NOTICE

All drawings located at the end of the document.

MEMORANDUM

DATE: November 1, 1995

TO: Annette Primrose, Sitewide Actions, Bldg. T893A, x4385

FROM: Fred Grigsby, Hydrogeology, Bldg. T893B, x7728 FG

SUBJECT: Indicated Faults at RFETS

INTRODUCTION

The fault study at RFETS originated as a result of drilling and logging the pilot holes 21193 through 21693 on OU2. These holes were close spaced, had good core recovery, and a full suite of downhole geophysical logs were run for each hole. I had the opportunity to look at the core from each of these holes as it was recovered, and was either present when the downhole logs were run, or saw the logs soon after logging procedures were completed. I also did the QA on each of the core logs as they were in progress. Because of the hole spacing it seemed feasible that the geophysical logs would correlate over the short distances between holes even though the depositional environment was not generally favorable for producing continuous stratigraphic horizons that could be identified on the logs. The results were better than expected, and one unit ("A" Claystone) was identified that appeared to be the most reliable over the area. The initial interpretation of the data at that time was that fault No.4 probably exists as shown on Plate 7-1 of the 1995 Geologic Characterization Report and on Figure 1 which is included with this memorandum. The intensity of faulting along the front range province is illustrated on Figure 2 and tends to substantiate the interpretation that faulting also is likely at RFETS.

At about the same time that the OU2 program was in progress, the Systematic Evaluation Program (SEP) group was drilling a series of boreholes for shear wave determinations. One of these holes, No. 01193 was drilled to a depth of 500 feet, and was located 1200 feet west of hole 21393. The neutron log from hole 01193 was basically identical with the OU2 neutron logs, and a correlation of these logs indicated a distinct down to the west fault that is shown as fault No.3 on Plate 7-1 and Figure 1. Hole 01193 became the type section for the Laramie Formation at RFETS, and the neutron, density and natural gamma logs from the remaining deep holes were correlated to provide the subsurface data used to construct the present structure map. Because of a lack of data, most of the faults were considered as inferred, and most need to be further

ADMIN RECORD

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delineated and evaluated to determine their hydraulic nature with depth.

SUMMARY

The data incorporated into the structural map presented in the 1995 geologic characterization report was derived from the geophysical logs of 17 bedrock wells that were drilled in 1989, 23 geophysical logs from boreholes drilled under the sitewide drilling program in 1991 and 1992, the geophysical logs from the six pilot holes drilled on OU2 in 1993, geophysical logs from four of the boreholes drilled for the Systematic Evaluation Program in 1993 and geophysical logs from six wells in the 1993 WARP program. The geophysical logs of the six SEP control boreholes that were used to determine the length and location of the SEP trench were incorporated into the map just prior to completing the report. Some additional supporting data was also included when 20 existing bedrock wells were logged in 1994. Much of this data is still subject to review.

The resulting interpretation identified 7 possible faults as shown on Figure 1. As previously stated faults 3 and 4 were originally considered the most probable because of the quality of the data, and the close proximity of the boreholes. However the strike of both of these structures remains uncertain because of a lack of data. Fault No.2 received the most attention because of its proximity to building 371, and the fact that the shear wave study suggested a fault of similar orientation (down to the east) is present in the general area. Cross sections and a geologic structure map were constructed from the above data. After a comprehensive review of this information the Defense Nuclear Facilities Safety Board(DNFSB) made the decision to determine if a capable fault system does exist by excavating a trench across the indicated fault zone. The trench location was determined by drilling 3 pilot holes to confirm the presence of the fault, followed by 3 offset holes to attempt to determine the attitude of the fault. Hole 69494, which is shown on Figure 3, was drilled into the fault zone. The trench was located to the north of the present landfill and across No Name Gulch, in an undisturbed area, to isolate it from contaminated groundwater. The trench was 570 feet in length, averaged approximately 18 feet in depth, and was 4 feet wide. Hydraulic shoring was used for support while mapping the south wall of the trench. Attempts to locate a site closer to Building 371 had not been successful. After the trench was completed, several holes were completed in OU5 that also crossed and confirmed the fault. However, offset holes were not drilled into the fault zone. Fault No. 2 is now considered a proven structure.

In the 1995 Geologic Characterization Report, all of the faults identified were inferred to be high angle reverse faults (based on previous studies that had been done along the front range).

However, many of the faults occurring at the Marshal Landfill were mapped as high angle normal faults (personal communication with Mark Wood, RMRS),and normal faults may occur at RFETS. The subsurface information that is presently available does indicate that faults 2 and 4 are high angle reverse faults.

SEISMIC SURVEYS

Seismic surveys of the area also support the presence of faulting. The deep seismic section show blind thrust faults that originate near the base of the Pierre Shale and terminate below the Fox Hills Formation. This survey was designed to acquire deep data and does not effectively show structure in the shallower formations. The correlation of these deep faults with the indicated and inferred near surface faults is not feasible with the present data.

Of the shallow high resolution seismic surveys that have been conducted at RFETS, only the data acquired along Indiana Street show faults that penetrate the Fox Hills Formation and may extend into the Upper Laramie Formation. A fault shown on section WIN 4 indicates a reverse fault with about the same displacement and orientation that can be aligned with fault No. 4 on Figure 1. This fault would project to within approximately 500 feet or less to well 41692. Another fault shown further to the north, also penetrates the Fox Hills Formation. Because of the impedance contrast between the Laramie claystones and the Fox Hills Sandstone, the deep data on this section, and other HR surveys, may be the only generally reliable information that was derived from the HR surveys. The fault to the north may indicate a fault that could be projected back to RFETS and is yet undefined.

Seismic line WIN 5 indicates good apparent Fox Hills reflections on either end of the line, with a central zone of several hundred feet where the data badly deteriorates which may possibly be due to faulting. Fault No. 5 can be projected to coincide with this zone. It is likely that the fault system at RFETS is complex and that contaminant pathways may exist.

CORE ANALYSIS

Fracturing is relatively common in core recovered from the area, but several of the deep boreholes drilled during the sitewide program in 1991 and 1992 recovered intervals in the middle of core runs consisting of damp to saturated clays and/or breccia. Because these intervals occurred in the middle of a run there was no chance that they consisted of sluff from shallower sediments, and it was unlikely that these sediments could become saturated during the short time they were exposed to the drilling fluids. The core from this program was logged as soon as possible after the core was recovered so the insitu moisture could be recorded. These intervals, which sometimes occurred at depths exceeding 100 to 150 feet, tend to suggest that there are some open saturated fractures.

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WEATHERING

Weathering was best observed in the walls of the SEP trench which normally exposed six to eight feet of bedrock. A primary weathering profile could usually be observed in the upper few feet of the bedrock, and secondary, strong oxidation was found along fractures that would extend several inches into the bedrock. In the areas where the fracturing was not extensive, the bedrock between the fractures was fresh to only weakly weathered. Strong oxidation at depth should indicate an extensive or deep fracture and/or fault system. The isopach map of the weathered bedrock at RFETS shows areas in the proximity of the indicated faults with thickness up to 50 feet.

SEP TRENCH

One of the objectives of the Systematic Evaluation Program (SEP) is to evaluate the seismic risk at RFETS and to evaluate Building 371 as a primary plutonium storage facility. Because of the indicated fault to the east of building 371, it was mandated by the Defense Nuclear Facilities Safety Board (DNFSB) that the indicated fault be confirmed and evaluated to determine if the fault system is capable of producing an earthquake. A capable fault by Nuclear Regulatory Commission definition is a fault that shows evidence of a single displacement in 35,000 years, or multiple displacements in the past 500,000 years. The data were subjected to multiple reviews and a suitable site for a trench was selected. Attempts to locate the trench closer to the building were unsuccessful, so a series of six boreholes were drilled to the north of the landfill, and across NO Name Gulch (taken from the monitor well location map) to confirm the fault and determine the length of the trench. The fault was located between boreholes 69194 and 69294, and offset hole 69494 was drilled into the fault zone. At this time this has been the only borehole that has been intentionally drilled into a fault zone. Because of budget and objective considerations the holes were not cored but were rotary drilled and a suite of downhole geophysical logs run on each hole. In addition to confirming the fault these holes provided evidence that this fault is relatively transmissive with respect to groundwater. Hole 69494 filled with water to a depth of 13 feet below ground level in a matter of hours (contained a column of water 232 feet deep) and stabilized at a depth equivalent to the alluvium-bedrock contact. The holes on either side made water at a very slow rate, and with the exception of hole 69694, which sustained damage when the casing was dislodged while tripping out, all showed no indications of significant water flows. Hole 69694 eventually filled to a higher level because of the damaged seal, but did not show indications of the high water flow as was encountered in 69494. During the time that hole 69494 was open, water movement could be visually detected in the hole.

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Because the hole was not cored it was not possible to determine the interval which accounted for the flow.

The trench was opened to a length of 570 feet, and an average depth of approximately 18 feet. It was 4 feet wide and was supported by hydraulic shoring on 4 foot centers. The Rocky Flats Alluvium remained competent for the entire length of the trench, while the bedrock encountered water flow and caving in the extensive fracture zone associated with the indicted fault. At that interval only 6 to 8 feet of bedrock were exposed, and it was necessary to pump the water and add extra shoring to maintain adequate safety conditions to continue the investigation of the trench. It is likely that the water flow would have increased if the trench would have been deeper. This interval was offset from borehole 69494 by 100 feet or less. Colored photographs of the trench are available for review.

CONCLUSIONS

All of the information presented above supports the potential for ground water movement through the fracture systems or faults at RFETS. The nature of fracture flow, including depth, direction and rate has not been determined. The probability that contaminants have migrated vertically to the Fox Hills Formation is unlikely because of the tendency of fractures to heal with depth. However there is uncertainty as to the extent to which faulting plays a role in vertical contaminant transport.

REFERENCES

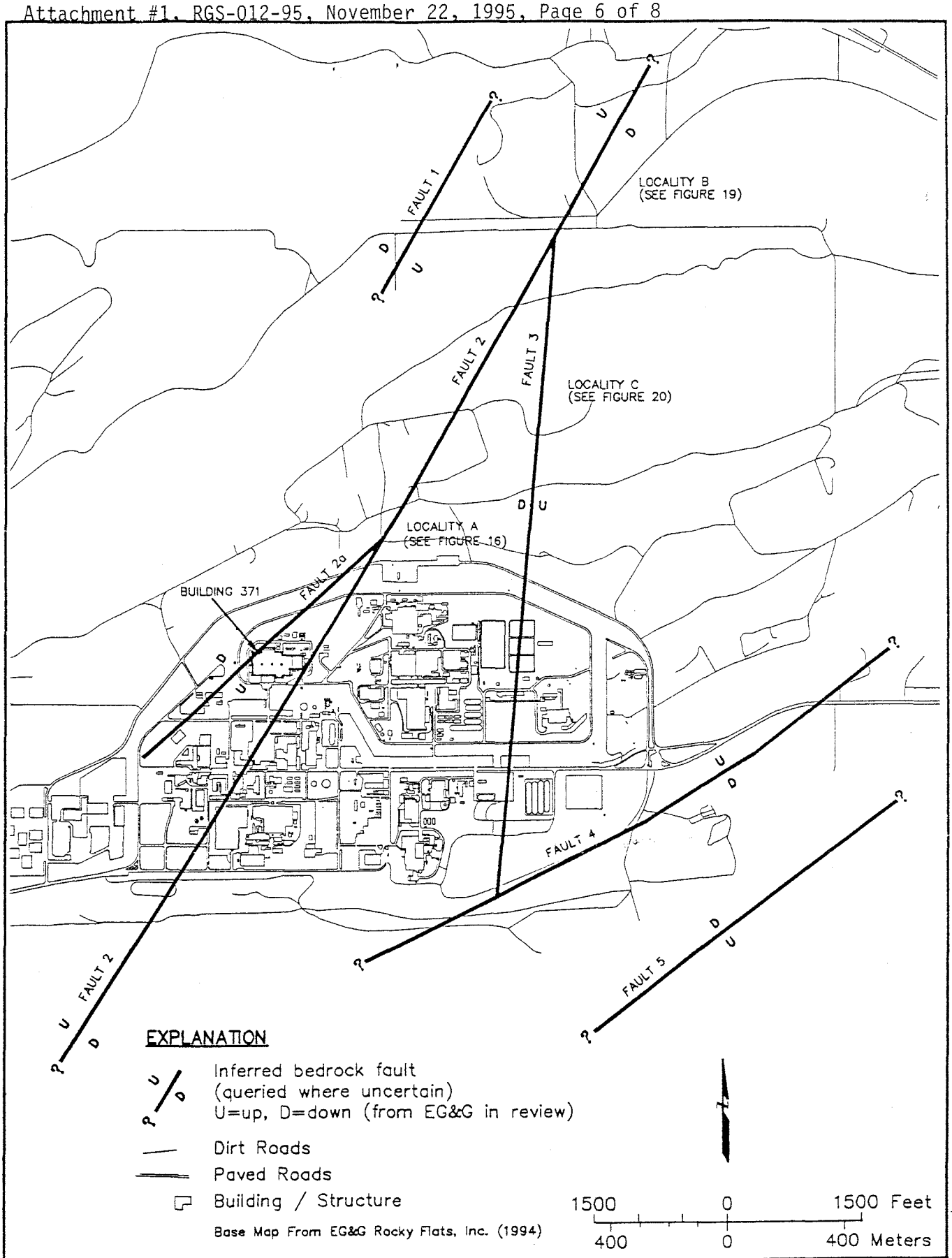
1. Report on Deep Seismic Data Acquisition from Coal Creek Canyon to Great Western Reservoir by Write Water Engineering, May 1994

2. Final Report on Additional Shallow High-Resolution Seismic Reflection Profiling on Indiana Street by the Ebasco Team, September 1, 1993

3. Geologic Characterization Report for the Rocky Flats Environmental Technology Site, Final Report by EG&G, March 1995

4. Evaluation of the Capability of Inferred Faults in the Vicinity of Building 371, Rocky Flats Environmental Technology Site, Colorado by Geomatrix Consultants, Inc., February 1995

5. Evaluation of "A" Claystone Structure Contour Map, Rocky Flats Plant, Golden, Colorado by Alam Mozumder, DOE/DP311



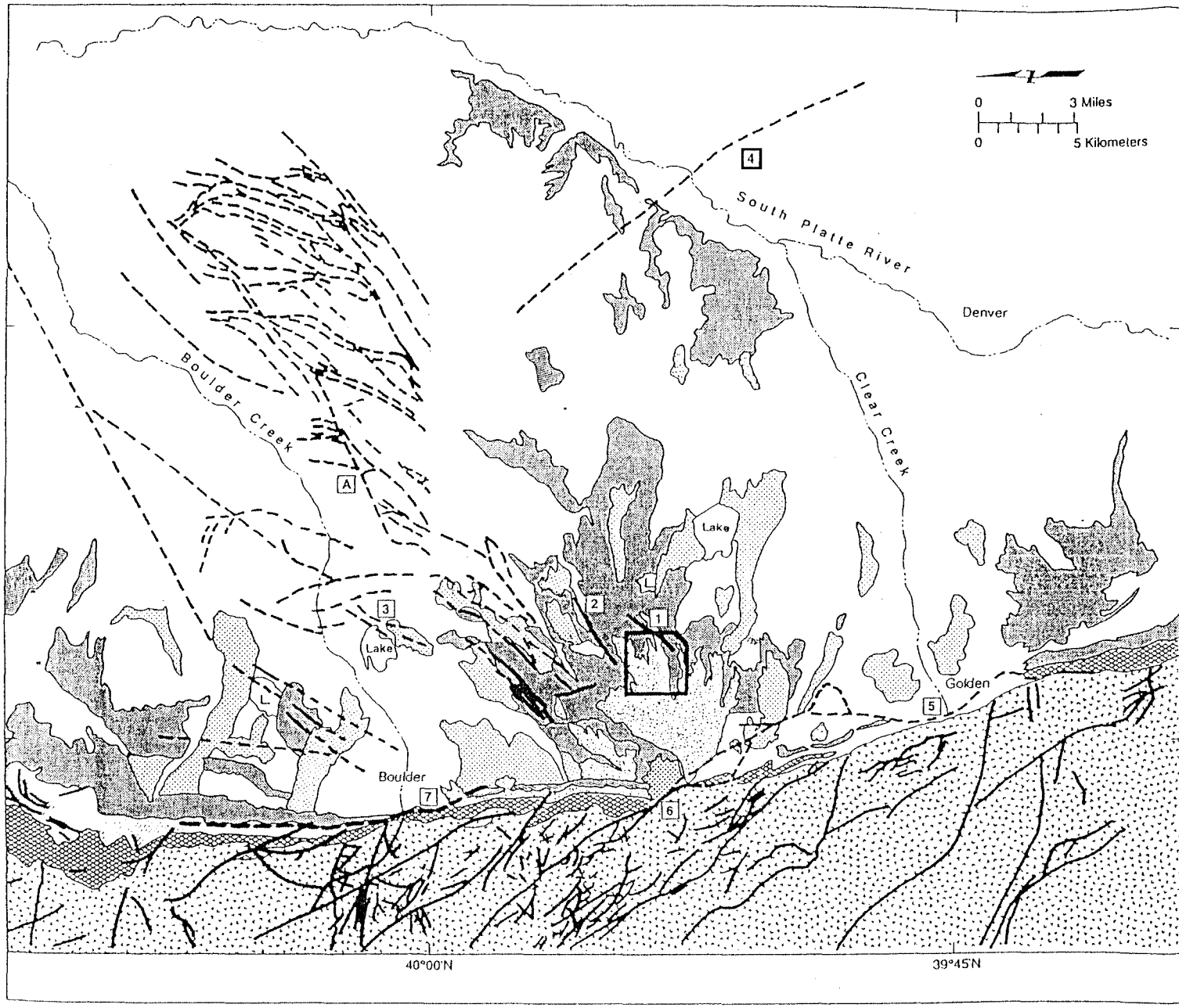
GEOMATRIX

LOCATIONS OF INFERRED FAULTS

Rocky Flats Environmental Technology Site

Figure 1

Project No. 2722



EXPLANATION

- Younger Quaternary alluvium
- Older Quaternary alluvium
- Rocky Flats alluvium
- Nussbaum alluvium
- Tertiary bedrock
- Upper Cretaceous bedrock
- Undifferentiated Mesozoic bedrock
- Paleozoic basement
- Crystalline basement
- Fault; dashed where buried
- Boundary of Rocky Flats Plant
- A Local source zone containing northeast-trending faults
- 1 Walnut Creek fault
- 2 Rock Creek fault
- 3 Valmont fault
- 4 Derby fault

Rocky Mountain Front Range Fault System

- 5 Golden fault
- 6 Livingston fault
- 7 Boulder fault

Modified from Risk Engineering (1994) (Geology from Trimble and Machette, 1979a; Colton, 1978).

LOCAL GEOLOGY AND SEISMIC SOURCES IN THE VICINITY OF ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

GEOMATRIX	Project No.	Figure
	2722	2

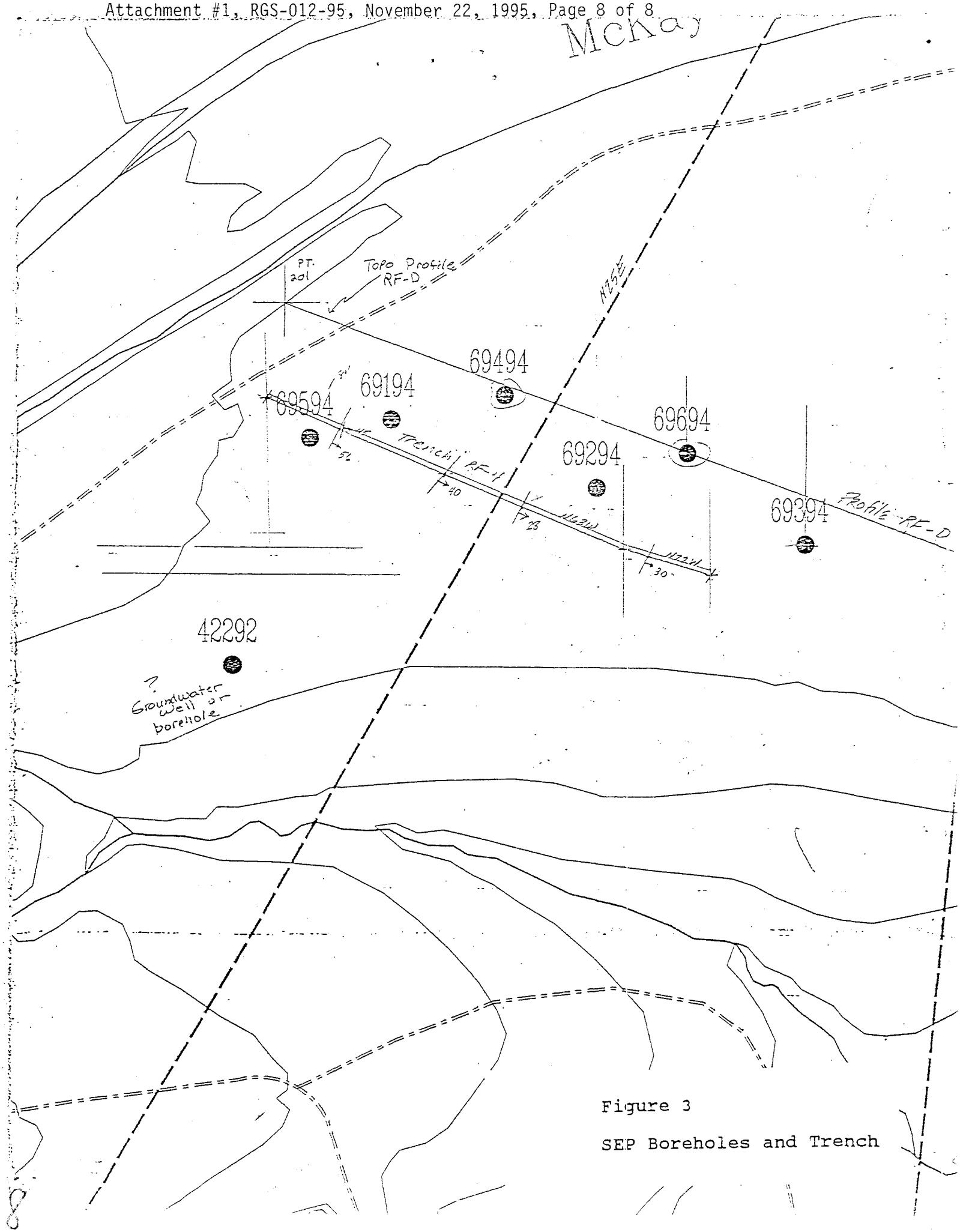


Figure 3

SEP Boreholes and Trench

Figure 2
Site-Wide Vertical Distribution of Tritium in Groundwater

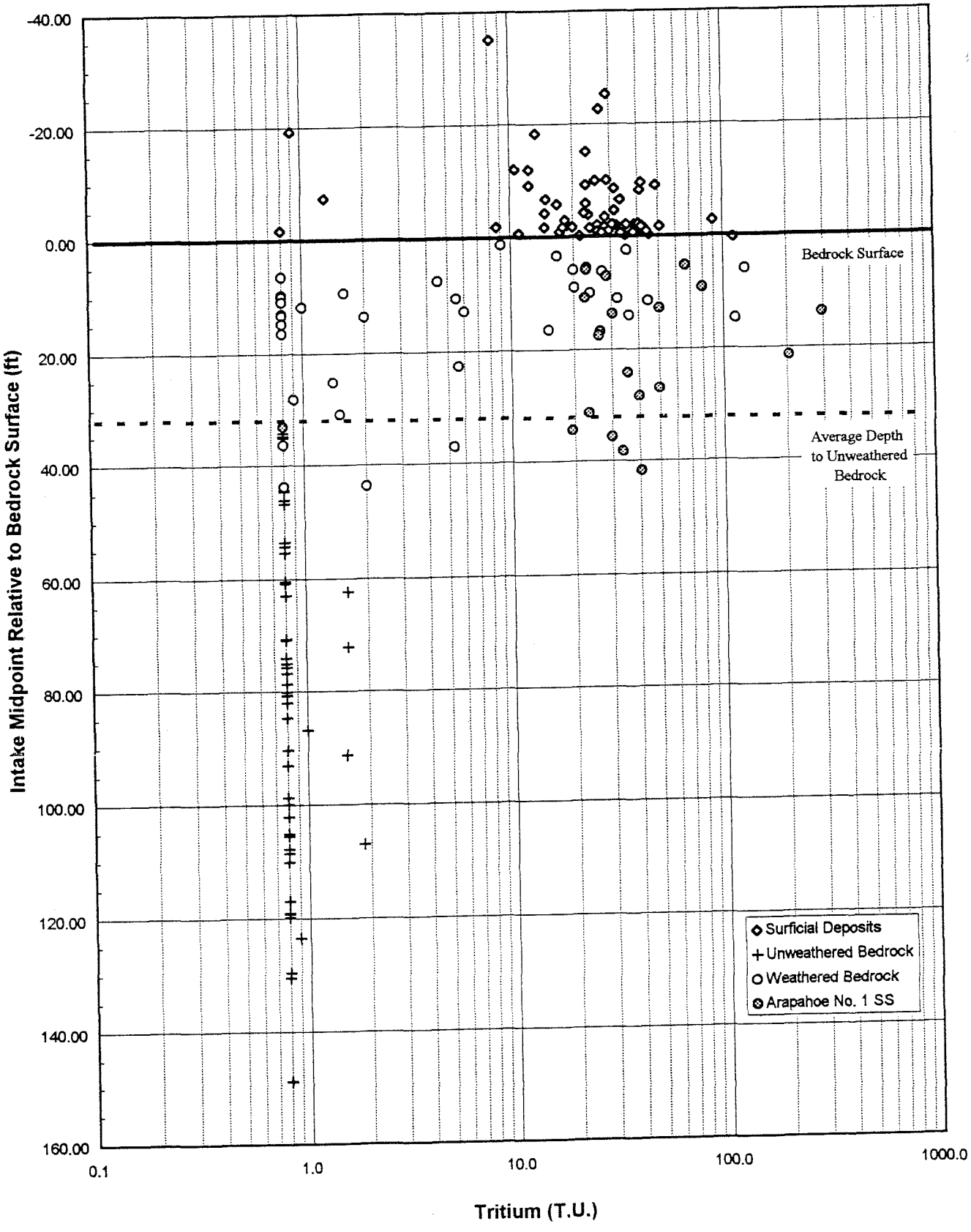


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Figure 3
Site-Wide Vertical Distribution of Oxygen-18 in Groundwater

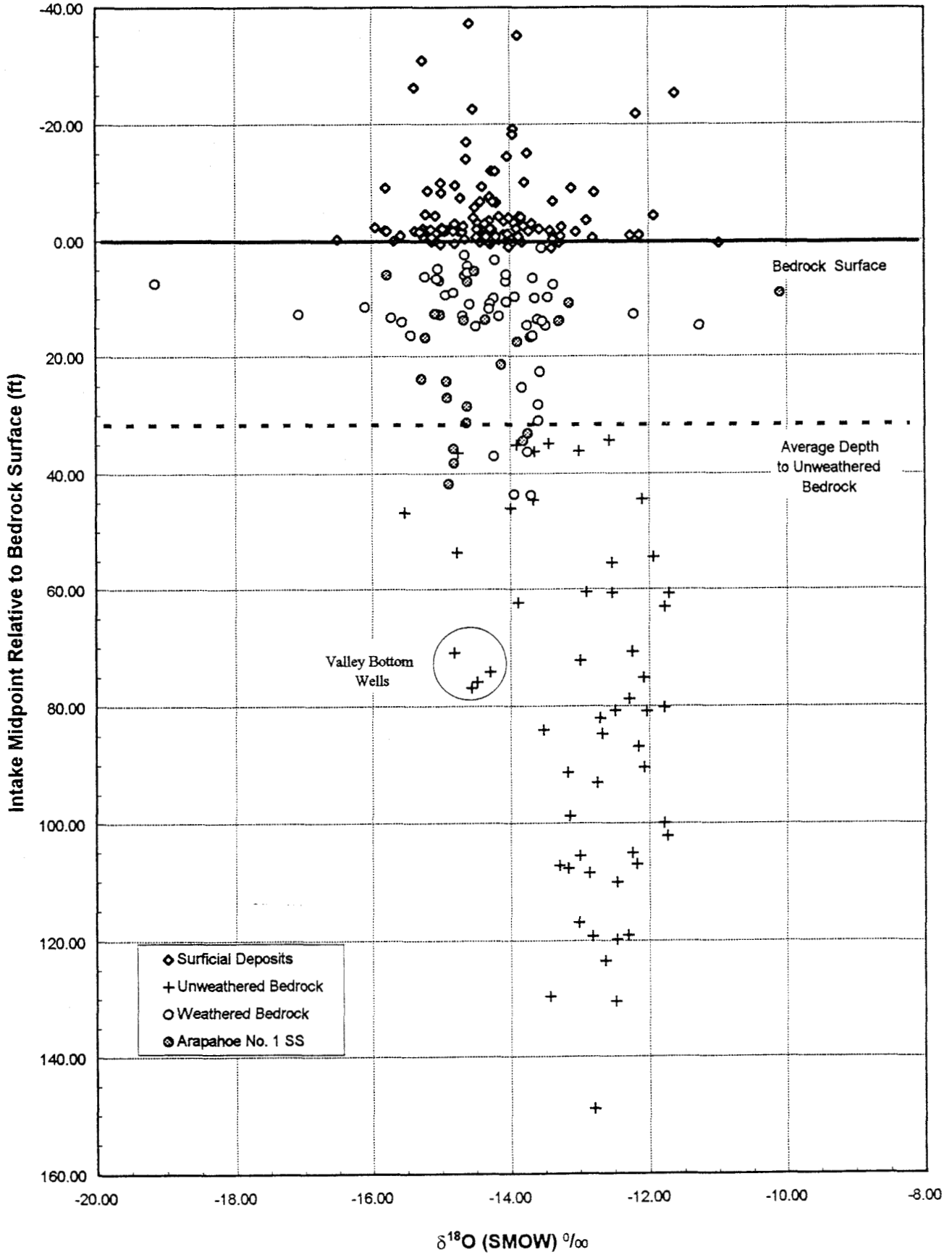

Table 1
Isotopic Compositions of Groundwater

Well Name	Completion Unit	Lithologic Unit[1]	Surface Elevation[2]	Top of Casing[2]	Well Stick-Up[3]	Total Depth of Casing[4]	Depth to Top of Screen[4]	Depth to Bottom of Screen[4]	Screen Length (ft)	Depth to Top of Bedrock[4]	Depth to Middle of Screen[4]	Depth below Top of Bedrock[4]	Screen/Sat. Int. Midpoint Depth	Midpoint Depth Relative to Bedrock
0186	Qa	s	5627.67	5629.32	1.65	10.2	3.2	10.2	7.0	9.3	6.7	NP	9.57	0.27
586			5724.40	5726.37	1.97	9.8	4.4	9.8	5.4	9.0			9.0	-0.03
686			5814.70	5816.72	2.02	8.9	3.3	8.9	5.6	10.5				
786			5924.90	5926.54	1.64	5.7	3.0	5.7	2.7	5.0			4.8	-0.23
1186	Qa	s	5718.04	5720.09	2.05	10.3	3.9	10.3	6.3	9.5	7.1	NP	7.1	-2.40
1586	Qc	s	5848.43	5850.63	2.20	14.4	4.1	14.4	10.4	12.5	9.3	NP	9.4	-3.11
1786	Qc	s	5868.43	5869.57	1.14	14.0	3.7	14.0	10.3	12.5	8.9	NP	9.2	-3.33
1986	Qc	s	5943.08	5943.86	0.78	12.3	3.0	12.3	9.3	11.5	7.6	-3.9	7.6	-3.87
2286	Qrf	s	5978.77	5979.55	0.78	11.2	3.2	11.2	8.0	11.0	7.2	NP	9.2	-1.78
2486	Qrf	s	5982.45	5983.56	1.11	7.5	3.0	7.5	4.5	7.2	5.2	NP	6.9	-0.35
2686	Qrf	s	5975.42	5977.17	1.75	11.0	3.8	11.0	7.3	10.5	7.4	NP	10.0	-0.54
3386	Qrf	s	5951.40	5952.42	1.02	7.3	3.0	7.3	4.4	6.8	5.2	NP	6.0	-0.85
3586	Qc	s	5910.75	5912.76	2.01	11.6	4.9	11.6	6.7	10.5	8.2	NP	8.6	-1.92
3686	Qc	s	5883.69	5885.22	1.53	6.5	3.5	6.5	3.0	5.5	5.0	NP	5.7	0.16
3886	Qa	s	5734.05	5736.08	2.03	8.5	2.9	8.5	5.6	6.0	5.7	NP	5.8	-0.20
3986	Qrf	s	5908.23	5909.41	1.18	31.5	5.0	31.5	26.5	30.5	18.3	NP	29.5	-1.01
4186	Qrf	s	5942.62	5944.36	1.74	44.7	3.9	44.7	40.8	44.6	24.3	NP	44.7	0.14
4286	Qrf	s	5956.27	5957.87	1.60	29.7	6.1	29.7	23.6	28.3	17.9	NP	24.2	-4.14
4486	Qrf	s	6019.9	6021.96	2.06	26.3	3.2	26.3	23.1	25.5	14.8	NP	16.4	-9.06
4586	Qrf	s	6049.99	6051.55	1.56	48.2	3.0	48.2	45.2	49.7	25.6	NP		
4786	Qrf	s	6081.90	6083.67	1.77	94.5	6.2	94.5	88.3	93.0	50.4	NP	78.5	-14.48
4986	Qrf	s	6097.37	6098.89	1.52	67.6	4.1	67.6	63.5	68.0	35.9	NP	58.8	-9.20
5086	Qrf	s	6121.04	6122.94	1.90	96.2	2.9	96.2	93.3	98.0	49.5	NP	72.7	-25.32
5186	Qrf	s	6142.37	6144.25	1.88	79.1	4.8	79.1	74.2	78.5	41.9	NP	70.3	-8.18
5386	Qrf	s	6065.75	6066.63	0.88	7.8	2.5	7.8	5.3	7.0	5.2	NP	6.7	-0.32
5586	Qrf	s	6116.64	6118.72	2.08	36.4	3.6	36.4	32.8	35.5	20.0	NP	26.5	-9.02
5686	Qc	s	5987.46	5988.93	1.47	9.6	2.6	9.6	7.0	9.0	6.1	NP	7.3	-1.72
5786	Qc	s	5951.46	5952.88	1.42	6.8	2.5	6.5	4.0	6.0	4.5	NP	6.3	0.30
6186	Qrf	s	5999.5	6000.60	1.10	12.3	5.0	12.0	7.0	11.5	8.5	NP	10.6	-0.86
6586	Qa	s	5786.66	5788.27	1.61	8.0	2.5	8.0	5.5	7.1	5.3	NP	6.6	-0.48
6686			5692.60	5694.20	1.60	6.5	2.5	6.5	4.0	5.8			4.8	-0.97
6886	Qc	s	5887.97	5890.49	2.52	3.5	1.5	3.5	2.0	2.8	2.5	NP	2.5	-0.30
7086	Qc	s	5937.69	5939.39	1.70	7.9	2.4	7.9	5.5	7.0	5.1	NP	5.2	-1.82
0487	Qc	s	5910.12	5911.58	1.46	19.7	3.5	19.5	16.0	19.7	11.5	NP	14.0	-5.72
1787	Qrf	s	5968.01	5969.56	1.55	25.8	3.5	25.5	22.0	25.0	14.5	NP	20.8	-4.16
2187	Qc	s	5928.43	5929.69	1.26	10.6	3.3	10.4	7.2	8.0	6.8	NP	8.6	0.59
2987	Qc	s	5812.61	5814.29	1.68	20.6	3.5	20.3	16.8	19.8	11.9	NP	16.1	-3.70
3287	Qrf	s	5946.38	5947.97	1.59	46.8	36.0	46.6	10.6	46.0	41.3	NP		
4087	Qa	s	5883.00	5884.61	1.61	6.7	3.5	6.5	3.0	5.8				-5.80
4287			5854.30	5855.87	1.57	6.6	3.0	6.4	3.4	6.1			4.1	-1.98
4387	Qc	s	5925.06	5926.41	1.35	12.5	3.5	12.3	8.8	12.0	7.9	NP	10.2	-1.83
5487	Qc	s	5955.85	5957.62	1.77	4.7	1.3	4.5	3.2	4.0	2.9	NP	3.0	-0.99
5687	Qrf	s	5978.39	5979.77	1.38	9.9	3.5	9.7	6.2	9.4	6.6	NP	8.5	-0.94
B400189	Qrf	s	6122.20	6124.15	1.95	51.4	10.1	49.6	39.5	52.5	29.8	NP	35.5	-17.01

[1]s=surficial deposits, w=weathered bedrock, u=unweathered bedrock
[2]units=feet above mean sea level
[3]units=feet above ground level
[4]units=feet below ground level, NP=not penetrated, ND=not determined

Table 1
Isotopic Compositions of Groundwater

Well Name	Completion Unit	Lithologic Unit[1]	Surface Elevation[2]	Top of Casing[2]	Well Stick-Up[3]	Total Depth of Casing[4]	Depth to Top of Screen[4]	Depth to Bottom of Screen[4]	Screen Length (ft)	Depth to Top of Bedrock[4]	Depth to Middle of Screen[4]	Depth below Top of Bedrock[4]	Screen/Sat. Int. Midpoint Depth	Midpoint Depth Relative to Bedrock
B400289	Qrf	s	6106.00	6107.71	1.71	51.3	20.5	50.0	29.5	NP	35.3	NP	35.3	
B400389	Qrf	s	6122.00	6124.00	2.00	50.3	9.5	49.0	39.5	48.5	29.3	NP	34.4	-14.06
B400489	Qrf	s	6105.01	6107.07	2.06	55.7	9.9	54.5	44.6	54.0	32.2	NP	32.2	-21.83
B200589	Qrf	s	5968.40	5970.17	1.77	33.3	11.9	31.6	19.7	30.5	21.7	NP	20.6	-9.89
B200689	Qrf	s	5960.10	5961.94	1.84	32.8	11.6	31.1	19.5	30.5	21.3	NP	26.2	-4.27
B200789	Qrf	s	5946.10	5948.08	1.98	30.5	9.1	28.5	19.4	28.0	18.8	NP	23.4	-4.56
B200889	Qrf	s	5936.10	5938.08	1.98	24.7	8.6	23.1	14.5	22.7	15.9	NP	20.6	-2.07
B401989	Qc	s	6025.60	6027.67	2.07	22.7	6.6	21.0	14.5	20.5	13.8	NP	13.8	-6.72
B302089	Qc	s	5907.60	5909.55	1.95	15.0	3.9	13.3	9.5	13.5	8.6	NP	13.3	-0.17
B102289	Qc	s	5978.30	5980.06	1.76	14.2	3.0	12.5	9.5	12.5	7.7	NP	7.7	-4.80
B202489	Qc	s	5770.90	5772.83	1.93	14.7	3.4	12.9	9.5	12.4	8.2	NP	9.7	-2.67
B402689	Qc	s	6045.40	6047.07	1.67	5.9	2.6	3.3	0.7	2.8	2.9	NP	2.9	0.13
B205589	Qc	s	5806.4	5808.46	2.06	18.0	6.9	16.3	9.4	32.3	11.6	NP	13.1	-19.23
B405689	Qrf	s	6105.30	6107.25	1.95	23.8	3.0	22.5	19.5	52.0	12.8	NP	14.8	-37.20
B405789	Qrf	s	6104.80	6106.70	1.90	53.7	43.0	52.5	9.5	52.0	47.8	NP	47.7	-4.30
P207689	Qrf	s	5966.32	5967.88	1.56	14.4	3.6	13.1	9.5	12.6	8.4	NP	9.9	-2.67
P207889	Qrf	s	5962.82	5964.90	2.08	9.0	3.3	7.7	4.4	8.5	5.5	NP	5.5	-3.02
B208089	Qc	s	5935.40	5937.07	1.67	14.2	3.4	12.9	9.5	12.2	8.2	NP	12.8	0.62
B208789	Qc	s	5907.10	5909.03	1.93	12.3	2.9	10.9	8.1	8.4	6.9	NP	6.9	-1.49
P209289	Qrf	s	5981.59	5983.42	1.83	13.4	8.2	12.7	4.5	12.2	10.4	NP	12.6	0.38
P209789	Qrf	s	5962.82	5964.94	2.12	13.8	3.0	12.5	9.5	12.0	7.8	NP	8.0	-4.00
B210489	Qc	s	5856.40	5858.71	2.31	8.7	3.0	7.4	4.4	7.0	5.2	NP	5.2	-1.80
P213689	Qrf	s	5994.3	5996.04	1.74	14.8	9.1	13.5	4.4	13.0	11.3	NP	11.3	-1.70
P215789	Qrf	s	6002.0	6003.66	1.66	19.6	14.5	18.5	4.0	18.0	16.5	NP	16.6	-1.40
P218289	Qrf	s	6016.9	6018.20	1.30	24.7	9.5	23.5	14.0	23.0	16.5	NP	16.5	-6.50
P313589	Qrf	s	6008.5	6010.11	1.61	13.8	8.1	12.5	4.4	11.0	10.3	NP	10.3	-0.70
P317989	Qrf	s	5990.9	5992.84	1.94	8.7	3.0	7.5	4.5	6.4	5.3	NP	6.3	-0.15
B410589	Qrf	s	6111.80	6113.80	2.00	61.3	40.6	60.0	19.5	NP	50.3	NP	56.1	
B410689	Qrf	s	6091.70	6093.71	2.01	51.3	30.5	50.1	19.6	NP	40.3	NP	46.4	
B410789	Qrf	s	6082.10	6083.66	1.56	46.3	25.5	45.0	19.5	NP	35.3	NP	42.6	
B110889	Qrf	s	6075.60	6077.77	2.17	65.8	45.3	64.8	19.5	65.0	55.0	NP	55.0	-10.00
B110989	Qrf	s	6082.30	6084.36	2.06	66.9	46.1	65.6	19.5	71.0	55.9	NP	55.9	-15.10
B111189	Qrf	s	6105.70	6107.52	1.82	73.8	53.1	72.6	19.5	NP	62.8	NP	64.4	
B411289	Qrf	s	6125.40	6127.30	1.90	69.7	48.9	68.4	19.5	NP	58.6	NP	64.2	
B411389	Qrf	s	6109.50	6111.06	1.56	64.8	44.0	63.5	19.5	NP	53.8	NP	58.1	
P114489	Qrf	s	6033.4	6035.43	2.03	50.1	44.4	48.8	4.4	48.3	46.6	NP	46.6	-1.70
P114689	Qrf	s	6004.00	6005.76	1.76	23.5	17.8	22.2	4.4	22.0	20.0	NP	20.0	-2.00
P114789	Qrf	s	6010.7	6012.40	1.70	27.7	21.8	26.2	4.4	26.0	24.0	NP	24.0	-2.00
P114989	Qrf	s	6029.8	6031.84	2.04	39.3	33.6	38.0	4.4	37.5	35.8	NP	35.8	-1.70
P115089	Qrf	s	6038.1	6040.10	2.00	42.0	36.3	40.7	4.4	40.2	38.5	NP	38.5	-1.70
P115489	Qrf	s	6023.4	6025.10	1.70	27.8	22.1	26.5	4.4	26.0	24.3	NP	24.3	-1.70
P115589	Qrf	s	6014.1	6015.77	1.67	30.7	25.1	29.5	4.4	29.0	27.3	NP	27.3	-1.70
P115689	Qrf	s	6006.9	6008.71	1.81	21.3	16.2	20.2	4.0	19.7	18.2	NP	18.2	-1.50
P119389	Qrf	s	6011.7	6013.18	1.48	18.2	12.5	16.9	4.4	16.4	14.7	NP	14.7	-1.70

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Table 1
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Well Name	Completion Unit	Lithologic Unit[1]	Surface Elevation[2]	Top of Casing[2]	Well Stick-Up[3]	Total Depth of Casing[4]	Depth to Top of Screen[4]	Depth to Bottom of Screen[4]	Screen Length (ft)	Depth to Top of Bedrock[4]	Depth to Middle of Screen[4]	Depth below Top of Bedrock[4]	Screen/Sat. Int. Midpoint Depth	Midpoint Depth Relative to Bedrock
P314089	Qrf	s	5996.70	5998.49	1.79	11.1	5.4	9.8	4.4	9.3	7.6	NP	9.8	0.45
P320089	Qrf	s	6009.90	6011.87	1.97	20.1	14.4	18.8	4.4	18.8	16.6	NP	16.6	-2.20
P414189	Qrf	s	6010.6	6012.18	1.58	19.8	14.1	18.5	4.4	18.0	16.3	NP	16.3	-1.70
P415889	Qrf	s	6050.4	6052.60	2.20	44.5	38.8	43.2	4.4	49.5	41.0	NP	41.0	-8.50
P415989	Qrf	s	6044.9	6046.71	1.81	28.0	22.3	26.7	4.4	34.0	24.5	NP	24.5	-9.50
P416089	Qrf	s	6051.7	6053.95	2.25	35.4	29.2	34.0	4.8	33.5	31.6	NP	31.6	-1.90
P416189	Qrf	s	6045.6	6047.95	2.35	30.9	25.2	29.7	4.5	29.2	27.5	NP	27.5	-1.70
P416289	Qrf	s	6038.6	6040.22	1.62	24.8	19.1	23.5	4.4	23.0	21.3	NP	21.3	-1.70
P416389	Qrf	s	6055.40	6057.14	1.74	31.4	25.7	30.1	4.4	30.0	27.9	NP	27.9	-2.10
P416489	Qrf	s	6048.50	6050.15	1.65	27.0	21.3	25.7	4.4	25.2	23.5	NP	23.5	-1.70
P416589	Qrf	s	6041.20	6042.81	1.61	32.1	27.0	31.0	4.0	30.5	29.0	NP	29.1	-1.45
P416689	Qrf	s	6035.00	6036.55	1.55	33.8	28.1	32.5	4.4	32.0	30.3	NP	30.3	-1.70
P416789	Qrf	s	6027.80	6029.27	1.47	28.2	22.5	26.9	4.4	26.4	24.7	NP	26.3	-0.15
P416889	Qrf	s	6017.4	6018.79	1.39	21.5	15.9	20.3	4.4	20.2	18.1	NP	18.1	-2.10
P218089	Qrf	s	5985.80	5987.55	1.75	8.7	3.0	7.4	4.4	6.0	5.2	NP	5.4	-0.60
P219189	Qc	s	5941.20	5943.15	1.95	12.8	7.1	11.5	4.4	11.0	9.3	NP	11.4	0.44
P419689	Qrf & Kss	s	6022.40	6023.42	1.02	24.8	19.1	23.5	4.4	22.0	21.3	NP	21.3	-0.70
190	Qrf	s	6044.30	6045.88	1.58	49.5	29.5	44.5	15.0	62.5			39.9	-22.64
290	Qrf	s	6048.30	6050.65	2.35	62.5	42.5	57.5	15.0	63.5			51.5	-12.02
0390	Qrf	s	6075.4	6079.13	3.73	70.0	50.0	65.0	15.0	92.0	57.5	NP	56.9	-35.12
0590	Qrf	s	6096.80	6099.77	2.97	31.5	11.0	26.0	15.0	50.0	18.5	NP	19.2	-30.85
0690	Qrf	s	6083.70	6086.91	3.21	27.3	7.0	22.0	15.0	41.3	14.5	NP	15.1	-26.25
0790	Qrf	s	6095.90	6098.79	2.89	53.3	33.0	48.0	15.0	48.8	40.5	NP	40.5	-8.30
0990	Qrf	s	6080.50	6083.48	2.98	40.3	20.0	35.0	15.0	35.0	27.5	NP	27.5	-7.50
1490	Qrf	s	6068.90	6071.28	2.38	64.5	44.5	59.5	15.0	66.0			54.1	-11.94
00191	Qrf	s	5968.86	5970.44	1.58	27.0	15.0	25.0	10.0	24.2	20.0	NP	20.1	-4.06
01391	Qrf	s	5973.70	5975.30	1.60	16.0	6.0	14.0	8.0	14.5	10.0	NP	12.0	-2.51
03991	Qrf	s	5935.17	5936.87	1.70	39.4	27.4	37.4	10.0	36.0	32.4	NP	35.1	-0.89
04191	Qrf	s	5955.58	5956.99	1.41	19.1	7.1	17.1	10.0	17.1	12.1	NP	18.2	1.11
04591	Qrf	s	5948.69	5950.25	1.56	46.1	34.1	44.1	10.0	44.2	39.1	NP	43.8	-0.44
05091	Qrf	s	5937.63	5939.24	1.61	46.0	34.0	44.0	10.0	43.5	39.0	NP	42.8	-0.75
05191	Qrf	s	5938.40	5939.85	1.45	48.0	36.0	46.0	10.0	44.8	41.0	NP	44.2	-0.62
05391	Qrf	s	5940.19	5941.67	1.48	37.1	22.0	35.1	13.1	34.9	28.6	NP	33.9	-0.98
5691	Qrf	s	5947.60	5948.99	1.39	37.1	25.1	35.1	10.0	35.2	30.1	NP	31.8	-3.42
06091	Qrf	s	5930.08	5931.60	1.52	42.7	30.7	40.7	10.0	39.1	35.7	NP	38.0	-1.13
06191	Qrf	s	5919.21	5920.72	1.51	34.1	22.1	32.1	10.0	32.0	27.1	NP	32.3	0.27
06791	Qrf	s	5978.87	5980.38	1.51	23.2	11.2	21.2	10.0	21.2	16.2	NP	19.9	-1.29
06891	Qrf	s	5974.14	5975.62	1.48	16.0	6.0	14.0	8.0	14.0	10.0	NP	11.7	-2.28
06991	Qrf	s	5972.91	5974.57	1.66	31.0	14.0	29.0	15.0	28.6	21.5	NP	21.9	-6.70
07191	Qrf	s	5974.79	5976.34	1.55	23.1	11.1	21.1	10.0	20.0	16.1	NP	19.4	-0.64
13091	Qrf	s	5973.68	5975.20	1.52	23.3	11.3	21.3	10.0	19.5	16.3	NP	18.0	-1.50
13391	Qrf	s	5923.83	5925.35	1.52	41.0	29.0	39.0	10.0	38.6	34.0	NP	37.9	-0.71
20591	Qrf	s	5968.00	5969.61	1.61	24.6	4.1	24.1	20.0	24.5			21.6	-2.95
37591	Qrf	s	5991.42	5993.45	2.03	14.6	7.6	12.6	5.0	12.0	10.1	NP	10.1	-1.90

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Well Name	Completion Unit	Lithologic Unit[1]	Surface Elevation[2]	Top of Casing[2]	Well Stick-Up[3]	Total Depth of Casing[4]	Depth to Top of Screen[4]	Depth to Bottom of Screen[4]	Screen Length (ft)	Depth to Top of Bedrock[4]	Depth to Middle of Screen[4]	Depth below Top of Bedrock[4]	Screen/Sat. Int. Midpoint Depth	Midpoint Depth Relative to Bedrock
41091	Qa	s	5719.56	5721.85	2.29	12.3	7.8	10.0	2.2	10.0	8.9	NP	9.2	-0.83
41691	Qa	s	5644.00	5645.88	1.88	17.1	5.1	14.7	9.6	14.7			11.2	-3.48
10692	Qc	s	5941.50	5943.60	2.10	21.3	5.0	19.4	14.4	18.9	12.2	NP	12.2	-6.68
43392	Qrf	s	6041.9	6043.44	1.54	32.8	25.6	30.3	4.7	31.4	28.0	NP		
46192	Qrf	s	6141.50	6143.37	1.87	80.0	57.2	77.2	20.0	77.0	67.2	NP	74.1	-2.95
46292	Qrf	s	6095.30	6097.24	1.94	93.3	45.5	90.5	45.0	90.5	68.0	NP	72.2	-18.31
46492	Qrf	s	6054.7	6056.81	2.11	46.0	28.2	43.2	15.0	43.0	35.7	NP	35.7	-7.30
50092	Qa	s	5822.3	5824.30	2.00	13.1	5.3	10.3	5.0	10.2	7.8	NP		
50192			5745.8	5747.66	1.86	12.9	5.0	10.0	5.0	9.8				
50292			5742.4	5744.46	2.06	12.4	4.5	9.5	5.0	9.8				
75292	Qa	s	5754.9	5756.90	2.00	9.6	5.6	7.6	2.0	7.6	6.6	NP	5.5	-2.06
5093			5963.3	5965.54	2.24	12.5	3.5	10.5	7.0	9.7			9.2	-0.49
5193			5968.4	5970.58	2.18	13.4	4.4	11.4	7.0	12.1			9.6	-2.52
61593	Qc	s	5931.4			8.1	3.1	8.1	5.0	NP	5.6	NP		
61693	Qc	s	5945.5			14.8	9.8	14.8	5.0	NP	12.3	NP		
61793	Qc	s	5918.7			5.9	0.9	5.9	5.0	NP	3.4	NP		
61893	Qc	s	5946.2			8.8	3.8	8.8	5.0	NP	6.3	NP		
62093	Qc	s	6011.3			8.8	3.8	8.8	5.0	NP	6.3	NP		
62193	Qc	s	6018.4			5.9	0.9	5.9	5.0	NP	3.4	NP		
62293	Qc	s	6023.3			5.7	0.7	5.7	5.0	NP	3.2	NP		
62393	Qc	s	6064.1			5.7	0.7	5.7	5.0	NP	3.2	NP		
62493	Qc	s	6047.6			8.8	3.8	8.8	5.0	NP	6.3	NP		
62593	Qc	s	6047.8			8.4	3.4	8.4	5.0	NP	5.9	NP		
62693	Qc	s	6041.8			8.6	3.6	8.6	5.0	NP	6.1	NP		
62793	Qc	s	5939.5			11.8	6.8	11.8	5.0	NP	9.3	NP		
62893	Qc	s	5995.2			14.8	9.8	14.8	5.0	NP	12.3	NP		
10394	Qa	s	5650.4	5653.13	2.73	10.5	3.2	8.2	5.0	8.0			5.1	-2.91
10894	Qa	s	5666.8	5668.91	2.11	10.2	3.0	8.0	5.0	4.7			6.0	1.28
11294	Qrf	s	6171.4	6173.50	2.10	78.5	61.2	76.2	15.0	75.8				
11494	Qrf	s	6184.6	6186.63	2.03	69.5	52.0	67.0	15.0	69.0				
12094	Qa	s	5760.0	5763.07	3.07	12.0	5.6	10.0	4.4	NP			8.1	
50194	Qrf	s	6114.4	6116.29	1.89	97.0	74.7	94.7	20.0	NP				
50394	Qrf	s	6120.3	6122.21	1.91	66.8	49.5	64.5	15.0	NP				
50694	Qrf	s	6085.5	6087.50	2.00	29.1	11.8	26.8	15.0	NP				
50794	Qrf	s	6132.8	6134.81	2.01	25.0	13.0	23.0	10.0	27.3				
50894	Qrf	s	6111.4	6113.37	1.97	27.3	10.0	25.0	15.0	NP				
50994	Qrf	s	6107.6	6109.71	2.11	24.0	13.0	23.0	10.0	NP				
51094	Qrf	s	6091.2	6093.25	2.05	60.0	37.7	57.7	20.0	58.0				
51194	Qrf	s	6071.4	6073.31	1.91	52.0	35.0	50.0	15.0	NP				
51294	Qrf	s	6062.8	6064.68	1.88	37.3	20.0	35.0	15.0	NP				
51494	Qrf	s	6097.4	6099.26	1.86	70.7	48.7	68.7	20.0	69.0				
51594	Qrf	s	6097.5	6099.49	1.99	20.0	10.0	20.0	10.0	69.0				
53194			5838.8	5839.38	0.58	9.4	4.5	7.0	2.5	7.0				
60695														

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60795														
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61295														
0886	Ksslt	u	5925.60	5926.90	1.30	63.8	59.1	63.8	4.7	1.0	61.4	60.4	61.4	60.44
0986	Kss & Ksslt	u	5996.39	5998.23	1.84	135.4	122.6	135.4	12.8	30.3	129.0	98.7	129.0	98.66
1486	Kss & Ksclst	u	5844.71	5846.71	2.00	55.4	39.4	55.4	15.9	11.0	47.4	36.4	47.4	36.39
1686	Ksltss	u	5867.92	5869.55	1.63	45.1	39.1	45.1	6.0	7.0	42.1	35.1	42.1	35.06
2186	Kss & Ksltclst	u	6004.8	6005.96	1.16	67.3	35.0	67.2	32.2	15.0	51.1	36.1	51.1	36.10
2386	Kslt & Ksltclst	u	5982.46	5982.46	0.00	117.3	113.0	117.3	4.3	8.2	115.1	106.9	115.1	106.93
2586	Ksltclst & Kclst	u	5975.24	5977.14	1.90	82.0	59.9	82.0	22.1	8.0	71.0	63.0	71.0	62.95
2786	Ksslts & Ksclst	u	5962.89	5963.88	0.99	133.0	128.5	133.0	4.5	11.0	130.8	119.8	130.8	119.75
3286	Kss & Ksltss	u	5966.08	5967.92	1.84	125.5	114.9	125.5	10.6	1.0	120.2	119.2	120.2	119.20
3486	Kcss & Kcslt	u	5912.00	5913.95	1.95	56.3	44.2	56.3	12.0	16.0	50.2	34.2	50.3	34.25
4086	Kclst	u	5943.85	5944.89	1.04	111.5	88.0	111.5	23.5	45.0	99.7	54.7	105.7	60.71
4686	Kslt & Kcslt	u	6081.99	6083.99	2.00	160.8	140.3	160.8	20.5	90.0	150.6	60.6	150.6	60.56
4886	Ksslt & Kcslt	u	6097.14	6099.10	1.96	207.1	192.0	207.1	15.1	70.0	199.5	129.5	199.5	129.53
5486	Ksslt & Kslt	u	6116.48	6117.62	1.14	85.3	75.4	85.2	9.8	36.0	80.3	44.3	80.3	44.34
0387	Ksslt & Kcslt	u	5930.58	5932.44	1.86	108.0	102.8	107.8	5.0	20.8	105.3	84.5	105.3	84.50
0887	Ksltclst & Kclst	u	5919.95	5921.55	1.60	89.3	84.0	89.0	5.0	8.7	86.5	77.8	86.5	77.80
1687	Kslt	u	5969.49	5970.79	1.30	125.2	100.0	125.0	25.0	22.2	112.5	90.3	112.5	90.30
1887	Kss & Ksslt	u	5967.99	5969.49	1.50	133.7	127.0	133.5	6.4	25.2	130.2	105.0	130.2	105.03
2087	Ksltclst	u	5968.66	5970.14	1.48	116.4	107.3	116.1	8.8	11.8	111.7	99.9	111.7	99.90
2287	Kss & Kslt	u	5931.18	5932.80	1.62	88.7	81.4	88.5	7.1	12.8	84.9	72.1	84.9	72.14
2887	Kslt & Kclst	u	5947.56	5949.90	2.34	197.7	187.4	197.4	10.0	43.5	192.4	148.9	192.4	148.87
3087	Kcslt	u	5810.12	5811.77	1.65	94.4	85.8	94.4	8.6	16.0	90.1	74.1	90.1	74.07
3187		u	5945.31	5947.46	2.15	129.6	110.7	129.4	18.8	45.0	120.0	75.0	120.0	75.04
3487	Ksltclst & Kslt	u	5945.60	5947.22	1.62	104.5	97.3	104.2	6.9	20.0	100.8	80.8	100.8	80.77
3987	Ksslt & Kclst	u	5946.95	5948.42	1.47	117.4	110.0	117.1	7.2	3.5	113.6	110.1	113.6	110.07
4187	Ksltss	u	5883.0	5884.49	1.49	94.0	81.2	93.8	12.6	3.5	87.5	84.0	87.5	84.00
4587	Kss & Kslt & Kclst	u	5949.32	5950.91	1.59	101.3	89.5	97.1	7.6	4.0	93.3	89.3	95.3	91.25
B203789	Kcslt & Kclst	u	5946.20	5948.28	2.08	140.8	134.2	138.6	4.4	28.7	136.4	107.7	136.4	107.70
B203889	Kclst	u	5935.80	5937.69	1.89	113.9	107.0	111.4	4.4	28.5	109.2	80.7	109.2	80.70
B203989	Ksltss & Kslt	u	5920.9	5922.78	1.88	132.7	126.0	130.4	4.4	22.7	128.2	105.5	128.2	105.50
B204089	Ksltss	u	5877.60	5879.29	1.69	115.2	106.5	112.9	6.4	1.2	109.7	108.5	109.7	108.50
B204189	Kcss, Ksltss & Ksclst	u	5826.90	5828.86	1.96	97.6	81.1	95.3	14.2	3.5	88.2	84.7	88.2	84.70
B304289	Kss & Kslt & Kclst	u	5833.00	5838.18	5.18	91.0	84.0	88.5	4.5	10.5	86.3	75.8	86.3	75.75
B304989	Ksltss & Ksslt	u	5729.70	5731.85	2.15	86.3	75.5	83.9	8.4	8.4	79.7	71.3	79.2	70.80
B405289	Ksclst & Ksltclst	u	5965.70	5967.31	1.61	48.0	41.2	45.7	4.5	8.6	43.5	34.9	43.5	34.85
B207089	Ksclst & Ksltclst	u	5883.1	5884.95	1.85	54.0	31.3	53.0	21.7	6.0	42.2	36.2	42.2	36.20
P208889	Ksltclst	u	5947.30	5949.25	1.95	99.2	87.8	96.9	9.2	5.5	92.4	86.9	92.4	86.85
P416989	Ksslt & Kslt	u	6045.2	6047.55	2.35	158.0	151.2	155.6	4.4	30.0	153.4	123.4	153.4	123.40
B217289	Kss, Ksltss, Kcslt	u	5677.60	5679.10	1.50	136.4	109.8	134.1	24.3	5.1	122.0	116.9	122.0	116.90
B217489	Kss	u	5961.20	5963.23	2.03	148.7	142.0	146.4	4.4	25.2	144.2	119.0	144.2	119.03

[1]s=surficial deposits, w=weathered bedrock, u=unweathered bedrock
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Table 1
Isotopic Compositions of Groundwater

Well Name	Completion Unit	Lithologic Unit[1]	Surface Elevation[2]	Top of Casing[2]	Well Stick-Up[3]	Total Depth of Casing[4]	Depth to Top of Screen[4]	Depth to Bottom of Screen[4]	Screen Length (ft)	Depth to Top of Bedrock[4]	Depth to Middle of Screen[4]	Depth below Top of Bedrock[4]	Screen/Sat. Int. Midpoint Depth	Midpoint Depth Relative to Bedrock
B217589	Kss & Ksltclst	u	5952.90	5954.89	1.99	92.9	85.2	90.7	5.5	17.3	88.0	70.7	88.0	70.65
B217689	Kclss	u	5960.53	5961.82	1.29	105.1	98.5	102.9	4.4	22.0	100.7	78.7	100.7	78.70
B217789	Ksltclst	u	5954.9	5956.85	1.95	86.0	72.0	83.8	11.8	23.6	77.9	54.3	77.9	54.30
46692	Ksltss, Ksslt & Kclst	u	5956.20	5958.25	2.05	89.8	72.0	87.0	15.0	24.5	79.5	55.0	79.8	55.33
46792	Ksslt, Kcslt & Kslt	u	5956.30	5958.44	2.14	114.6	96.8	111.8	15.0	24.5	104.3	79.8	104.6	80.14
46892	Ksltss, Ksslt & Kclst	u	5956.70	5958.56	1.86	164.7	146.9	161.9	15.0	24.5	154.4	129.9	154.9	130.40
22093	Kclst, Kclst & Ksltss	u	5945.0	5947.43	2.43	66.3	48.0	63.0	15.0	8.8	55.5	46.7	55.5	46.70
22193	Ksclst, Kcss & Kcls	u	5960.9	5963.36	2.46	59.7	49.6	56.4	6.8	8.5	53.0	44.5	53.0	44.50
22293	Ksclst, Kslst & Kcss	u	5881.5	5884.12	2.62	85.0	67.0	82.0	15.0	21.0	74.5	53.5	74.5	53.50
22393	Kcslst & Kclst	u	5969.3	5972.14	2.84	121.3	108.2	118.0	9.8	12.7	113.1	100.4	114.8	102.08
23193	Kss, Ksltss & Kcss	u	5948.2	5950.46	2.26	77.0	66.8	73.8	7.0	8.0	70.3	62.3	70.3	62.30
22593		u	5947.6	5950.20	2.60	98.0	85.0	95.0	10.0	8.0	90.0	82.0	90.0	82.00
70593			5998.0	6000.00	2.00	138.00	121.0	136.0	15.0	21.3	128.5	107.2	128.5	107.20
53094 ???			5872.9	5873.37	0.47	67.00	55.0	65.0	10.0	14.0	60.0	46.0	60.0	46.00
57594 ???			5946.2	5948.43	2.23	92.2	79.9	89.9	10.0	7.6	84.9	77.3	84.4	76.80
59894		u	6025.7	6028.34	2.64	122.1	105.1	120.1	15.0	19.6	112.6	93.0	112.6	93.00
0386	Kss	w	5676.2	5677.86	1.66	23.7	10.4	23.7	13.3	8.0	17.1	9.1	19.4	11.41
3086	Kclst	w	5957.42	5958.39	0.97	14.9	2.5	14.9	12.5	2.5	8.7	6.2	9.3	6.82
5286	Kss & Ksltclst	w	6142.14	6144.44	2.30	125.7	92.0	125.8	33.8	72.0	108.9	36.9	108.9	36.90
6286	Ksltss & Kcss	w	5902.01	5903.18	1.17	35.2	25.2	35.2	10.0	22.0	30.2	8.2	31.3	9.33
0587	Kss & Ksltss	w	5927.85	5929.99	2.14	51.5	42.0	51.3	9.3	11.0	46.6	35.6	47.2	36.22
0987	Kss	w	5980.22	5981.70	1.48	32.4	14.5	32.2	17.7	12.5	23.3	10.8	25.2	12.74
1187	Kcss	w	5913.60	5915.12	1.52	20.5	15.2	20.3	5.1	5.2	17.7	12.5	19.2	13.96
1287	Kcslt	w	5934.81	5936.30	1.49	10.3	4.9	10.0	5.1	3.5	7.5	4.0	10.0	6.51
1487	Kss & Kslt	w	5854.98	5856.56	1.58	24.3	19.0	24.1	5.1	5.2	21.5	16.3	21.5	16.33
2587	Ksltss & Kss	w	5959.48	5960.98	1.50	43.7	17.5	43.5	26.0	16.5	30.5	14.0	33.2	16.69
3687	Kss & Kslt & Kclst	w	5949.67	5951.11	1.44	63.6	19.8	63.4	43.6	7.4	41.6	34.2	49.1	41.67
B402189	Kss	w	6024.50	6026.49	1.99	24.6	13.5	22.9	9.4	7.5	18.2	10.7	18.2	10.70
B203189	Kclst & Ksclst	w	5968.00	5970.12	2.12	46.5	35.3	44.7	9.4	29.7	40.0	10.3	42.7	12.99
B203289	Kclst & Ksclst	w	5959.70	5961.59	1.89	46.0	35.0	44.5	9.5	30.1	39.8	9.7	39.7	9.60
B203489	Kclst	w	5945.70	5947.71	2.01	41.3	31.0	40.5	9.5	28.6	35.8	7.2	39.2	10.58
B203589	Qrf & Ksclst & Kclst	w	5935.20	5937.07	1.87	40.9	29.7	39.2	9.5	31.1	34.5	3.4	37.5	6.35
B303089	Kclst	w	5601.2	5602.93	1.73	8.9	4.6	7.0	2.4	4.6	5.8	1.2	5.8	1.20
B304889	Kclst	w	5730.60	5732.56	1.96	25.9	14.7	24.1	9.2	9.2	19.4	10.2	22.4	13.17
B305389	Ksltclst & Kclst	w	5831.90	5833.90	2.00	26.3	15.2	24.6	9.4	10.0	19.9	9.9	19.9	9.90
B405489	Ksltclst & Kclst	w	6115.90	6117.67	1.77	50.1	39.1	48.6	9.5	34.0	43.9	9.9	43.9	9.85
B405889	Kss	w	6024.90	6026.87	1.97	46.8	36.0	45.5	9.5	6.5	40.8	34.3	40.8	34.30
B206989	Ksclst	w	5882.40	5884.32	1.92	22.5	11.8	21.3	9.5	6.0	16.6	10.6	20.7	14.69
P207389	Kss & Kclst	w	5981.02	5982.77	1.75	16.3	10.5	15.2	4.7	7.0	12.9	5.9	12.9	5.86
P207589	Ksltclst	w	5974.06	5975.96	1.90	25.1	14.4	23.9	9.5	9.4	19.1	9.7	24.0	14.58
P207789	Ksltclst	w	5965.88	5967.75	1.87	28.6	17.9	27.3	9.4	12.9	22.6	9.7	27.6	14.67
P207989	Kclst	w	5963.09	5965.17	2.08	21.7	11.0	20.5	9.5	5.8	15.7	9.9	19.3	13.50
B208189	Kclst	w	5935.40	5937.46	2.06	27.6	16.9	26.3	9.4	11.0	21.6	10.6	23.7	12.65

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Well Name	Completion Unit	Lithologic Unit[1]	Surface Elevation[2]	Top of Casing[2]	Well Stick-Up[3]	Total Depth of Casing[4]	Depth to Top of Screen[4]	Depth to Bottom of Screen[4]	Screen Length (ft)	Depth to Top of Bedrock[4]	Depth to Middle of Screen[4]	Depth below Top of Bedrock[4]	Screen/Sat. Int. Midpoint Depth	Midpoint Depth Relative to Bedrock
B208389	Ksclst & Kclst	w	5876.80	5878.66	1.86	9.1	3.4	7.8	4.4	0.2	5.6	5.4	7.4	7.24
B208689	Ksltclst	w	5867.60	5869.60	2.00	23.1	12.3	21.8	9.5	7.3	17.1	9.8	18.1	10.82
P208989	Ksltss & Ksltclst	w	5962.53	5964.56	2.03	26.1	15.4	24.8	9.4	3.5	20.1	16.6	20.1	16.62
P209089	Ksltclst	w	5972.16	5974.25	2.09	27.2	16.5	26.0	9.5	11.5	21.2	9.7	25.3	13.80
P209189	Kss & Ksltclst	w	5980.66	5982.21	1.55	36.1	13.3	35.0	21.7	10.3	24.2	13.9	24.2	13.86
P209389	Kss & Ksltss & Kcss	w	5981.47	5983.39	1.92	30.1	16.8	28.8	12.0	13.8	22.8	9.0	22.8	9.01
P209489	Kss & Ksltss	w	5977.98	5980.10	2.12	36.3	15.5	35.0	19.5	9.0	25.2	16.2	30.3	21.29
P209589	Ksltclst & Ksclst	w	5948.17	5950.04	1.87	19.8	9.1	18.5	9.5	4.1	13.8	9.7	17.9	13.78
P209689	Ksltclst	w	5962.63	5964.43	1.80	27.9	17.2	26.7	9.5	12.2	21.9	9.7	26.8	14.64
P209889	Ksltclst	w	5940.28	5942.40	2.12	19.6	8.9	18.3	9.4	3.9	13.6	9.7	13.6	9.71
P210089	Ksltclst	w	5898.40	5900.40	2.00	22.9	12.2	21.5	9.3	7.2	16.9	9.7	19.8	12.61
P210189	Ksltss & Ksclst	w	5980.82	5982.48	1.66	37.1	20.4	36.1	15.7	14.6	28.3	13.7	28.3	13.67
P114589	Qrf	w	6024.1	6025.90	1.80	37.6	32.5	36.5	4.0	27.5	34.5	NP	34.5	7.00
00291	Kclss & Ksclst	w	5966.17	5967.57	1.40	56.0	44.0	54.0	10.0	16.0	49.0	33.0	49.0	33.00
00391	Ksclst & Kcss	w	5920.84	5922.40	1.56	23.8	16.8	21.8	5.0	16.9	19.3	2.4	19.3	2.40
01491	Kss & Kcs	w	5970.37	5972.03	1.66	26.0	14.0	24.0	10.0	1.6	19.0	17.4	19.0	17.40
02091	Ksclst, Ksslt, Ksltclst	w	5965.19	5966.65	1.46	32.6	15.6	30.6	15.0	16.1	23.1	7.0	23.1	7.00
02291	Ksclst & Kclss	w	5936.66	5938.26	1.60	18.5	11.5	16.5	5.0	8.8	14.0	5.2	14.0	5.20
02491	Ksltss, Ksslt	w	5944.54	5946.21	1.67	18.8	11.8	16.8	5.0	8.5	14.3	5.8	14.3	5.80
02591	Kclss & Ksclst	w	5923.57	5925.34	1.77	51.1	42.1	49.1	7.0	39.8	45.6	5.8	45.6	5.80
02991	Kclss & Ksclst	w	5956.30	5957.90	1.60	54.0	42.0	52.0	10.0	15.8	47.0	31.2	47.0	31.20
03391	Kss, Ksltss & Ksclst	w	5944.54	5946.22	1.68	41.9	29.9	39.9	10.0	10.8	34.9	24.1	34.9	24.10
03691	Kss & Kcss	w	5932.55	5934.43	1.88	42.0	30.0	40.0	10.0	7.5	35.0	27.5	35.9	28.37
03791	Kss, Ksclst & Ksltss	w	5936.80	5938.24	1.44	50.0	38.0	48.0	10.0	4.9	43.0	38.1	43.0	38.10
06591	Ksclst & Ksltclst	w	5978.28	5979.78	1.50	50.0	33.0	48.0	15.0	15.4	40.5	25.1	40.5	25.10
09691	Ksltss & Kclst	w	5935.6	5937.05	1.45	16.0	6.0	14.0	8.0	3.1	10.0	6.9	12.0	8.90
10991	Ksltss	w	5940.01	5941.64	1.63	53.0	46.0	51.0	5.0	45.2	48.5	3.3	48.5	3.30
11691	Kclss & Kss	w	5938.63	5939.91	1.28	35.5	18.5	33.5	15.0	9.5	26.0	16.5	33.2	23.72
11791	Ksclst	w	5923.29	5925.03	1.74	15.7	8.7	13.7	5.0	6.9	11.2	4.3	11.2	4.30
11891	Ksslt & Ksltss	w	5945.51	5947.44	1.93	30.0	13.0	28.0	15.0	12.0	20.5	8.5	25.6	13.58
12091	Ksltss	w	5971.59	5973.27	1.68	24.0	14.0	22.0	8.0	13.2	18.0	4.8	18.0	4.80
12191	Ksltss & Kss	w	5956.49	5958.19	1.70	35.0	18.0	33.0	15.0	15.7	25.5	9.8	28.3	12.56
12391	Kss, Ksltss & Kclss	w	5940.07	5941.70	1.63	70.4	58.4	68.4	10.0	36.5	63.4	26.9	63.4	26.90
12491	Kss & Kclss	w	5946.84	5948.35	1.51	62.0	45.0	60.0	15.0	30.0	52.5	22.5	52.5	22.50
12691	Kss	w	5949.68	5951.08	1.40	65.1	48.1	63.1	15.0	20.0	55.6	35.6	55.6	35.60
12991	Ksclst	w	5965.71	5967.22	1.51	36.5	19.5	34.5	15.0	16.1	27.0	10.9	27.0	10.90
13191	Ksclst	w	5978.25	5979.90	1.65	27.7	15.7	25.7	10.0	15.4	20.7	5.3	20.8	5.44
20791	Kclst & Ksclst	w	5967.90	5969.49	1.59	36.5	29.5	34.5	5.0	24.5	32.0	7.5	32.0	7.50
37891	Kcsltst & Ksltst	w	5925.22	5926.29	1.07	55.2	43.2	53.2	10.0	4.7	48.2	43.5	48.2	43.50
37991	Kcsltst & Ksltst	w	5931.45	5933.55	2.10	57.2	45.2	55.2	10.0	6.9	50.2	43.3	50.5	43.63
38991	Kclst, Ksltst, Kcsltst	w	5893.08	5895.45	2.37	38.8	26.8	36.8	10.0	19.5	31.8	12.3	32.4	12.90
39191	Ksltst, Kclsltst, Kclst	w	5918.16	5918.32	0.16	44.8	32.8	42.8	10.0	7.1	37.8	30.7	38.0	30.85
39291	Ksltclst, Kcsltst	w	5908.38	5910.24	1.86	46.0	34.0	44.0	10.0	10.8	39.0	28.2	38.9	28.10

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46392	Kclst	w	6063.20	6065.03	1.83	82.3	64.5	79.5	15.0	56.0	72.0	16.0	72.4	16.37
75092	Ksltclst	w	5723.4	5725.40	2.00	16.7	7.2	14.7	7.5	6.3	11.0	4.7	12.4	6.14
193			5765.7	5767.84		22.2	10.0	20.0	10.0	8.8	15.0	6.2	20.5	11.67

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Well Name	Completion Unit	Lithologic Unit[1]	Mean $\delta^{18}O$ (SMOW)	Number of Values	Mean δD(SMOW)	Number of Values	Mean Tritium (TU) Surficial Deposits	Unweathered Bedrock	Weathered Bedrock	Arapahoe No. 1 SS	Number of Values
0186	Qa	s	-13.82	1	-102.0	1					0
586			-15.68	1	-117.2	1					0
686			-14.41	1	-109.4	1	17.2				1
786			-14.08	1	-109.3	1	45.1				1
1186	Qa	s	-12.19	6	-96.4	6					0
1586	Qc	s	-13.20	7	-100.8	7					0
1786	Qc	s	-14.09	2	-107.6	2					0
1986	Qc	s	-14.02	2	-108.4	2	23.6				1
2286	Qrf	s	-15.81	1	-115.8	1					0
2486	Qrf	s	-15.16	1	-111.9	1					0
2686	Qrf	s	-13.60	5	-105.5	5					0
3386	Qrf	s	-11.30	2	-77.6	2					0
3586	Qc	s	-14.28	3	-108.9	3					0
3686	Qc	s	-15.13	1	-113.3	1					0
3886	Qa	s	-16.51	1	-126.2	1					0
3986	Qrf	s	-14.09	1	-100.5	1					0
4186	Qrf	s	-12.91	1	-102.8	1					0
4286	Qrf	s	-13.98	10	-105.3	10	22.6				3
4486	Qrf	s	-15.80	1	-120.3	1	12.3				1
4586	Qrf	s	-14.44	2	-109.3	2					0
4786	Qrf	s	-13.42	4	-103.4	4					0
4986	Qrf	s	-14.40	1	-107.2	1	22.9				1
5086	Qrf	s	-11.56	4	-90.2	4	29.1				3
5186	Qrf	s	-14.63	2	-112.9	2	41.0				1
5386	Qrf	s	-14.65	1	-109.0	1					0
5586	Qrf	s	-13.11	1	-102.0	1	48.5				1
5686	Qc	s	-13.42	1	-104.6	1					0
5786	Qc	s	-13.28	1	-97.5	1					0
6186	Qrf	s	-15.58	1	-109.7	1	17.3				1
6586	Qa	s	-12.76	5	-97.3	5					0
6686			-13.37	1	-99.6	1	17.3				1
6886	Qc	s	-13.38	1	-103.4	1					0
7086	Qc	s	-14.95	1	-114.6	1					0
0487	Qc	s	-14.51	1	-111.3	1	16.8				1
1787	Qrf	s	-13.68	4	-103.6	4	14.7				1
2187	Qc	s	-14.28	1	-107.8	1					0
2987	Qc	s	-13.84	1	-102.3	1					0
3287	Qrf	s	-13.86	2	-106.1	2					0
4087	Qa	s	-15.99	1	-118.3	1	23.1				1
4287			-15.00	1	-109.3	1	18.6				1
4387	Qc	s	-14.91	1	-114.2	1	8.6				1
5487	Qc	s	-12.13	1	-83.5	1					0
5687	Qrf	s	-13.88	1	-105.1	1					0
B400189	Qrf	s	-7.31	2	-55.9	2					0

[1]s=surficial deposits, w=weathered bedrock, u=unweathered bedrock
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Table 1
Isotopic Compositions of Groundwater

Well Name	Completion Unit	Lithologic Unit[1]	Mean $\delta^{18}O$ (SMOW)	Number of Values	Mean δD(SMOW)	Number of Values	Mean Tritium (TU) Surficial Deposits	Unweathered Bedrock	Weathered Bedrock	Arapahoe No. 1 SS	Number of Values
B400289	Qrf	s	-13.84	5	-106.5	5	30.2				1
B400389	Qrf	s	-14.63	1	-108.9	1					0
B400489	Qrf	s	-12.18	1	-99.2	1					0
B200589	Qrf	s	-15.00	1	-113.3	1	25.4				1
B200689	Qrf	s	-15.08	1	-111.2	1					0
B200789	Qrf	s	-14.93	7	-112.4	7	31.3				1
B200889	Qrf	s	-15.25	1	-109.4	1	38.9				1
B401989	Qc	s	-13.38	1	-105.3	1					0
B302089	Qc	s	-14.35	1	-109.7	1					0
B102289	Qc	s	-13.61	4	-103.6	4					0
B202489	Qc	s	-13.33	3	-101.6	3					0
B402689	Qc	s	-14.31	1	-108.6	1					0
B205589	Qc	s	-13.95	1	-110.0	1	0.9				1
B405689	Qrf	s	-14.34	5	-110.2	5					0
B405789	Qrf	s	-11.70	4	-95.1	4					0
P207689	Qrf	s	-14.80	1	-114.2	1	89.9				1
P207889	Qrf	s	-14.46	1	-105.5	1					0
B208089	Qc	s	-15.00	1	-111.3	1					0
B208789	Qc	s	-13.04	1	-99.6	1					0
P209289	Qrf	s	-10.99	1	-82.2	1	112.3				1
P209789	Qrf	s	-14.53	2	-109.9	2					0
B210489	Qc	s	-14.71	2	-114.1	2					0
P213689	Qrf	s	-14.94	1	-116.9	1					0
P215789	Qrf	s	-14.43	1	-111.2	1	42.9				1
P218289	Qrf	s	-14.20	1	-100.1	1	33.4				1
P313589	Qrf	s	-15.25	1	-116.0	1	38.3				1
P317989	Qrf	s	-15.09	1	-111.0	1	21.5				1
B410589	Qrf	s	-12.41	4	-98.1	4	43.2				1
B410689	Qrf	s	-13.36	4	-105.8	4	31.3				1
B410789	Qrf	s	-14.59	2	-108.3	2	28.3				1
B110889	Qrf	s	-13.47	2	-108.6	2	28.7				1
B110989	Qrf	s	-13.09	4	-100.6	4	23.2				1
B111189	Qrf	s	-13.53	5	-104.0	5	4.9				1
B411289	Qrf	s	-13.71	2	-105.7	2	1.4				1
B411389	Qrf	s	-13.92	2	-108.6	2	11.1				1
P114489	Qrf	s	-15.37	1	-113.7	1	32.6				1
P114689	Qrf	s	-13.57	1	-100.9	1					0
P114789	Qrf	s	-14.48	1	-109.9	1	26.1				1
P114989	Qrf	s	-13.72	1	-102.6	1	0.8				1
P115089	Qrf	s	-15.17	1	-113.7	1	41.2				1
P115489	Qrf	s	-14.96	1	-110.6	1	28.1				1
P115589	Qrf	s	-14.74	1	-109.3	1	42.2				1
P115689	Qrf	s	-14.68	1	-110.3	1	24.0				1
P119389	Qrf	s	-14.25	1	-100.9	1	14.6				1

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Table 1
Isotopic Compositions of Groundwater

Well Name	Completion Unit	Lithologic Unit[1]	Mean $\delta^{18}O$ (SMOW)	Number of Values	Mean δD(SMOW)	Number of Values	Mean Tritium (TU) Surficial Deposits	Unweathered Bedrock	Weathered Bedrock	Arapahoe No. 1 SS	Number of Values
P314089	Qrf	s	-14.80	1	-109.8	1					0
P320089	Qrf	s	-14.98	1	-111.1	1	40.5				1
P414189	Qrf	s	-13.73	1	-108.4	1	50.7				1
P415889	Qrf	s	-15.19	1	-111.7	1	31.2				1
P415989	Qrf	s	-14.79	1	-112.8	1	41.6				1
P416089	Qrf	s	-15.01	1	-107.2	1	32.0				1
P416189	Qrf	s	-14.82	1	-113.1	1	19.9				1
P416289	Qrf	s	-15.78	1	-118.7	1	34.6				1
P416389	Qrf	s	-14.98	2	-109.8	2	35.6				2
P416489	Qrf	s	-15.21	2	-114.7	2	17.8				1
P416589	Qrf	s	-15.28	2	-115.7	2	41.4				1
P416689	Qrf	s	-14.36	2	-110.9	2	41.8				1
P416789	Qrf	s	-14.16	2	-107.9	2	34.9				1
P416889	Qrf	s	-13.90	1	-106.1	1	30.9				1
P218089	Qrf	s	-14.12	2	-106.3	2	33.5				0
P219189	Qc	s	-13.97	1	-103.3	1					2
P419689	Qrf & Kss	s	-13.88	2	-102.8	2	28.6				1
190	Qrf	s	-14.54	1	-111.6	1	26.7				1
290	Qrf	s	-14.27	1	-108.7	1	10.5				2
0390	Qrf	s	-13.89	2	-104.2	2	8.2				0
0590	Qrf	s	-15.26	1	-113.4	1					0
0690	Qrf	s	-15.38	1	-113.5	1					0
0790	Qrf	s	-12.78	1	-103.3	1					0
0990	Qrf	s	-14.29	1	-112.9	1					1
1490	Qrf	s	-14.22	1	-107.1	1	12.3				0
00191	Qrf	s	-13.84	1	-102.7	1					0
01391	Qrf	s	-13.80	1	-104.6	1					1
03991	Qrf	s	-14.37	1	-103.1	1	26.0				0
04191	Qrf	s	-14.02	1	-108.3	1					0
04591	Qrf	s	-14.28	1	-109.6	1					0
05091	Qrf	s	-14.12	2	-109.0	2					0
05191	Qrf	s	-14.35	2	-109.9	2					1
05391	Qrf	s	-14.58	2	-113.1	2	29.5				1
5691	Qrf	s	-14.30	1	-103.6	1	28.3				0
06091	Qrf	s	-13.37	2	-103.7	2					0
06191	Qrf	s	-14.43	1	-111.6	1					0
06791	Qrf	s	-15.07	1	-110.8	1					0
06891	Qrf	s	-15.95	1	-120.7	1					1
06991	Qrf	s	-14.25	1	-106.9	1	14.8				1
07191	Qrf	s	-15.13	1	-113.0	1	11.0				0
13091	Qrf	s	-15.30	1	-112.3	1					1
13391	Qrf	s	-13.61	2	-109.3	2	27.3				0
20591	Qrf	s	-14.36	1	#DIV/0!	0					0
37591	Qrf	s	-15.14	1	-114.7	1					

[1]s=surficial deposits, w=weathered bedrock, u=unweathered bedrock
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Table 1
Isotopic Compositions of Groundwater

Well Name	Completion Unit	Lithologic Unit[1]	Mean $\delta^{18}O$ (SMOW)	Number of Values	Mean δD(SMOW)	Number of Values	Mean Tritium (TU) Surficial Deposits	Unweathered Bedrock	Weathered Bedrock	Arapahoe No. 1 SS	Number of Values
41091	Qa	s	-13.26	1	-104.1	1	44.2				1
41691	Qa	s	-12.89	2	-84.8	1					0
10692	Qc	s	-14.43	1	-111.0	1					0
43392	Qrf	s	-15.50	1	-111.6	1					0
46192	Qrf	s	-13.69	1	-104.5	1					0
46292	Qrf	s	-13.96	2	-105.7	2	13.3				1
46492	Qrf	s	-14.72	1	-109.5	1	1.3				1
50092	Qa	s	-12.41	1	-100.9	1	19.9				1
50192			-12.85	1	-103.7	1	16.3				1
50292			-14.01	1	-109.5	1	19.6				1
75292	Qa	s	-14.28	1	-108.8	1	30.6				1
5093			-12.80	1	-102.7	1					0
5193			-14.67	1	-114.7	1					0
61593	Qc	s	-14.39	1	-109.7	1	25.2				1
61693	Qc	s	-14.83	1	-112.0	1					0
61793	Qc	s	-14.41	1	-111.8	1	26.0				1
61893	Qc	s	-14.64	1	-110.1	1	23.1				1
62093	Qc	s	-14.51	1	-103.5	1					0
62193	Qc	s	-15.81	1	-119.7	1	20.5				1
62293	Qc	s	-14.39	1	-106.9	1	30.5				1
62393	Qc	s	-11.45	1	-87.4	1	38.7				1
62493	Qc	s	-12.71	1	-93.0	1					0
62593	Qc	s	-15.65	1	-103.8	1	32.8				1
62693	Qc	s	-15.29	1	-108.8	1	26.7				1
62793	Qc	s	-14.65	1	-110.6	1	37.2				1
62893	Qc	s	-14.85	1	-112.0	1	47.1				1
10394	Qa	s	-14.80	1	-112.8	1	18.3				1
10894	Qa	s	-13.40	1	-101.3	1					0
11294	Qrf	s	-14.71	1	-110.4	1	6.7				1
11494	Qrf	s	-14.93	1	-114.9	1	26.1				1
12094	Qa	s	-14.95	2	-114.8	2	18.2				1
50194	Qrf	s	-14.49	1	-107.1	1	4.4				1
50394	Qrf	s	-14.67	1	-108.9	1	1.9				1
50694	Qrf	s	-16.00	1	-109.2	1	44.0				1
50794	Qrf	s	-13.92	1	-106.6	1	22.6				1
50894	Qrf	s	-14.13	1	-105.4	1	38.0				1
50994	Qrf	s	-13.69	1	-102.4	1	40.8				1
51094	Qrf	s	-12.51	1	-99.3	1	26.9				1
51194	Qrf	s	-13.94	1	-104.3	1	18.3				1
51294	Qrf	s	-14.62	1	-109.0	1	23.5				1
51494	Qrf	s	-13.76	1	-104.3	1	15.1				1
51594	Qrf	s	-14.38	1	-105.2	1	36.6				1
53194			-14.59	1	-111.7	1	11.3				1
60695			-14.42	1	-109.9	1	38.2				1

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Table 1
Isotopic Compositions of Groundwater

Well Name	Completion Unit	Lithologic Unit[1]	Mean $\delta^{18}O$ (SMOW)	Number of Values	Mean δD(SMOW)	Number of Values	Mean Tritium (TU) Surficial Deposits	Unweathered Bedrock	Weathered Bedrock	Arapahoe No. 1 SS	Number of Values
60795			-14.71	1	-108.8	1	27.6				1
60895			-14.48	1	-107.3	1	31.4				1
61295			-14.29	1	-110.6	1	31.5				1
0886	Ksslt	u	-12.90	1	-94.8	1		0.8			1
0986	Kss & Ksslt	u	-13.14	1	-98.9	1		0.8			1
1486	Kss & Ksclst	u	-14.05	6	-108.6	6		0.8			1
1686	Ksltss	u	-13.90	1	-104.0	1		0.8			1
2186	Kss & Ksltclst	u	-13.00	1	-94.2	1		0.8			1
2386	Kslt & Ksltclst	u	-11.44	3	-90.7	3		1.9			2
2586	Ksltclst & Kclst	u	-11.35	6	-89.9	6		0.8			1
2786	Kssits & Ksclst	u	-12.41	4	-97.1	4		0.8			1
3286	Kss & Ksltss	u	-12.29	5	-93.1	5		0.8			1
3486	Kcss & Kcslt	u	-12.50	2	-95.9	2		0.8			1
4086	Kclst	u	-11.64	3	-88.3	3		0.8			1
4686	Kslt & Kcslt	u	-12.07	4	-92.8	4		0.8			1
4886	Kssit & Kcslt	u	-13.43	1	-102.7	1		0.8			1
5486	Ksslt & Kslt	u	-12.09	2	-90.3	2		0.8			1
0387	Ksslt & Kcslt	u	-14.56	2	-107.1	2					0
0887	Ksltclst & Kclst	u	-14.59	2	-112.7	2					0
1687	Kslt	u	-12.07	1	-91.0	1		0.8			1
1887	Kss & Ksslt	u	-11.94	3	-92.3	3		0.8			1
2087	Ksltclst	u	-11.63	2	-90.4	2		0.8			1
2287	Kss & Kslt	u	-12.99	1	-93.9	1		1.6			2
2887	Kslt & Kclst	u	-12.79	1	-96.8	1		0.8			1
3087	Kcslt	u	-14.29	1	-110.1	1		0.8			1
3187		u	-11.98	6	-92.1	6		0.8			1
3487	Ksltclst & Kslt	u	-12.04	1	-90.5	1		0.8			1
3987	Ksslt & Kclst	u	-12.11	3	-94.3	3		0.8			2
4187	Ksltss	u	-13.53	2	-98.7	2					0
4587	Kss & Kslt & Kclst	u	-13.23	2	-101.5	2		1.6			2
B203789	Kcslt & Kclst	u	-12.88	6	-96.3	6		0.8			1
B203889	Kclst	u	-12.49	1	-94.0	1		0.8			1
B203989	Ksltss & Kslt	u	-13.00	1	-100.7	1		0.8			1
B204089	Ksltss	u	-12.30	2	-98.9	2		0.8			1
B204189	Kcss, Ksltss & Ksclst	u	-11.87	2	-96.5	2		0.8			1
B304289	Kss & Kslt & Kclst	u	-14.48	1	-108.9	1		0.8			1
B304989	Ksltss & Ksslt	u	-14.81	1	-112.1	1		0.8			1
B405289	Ksclst & Ksltclst	u	-13.44	1	-103.1	1		0.8			1
B207089	Ksclst & Ksltclst	u	-13.65	2	-108.0	2		0.8			2
P208889	Ksltclst	u	-12.15	1	-91.4	1		1.0			1
P416989	Ksslt & Kslt	u	-12.63	1	-94.0	1		0.9			1
B217289	Kss, Ksltss, Kcslt	u	-13.01	2	-102.8	2		0.8			2
B217489	Kss	u	-12.30	1	-93.1	1		0.8			2

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Well Name	Completion Unit	Lithologic Unit[1]	Mean $\delta^{18}O$ (SMOW)	Number of Values	Mean δD(SMOW)	Number of Values	Mean Tritium (TU) Surficial Deposits	Unweathered Bedrock	Weathered Bedrock	Arapahoe No. 1 SS	Number of Values
B217589	Kss & Ksltclst	u	-12.24	1	-93.9	1		0.8			1
B217689	Kclss	u	-12.29	1	-93.7	1		0.8			1
B217789	Ksltclst	u	-11.94	1	-94.2	1		0.8			1
46692	Ksltss, Ksslt & Kclst	u	-12.53	1	-92.4	1		0.8			1
46792	Ksslt, Kcslt & Kslt	u	-11.79	1	-89.7	1		0.8			1
46892	Ksltss, Ksslt & Kclst	u	-12.48	1	-96.3	1		0.8			1
22093	Kclst, Kclst & Ksltss	u	-15.53	1	-115.0	1		0.8			1
22193	Ksclst, Kcss & Kcls	u	-13.67	1	-98.7	1		0.8			1
22293	Ksclst, Kslst & Kcss	u	-14.77	1	-110.1	1		0.8			1
22393	Kcslst & Kclst	u	-11.75	1	-87.5	1		0.8			1
23193	Kss, Ksltss & Kcss	u	-13.89	1	-104.9	1		1.6			1
22593		u	-12.71	2	-96.2	2		0.8			2
70593			-13.29	1	-89.4	1					0
53094 ???			-14.00	1	-106.6	1		0.8			1
57594 ???			-14.56	1	-110.7	1		0.8			1
59894		u	-12.75	1	-101.3	1		0.8			1
0386	Kss	w	-16.10	2	-119.0	2			44.5		1
3086	Kclst	w	-15.02	2	-115.5	2					0
5286	Kss & Ksltclst	w	-13.25	4	-103.0	4			5.3		1
6286	Ksltss & Kcss	w	-14.93	1	-115.8	1			1.6		1
0587	Kss & Ksltss	w	-13.75	1	-104.5	1			0.8		1
0987	Kss	w	-14.29	5	-108.6	5				49.9	1
1187	Kcss	w	-13.15	2	-99.3	2			36.1		1
1287	Kcslt	w	-15.06	1	-114.6	1					0
1487	Kss & Kslt	w	-15.43	1	-116.7	1			15.1		1
2587	Ksltss & Kss	w	-15.27	3	-114.3	3				26.4	1
3687	Kss & Kslt & Kclst	w	-14.47	7	-108.9	7				40.4	2
B402189	Kss	w	-13.14	1	-100.3	1				22.5	1
B203189	Kclst & Ksclst	w	-14.16	1	-104.2	1			0.8		1
B203289	Kclst & Ksclst	w	-13.93	1	-104.9	1			0.8		1
B203489	Kclst	w	-13.71	7	-103.6	7			5.5		1
B203589	Qrf & Ksclst & Kclst	w	-13.67	1	-103.8	1			0.8		1
B303089	Kclst	w	-13.54	1	-107.9	1			9.0		1
B304889	Kclst	w	-15.72	1	-122.1	1			0.8		1
B305389	Ksltclst & Kclst	w	-13.64	1	-107.7	1			23.8		1
B405489	Ksltclst & Kclst	w	-13.63	3	-103.2	3			0.8		1
B405889	Kss	w	-13.81	1	-103.5	1				19.4	1
B206989	Ksclst	w	-14.49	1	-113.0	1					0
P207389	Kss & Kclst	w	-14.65	1	-105.6	1			126.6		1
P207589	Ksltclst	w	-13.75	1	-99.8	1			0.8		1
P207789	Ksltclst	w	-13.48	1	-102.5	1			0.8		1
P207989	Kclst	w	-13.60	1	-102.0	1			2.0		1
B208189	Kclst	w	-17.08	1	-130.8	1					0

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Isotopic Compositions of Groundwater

Well Name	Completion Unit	Lithologic Unit[1]	Mean $\delta^{18}O$ (SMOW)	Number of Values	Mean δD(SMOW)	Number of Values	Mean Tritium (TU) Surficial Deposits	Unweathered Bedrock	Weathered Bedrock	Arapahoe No. 1 SS	Number of Values
B208389	Ksclst & Kclst	w	-19.15	1	-140.9	1					0
B208689	Ksltclst	w	-14.29	1	-110.9	1			0.8		1
P208989	Ksltss & Ksltclst	w	-13.27	5	-104.5	5					0
P209089	Ksltclst	w	-13.53	1	-103.1	1					0
P209189	Kss & Ksltclst	w	-13.29	1	-101.7	1					0
P209389	Kss & Ksltss & Kcss	w	-10.10	1	-74.2	1				79.8	1
P209489	Kss & Ksltss	w	-14.13	2	-107.0	2				204.2	1
P209589	Ksltclst & Ksclst	w	-13.28	1	-109.1	1			3703.0		1
P209689	Ksltclst	w	-11.27	1	-83.3	1			114.0		1
P209889	Ksltclst	w	-12.81	5	-103.2	5					0
P210089	Ksltclst	w	-12.22	2	-93.8	2					0
P210189	Ksltss & Ksclst	w	-14.66	1	-108.6	1				295.0	1
P114589	Qrf	w	-14.06	1	-106.7	1					0
00291	Kclss & Ksclst	w	-13.74	1	-99.1	1				0.8	1
00391	Ksclst & Kcss	w	-14.65	1	-109.0	1			35.4		1
01491	Kss & Kcs	w	-13.89	1	-106.5	1				26.1	1
02091	Ksclst, Ksslt, Ksltclst	w	-14.61	1	-110.8	1				28.4	1
02291	Ksclst & Kclss	w	-14.51	1	-112.6	1				66.3	1
02491	Ksltss, Ksslt	w	-15.78	1	-119.8	1				22.8	1
02591	Kclss & Ksclst	w	-14.05	1	-109.6	1			19.9		1
02991	Kclss & Ksclst	w	-14.63	1	-107.4	1				23.2	1
03391	Kss, Ksltss & Ksclst	w	-14.92	1	-113.1	1				35.4	1
03691	Kss & Kcss	w	-14.62	1	-110.9	1				39.8	1
03791	Kss, Ksclst & Ksltss	w	-14.29	5	-107.5	5				33.3	1
06591	Ksclst & Ksltclst	w	-13.83	1	-101.2	1			1.4		1
09691	Ksltss & Kclst	w	-14.82	1	-111.1	1			20.1		1
10991	Ksltss	w	-14.21	1	-103.0	1			16.6		1
11691	Kclss & Kss	w	-15.28	1	-109.6	1					0
11791	Ksclst	w	-14.61	1	-108.6	1					0
11891	Ksslt & Ksltss	w	-14.35	1	-102.3	1				30.2	1
12091	Ksltss	w	-15.04	1	-114.2	1					0
12191	Ksltss & Kss	w	-15.09	1	-113.2	1					0
12391	Kss, Ksltss & Kclss	w	-14.91	1	-115.5	1				49.4	1
12491	Kss & Kclss	w	-13.57	1	-104.4	1			5.6		1
12691	Kss	w	-14.82	1	-109.1	1				29.8	1
12991	Ksclst	w	-14.58	1	-108.4	1			32.0		1
13191	Ksclst	w	-14.61	1	-109.8	1			22.9		1
20791	Kclst & Ksclst	w	-13.37	1	-102.9	1			4.5		1
37891	Kcsltst & Ksltst	w	-13.94	1	-108.6	1			2.0		1
37991	Kcsltst & Kssltst	w	-13.70	1	-107.6	1			0.8		1
38991	Kclst, Ksltst, Kcsltst	w	-14.68	1	-112.0	1			6.0		1
39191	Ksltst, Kclsltst, Kclst	w	-13.59	1	-107.9	1			1.5		1
39291	Ksltclst, Kcsltst	w	-13.59	1	-105.0	1			0.9		1

[1]s=surficial deposits, w=weathered bedrock, u=unweathered bedrock
[2]units=feet above mean sea level
[3]units=feet above ground level
[4]units=feet below ground level, NP=not penetrated, ND=not determined

Table 1
Isotopic Compositions of Groundwater

Well Name	Completion Unit	Lithologic Unit[1]	Mean $\delta^{18}O$ (SMOW)	Number of Values	Mean δD(SMOW)	Number of Values	Mean Tritium (TU) Surficial Deposits	Unweathered Bedrock	Weathered Bedrock	Arapahoe No. 1 SS	Number of Values
46392	Kclst	w	-13.67	1	-102.7	1			0.8		1
75092	Ksltclst	w	-15.23	1	-114.1	1			27.1		1
193			-14.30	1	-107.7	1			1.0		1

[1]s=surficial deposits, w=weathered bedrock, u=unweathered bedrock
[2]units=feet above mean sea level
[3]units=feet above ground level
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Attachment #2
RGS-012-95
November 22, 1995
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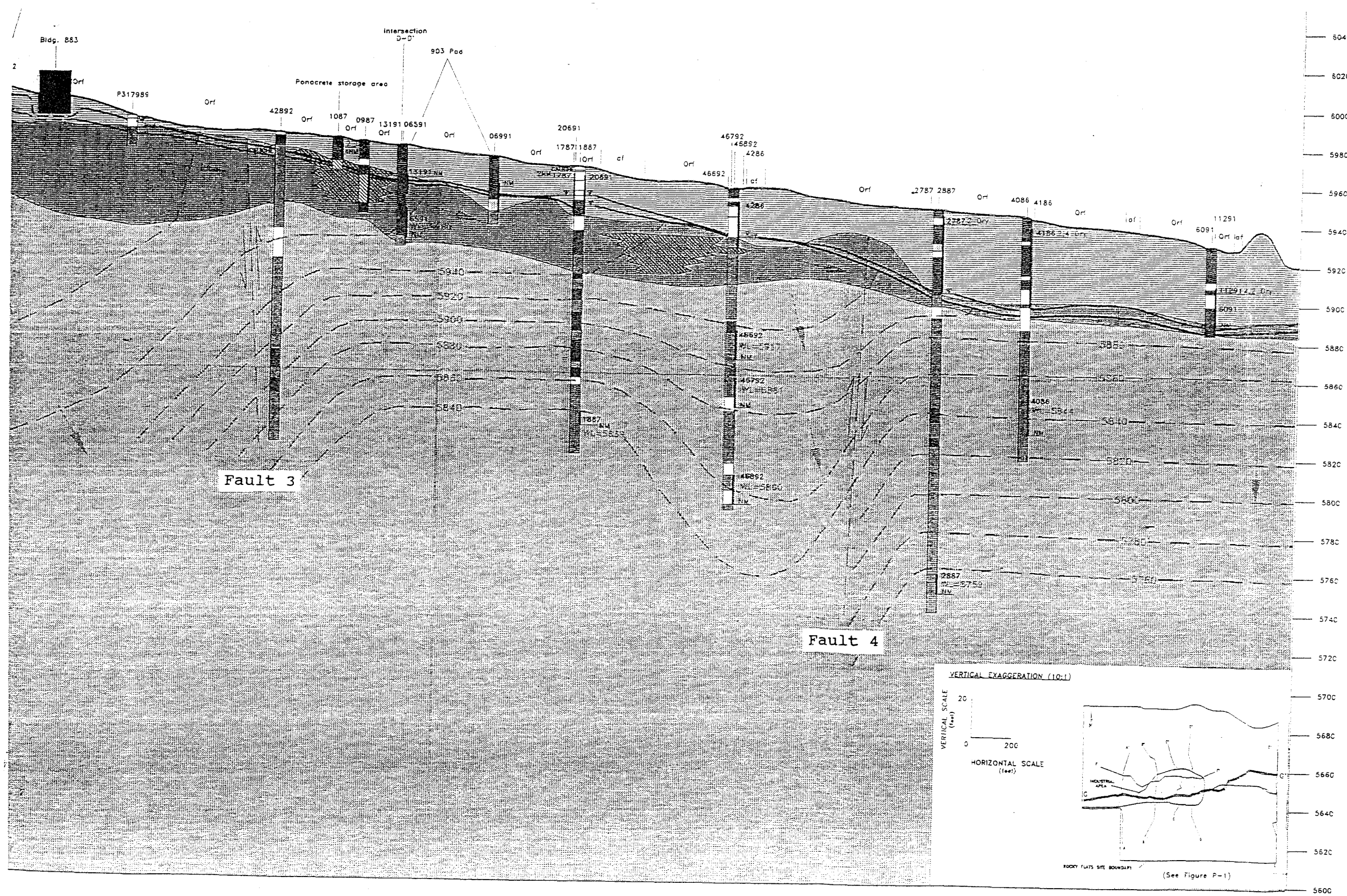

EXPLANATION

Orf — Designation of Surficial Deposits and Generalized Building Profile

- cf — Artificial Fill (Latest Recent)
- Qp — Piney Creek and Post-Piney Creek Alluvium (Recent)
- Qt — Terrace Alluvium, undivided (Middle to Late Pleistocene)
- Qs — Slocum Alluvium (Middle Pleistocene)
- Qv — Verdos Alluvium (Early to Middle Pleistocene)
- Qrf — Rocky Flats Alluvium (Early Pleistocene)
- Qc — Colluvium, undivided (Middle Pleistocene to Recent)
- Qls — Landslide Deposits (Middle Pleistocene to Recent)
- Ka — Arapahoe Formation (Late Cretaceous)
- Kl — Laramie Formation (Late Cretaceous)
- Kfh — Fox Hills Sandstone (Late Cretaceous)

Unconsolidated Surficial Deposits USCS Soil Types: Gravel (GW,GP,GM,GC); Sand (SW,SP,SM,SC); Silt (ML,OL,MH); Clay (CL,CH,OH)

Bedrock Lithofacies: Sandstone; Siltstone; Silty Claystone; Claystone

- No Recovery
- Unconsolidated Surficial Deposits
- Weathered Arapahoe or Laramie Formation
- Unweathered Arapahoe or Laramie Formation
- Weathered Fox Hills Sandstone
- Unweathered Fox Hills Sandstone
- Weathered Pierre Shale
- Unweathered Pierre Shale
- Arapahoe Formation Channel Deposit
- Location of inferred fault
- Unconsolidated Surficial Deposits Potentiometric Surface: 2nd Quarter 1993; 4th Quarter 1993
- 42192 — Black bar indicates screened interval. Well number is adjacent to screen for well clusters. Water levels for second (-) and fourth (-) quarters are labeled on alluvial wells. HM = No measurement. Black bar is well/boring
- * See attached text describing equipotential lines
- Equipotential line
- Indicates direction of potential (No magnitude intended)

Figure 1
Segment of Hydrogeologic Cross-Section G-G'
Showing Faulted Areas

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