NOTE: Nevada State Plane Coordinates

Source: SNL 2008a, Figure 6.2-7.

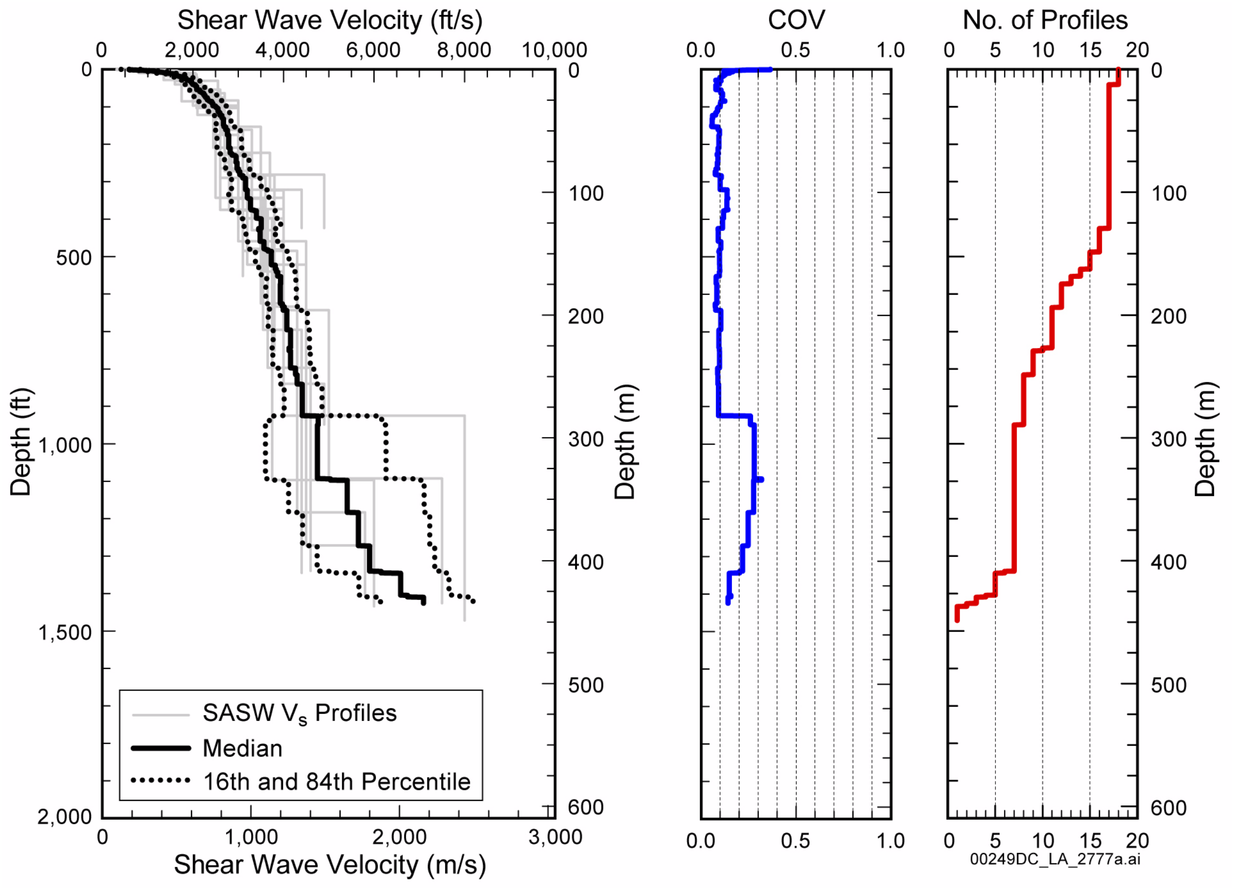

Figure 1.1-143. Individual Profiles and Statistical Analyses of 18 Spectral Analysis of Surface Waves Tests Performed in the Vicinity of the Surface GROA

Source: SNL 2008a, Figure 6.2-15.

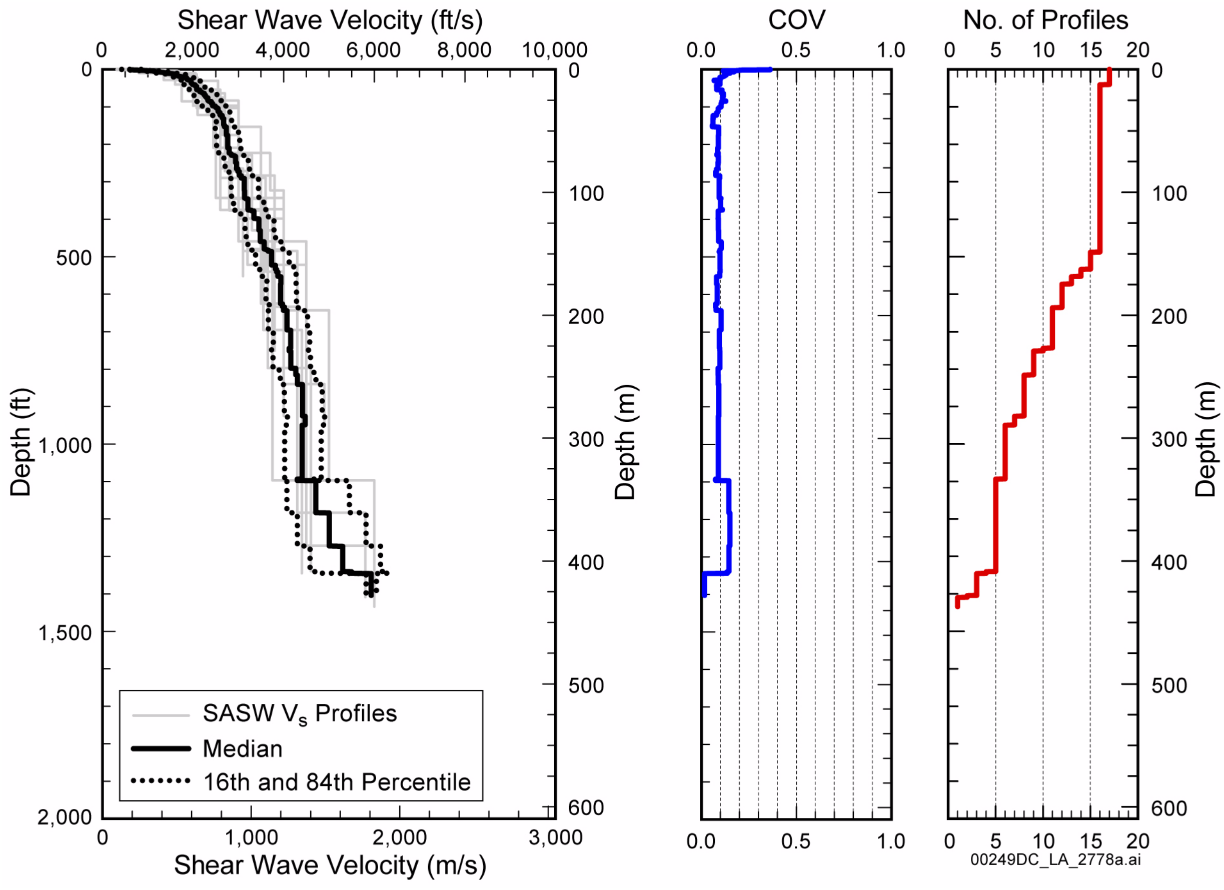

Figure 1.1-144. Individual Profiles and Statistical Analyses of Spectral Analysis of Surface Waves Tests Performed at Surface GROA Without Site NPF 28 and Without Bottom Portions of V_S profiles for Sites NPF 2 and 14 and NPF 3 and 9 below 900 ft

Source: SNL 2008a, Figure 6.2-17.

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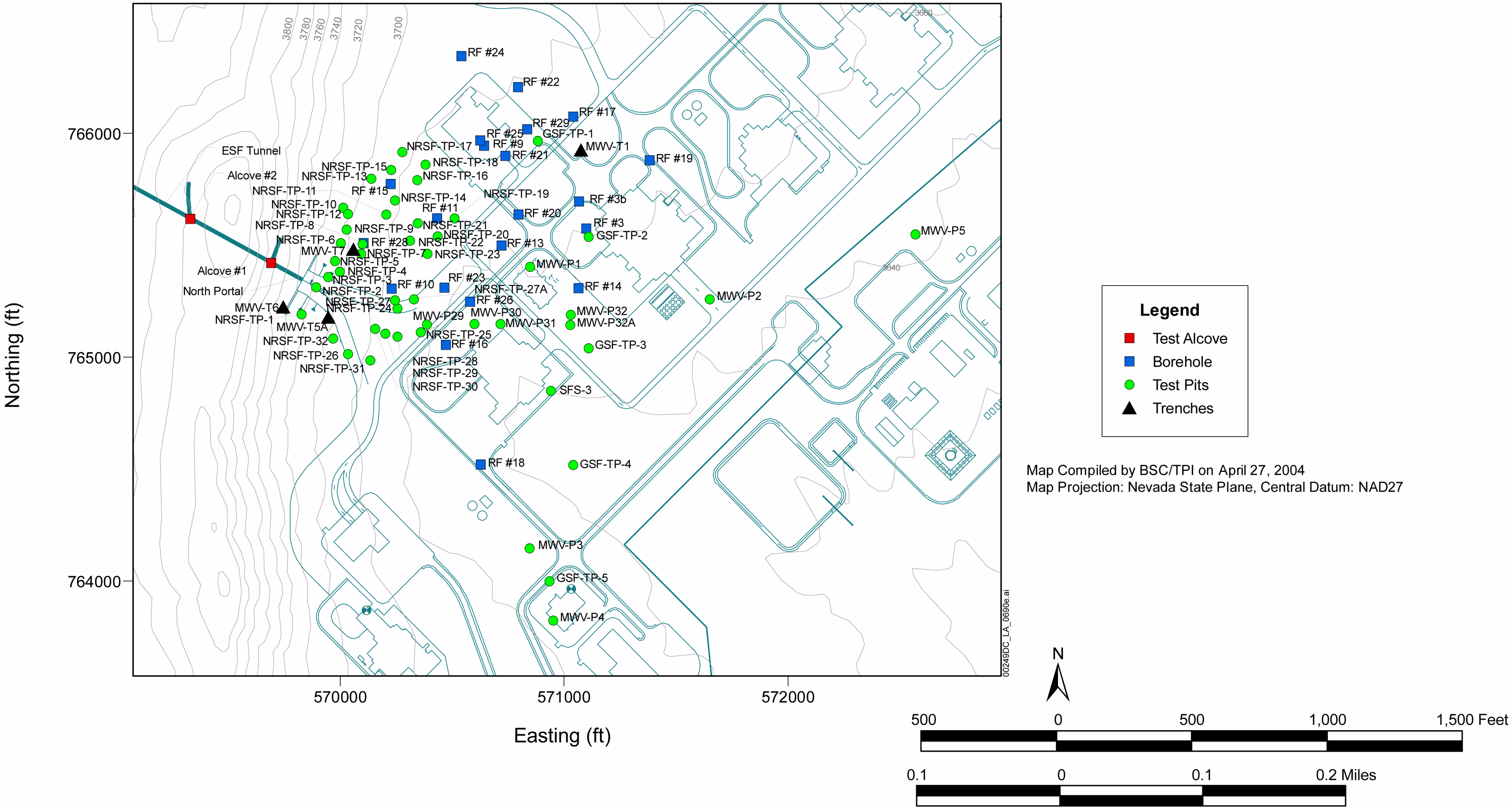

Map Compiled by BSC/TPI on April 27, 2004
Map Projection: Nevada State Plane, Central Datum: NAD27

Figure 1.1-145. Locations of Pre-2004 Boreholes and Test Pits Relative to the Surface Geologic Repository Operations Area

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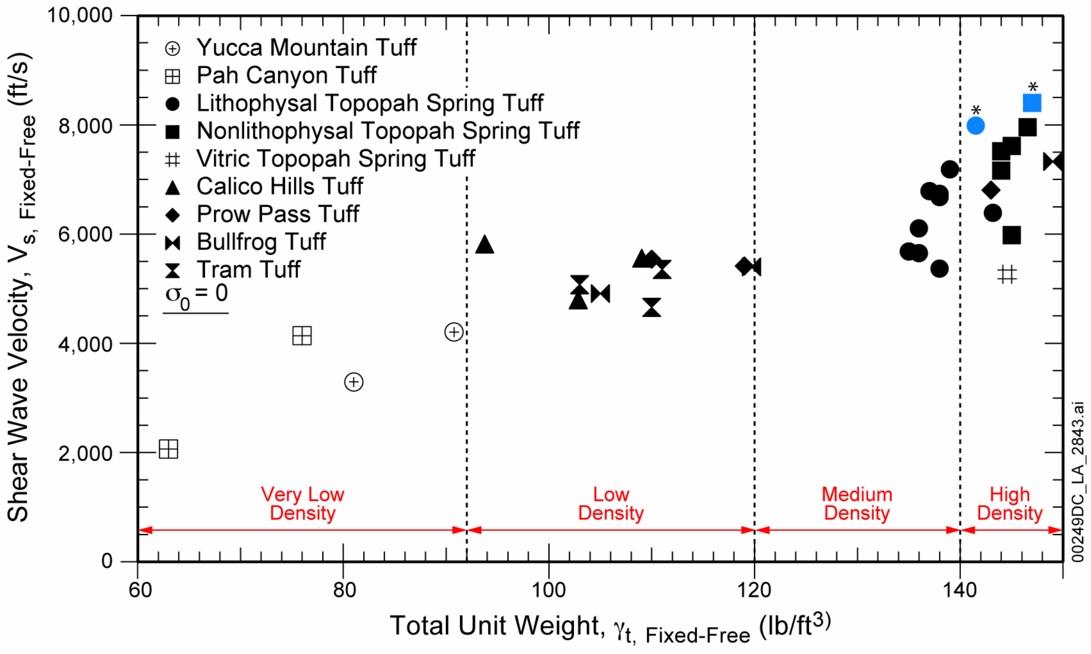

Figure 1.1-146. Variation of Shear Wave Velocity with Total Unit Weight of the Thirty-Three Tuff Specimens from Stratigraphic Units below Tiva Canyon Tuff; V_S Measured at the Unconfined State in the Resonant Column Test

NOTE: Group 1: Very low density specimens from Yucca Mountain Tuff (Tpy and Tpbt3) and Pah Canyon Tuff (Tpp and Tpbt2). Group 2: Low density specimens from Calico Hills Formation (Tac), Prow Pass Tuff (Tcp), Bullfrog Tuff (Tcb), and Tram Tuff (Tct). Group 3: Medium density specimens from Topopah Spring Tuff crystal-rich, lithophysal (Tptrl); Topopah Spring Tuff crystal-poor, upper lithophysal (Tptpul); and Topopah Spring Tuff crystal-poor, lower lithophysal (Tptpll). Group 4: High density specimens from Topopah Spring Tuff crystal-rich, nonlithophysal (Tptrn); Topopah Spring Tuff crystal-poor, middle nonlithophysal (Tptpmn); Topopah Spring Tuff crystal-poor, lower nonlithophysal (Tptpln); Topopah Spring Tuff crystal-poor, vitric (Tptpv); Prow Pass Tuff (Tcp); and Bullfrog Tuff (Tcb). Specimens marked with asterisks were cored from larger specimens and had fewer surface lithophysae.

Source: SNL 2008a, Figure 6.5-6.

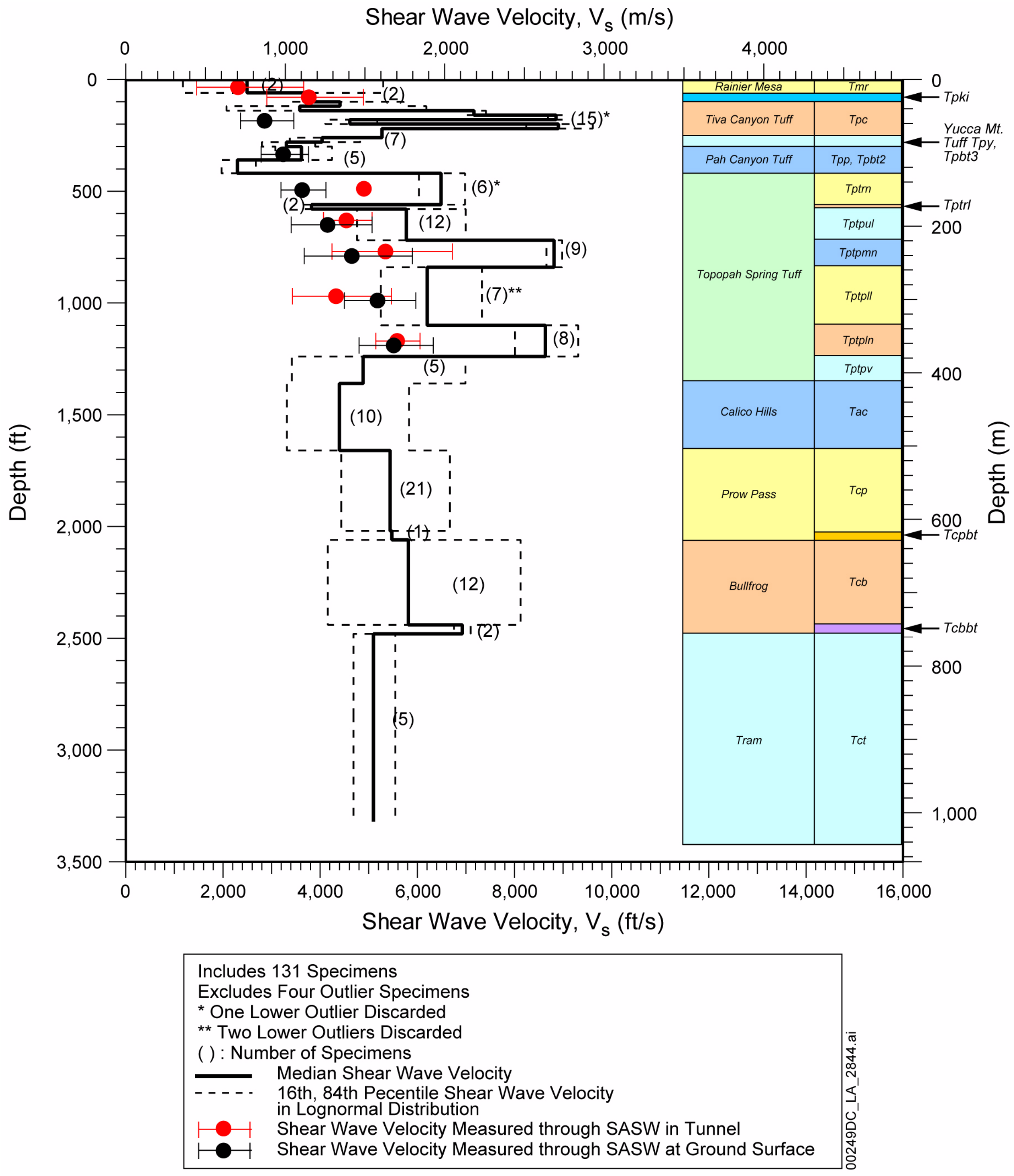

Figure 1.1-147. Summary Profile of Shear Wave Velocity versus Depth from Free-Free Resonant Column Tests

NOTE: SASW = spectral analysis of surface waves.

Source: SNL 2008a, Figure 6.5-60.

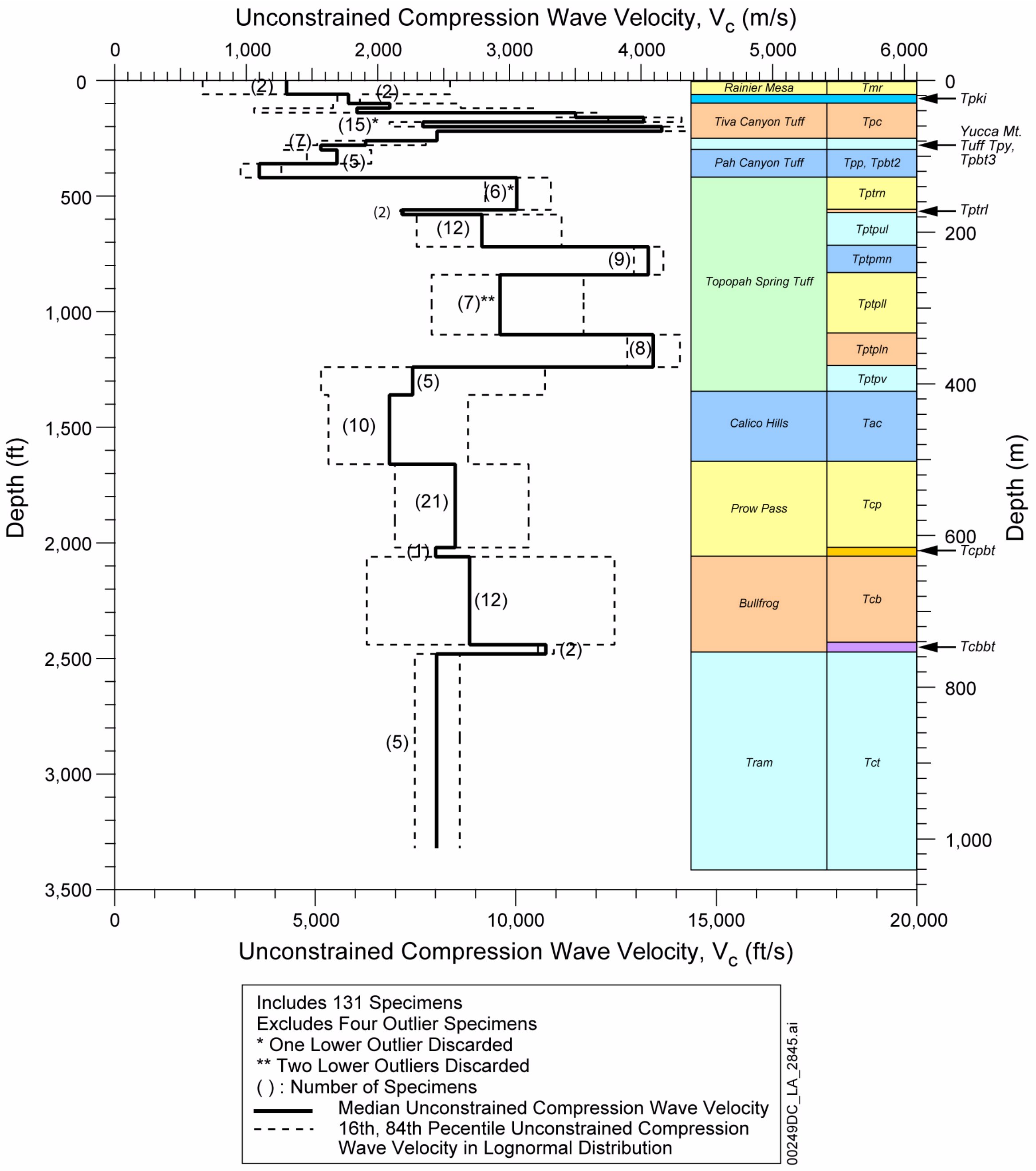

Figure 1.1-148. Summary Profile of Unconstrained Compression Wave Velocity versus Depth from Free-Free Resonant Column Tests

Source: SNL 2008a, Figures 6.5-65.

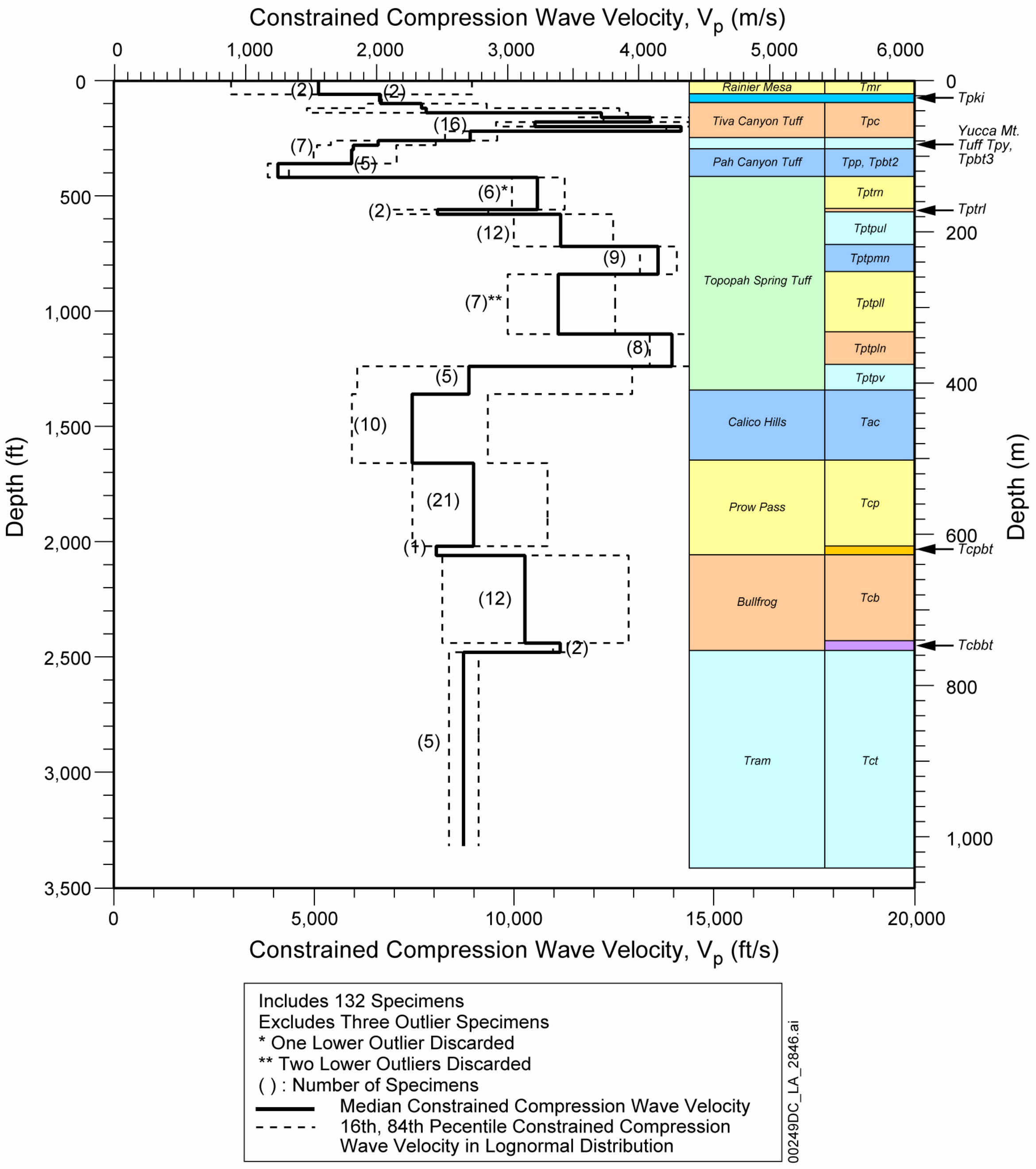

Figure 1.1-149. Summary Profile of Constrained Compression Wave Velocity versus Depth from Free-Free Resonant Column Tests

Source: SNL 2008a, Figure 6.5-69.

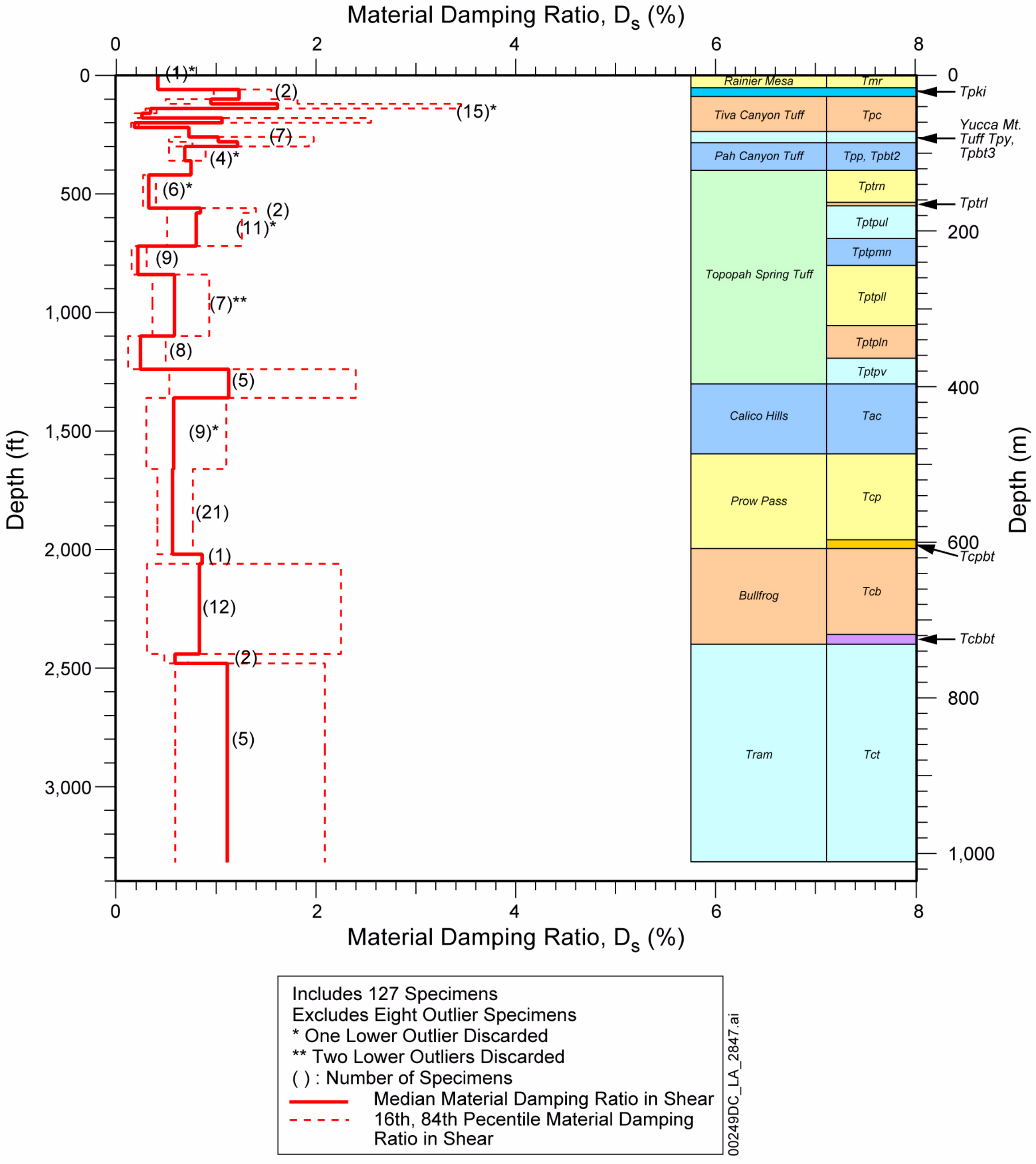

Figure 1.1-150. Summary Profile of Material Damping Ratio in Shear versus Depth from Free-Free Resonant Column Tests

Source: SNL 2008a, Figure 6.5-73.

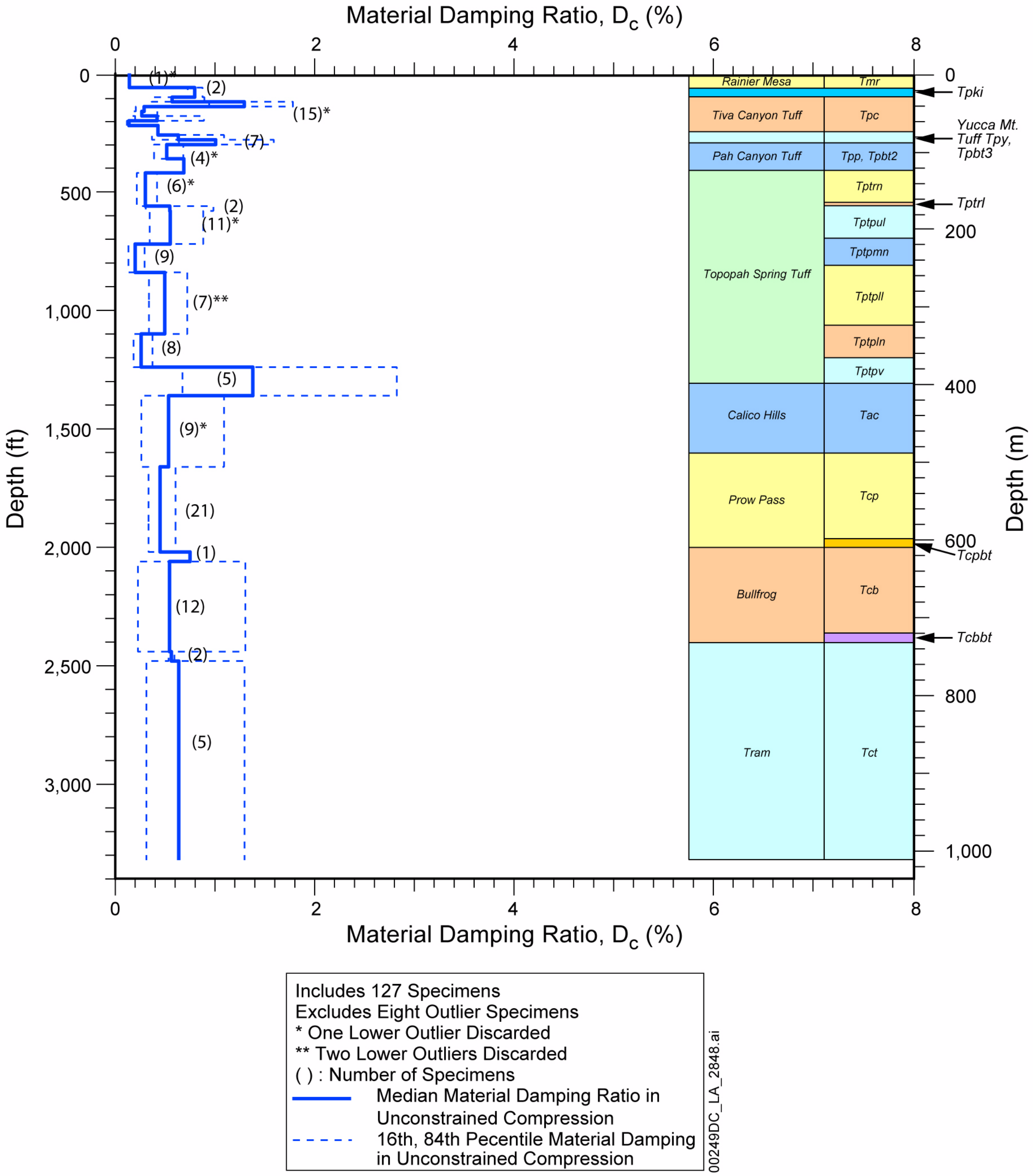

Figure 1.1-151. Summary Profile of Material Damping Ratio in Unconstrained Compression versus Depth from Free-Free Resonant Column Tests

Source: SNL 2008a, Figure 6.5-74.

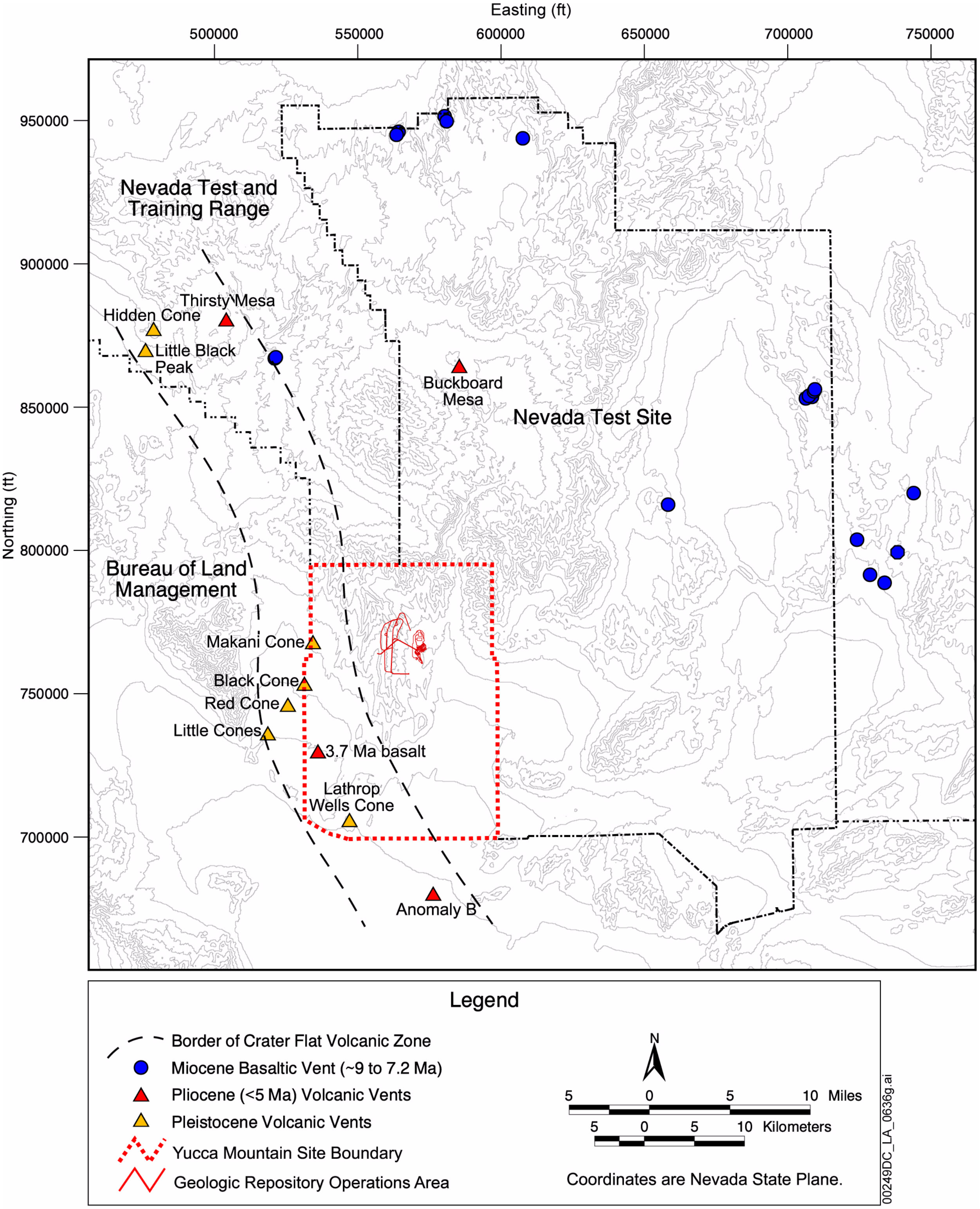

Figure 1.1-152. Miocene and Post-Miocene Basaltic Vent Locations in the Yucca Mountain Region

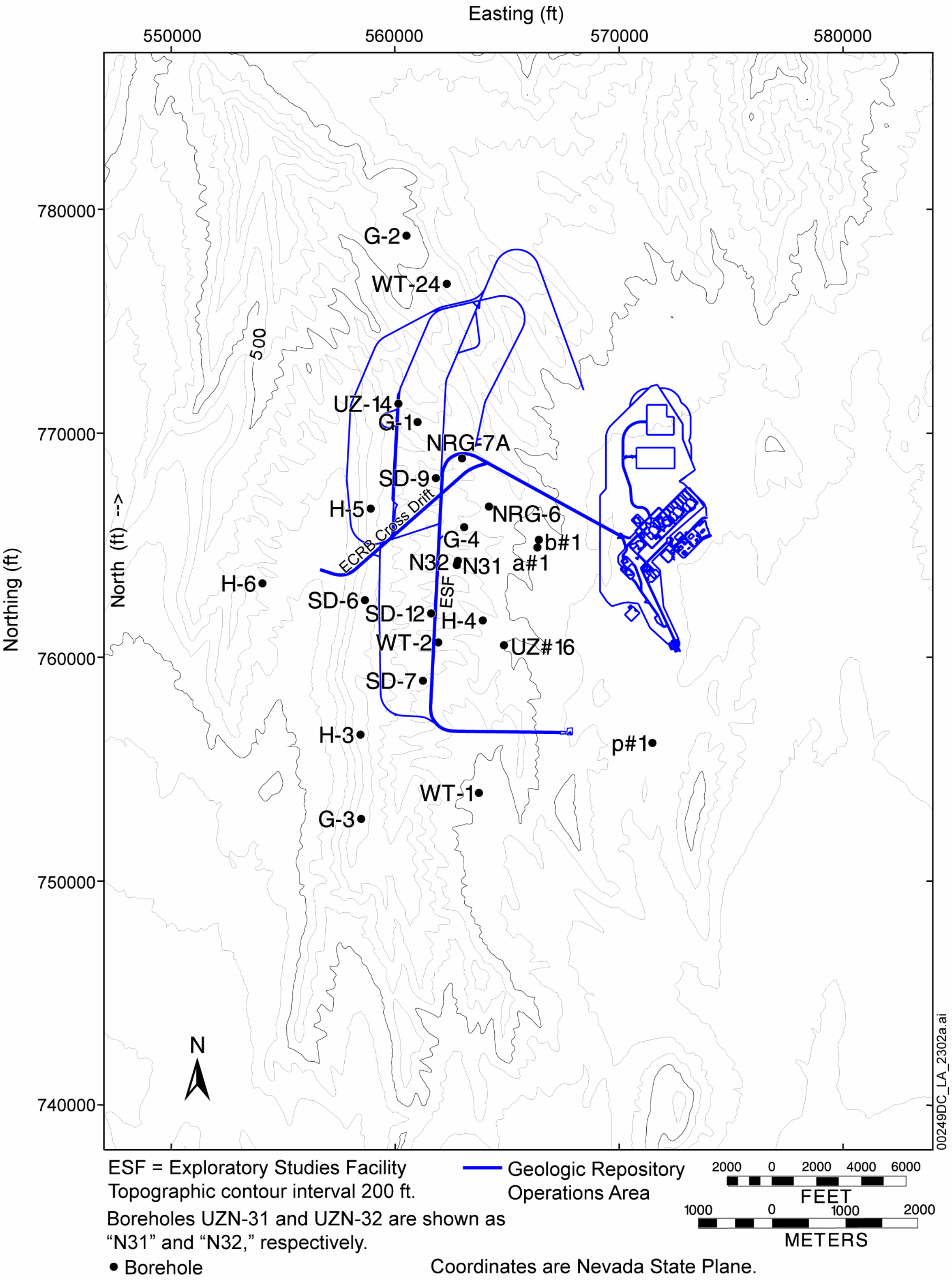

Figure 1.1-153. Locations of Boreholes Used for Characterizing Subsurface Mineralogy

Source: BSC 2004j, Figure 4-1.

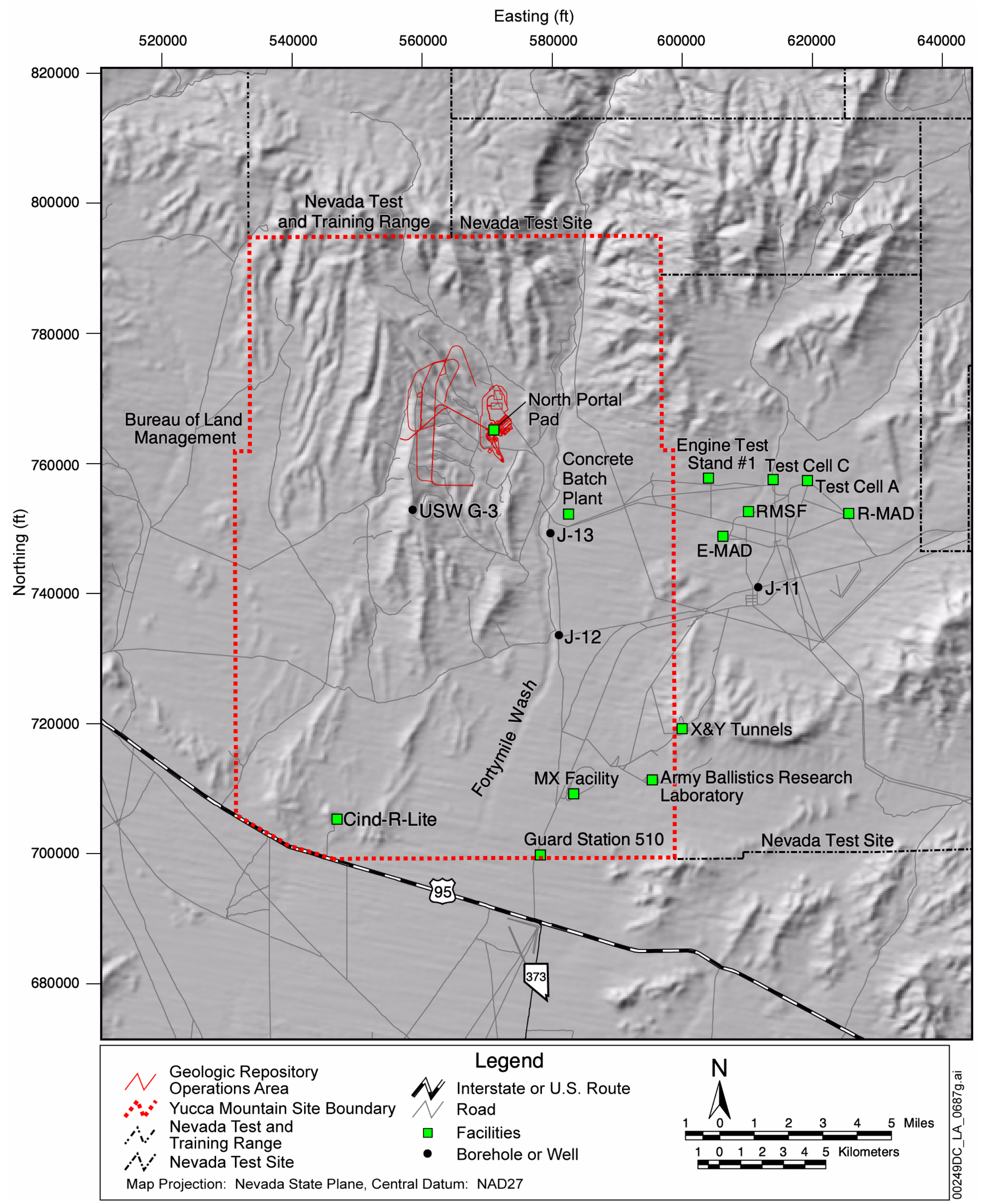

Figure 1.1-154. Yucca Mountain Repository Proposed Land Withdrawal Area

NOTE: E-MAD = Engine Maintenance, Assembly, and Disassembly; R-MAD = Reactor Maintenance, Assembly, and Disassembly; RMSF = Radioactive Material Storage Facility.

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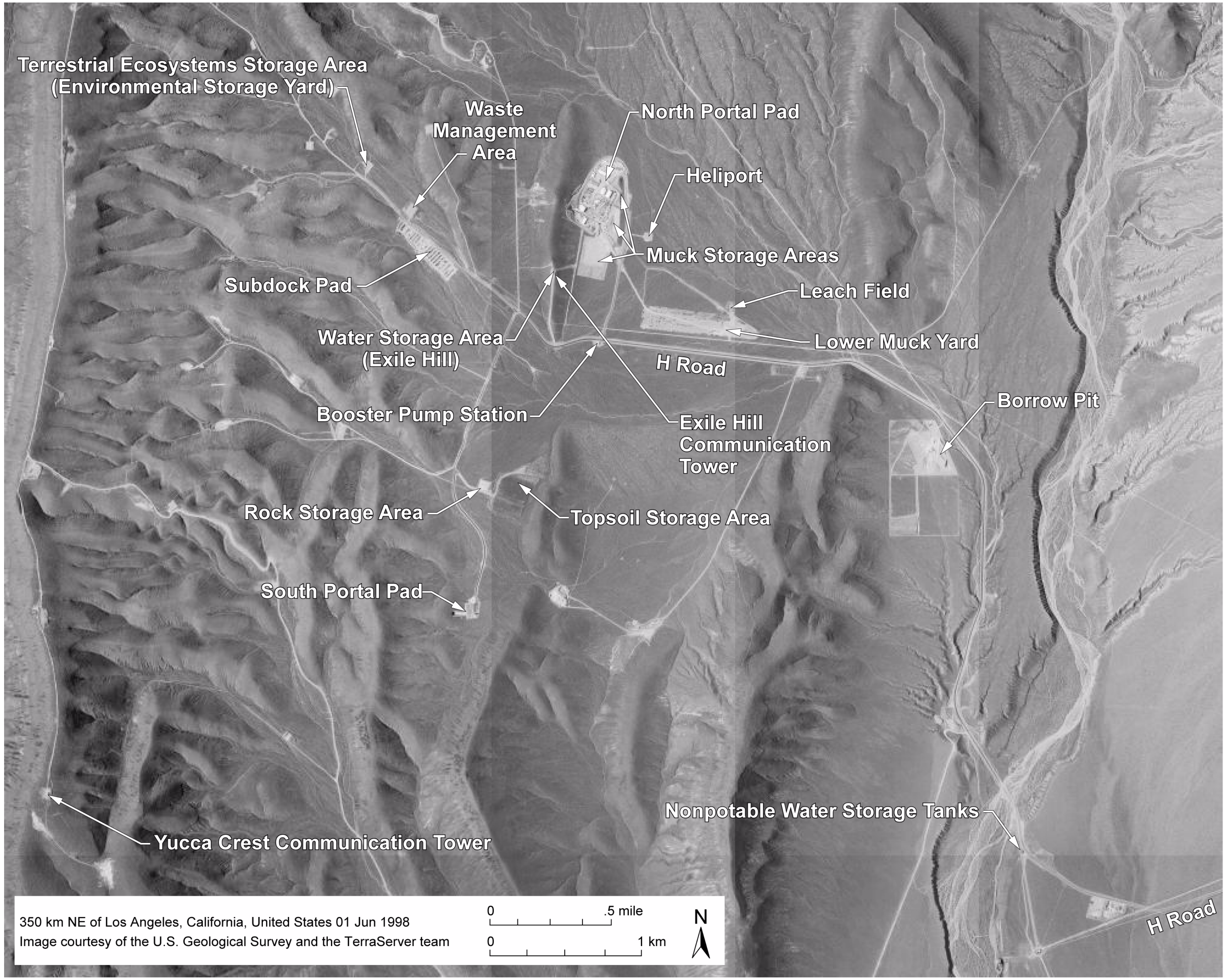

Figure 1.1-155. Yucca Mountain Structures and Facilities

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