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Principal facts and density estimates for borehole gravity
stations in exploratory wells Ue7h, Ue4al, and Ue11a
at the Nevada Test Site, Nye County, Nevada

by

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This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature. Any use of trade names is for descriptive purposes only and does not imply endorsement by the USGS.

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PRINCIPAL FACTS AND DENSITY ESTIMATES FOR BOREHOLE GRAVITY STATIONS
IN EXPLORATORY WELLS Ue7h, Ue4a1, AND Ue11a
AT THE NEVADA TEST SITE, NYE COUNTY, NEVADA

INTRODUCTION

Borehole gravity surveys were conducted in three exploratory wells in February and September, 1982, by the U.S. Geological Survey (USGS) using LaCoste and Romberg slim-hole borehole gravity meter (BHGM) BH-6. Wells Ue7h and Ue4a1 are located in Yucca Flats and Ue11a is in Frenchman Flat at the Nevada Test Site (fig. 1).

BHGMs are primarily density logging tools having a large radius of investigation compared to conventional logging tools and are not significantly affected by casing, borehole rugosity, or other near-borehole conditions. Therefore, a BHGM survey provides a unique and independent measurement of in-situ bulk density which, when integrated with data from conventional logs and (or) cores, can provide a better understanding of the physical properties of subsurface rocks in areas of "simple" geology, or the structure (remote sensing) when there are density changes horizontally away from the well. Robbins (1980) contains a complete listing of references pertaining to borehole gravimetry.

The primary objective of these studies was to obtain data for the determination of "apparent" in-situ formation densities, which when compared with the gamma-gamma density logs, will help to delineate the fault structures that are known to be present in the general vicinity of these wells. This report contains the principal facts obtained during the surveys (tables 1, 2, and 3) and estimates of "apparent" in-situ bulk densities from these data (tables 4, 5, and 6).

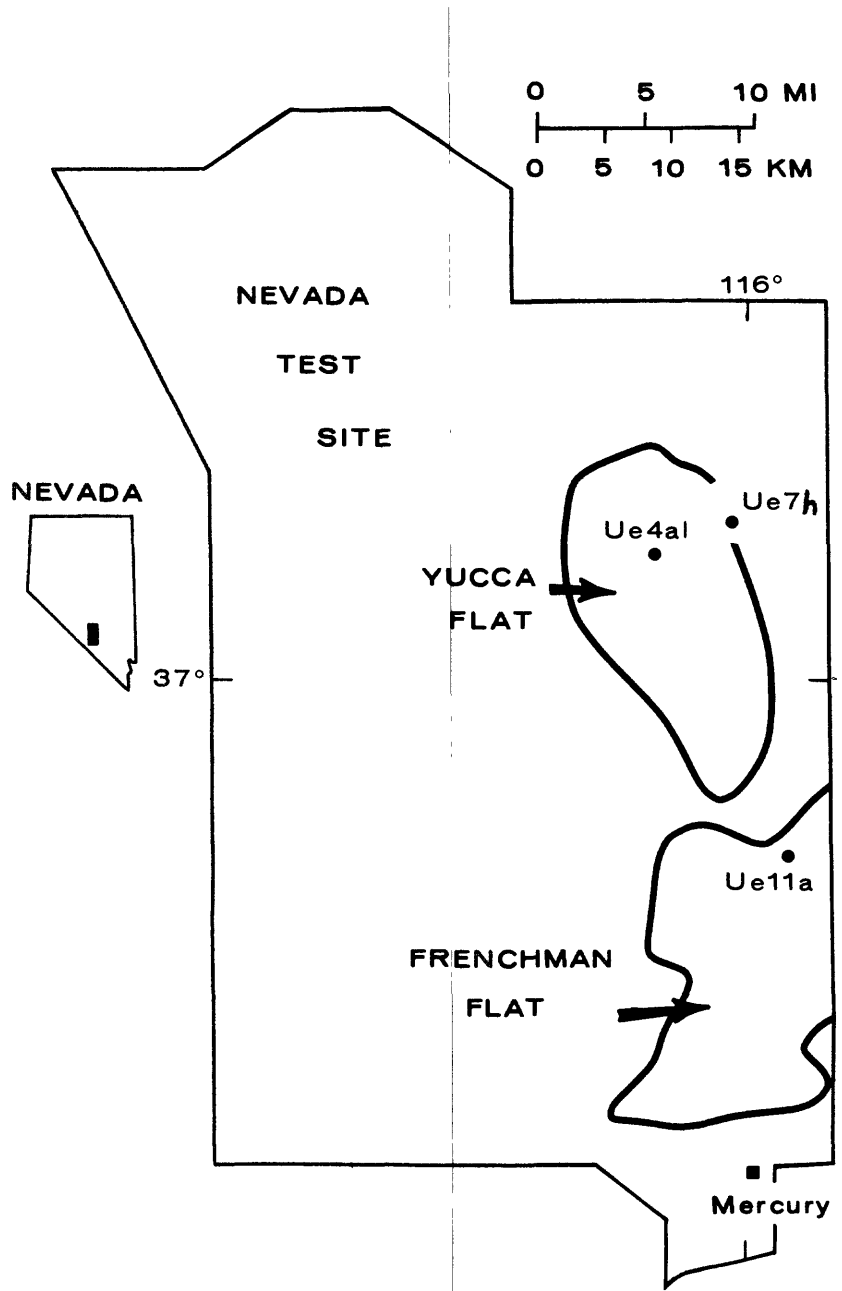


Figure 1.--Index map of the Nevada Test Site, showing locations of borehole gravity surveys.

Well Ue7h was logged in cooperation with Allen Cogbill and the Los Alamos National Laboratory (LANL) of New Mexico. Wells Ue4a1 and Ue11a were logged in cooperation with the Lawrence Livermore National Laboratory (LLNL) of California. Previous publications that contain borehole gravity information from the Nevada Test Site are: Healey (1970), Hearst and McKague (1976), Schmoker and Kososki (1978), Kososki and others (1978), and Robbins and others (1982).

BOREHOLE DATA

Tables 1, 2, and 3 present the principal facts for the gravity stations occupied during the BHGM surveys. The column headings for these tables are explained in the following list:

- Reading #: The order in which the borehole gravity stations were read.
- Depth: Depth of station in feet and meters. Datum is the ground elevation at the well.
- Time: Coordinated Universal Time (CUT) of the mean of each set of gravity slope readings (beam velocities).
- Meter readings: Counter reading of the BHGM in scale divisions at the station's calculated null position (no corrections have been made).
- Tide corr.: Theoretical correction for earth tides in milligals (Darroll Wood, written commun., 1968).
- Drift corr.: Correction for instrument drift in milligals derived from station reoccupations. Figures 2, 3, and 4 show the curves used.

Terr. corr.: Terrain correction in milligals. For well Ue7h, the calculations are from 175 feet (53.3 meters) out to a distance of 72,000 feet (22.9 kilometers), corresponding to zones D through M of Hammer's terrain correction chart (Hammer, 1939). The corrections were made by LANL from 30-second digitized terrain data by computer. For wells Ue4a1 and Ue11a; calculations from the well out to a distance of 14,662 ft (4,469 m), corresponding to zones A through zone I of Hammer (1939) were made using compartment elevations that were determined by using a template. The remaining terrain correction out to a distance of two 15-minute quadrangles was made from digitized terrain data. The corrections were made by LLNL on a computer. Densities used in the corrections for well Ue7h are as follows:

inner zones (out through zone G) = 1.90 g/cm^3

outer zones (zone H through M) = 2.00 g/cm^3

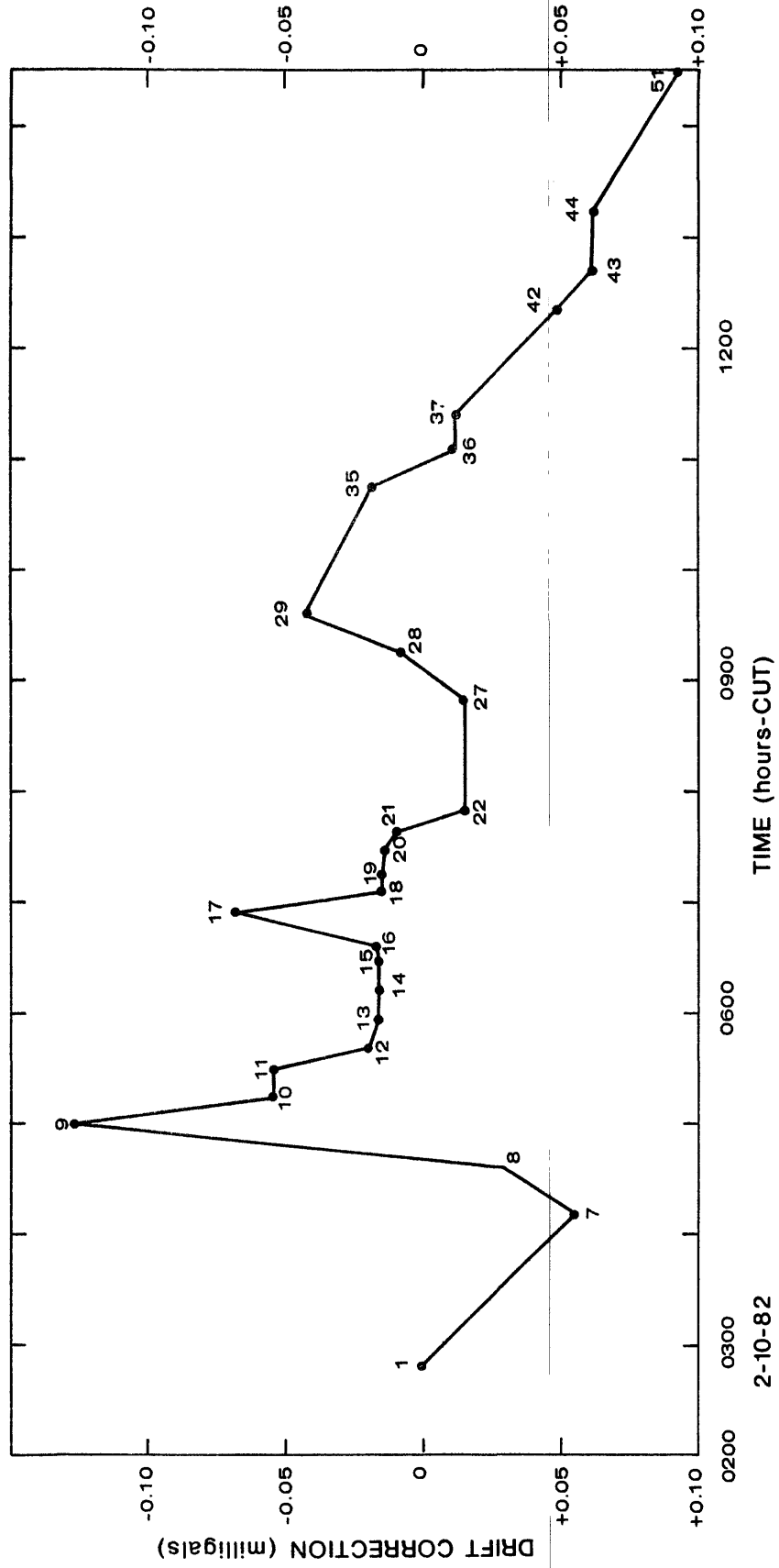
A density of 2.00 g/cm^3 was used for wells Ue4a1 and Ue11a.

Corr. gravity: Observed gravity in milligals, referenced to an arbitrary base. The value in this column is arrived at by first multiplying the meter reading by the "X Factor" number for the appropriate counter interval and adding the product to the "base value" in the following table and then adding in the tide, drift, and terrain effects.

<u>Counter Interval</u>	<u>X Factor</u>	<u>Base Value</u>
950-999.999	0.86428	821.365
1000-1049.999	0.86431	864.579
1050-1099.999	0.86436	907.795

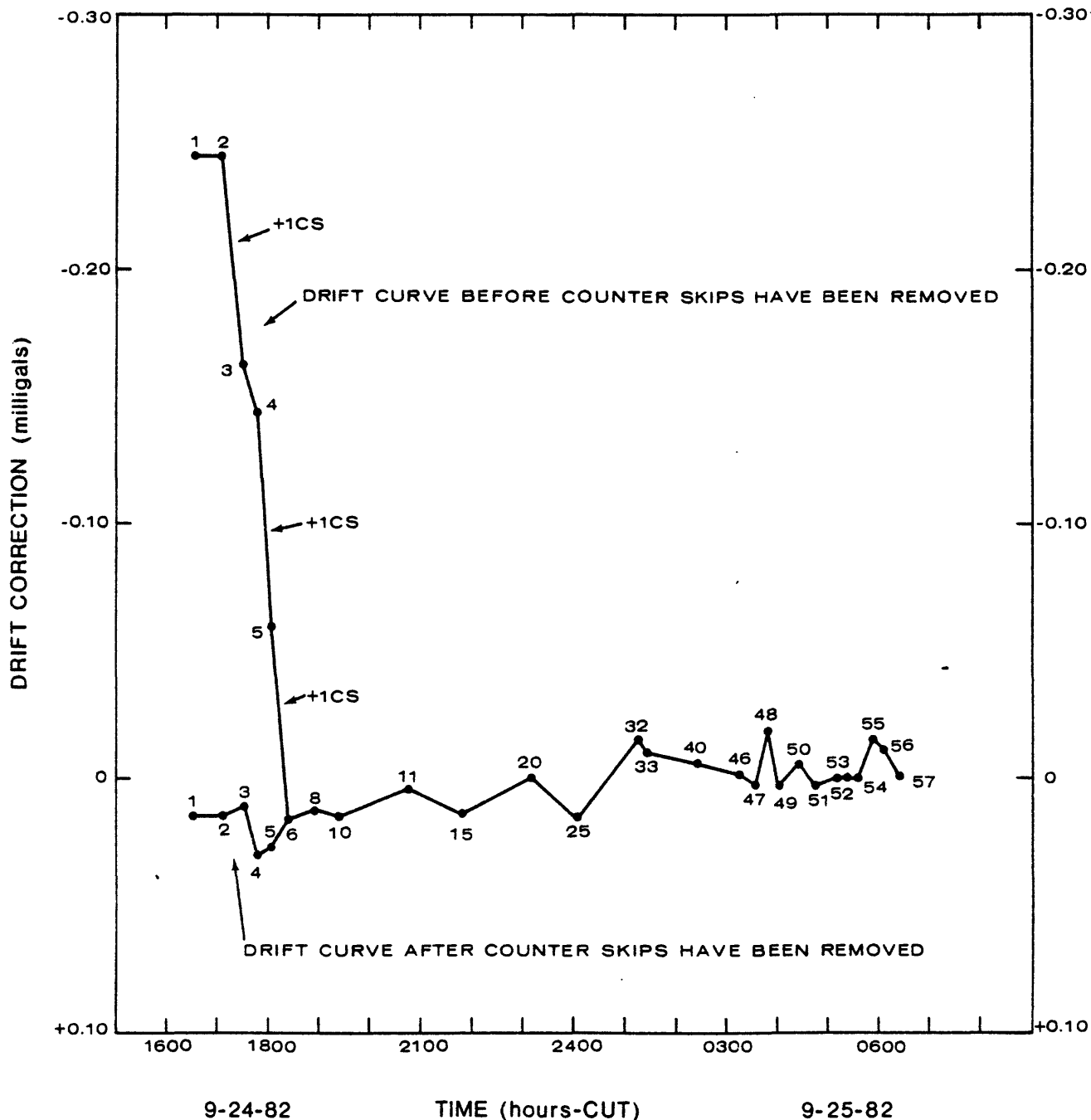
Error: This value, in microgals, is the estimated error caused by the rounding off of the various reduction corrections (that is, tide, drift, etc.) and by determination of the null position from the slope readings (beam velocities).

Prior to conducting the BHGM surveys, a gamma-ray log was run in each well for stratigraphic control and wireline depth correlations.



• Drift correction used at particular reading when more than one reading was made at that depth (numbers refer to reading numbers in Table 1).

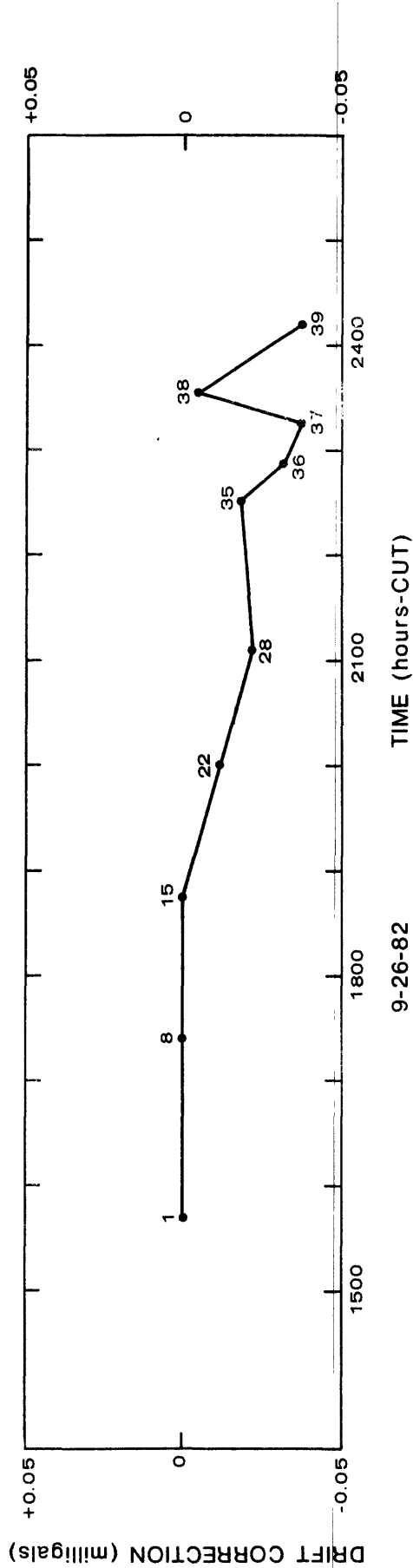
Figure 2.--Drift correction curve for BH-6 in well Ue7h; lat 37° 6' 11.0" N., long 116° 0' 19.8" W., Nevada Test Site, Nye County, Nev.



- Drift correction used at particular reading when more than one reading was made at that depth (numbers refer to reading numbers in Table 2).

CS Intervals in which 100 S.D. skips occurred in our surface control console.

Figure. 3.--Drift correction curve for BH-6 in well Ue4ai; lat $37^{\circ} 4' 48.7''$ N., long $116^{\circ} 4' 30.3''$ W., Nevada Test Site, Nye County, Nev.



• Drift correction used at particular reading when more than one reading was made at that depth (numbers refer to reading numbers in Table 3).

Figure 4.--Drift Correction curve for BH-6 in well Uella; lat 36° 52' 58.6" N., Long 115° 57' 16.2" W., Nevada Test Site, Nye County, Nev.

Table 1.--Principal Facts for Well Ue7h, Yucca Flats,
Nevada Test Site, Nye County, Nev.

[Located at lat 37° 6' 11.0" N., long 116° 0' 19.8" W.;
ground elevation 4392.4 ft (1338.8 m)].

Logged 02-10-82

Reading #	Depth		Time CUT	Meter	Tidal	Drift	Terrain	Corr.	Error
	ft	(m)		readings S.D.	corr. mgal	corr. mgal	corr. mgal	gravity mgal	+G μ gal
1	177.0	53.95	0249	0972.041	-.090	0.000	.433	0840.758	+3
2	126.0	38.40	0307	0969.497	-.087	+.012	.410	0838.551	+3
3	101.0	30.78	0310	0968.241	-.084	+.021	.399	0837.466	+5
4	60.0	18.29	0332	0966.195	-.079	+.030	.382	0835.695	+4
5	32.0	9.75	0343	0964.751	-.075	+.037	.371	0834.447	+3
6	0.0	0.00	0354	0963.059	-.069	+.044	.357	0832.984	+4
7	177.0	53.95	0412	0971.943	-.060	+.055	.433	0840.758	+3
8	212.0	64.62	0436	0974.272	-.044	+.029	.448	0842.776	+5
9	237.0	72.24	0501	0975.932	-.026	-.127	.460	0844.085	+7
10	277.0	84.43	0516	0978.502	-.014	-.054	.478	0846.409	+7
11	325.0	99.06	0529	0981.012	-.003	-.054	.500	0848.614	+2
12	403.0	122.83	0541	0985.803	+.007	-.019	.537	0852.834	+4
13	443.0	135.03	0556	0988.158	+.020	-.016	.556	0854.904	+4
14	177.0	53.95	0614	0971.913	+.037	-.016	.433	0840.758	+4
15	212.0	64.62	0627	0974.219	+.047	-.016	.448	0842.776	+5
16	237.0	72.24	0637	0975.710	+.056	-.017	.460	0844.085	+2
17	177.0	53.95	0654	0971.934	+.070	-.067	.433	0840.758	+6
18	237.0	72.24	0706	0975.683	+.078	-.015	.460	0844.085	+4
19	277.0	84.43	0716	0978.342	+.086	-.015	.478	0846.409	+4
20	325.0	99.06	0729	0980.852	+.095	-.014	.500	0848.611	+4
21	403.0	122.83	0740	0985.684	+.101	-.010	.537	0852.834	+4
22	443.0	135.03	0750	0988.021	+.107	+.015	.556	0854.904	+5
23	503.0	153.31	0802	0991.872	+.113	+.015	.584	0858.266	+2.5
24	582.0	177.39	0812	0996.523	+.118	+.015	.621	0862.328	+4
25	692.0	210.92	0825	1003.231	+.122	+.015	.672	0868.181	+3
26	746.0	227.38	0835	1006.530	+.125	+.015	.697	0871.060	+3
27	854.0	260.30	0850	1012.472	+.129	+.015	.748	0876.251	+4
28	443.0	135.03	0915	0988.021	+.130	-.008	.556	0854.904	+3
29	854.0	260.30	0935	1012.541	+.128	-.043	.748	0876.251	+4
30	926.0	282.24	0949	1016.701	+.125	-.038	.781	0879.882	+3
31	1011.0	308.15	0958	1021.471	+.122	-.035	.820	0884.044	+4
32	1083.0	330.10	1009	1025.298	+.118	-.031	.854	0887.385	+5
33	1170.0	356.62	1018	1029.289	+.114	-.028	.894	0890.874	+4
34	1237.0	377.04	1029	1032.731	+.109	-.024	.924	0893.878	+3
35	1342.0	409.04	1045	1038.081	+.100	-.019	.972	0898.546	+3
36	854.0	260.30	1105	1012.525	+.087	+.012	.748	0876.251	+7
37	1342.0	409.04	1125	1038.078	+.072	+.012	.972	0898.546	+4
38	1422.0	433.43	1135	1042.161	+.064	+.019	1.008	0902.110	+2.5
39	1527.0	465.43	1145	1047.624	+.056	+.025	1.055	0906.877	+4
40	1627.0	495.91	1156	1051.771	+.047	+.032	1.100	0910.504	+4
41	1747.0	532.49	1206	1056.911	+.039	+.038	1.153	0914.998	+7
42	1807.0	550.77	1222	1059.225	+.024	+.048	1.179	0917.019	+2.5
43	1342.0	409.04	1243	1038.099	+.005	+.061	.972	0898.546	+5
44	1807.0	550.77	1316	1059.263	-.022	+.061	1.179	0917.019	+2.5
45	1839.0	560.53	1327	1060.478	-.031	+.067	1.193	0918.080	+4
46	1869.0	569.67	1340	1061.606	-.041	+.072	1.207	0919.064	+3
47	1892.0	576.68	1348	1062.428	-.047	+.075	1.217	0919.781	+5
48	1937.0	590.40	1356	1063.912	-.052	+.079	1.236	0921.082	+3
49	1981.0	603.81	1405	1065.358	-.058	+.083	1.255	0922.349	+4
50	2021.0	616.00	1412	1066.334	-.062	+.086	1.272	0923.208	+4
51	1807.0	550.77	1429	1059.286	-.072	+.092	1.179	0917.019	+3

Table 2.--Principal Facts for Well Ue4a1, Yucca Flats,
Nevada Test Site, Nye County, Nev.

[Located at lat 37° 4' 48.7" N., long 116° 4' 30.3" W.;
ground elevation 4154 ft (1266 m)].

Logged 09-24-82

Reading #	Depth		Time CUT	Meter readings S.D.	Tidal corr. mgal	Drift corr. mgal	Terrain corr. mgal	Corr. gravity mgal	Error +G μgal
	ft	(m)							
1	4.7	1.43	1632	0988.774	+0.026	-.244	.333	854.992	+3
2	35.1	10.70	1707	0990.428	+0.016	-.244	.351	856.429	+4
3	84.0	25.60	1732	0993.054	+0.008	-.162	.373	858.795	+4
4	131.0	39.93	1747	0995.618	+0.003	-.143	.394	861.046	+2.5
5	177.0	53.95	1804	0997.984	-.001	-.059	.416	863.193	+3
6	216.0	65.84	1823	1000.011	-.007	+0.016	.434	865.032	+3
7	252.0	76.81	1836	1001.938	-.010	+0.014	.451	866.709	+2
8	306.0	93.27	1855	1004.824	-.015	+0.012	.476	869.221	+4
9	376.0	114.60	1903	1008.263	-.017	+0.013	.510	872.227	+2
10	410.0	124.97	1925	1009.929	-.022	+0.015	.527	873.681	+2
11	410.0	124.97	2044	1009.957	-.035	+0.004	.527	873.681	+2.5
12	440.0	134.11	2103	1011.362	-.037	+0.007	.541	874.910	+3
13	489.0	149.05	2116	1013.858	-.038	+0.009	.565	877.093	+2.5
14	538.0	163.98	2131	1016.521	-.040	+0.011	.589	879.418	+3.5
15	609.0	185.62	2149	1020.237	-.041	+0.014	.624	882.667	+3
16	678.0	206.65	2203	1023.733	-.042	+0.012	.658	885.720	+4
17	745.0	227.08	2219	1027.241	-.042	+0.009	.692	888.783	+2.5
18	821.0	250.24	2236	1031.309	-.043	+0.006	.729	892.332	+3
19	867.0	264.26	2249	1033.633	-.043	+0.004	.752	894.361	+2.5
20	912.1	278.01	2308	1035.922	-.044	0.000	.775	896.358	+2.5
21	990.0	301.75	2324	1039.949	-.044	+0.004	.813	899.880	+3
22	1041.0	317.30	2336	1042.517	-.044	+0.008	.838	902.129	+2
23	1072.0	326.75	2346	1044.142	-.044	+0.011	.854	903.552	+3
24	1147.0	349.61	2355	1047.920	-.044	+0.014	.891	906.858	+3
25	1197.0	364.85	0004	1050.434	-.044	+0.016	.915	909.056	+2
26	1248.0	380.39	0013	1053.035	-.044	+0.013	.940	911.326	+3
27	1285.0	391.67	0020	1054.891	-.045	+0.009	.958	912.944	+2
28	1335.0	406.91	0028	1057.281	-.045	+0.006	.983	915.031	+3
29	1386.0	422.45	0044	1059.799	-.045	-.001	1.007	917.225	+2
30	1427.0	434.95	0056	1061.721	-.045	-.006	1.027	918.901	+3
31	1457.0	444.09	0106	1063.179	-.045	-.011	1.042	920.171	+2.5
32	1496.0	455.98	0116	1064.902	-.045	-.015	1.061	921.676	+2
33	1496.0	455.98	0123	1064.896	-.045	-.010	1.061	921.676	+2
34	1531.0	466.65	0132	1066.477	-.045	-.009	1.078	923.060	+2.5
35	1575.0	480.06	0141	1068.417	-.045	-.009	1.099	924.758	+3
36	1631.0	497.13	0149	1070.898	-.045	-.008	1.126	926.930	+2
37	1671.0	509.32	0156	1072.650	-.045	-.008	1.145	928.464	+3
38	1714.0	522.43	0205	1074.117	-.045	-.007	1.165	929.753	+2.5
39	1766.0	538.28	0212	1075.996	-.045	-.007	1.190	931.420	+2.5
40	1832.0	558.39	0225	1078.415	-.045	-.006	1.221	933.525	+2.5
41	1886.0	574.85	0233	1080.319	-.045	-.005	1.247	935.198	+3
42	1939.0	591.01	0241	1082.011	-.045	-.004	1.272	936.686	+3
43	1985.0	605.03	0250	1083.552	-.045	-.004	1.294	938.040	+2.5
44	2015.0	614.17	0255	1084.558	-.045	-.003	1.308	938.925	+2.5
45	2027.0	617.83	0304	1085.021	-.045	-.002	1.313	939.331	+2.5
46	1832.0	558.39	0315	1078.409	-.045	-.001	1.221	933.525	+3
47	1496.0	455.98	0335	1064.882	-.045	+0.003	1.061	921.676	+2.5
48	1197.0	364.85	0350	1050.474	-.045	-.018	0.915	909.056	+3
49	912.1	278.01	0402	1035.921	-.045	+0.003	0.775	896.358	+5
50	609.0	185.62	0423	1020.262	-.044	-.005	0.624	882.667	+3.5
51	306.0	93.27	0446	1004.866	-.043	+0.003	0.476	869.221	+3
52	4.7	1.43	0509	0988.571	-.042	0.000	0.333	854.992	+3
53	35.1	10.70	0521	0990.211	-.041	0.000	0.351	856.429	+3
54	84.0	25.60	0535	0992.922	-.040	0.000	0.373	858.795	+5
55	131.0	39.93	0553	0995.518	-.038	-.015	0.394	861.046	+3
56	177.0	53.95	0605	0997.971	-.036	-.012	0.416	863.193	+4
57	216.0	65.84	0624	1000.062	-.034	-.001	0.434	865.032	+2.5

Table 3.--Principal Facts for Well Ue11a, Frenchman Flat,
Nevada Test Site, Nye County, Nev.

[Located at lat 36° 52' 58.6" N., long 115° 57' 16.2" W.;
ground elevation 3540 ft (1079 m)].

Logged 09-26-82

Reading #	Depth		Time CUT	Meter	Tidal	Drift	Terrain	Corr.	Error +G μgal
	ft	(m)		readings S.D.	corr. mgal	corr. mgal	corr. mgal	gravity mgal	
1	0.0	0.00	1541	1010.242	+0.079	0.000	0.841	874.351	+3
2	47.0	14.33	1557	1012.743	+0.079	0.000	0.718	876.390	+3
3	86.0	26.21	1611	1014.793	+0.078	0.000	0.691	878.134	+5
4	125.0	38.10	1625	1016.807	+0.076	0.000	0.698	879.879	+2.5
5	171.0	52.12	1639	1019.135	+0.074	0.000	0.722	881.914	+3
6	213.0	64.92	1655	1021.266	+0.071	0.000	0.751	883.781	+2.5
7	251.0	76.50	1710	1023.164	+0.067	0.000	0.780	885.447	+2.5
8	298.0	90.83	1724	1025.559	+0.063	0.000	0.817	887.550	+2.5
9	340.0	103.63	1738	1027.606	+0.059	0.000	0.852	889.350	+3.5
10	363.0	110.64	1748	1028.723	+0.056	0.000	0.871	890.332	+4
11	414.0	126.19	1800	1031.206	+0.052	0.000	0.914	892.517	+3
12	464.0	141.43	1811	1033.641	+0.047	0.000	0.956	894.658	+2
13	496.0	151.18	1820	1035.128	+0.044	0.000	0.983	895.967	+3.5
14	553.0	168.55	1830	1037.736	+0.040	0.000	1.031	898.266	+3
15	610.0	185.93	1845	1040.526	+0.033	0.000	1.079	900.718	+2.5
16	631.0	192.33	1854	1041.562	+0.029	-0.001	1.096	901.625	+4
17	685.0	208.79	1907	1043.902	+0.023	-0.004	1.141	903.684	+4
18	731.0	222.81	1917	1045.828	+0.019	-0.006	1.179	905.381	+7
19	758.1	231.07	1926	1047.053	+0.014	-0.008	1.202	906.455	+3.5
20	791.0	241.10	1937	1048.687	+0.009	-0.010	1.229	907.888	+3
21	818.0	249.33	1947	1050.040	+0.004	-0.012	1.251	909.072	+5
22	860.0	262.13	2001	1052.363	-0.003	-0.014	1.285	911.104	+4
23	907.0	276.45	2012	1054.948	-0.008	-0.016	1.323	913.370	+2.5
24	948.0	288.95	2023	1057.210	-0.013	-0.018	1.355	915.350	+3.5
25	992.0	302.36	2034	1059.533	-0.018	-0.020	1.390	917.386	+2
26	1053.0	320.95	2046	1062.387	-0.023	-0.023	1.438	919.893	+3.5
27	1095.0	333.76	2057	1064.189	-0.028	-0.025	1.471	921.476	+2.5
28	1130.0	344.42	2106	1065.595	-0.032	-0.026	1.498	922.714	+3
29	1151.0	350.82	2118	1066.375	-0.036	-0.026	1.514	923.400	+5
30	1183.0	360.58	2128	1067.503	-0.040	-0.025	1.538	924.396	+4
31	1217.0	370.94	2138	1068.690	-0.043	-0.025	1.564	925.445	+2.5
32	1243.0	378.87	2149	1069.659	-0.047	-0.024	1.584	926.299	+3
33	1286.0	391.97	2159	1071.260	-0.050	-0.024	1.616	927.712	+4
34	1340.0	408.43	2215	1073.316	-0.055	-0.023	1.656	929.525	+3
35	1130.0	344.42	2230	1065.621	-0.058	-0.022	1.498	922.714	+3
36	860.0	262.13	2252	1052.459	-0.062	-0.038	1.285	911.104	+3
37	610.0	185.93	2314	1040.690	-0.064	-0.045	1.079	900.718	+5
38	298.0	90.83	2334	1025.715	-0.066	-0.006	0.817	887.550	+5
39	0.0	0.00	2410	1010.461	-0.066	-0.045	0.841	874.351	+7

BHGM INTERPRETATIVE SUMMARY

References to fundamentals of borehole gravity logging, data interpretation and relationships between subsurface gravity measurements and mass distribution in the Earth can be found in Robbins (1980). In the absence of complicating factors (assuming near-horizontal beds), the in-situ bulk density (g/cm^3) between two points in a borehole is given by:

$$\rho_B = \frac{F - \frac{\Delta G}{\Delta Z}}{0.02556} \quad (1)$$

where F is the free-air gradient of gravity in mgals/feet (Robbins, 1981), and $\frac{\Delta G}{\Delta Z}$ is the measured gradient of gravity between the two stations on a vertical line underground in mgal/ft.

ρ_B values for well Ue7h (table 4) are not "true" density values but are "apparent" values because of a "graben" structure within which the well is located, thus there exists a density increase at some short distance horizontally from the well. These BHGM density values are influenced by both the lower density rocks within the graben which are adjacent to the well and the higher-density laterally removed rocks of the surrounding horst blocks. Preliminary comparisons with the gamma-gamma density log indicates density increases in the BHGM values of up to 0.2 g/cm^3 with the departures starting between 1,000 and 1,200 ft (300 and 360 m) below the ground surface.

ρ_B values for wells Ue4a1 and Ue11a (tables 5 and 6) are also not "true" values because of block faulting in the immediate vicinity of the wells. Preliminary comparisons between the BHGM density values and the gamma-gamma density values indicate maximum departures greater than 0.1 g/cm^3 with the departures starting within the lower alluvium.

Tables 4, 5, and 6 present the calculated "apparent" densities, and the column headings are explained in the following list:

- Station depth: Depth in well (in feet) at which BHGM was read one or more times. The points are in descending order relative to the ground surface at the well.
- Interval (ΔZ): Vertical distance between the two adjacent station points in the well. Values are given in both feet and meters.
- ΔG : Gravity difference between the two adjacent stations in the well in milligals.
- $\rho(.09406)$: "Apparent" in-situ bulk density in g/cm^3 as determined by equation (1) using the "normal" value of 0.09406 for F.
- $\rho(.09193)$: "Apparent" in-situ bulk density in g/cm^3 as determined by equation (1) using a value for F that was determined from tower measurements that have been made at numerous locations throughout Yucca and Frenchman Flats by LLNL and LANL.

Error:

The first value is the sum of the estimated errors (error column, tables 1, 2, and 3) of the two adjacent stations in microgals. The second value is the same error but in g/cm^3 after the density has been calculated. The values in this column do not include any error that would be associated with unknowns in the drift curves. Schmoker (1978) found the accuracy of most measurements between two points to be about +10 microgals. Because the mean error for the data in Robbins and others (1982) is about +6 microgals, it was suggested that 4 microgals be added to the values in the column for a total error. Since the means for the data in this report are +7.5, +5.5, and +6.7 mgal, the addition of 4 microgals still seems reasonable.

Tables 7, 8, and 9 contain stratigraphic section and unit depths for each well.

Table 4.--Density Estimates for Well Ue7h
 Yucca Flats, Nevada Test Site, Nye County, Nev.
 [Located at lat 37° 6' 11.0" N., long 116° 0' 19.8" W.;
 ground elevation 4392.4 ft (1338.8 m)]

Station depth	Interval (ΔZ)		ΔG mgal	ρ (g/cm ³)	ρ (g/cm ³)	Error	
	ft	(m)		for F= .09406 mgal/ft	for F= .09193 mgal/ft	+g μ gal	+ ρ g/cm ³
0.0	32.0	9.75	1.463	1.891	1.808	+7	+ .009
32.0	28.0	8.53	1.248	1.936	1.853	+7	+ .010
60.0	41.0	12.50	1.771	1.990	1.907	+9	+ .009
101.0	25.0	7.62	1.085	1.982	1.899	+8	+ .013
126.0	51.0	15.54	2.207	1.987	1.903	+6	+ .005
177.0	35.0	10.67	2.018	1.424	1.341	+8	+ .009
212.0	25.0	7.62	1.309	1.631	1.548	+7	+ .011
237.0	40.0	12.19	2.324	1.407	1.323	+8	+ .008
277.0	48.0	14.63	2.202	1.885	1.802	+8	+ .007
325.0	78.0	23.77	4.223	1.562	1.478	+6	+ .003
403.0	40.0	12.19	2.070	1.655	1.572	+8	+ .008
443.0	60.0	18.29	3.362	1.488	1.404	+7.5	+ .004
503.0	79.0	24.08	4.062	1.668	1.585	+6.5	+ .003
582.0	110.0	33.53	5.853	1.598	1.515	+7	+ .003
692.0	54.0	16.46	2.879	1.594	1.511	+6	+ .004
746.0	108.0	32.92	5.191	1.799	1.716	+7	+ .002
854.0	72.0	21.95	3.631	1.707	1.623	+7	+ .003
926.0	85.0	25.91	4.162	1.764	1.681	+7	+ .003
1011.0	72.0	21.95	3.341	1.865	1.781	+9	+ .005
1083.0	87.0	26.52	3.489	2.111	2.028	+9	+ .004
1170.0	67.0	20.42	3.004	1.926	1.842	+7	+ .004
1237.0	105.0	32.00	4.668	1.941	1.857	+6	+ .003
1342.0	80.0	24.38	3.564	1.937	1.854	+6.5	+ .004
1422.0	105.0	32.00	4.767	1.904	1.820	+6.5	+ .003
1527.0	100.0	30.48	3.627	2.261	2.177	+8	+ .004
1627.0	120.0	36.58	4.494	2.215	2.131	+11	+ .004
1747.0	60.0	18.29	2.021	2.362	2.279	+9.5	+ .006
1807.0	32.0	9.75	1.061	2.383	2.299	+6.5	+ .008
1839.0	30.0	9.14	0.984	2.397	2.313	+7	+ .009
1869.0	23.0	7.01	0.717	2.460	2.377	+8	+ .014
1892.0	45.0	13.72	1.301	2.549	2.465	+8	+ .006
1937.0	44.0	13.41	1.267	2.553	2.470	+7	+ .006
1981.0	40.0	12.19	0.859	2.840	2.756	+8	+ .008
2021.0							

Table 5.--Density estimates for well Ue4al
 Yucca Flats, Nevada Test Site, Nye County, Nev.
 [Located at lat 37° 4' 48.7" N., long 116° 4' 30.3" W.;
 Ground elevation 4154 ft (1266 m)]

Station depth	Interval (ΔZ)		ΔG mgal	ρ (g/cm^3) for F=		Error	
	ft	(m)		.09406 mgal/ft	.09350 mgal/ft	+g μ gal	+ $\rho g/cm^3$
4.7	30.4	9.27	1.437	1.831	1.809	+6	+.007
35.1	48.9	14.90	2.366	1.787	1.765	+8	+.006
84.0	47.0	14.33	2.251	1.806	1.784	+6.5	+.005
131.0	46.0	14.02	2.147	1.854	1.832	+5.5	+.005
177.0	39.0	11.89	1.839	1.835	1.813	+6	+.006
216.0	36.0	10.97	1.677	1.857	1.836	+5	+.005
252.0	54.0	16.46	2.512	1.860	1.838	+6	+.004
306.0	70.0	21.34	3.006	2.000	1.978	+6	+.003
376.0	34.0	10.36	1.454	2.007	1.985	+4	+.005
410.0	30.0	9.14	1.229	2.077	2.055	+5.5	+.007
440.0	49.0	14.94	2.183	1.937	1.915	+5.5	+.004
489.0	49.0	14.94	2.325	1.824	1.802	+6	+.005
538.0	71.0	21.64	3.249	1.890	1.868	+6.5	+.003
609.0	69.0	21.03	3.053	1.949	1.927	+7	+.004
678.0	67.0	20.42	3.063	1.891	1.869	+6.5	+.003
745.0	76.0	23.16	3.549	1.853	1.831	+5.5	+.003
821.0	46.0	14.02	2.029	1.954	1.932	+5.5	+.005
867.0	45.1	13.75	1.997	1.948	1.926	+5	+.004
912.1	77.9	23.74	3.522	1.911	1.889	+5.5	+.003
990.0	51.0	15.54	2.249	1.955	1.933	+5	+.004
1041.0	31.0	9.45	1.423	1.884	1.862	+5	+.006
1072.0	75.0	22.86	3.306	1.955	1.933	+6	+.004
1147.0	50.0	15.24	2.198	1.960	1.938	+5	+.004
1197.0	51.0	15.54	2.270	1.939	1.917	+5	+.004
1248.0	37.0	11.28	1.618	1.969	1.947	+5	+.005
1285.0	50.0	15.24	2.087	2.047	2.025	+5	+.004
1335.0	51.0	15.54	2.194	1.997	1.975	+5	+.004
1386.0	41.0	12.50	1.676	2.081	2.059	+5	+.005
1427.0	30.0	9.14	1.270	2.024	2.002	+5.5	+.007
1457.0	39.0	11.89	1.505	2.170	2.148	+4.5	+.004
1496.0	35.0	10.67	1.384	2.133	2.111	+4.5	+.005
1531.0	44.0	13.41	1.698	2.170	2.148	+5.5	+.005
1575.0	56.0	17.07	2.172	2.163	2.141	+5	+.004
1631.0	40.0	12.19	1.534	2.180	2.158	+5	+.005
1671.0	43.0	13.11	1.289	2.507	2.485	+5.5	+.005
1714.0	52.0	15.85	1.649	2.439	2.417	+5	+.004
1766.0	66.0	20.12	2.123	2.421	2.400	+5	+.003
1832.0	54.0	16.46	1.673	2.468	2.446	+5.5	+.004
1886.0	53.0	16.15	1.488	2.582	2.560	+6	+.004
1939.0	46.0	14.02	1.354	2.528	2.506	+5.5	+.004
1985.0	30.0	9.14	0.885	2.526	2.504	+5	+.006
2015.0	12.0	3.66	0.406	2.356	2.334	+5	+.015
2027.0							

Table 6.--Density Estimates for Well Ue11a
 Frenchman Flat, Nevada Test Site, Nye County, Nev.
 [Located at lat 36° 52' 58.6" N., long 115° 57' 16.2" W.;
 ground elevation 3540 ft (1079 m)]

Station depth	Interval (ΔZ)		ΔG mgal	ρ (g/cm ³)		Error	
	ft	(m)		for F= .09406 mgal/ft	for F= .09340 mgal/ft	+G μ gal	+ ρ g/cm ³
0.0	47.0	14.33	2.039	1.983	1.957	+6	+ .005
47.0	39.0	11.89	1.744	1.930	1.905	+8	+ .008
86.0	39.0	11.89	1.745	1.929	1.904	+7.5	+ .007
125.0	46.0	14.02	2.035	1.949	1.923	+5.5	+ .005
171.0	42.0	12.80	1.867	1.941	1.915	+5.5	+ .005
213.0	38.0	11.58	1.666	1.965	1.939	+5	+ .005
251.0	47.0	14.33	2.103	1.929	1.904	+5	+ .004
298.0	42.0	12.80	1.800	2.003	1.977	+6	+ .005
340.0	23.0	7.01	0.982	1.010	1.984	+7.5	+ .013
363.0	51.0	15.54	2.185	2.004	1.978	+7	+ .006
414.0	50.0	15.24	2.141	2.005	1.979	+5	+ .004
464.0	32.0	9.75	1.309	2.080	2.054	+5.5	+ .006
496.0	57.0	17.37	2.299	2.102	2.076	+6.5	+ .004
553.0	57.0	17.37	2.452	1.997	1.971	+5.5	+ .004
610.0	21.0	6.40	0.907	1.990	1.964	+6.5	+ .012
631.0	54.0	16.46	2.059	2.188	2.162	+8	+ .006
685.0	46.0	14.02	1.697	2.237	2.211	+11	+ .009
731.0	27.1	8.26	1.074	2.129	2.104	+10.5	+ .015
758.1	32.9	10.03	1.433	1.976	1.950	+6.5	+ .008
791.0	27.0	8.23	1.184	1.964	1.939	+8	+ .011
818.0	42.0	12.80	2.032	1.787	1.761	+8	+ .007
860.0	47.0	14.33	2.266	1.794	1.768	+5.5	+ .004
907.0	41.0	12.50	1.980	1.791	1.765	+6	+ .006
948.0	44.0	13.41	2.036	1.870	1.844	+5.5	+ .005
992.0	61.0	18.59	2.507	2.072	2.046	+5.5	+ .004
1053.0	42.0	12.80	1.583	2.205	2.180	+6	+ .005
1095.0	35.0	10.67	1.238	2.296	2.270	+5.5	+ .006
1130.0	21.0	6.40	0.686	2.402	2.376	+8	+ .015
1151.0	32.0	9.75	0.996	2.462	2.436	+9	+ .011
1183.0	34.0	10.36	1.049	2.473	2.447	+6.5	+ .007
1217.0	26.0	7.92	0.854	2.395	2.369	+5.5	+ .008
1243.0	43.0	13.11	1.413	2.394	2.369	+7	+ .006
1286.0	54.0	16.46	1.813	2.366	2.341	+7	+ .005
1340.0							

Table 7. Stratigraphic section and unit depths in well Ue7h
 (from Allen Cogbill with LANL, 1982, written commun.).

[T.D. = bottom of BHGM survey]

Stratigraphic units	Unit depths
	(Surface)
Alluvium	177 ft (54 m)
Timber Mountain Tuff	237 ft (72 m)
Ammonia Tanks Member	
Rainier Mesa Member	503 ft (153 m)
Paintbrush Tuff	774 ft (236 m)
Tunnel Beds Tuff	1237 ft (377 m)
Crater Flat Tuff	1527 ft (466 m)
Unit #1 Tunnel Beds Tuff	1627 ft (496 m)
Undifferentiated Older Tuffs	1937 ft (590 m)
Paleocolluvium	1981 ft (604 m)
Paleozoic Limestone	2021 ft (616 m) T.D.

Table 8. Stratigraphic section and unit depths in well Ue4a1
 (from Lawrence Livermore National Laboratory, 1982, written commun.).

[w.t. = approximate depth to water table]

[T.D. = bottom of BHGM survey]

Stratigraphic units	Unit depths
	(Surface)
Alluvium	
	1575 ft (480 m)
Tunnel Beds and Older Tuffs	
	1670 ft (509 m)
Paleozoic Rocks	
	1735 ft (529 m) w. t.
	2027 ft (618 m) T. D.

Table 9. Stratigraphic section and unit depths in well Ue11a
 (from United States Geological Survey, 1965, written commun.).

[w.t. = approximate depth to water table]

[T.D. = bottom of BHGM survey]

Stratigraphic units	Unit depths
	(Surface)
Alluvium	
	550 ft (168 m)
Timber Mountain	Ammonia Tanks Member
	900 ft (274 m)
Tuff	Rainier Mesa Member
	1128 ft (344 m) w.t.
	1340 ft (408 m) T.D.

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