UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

AQUIFER DATA FROM FOUR WELLS IN THE MENDENHALL VALLEY NEAR JUNEAU, ALASKA

By Gary O. Balding

U.S. GEOLOGICAL SURVEY

OPEN-FILE REPORT 82-271

Prepared in cooperation with the
CITY AND BOROUGH OF JUNEAU

Anchorage, Alaska
1982

UNITED STATES DEPARTMENT OF THE INTERIOR

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GEOLOGICAL SURVEY

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CONTENTS

ILLUSTRATIONS

TABLES

CONVERSION TABLE

Multiply	By	To obtain
feet (ft)	0.3048	meters (m)
inches (in.)	2.54	centimeters (cm)
gallons per minute (gal/min)	0.06308	liters per second (L/s)
degrees Fahrenheit (°F)	(°F-32)0.555	degrees Celsius (°C)

Micrograms per liter (ug/L), milligrams per liter (mg/L), and micromhos per centimeter (umho/cm) are standard reporting units.

Note: The National Geodetic Vertical Datum of 1929 (NGVD of 1929) is a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called "mean sea level".

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ABSTRACT

The report summarizes data collected during drilling and testing of four wells in Mendenhall Valley, an area being developed as a suburb of Juneau. Previous studies indicated that the glacial deposits on the east side of the valley had the potential for producing the large quantities of water needed for a community water supply. The drilling defined an upper aquifer between the water table and a depth of 215 feet and a lower aquifer below 347 feet. The testing did not define the storage coefficient or transmissivity of the upper aquifer. Drawdowns within 20 feet of the test well were less than 12 feet when the pumping rate was 300 gallons per minute. Greater pumping rates could be sustained in larger diameter wells having larger screened intervals in the upper aquifer but would produce greater drawdowns. The performance of the lower aquifer was not tested. Water in the upper aquifer is of adequate quality for drinking water, but may require treatment for iron; water from the lower aquifer is brackish.

INTRODUCTION

The City and Borough of Juneau are investigating the feasibility of a centralized water-distribution system in the Mendenhall Valley-Auke Bay area, west of Juneau. Ground water from the Mendenhall Valley is a likely source of water for the system.

This study, which was jointly funded by the U.S. Geological Survey and the City and Borough of Juneau, consisted of an evaluation of three existing wells and the drilling and testing of a 386-foot well.

The objectives of the study were to:

- Describe the unconsolidated materials that might provide water to high-capacity public-supply wells.
- Evaluate the quality of the ground water as a public-supply source.

HYDROGEOLOGY

The Mendenhall Valley (fig. 1) is underlain by fluvial, glaciofluvial, and glaciomarine sediments that are locally overlain by peat (Miller, 1975). Seismic studies indicate that the unconsolidated sediments range from 250 ft thick near Mendenhall Lake to 750 ft thick near the coast. The valley walls consist of metamorphic rocks that are mantled on the lower slopes by mass-wasting deposits.

Barnwell and Boning (1968) concluded that bedrock, mass-wasting deposits, and glaciomarine deposits are unlikely to provide the large quantities of water required by municipal-supply wells. However, they thought that the fluvial and

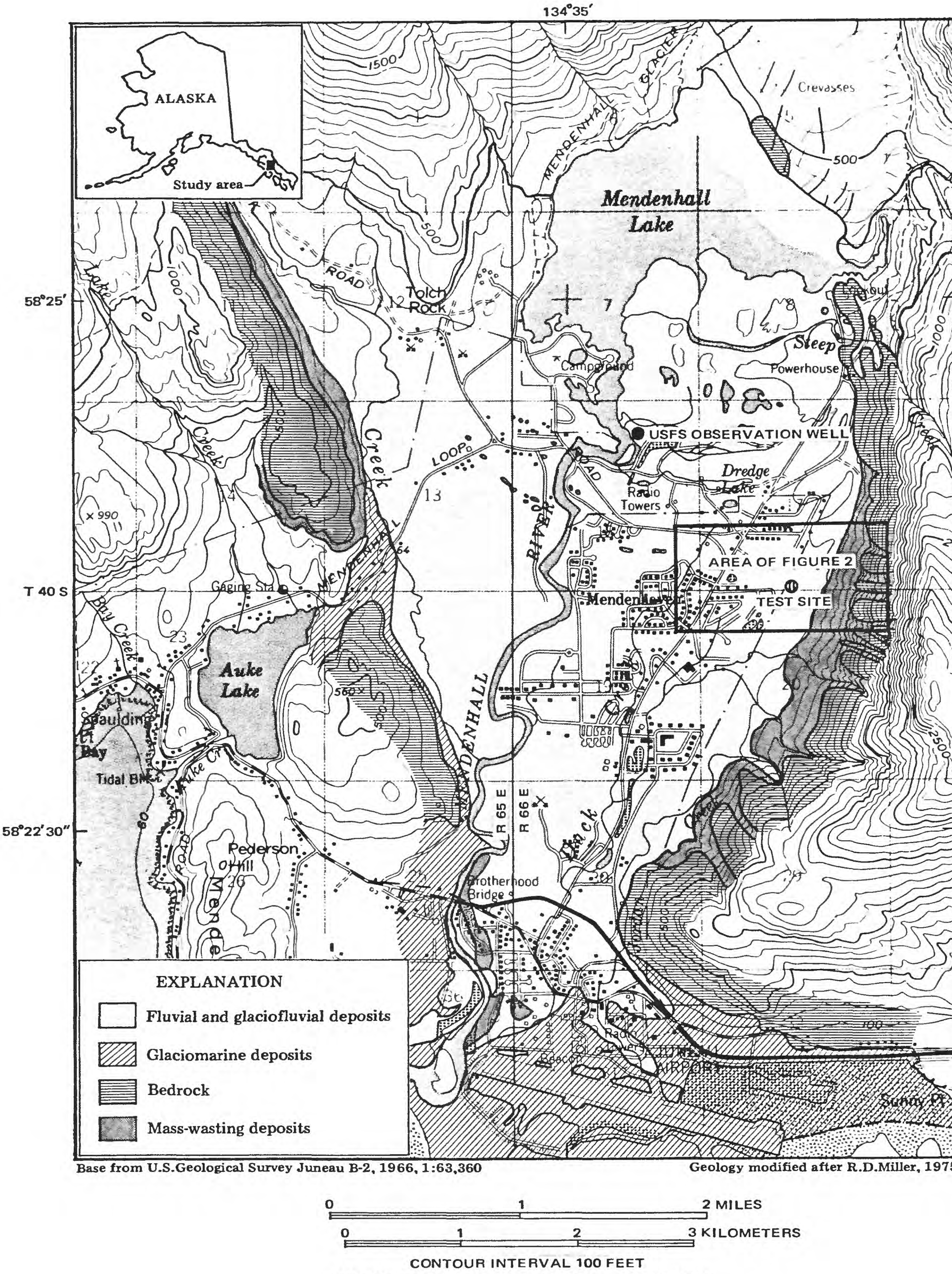

Figure 1. -- Location of study area and surficial geology of Mendenhall Valley.

glaciofluvial deposits had good potential as sources of ground water for municipal wells. Logs of domestic wells (McConaghy, 1969) also indicated abundant water from the fluvial and glaciofluvial sediments. Consequently, a site for a test-well field was chosen in glaciofluvial sediments, more specifically in glacial outwash near the east side of the valley (fig. 2).

DRILLING AND TESTING

The test well and observation wells 1 and 2 were drilled by the City and Borough of Juneau in 1974 (table 1). The wells penetrated sand and gravel and were completed at depths that range from 70 to 82 ft. Highly permeable zones were found in those wells at 55-60 ft and 78-82 ft. The 55-60 ft zone produced water having a high concentration of iron and consequently was cased off.

Table 1.--Well-construction data.

Well	Diameter (in.)	Hole depth (ft)	Finished well depth (ft)	Screened interval (ft)	Screen size (in.)	Completion date
Test*	6	85	82	78-82	.060	1974
Test*	6	110	106	102-106	.040	1979
Obs. 1	6	71.5	71	67.5-71	.040	1974
Obs. 2	6	70	70	67.5-70	.040	1974
Obs. 3	6	386	386	open end	none	1979

*Test well was first pumped when it was 85 ft deep. It was subsequently deepened to 110 ft for the February 1980 test.

In 1979, observation well 3 was drilled (table 1), and two aquifer performance tests were conducted. The configuration of the wells is shown in figures 2 and 3. Observation well 3 at the time of the tests was 67 ft deep, as shown by the solid line. It was subsequently deepened to 386 ft but did not reach bedrock. The total depth is shown as a dotted line.

Geophysical logs were run in the three observation wells to aid in correlation of geologic units. The composite driller's and geophysical logs for observation wells 1, 2, and 3 are shown in figures 4 and 5.

Observation well 3 (fig. 5) was drilled to 386 ft to evaluate deep aquifers and their water quality. The well penetrated a generally downward-fining sequence of interlayered sand, silt, and gravel from land surface to 347 ft. Between 347 ft and 386 ft the sand was coarser than in the interval between 200 and 347 ft. Marine shell fragments found at 302 and 352 ft indicate that the lower part of the sedimentary sequence contains marine sediments.

The sediments between the water table and a depth of 215 ft are hereafter referred to as the upper aquifer. The sediments below 347 ft are the lower aquifer. The fine-grained, silty sand between 215 and 347 ft was much less permeable than the aquifers.

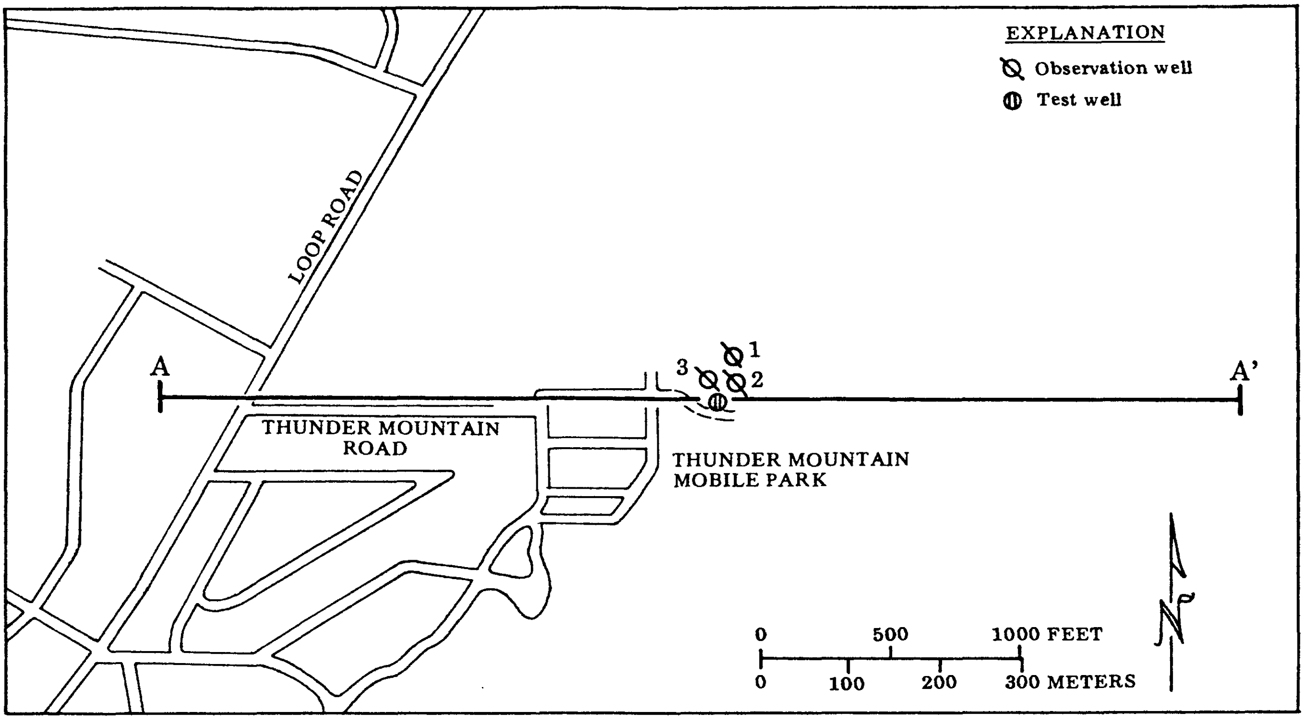

Figure 2. -- Map of test-site area showing locations of wells.

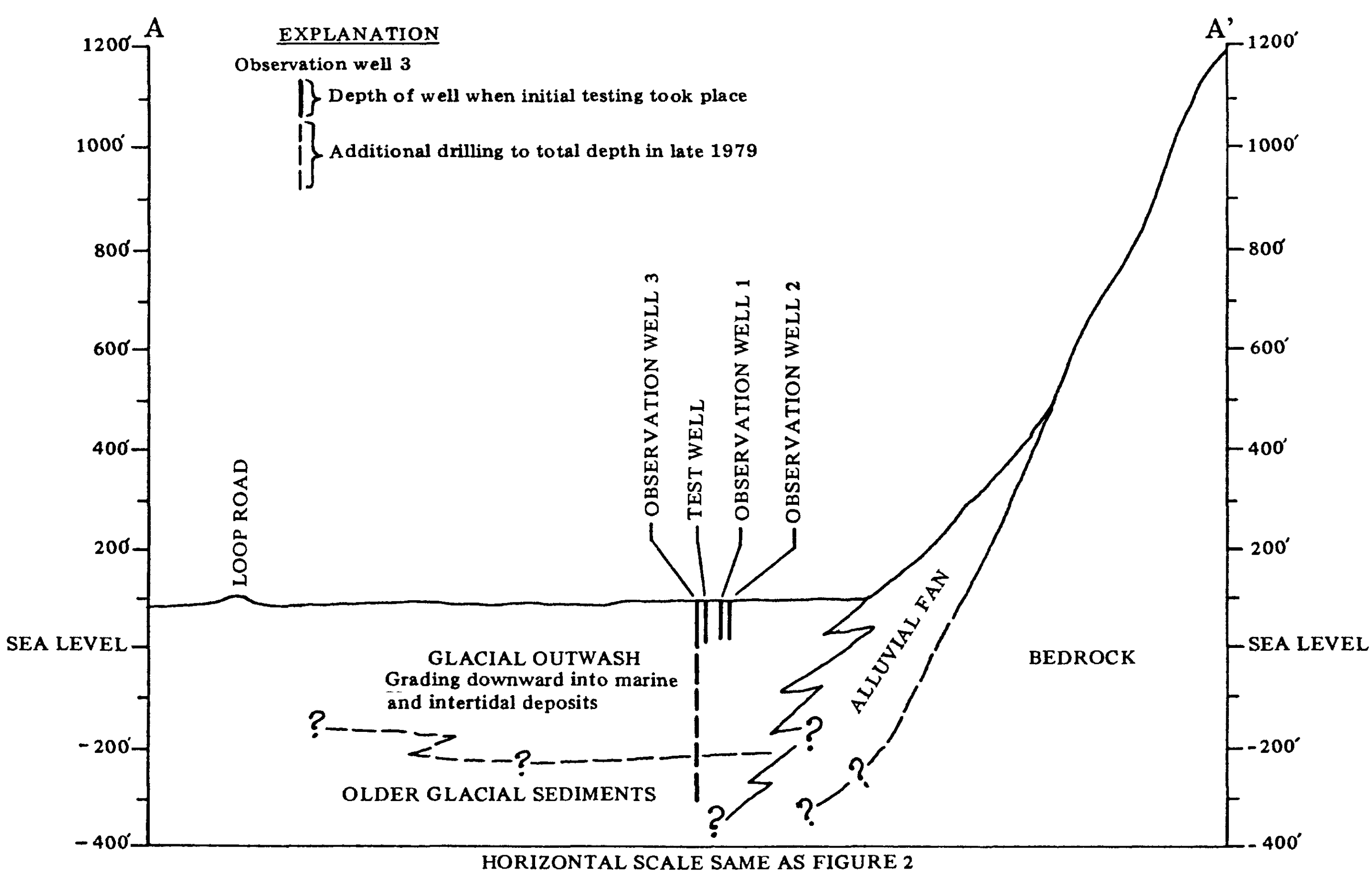

Figure 3. -- Geologic section along A-A' in figure 2. Observation wells are projected onto the plane of the section.

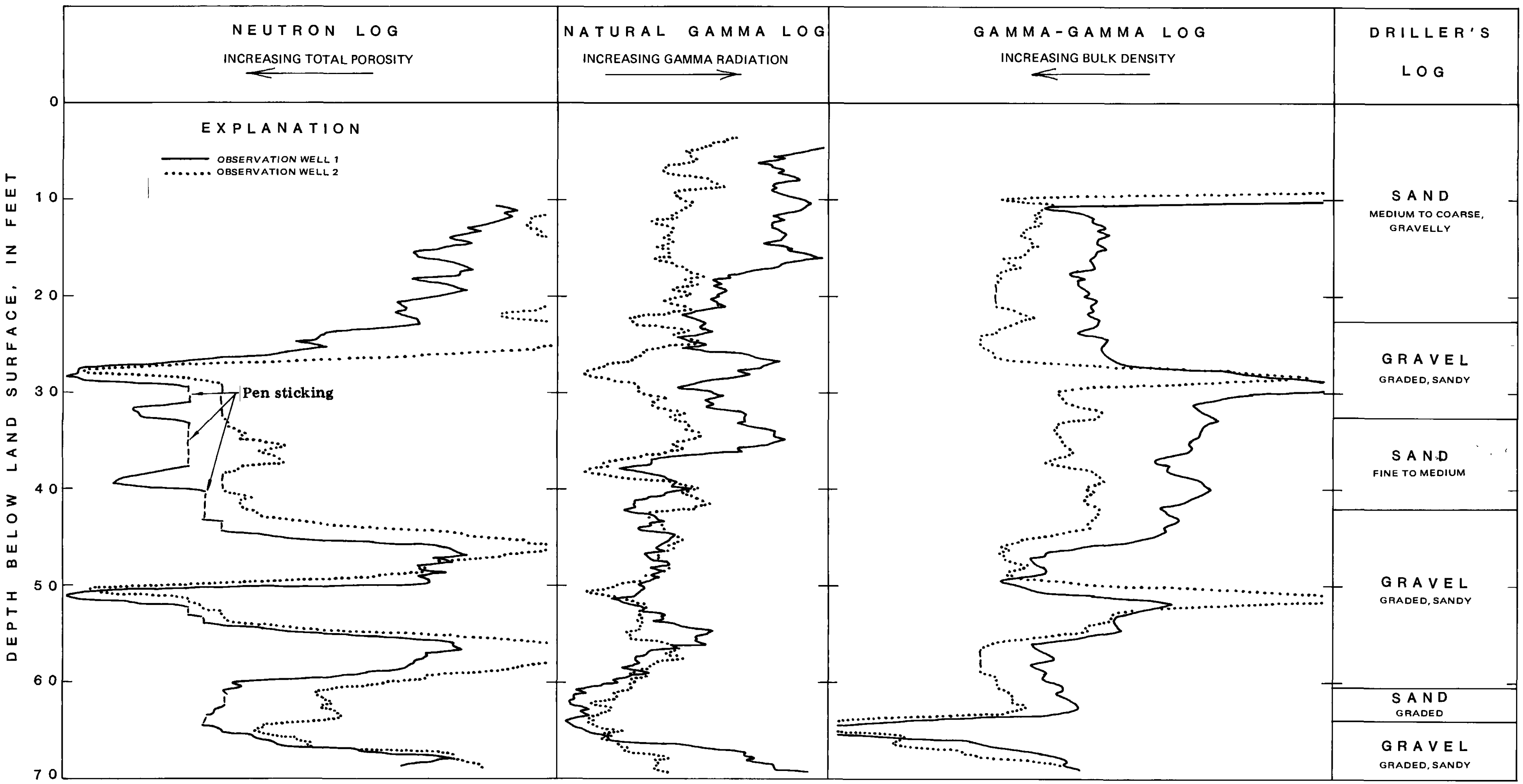

Figure 4. -- Geophysical and driller's logs of observation wells 1 and 2.

The analyses of particle-size distribution for samples collected at 5-foot intervals during drilling of the wells are shown in table 2. The actual percentage of silt and clay in undisturbed material may be higher than indicated because some fine materials are washed from the sample during bailing. No samples were collected from observation well 1 because of its proximity to the other wells and the physical similarity of the materials.

The upper aquifer was tested by pumping the test well at 300 gal/min for 24 hours on September 30 - October 1, 1979, and observation well 3 at 290 gal/min for 24 hours on October 4-5, 1979. A third 24-hour test was conducted on February 5-6, 1980, after the test well and observation well 3 had been deepened. Data collected during the three tests (tables 3, 4, and 5) were insufficient to calculate accurate values for the physical properties of the aquifer. The maximum drawdowns, after adjusting for natural fluctuations in the water table, were 10.42 ft, 1.35 ft, and 1.19 ft in the observation wells located 22.7 ft, 100.3 ft, and 148.9 ft respectively, from the test well. A greater pumping rate could have been sustained by the aquifer, but the well diameter was too small to accommodate a larger pump. Well yield could also be increased by increasing the length of the screened interval.

WATER QUALITY

Water from the upper aquifer is of the calcium bicarbonate type (table 6). All properties and dissolved constituents analyzed, except iron, are within the recommended limits for drinking water (U.S. Environmental Protection Agency, 1976). The recommended limit for dissolved iron in drinking water is 300 µg/L. Observation well 2 was not sampled because of its proximity to the other wells.

Analyses of samples collected from various depths during the drilling of observation well 3 indicate that dissolved solids and specific conductance, which is a general measure of dissolved solids, increase with depth (table 6). The salinity of the sample collected from the zone between 349 and 360 ft was about half that of sea water. Observation well 3 produced a small amount of methane gas from a depth of 360 ft during drilling; the gas flowed for about one minute.

SUMMARY

The test site was drilled in glacial outwash deposits that consisted of a generally downward-fining sequence of gravel, sand, and silt. Pumping the 6-inch test well at 300 gal/min for 24 hours produced drawdowns of 10.42 ft, 1.35 ft, and 1.19 ft in observation wells located 22.7 ft, 100.3 ft, and 148.9 ft, respectively, from the test well. Such small drawdowns indicate that more than 300 gal/min could be pumped from wells having a larger diameter and screened interval than the test well. All dissolved constituents analyzed, except iron, and all physical properties of the water were within the range defined by the Environmental Protection Agency as being acceptable for drinking water.

Observation well 3 was deepened to 386 ft and penetrated a brackish-water aquifer below 349 ft. Because the aquifer did not contain potable water, no further evaluation was conducted.

Table 2.--Particle-size analyses of drill cuttings.

	Percent of sample, weight retained (sieve-opening size indicated in inches)											
	Gravel					Sand						Classification F=Fine M=Medium C=Coarse V=Very
Sample depth (ft)	Very coarse (1.26)	Coarse (0.63)	Medium (0.31)	Fine (0.16)	Very fine (0.08)	Very coarse (0.04)	Coarse (0.02)	Medium (0.01)	Fine (.005)	Very fine (.002)	Silt and clay (<.002)	
						TEST WELL						
5			0.1		1.1	5.4	16.2	24.4	21.9	16.8	14.0	Sand, M-F, silty
10			.6	11.3	16.2	18.1	26.0	16.0	7.3	3.0	1.6	Sand, M-VC, gravelly
15		6.4	8.9	19.0	18.5	17.3	13.7	9.3	4.9	1.6	.6	Gravel, VF-C, sandy
20	9.7	8.9	8.1	5.5	3.8	12.5	22.4	16.3	8.8	2.6	1.3	Sand, M-VC, gravelly
25	10.7	10.8	23.4	13.6	6.5	6.2	7.6	10.7	7.3	2.2	.8	Gravel, F-VC, sandy
26.75	11.1	3.6	6.7	6.0	4.6	9.8	27.0	19.9	8.9	1.7	.8	Sand, M-VC, gravelly
30			.3	.1	.6	4.3	10.7	14.2	36.3	23.3	10.3	Sand, F-VF, silty
35				.1	.3	1.0	3.3	15.2	40.1	26.5	13.6	Sand, F-VF, silty
40				2.7	10.3	9.7	21.5	29.3	17.6	6.1	2.9	Sand, M-C
45	14.4	12.1	15.3	6.8	5.1	4.1	8.0	11.3	13.6	6.6	2.7	Gravel, M-VC, sandy
47			.1	1.6	11.0	28.1	25.6	18.0	8.9	3.9	2.8	Sand, VC-C
50	12.1	1.3	3.0	7.8	12.4	14.5	14.4	13.1	13.6	5.8	2.1	Sand, VC-F, gravelly
55	6.0	15.0	18.8	13.9	8.8	7.9	11.2	10.3	5.3	1.8	1.0	Gravel, VF-C, sandy
60	10.2	9.4	8.4	12.4	13.8	13.6	12.1	10.5	6.0	2.6	1.2	Gravel, VF-VC, sandy
65	10.1	7.0	12.3	4.9	6.5	15.5	19.9	11.9	6.6	3.3	1.1	Sand, VC-F, gravelly
65.5		15.0	19.3	12.4	8.3	12.9	16.3	9.5	4.2	1.5	.7	Gravel, C-VF, sandy
70		1.8	6.1	4.8	6.9	18.2	34.9	21.1	4.6	1.1	.5	Sand, C-M
72			.4	.7	10.4	19.2	33.4	26.0	7.4	1.6	.8	Sand, C-M
75			2.4	3.2	5.5	20.9	30.9	25.5	9.2	1.7	.6	Sand, C-M
80		12.7	23.0	21.7	12.4	13.3	9.6	5.1	1.5	.4	.2	Gravel, F-C
82			23.1	9.5	9.4	22.7	15.8	15.8	3.3	.5		Sand, VC-M, gravelly
85			8.4	6.0	7.0	24.1	24.8	22.3	5.9	1.4		Sand, VC-M
90			.9	1.4	4.6	12.5	31.5	27.4	13.3	6.2	2.3	Sand, C-M
93			1.3	3.2	6.3	9.7	27.1	32.6	14.4	4.1	1.3	Sand, M-C
95			.3	1.3	3.0	11.9	35.5	30.1	12.7	3.8	1.4	Sand, C-M
97			.3	.4	1.9	13.1	39.6	32.6	8.4	2.3	1.4	Sand, C-M
99			.4	.6	2.3	9.1	33.9	37.5	11.9	3.1	1.2	Sand, M-C
101			1.0	1.5	2.6	7.3	26.0	36.2	17.8	5.8	1.7	Sand, M-C
103		5.8	6.4	3.9	4.9	12.0	21.4	28.9	12.7	3.3	.7	Sand, M-C
105		2.0	1.1	3.1	8.3	15.2	30.4	24.4	10.9	3.3	1.4	Sand, C-M
106		5.6	10.1	6.9	8.5	17.3	30.0	16.7	3.9	.8	.2	Sand, VC-M, gravelly
107			.5	.9	4.6	8.8	25.2	36.2	17.0	5.1	1.6	Sand, M-C
110				.1	1.2	6.4	21.6	33.0	24.7	9.6	3.4	Sand, M-F
						OBSERVATION WELL 2						
20		0.7	7.7	7.6	9.1	15.3	17.4	17.0	12.5	10.6	2.2	Sand, M-VC, gravelly
25	6.5	10.4	12.2	14.6	14.6	15.7	10.8	5.8	4.4	3.2	1.7	Gravel, VF-C, sandy
30	13.2	12.1	11.9	7.8	5.4	8.1	8.4	8.7	12.1	9.0	3.3	Gravel, VC-VF, sandy
35			1.0	.4	3.0	3.3	6.8	21.4	47.8	8.0	7.3	Sand, F-M
40				.4	1.9	5.5	12.0	24.0	36.9	15.2	4.1	Sand, F-M
45		16.5	20.9	16.1	9.8	6.8	6.2	7.9	9.1	5.0	1.7	Gravel, C-F, sandy
48	13.1	15.4	21.4	14.4	9.6	3.6	5.9	6.6	5.0	3.2	2.0	Gravel, F-VC, sandy
50	12.1	10.0	14.9	10.0	9.9	13.4	12.3	8.4	4.8	2.9	1.4	Gravel, VC-VF, sandy
55	3.1	13.4	17.9	10.2	7.1	6.9	9.7	9.1	11.5	7.7	3.1	Gravel, VC-VF, sandy
60	11.4	15.0	12.8	14.0	9.0	13.5	16.1	5.0	1.2	1.0	.8	Gravel, VC-F, sandy
62.5		18.0	9.6	8.8	9.2	15.3	17.7	11.0	5.2	3.0	2.1	Sand, VC-F, gravelly
65	9.7	8.5	12.3	12.6	10.5	17.4	15.0	6.9	3.3	2.5	1.3	Gravel, VF-VC, sandy
67.5		15.2	14.0	11.6	10.4	14.0	15.4	11.7	4.4	2.1	1.2	Gravel, C-VF, sandy
70		15.5	14.5	12.6	13.0	20.1	17.4	7.4	2.1	.3	.2	Gravel, C-VF, sandy

Table 2.--Continued

Sample depth (ft)	Gravel: Very coarse (1.26)	Gravel: Coarse (0.63)	Gravel: Medium (0.31)	Gravel: Fine (0.16)	Gravel: Very fine (0.08)	Sand: Very coarse (0.04)	Sand: Coarse (0.02)	Sand: Medium (0.01)	Sand: Fine (.005)	Sand: Very fine (.002)	Silt and clay (<.002)	Classification F=Fine M=Medium C=Coarse V=Very
	Percent of sample, weight retained (sieve-opening size indicated in inches)											
						OBSERVATION WELL 3						
55	15.4	16.7	16.6	10.4	6.2	5.2	8.2	8.7	6.3	4.1	2.2	Gravel, M-VC, sandy
60	2.1	8.1	3.4	5.6	9.1	13.2	20.7	18.6	11.7	5.2	2.1	Sand, M-VC, gravelly
65	6.2	18.9	15.6	11.0	10.3	10.5	9.9	8.7	5.6	2.1	1.2	Gravel, C-VF, sandy
67		10.4	13.6	14.4	14.5	17.2	18.6	8.7	1.6	.6	.3	Gravel, VF-C, sandy
70			.2	4.0	12.6	14.4	25.8	23.1	11.3	5.2	3.4	Sand, M-VC
75	4.5	3.2	6.0	5.4	8.5	18.5	25.8	15.5	8.2	3.4	1.0	Sand, M-VC, gravelly
80			2.1	4.8	7.7	24.5	35.5	17.6	5.8	1.3	.5	Sand, C-VC
85		.4	7.2	6.5	7.4	12.2	22.5	25.4	12.7	4.4	1.5	Sand, C-F
90		6.8	3.2	3.3	4.0	15.1	34.8	23.1	6.5	2.2	1.0	Sand, C-M
95		2.8	8.9	10.6	15.9	19.0	21.2	13.4	5.8	1.7	.5	Sand, VC-M, gravelly
100		2.2	9.0	7.8	7.3	10.0	27.2	27.0	8.1	1.2	.2	Sand, C-M, gravelly
105			.1	.4	4.3	21.8	36.9	20.0	7.7	5.6	3.3	Sand, C-VC
110				.4	1.0	5.3	25.2	41.1	20.3	5.2	1.4	Sand, M-C
115			.1	.3	1.1	5.2	22.9	36.8	25.2	7.1	1.4	Sand, M-F
120		7.8	9.8	6.6	6.1	10.6	22.3	20.7	12.1	3.2	.6	Sand, C-F, gravelly
125			.4	2.0	4.8	15.9	40.9	23.9	9.3	2.0	.8	Sand, C-M
130			2.3	4.8	5.2	11.8	29.2	28.3	14.1	3.3	.9	Sand, C-M
135			.4	1.2	3.5	8.3	31.3	34.2	15.9	3.7	1.6	Sand, M-C
140					6.5	3.3	32.7	38.9	14.2	3.2	1.1	Sand, M-C
145		1.1	4.1	1.6	2.9	9.2	29.0	33.4	14.9	3.2	.6	Sand, M-C
152				1.4	7.2	23.9	38.2	19.7	6.8	1.9	.9	Sand, C-VC
157				.5	1.6	13.2	45.5	28.6	7.4	1.9	1.2	Sand, C-M
162					.1	5.2	23.0	43.9	20.6	5.1	2.1	Sand, M-C
167					.2	4.7	26.5	43.3	17.1	5.4	2.8	Sand, M-C
172					.2	2.2	19.1	40.7	24.8	8.3	4.8	Sand, M-F
177				.1	.6	3.6	15.0	34.9	29.0	10.9	5.9	Sand, M-F
182		.8		.1	.4	3.1	17.4	31.1	28.9	11.6	6.6	Sand, M-F
187				.1	.1	.6	6.2	33.6	41.2	12.2	6.1	Sand, F-M
192				.1	.2	.2	1.8	14.0	54.3	21.4	8.1	Sand, F
197				.2	.1	.2	1.7	18.6	51.6	21.4	6.3	Sand, F
202				.1	.1	1.1	6.6	28.6	39.2	17.8	6.6	Sand, F-M
207				.3	.2	.6	4.6	31.7	43.5	15.2	3.9	Sand, F-M
212					.1	.3	4.4	34.7	43.9	12.9	3.6	Sand, F-M
217					.1	.2	1.8	12.7	36.0	35.3	13.9	Sand, F-VF, silty
222				.1	.2	.2	.8	7.8	42.2	35.8	12.9	Sand, F-VF, silty
227				.1	.1	.2	.7	5.3	55.4	30.6	7.6	Sand, F
232				.2	.2	.2	.7	5.6	40.1	38.6	14.4	Sand, F-VF, silty
237				.1	.1	.5	4.0	16.5	48.0	24.0	6.8	Sand, F-VF
242						.2	1.9	30.6	50.9	13.2	3.2	Sand, F
247				.2	.1	.2	2.7	19.3	44.4	22.0	11.0	Sand, F-VF, silty
252				.1	.1	.2	1.7	14.4	48.1	25.6	9.8	Sand, F-VF, silty
257					.1	.1	.9	10.3	43.6	37.7	7.1	Sand, F-VF
262						.3	2.9	21.5	56.4	16.6	3.0	Sand, F
267						.1	3.1	20.6	51.1	20.9	4.2	Sand, F
272					.1	.7	7.3	25.4	44.1	18.7	3.7	Sand, F-M
277					.1	.2	1.2	7.6	49.4	34.3	7.2	Sand, F-VF
282						.1	.3	6.0	45.8	40.3	7.4	Sand, F-VF
287					.1	1.1	4.1	17.4	47.0	23.2	7.2	Sand, F-VF
292					.1	.1	.4	2.7	32.5	52.4	11.8	Sand, VF, silty
297				.2	.2	.2	1.7	6.6	43.3	40.1	7.7	Sand, F-VF
302						.1	1.6	9.3	31.8	44.4	12.8	Sand, VF-F, silty
307		.1		.1	.2	.2	1.2	11.0	38.6	34.7	13.9	Sand, F-VF, silty
312					.1	.2	1.3	11.7	38.9	34.4	13.4	Sand, F-VF, silty
317				.2	.2	.4	1.6	9.9	39.6	34.4	13.9	Sand, F-VF, silty
323				.2	.2	.9	5.0	18.5	35.7	26.1	13.2	Sand, F-VF, silty
327				.2	.3	1.4	5.8	18.6	42.8	22.2	8.7	Sand, F-VF
332					.1	.3	2.7	12.8	40.6	32.1	11.4	Sand, F-VF, silty
337				.4	.4	.6	2.4	12.4	44.0	27.2	12.8	Sand, F-VF, silty
342			.2	.3	.9	1.4	3.4	13.2	34.5	33.8	12.3	Sand, F-VF, silty
347			.2	2.4	2.9	2.6	4.1	16.6	44.3	15.7	11.4	Sand, F-VF, silty
352			2.2	6.5	15.7	21.0	17.9	12.0	11.4	8.1	5.1	Sand, VC-M, gravelly
355		2.5	5.5	11.2	15.8	25.8	19.9	8.7	5.8	4.5	.4	Sand, VC-M, gravelly
362				1.3	2.8	7.2	17.8	25.3	29.7	11.7	4.3	Sand, F-VF
366-368		2.7	2.2	4.9	6.0	9.3	20.0	24.5	19.2	8.2	2.8	Sand, C-F
371-373			.9	2.2	5.4	9.6	14.1	16.2	29.1	18.6	4.1	Sand, VF-M
376-377.5		.8	3.9	5.2	8.6	7.1	4.2	5.6	27.0	30.5	7.1	Sand, VF-F, gravelly
380-382		1.5	2.6	8.0	12.0	19.6	28.3	17.9	7.4	2.1	.7	Sand, VC-M
384-386			1.3	4.0	8.5	18.1	30.3	23.1	9.4	3.5	1.9	Sand, C-M

Table 3.--Drawdowns and recoveries during test of September 30 - October 2, 1979. Pumping rate from the test well was 300 gal/min. Observation Wells (OW) 1, 2, and 3 were 148.9 ft, 100.3 ft, and 22.7 ft, respectively, from the test well. Pumping began at 1:30 p.m. on September 30 and ended 24 hours later. Recovery measurements were discontinued on October 2 at 1:30 p.m.

DRAWDOWNS (in feet)

Time (min)	Test well	OW 1	OW 2	OW 3
.17				0.23
.33				.64
.50				.68
.58	7.5			
.67				.82
1				.94
1.17	28.45			.99
1.5	28.61			1.06
1.67				1.08
2			0.46	1.14
2.1	28.79			
2.5	28.89		.52	1.19
3	28.87		.56	1.22
3.5			.59	1.25
4			.61	1.26
4.5			.63	1.30
5			.64	1.30
5.5			.66	1.32
6			.68	1.33
6.5				1.34
7		0.56		1.35
7.5		.57		1.36
8			.73	1.37
8.5			.75	1.38
9			.76	1.42
9.5		.61		
10		.63		1.44
10.5		.63		
11			.79	
12	29.07		.80	1.46
12.5		.67		
13			.74	
14			.83	
15	29.15	.69		1.49
16			.86	
17		.72		
18			.87	
19		.74		
20	29.18		.90	1.54
22		.76		
24			.93	
25	29.16			1.57
26		.79		
30	29.14			
31		.82		
40	29.27		1.01	1.67
41		.86		
50	29.21		1.05	1.69
51		.90		
60	29.41		1.09	1.74
61		.93		
70	29.37		1.12	1.74
71		.96		
80	29.39		1.14	1.77
81		.99		
90	29.43		1.15	1.80
91		1.01		
100	29.45		1.17	1.82
101		1.02		
120	29.47	1.05	1.21	1.85
150	29.51	1.08	1.24	1.88
200	29.53	1.11	1.26	1.98
250	29.61	1.14	1.30	2.02
300	29.62	1.16	1.31	2.03
400	29.78	1.17	1.34	2.07
500	29.84	1.19	1.35	2.08
600	29.86	1.19	1.35	2.12
700	29.85	1.18	1.34	2.13
800	29.85	1.18	1.34	2.11
1000	30.16	1.19	1.34	2.08
1200	29.65	1.20	1.29	1.99
1440	29.67	1.19	1.35	2.06

RECOVERIES (in feet)

Time (min)	Test well	OW 1	OW 2	OW 3
.17				0.32
.30				
.33				.42
.5			0.18	.68
.67				.84
.75	28.78			
.83				.94
1.0		0.20		1.03
1.5	28.76		.41	1.10
2.0		.32		1.13
2.1	28.75			
2.5	28.84		.52	1.19
3	28.87	.40		1.23
3.5	28.86		.58	1.27
4	28.90	.44		1.30
4.5	28.94		.63	1.33
5	28.96	.50		1.35
5.5			.67	
6	29.00	.52		1.37
7	29.03		.71	1.39
8	29.05	.58		1.42
9			.75	1.45
10	29.09	.61		1.48
11			.79	
12	29.13	.64		1.50
13			.81	
14		.67		
15	29.18		.84	1.55
18		.70		
20	29.23		.89	1.56
23		.75		
25	29.27		.94	1.60
28		.78		
30	29.30		.96	1.62
38		.85		
40	29.35		1.02	1.68
48		.88		
50	29.39		1.06	1.72
58		.92		
59.5		.93		
60	29.43		1.09	1.77
69.5		.95		
70	29.45		1.11	1.76
80	29.49	.97	1.14	1.78
90	29.51	.99	1.16	1.83
100	29.53	1.01	1.18	1.84
120	29.19	1.06	1.21	1.89
150	29.25	1.08	1.24	1.93
200	29.30	1.13	1.29	1.97
250	29.33	1.16	1.32	2.01
300	29.34	1.17	1.34	2.02
400	29.37	1.19	1.36	2.03
500	29.38	1.21	1.37	2.05
600	29.37	1.23	1.40	2.08
700	29.42	1.26	1.43	2.11
800	29.44	1.29	1.45	2.13
1000	29.49	1.33	1.50	2.18
1200	29.51	1.35	1.50	2.19
1320	29.52			
1400		1.41	1.57	2.24

Table 4.--Drawdowns and recoveries during test of October 4-6, 1979. Pumping rate from Observation Well (OW) 3 was 290 gal/min. OW 1 and OW 2 were 132.4 ft and 86.5 ft, respectively, from the pumped well. Pumping began at 1:30 p.m. on October 4, and ended 24 hours later. Recovery measurements were discontinued at 1:30 p.m. on October 6.

Time (min)	DRAWDOWNS (in feet) OW 1	OW 2	OW 3
0			
.17	0.01	0.05	
.34	.03	.11	
.50	.09	.20	
.68	.17	.29	
.85	.20	.39	
1	.22	.38	
1.5	.28	.45	
1.75			40.28
2	.34	.51	40.38
2.5	.38	.56	40.53
3	.41	.59	40.53
3.5	.45	.62	40.51
4	.47	.65	40.52
4.5	.49	.67	40.54
5	.50	.69	40.54
5.5	.52		
6	.54	.73	39.54
6.5	.56		
7	.57	.75	40.18
7.5	.57		
8	.58	.77	40.21
8.5	.59		
9	.61	.80	40.25
10	.62	.82	40.32
11		.83	
12	.64	.84	40.43
13		.86	
14		.87	
15	.68	.89	40.59
20	.73	.93	40.62
25	.77	.96	40.64
30	.81	1.00	40.63
35			40.74
40	.84	1.04	40.71
45			40.78
50	.88	1.07	40.84
60	.91	1.09	40.83
70	.92	1.12	40.87
80	.94	1.13	41.01
90	.96	1.14	41.05
100	.97	1.16	41.06
120	.98	1.18	41.09
150	1.00	1.20	41.12
200	1.01	1.22	41.21
250	1.02	1.22	41.41
300	1.02	1.23	41.72
400	1.01	1.19	41.13
500	.98	1.17	41.45
600	.93	1.13	41.91
700	.85	1.07	41.62
800	.79	1.00	41.42
900	.70	.91	41.17
1000	.66	.87	40.83
1200	.54	.76	40.57
1440	.46	.66	40.91

Time (min)	RECOVERIES (in feet) OW 1	OW 2	OW 3
0	0	0	0
.17	.02	.02	
.34	.06	.12	
.50	.14	.20	
.68	.20	.28	
.85	.21	.33	
1	.24	.37	
1.5	.31	.46	
1.68			40.64
2	.37	.52	40.72
2.5	.39	.56	40.77
3	.43	.59	40.81
3.5	.45	.62	40.85
4	.48	.64	40.87
4.5		.67	40.89
5	.52	.68	40.91
6	.56	.71	40.95
7	.58	.75	40.97
8	.61	.77	41.01
9	.63	.79	41.03
10	.64	.81	41.04
12	.68	.84	41.08
15	.72	.88	41.11
20	.77	.94	41.16
25	.81	.97	41.21
30	.84	1.00	41.24
35	.87	1.04	41.27
40	.90	1.07	41.30
50	.94	1.10	41.34
60	.97	1.15	41.35
70	1.00	1.18	41.39
80	1.02	1.20	41.42
90	1.04	1.23	41.46
100	1.07	1.25	41.48
120	1.10	1.28	41.51
150	1.14	1.32	41.54
200	1.22	1.41	41.65
250	1.25	1.44	41.67
300	1.28	1.46	41.70
400	1.41	1.51	41.75
500	1.46	1.56	41.80
600			
700			
760	1.48	1.65	41.89
800	1.49	1.67	41.90
900	1.51	1.70	41.94
1000	1.55	1.74	41.96
1200	1.57	1.75	41.98
1440	1.57	1.75	

Table 5.--Drawdowns and recoveries during the test of February 5-7, 1980. Pumping rate from the test well was 300 gal/min. Observation Wells (OW) 1 and 2 were 148.9 ft and 100.3 ft, respectively, from the test well. Pumping began at 1:30 p.m. on February 5, and ended 24 hours later. Recovery measurements were discontinued on February 7 at 1:30 p.m. The water level in OW 3 was 9.7 ± .05 throughout the test.

	DRAWDOWNS (in feet)		
Time (min)	Test well	OW 1	OW 2
0			
0.5		0.04	0.07
1		.11	.17
1.2	39.81		.20
1.5	40.13	.15	.23
2		.18	.26
2.2	40.14		
2.5		.19	.29
3	40.20	.22	.27
3.5	40.22	.24	.34
4	40.26	.25	.34
4.5	40.28	.27	.36
5	40.26	.28	.38
5.5		.29	.39
6	40.28	.30	.40
7	40.29	.32	.42
8	40.33	.33	.43
9	40.35	.34	.44
10	40.35	.36	.45
12	40.38	.38	.45
15	40.39	.40	.49
18	40.53	.42	.51
20	40.49	.43	.53
25	40.53	.45	.61
30	40.54	.46	.65
35	40.60	.48	.66
40	40.58	.49	.67
45	40.57	.50	.68
50	40.64	.51	.69
60	40.64	.52	.70
70	40.62	.53	.72
80	40.62	.55	.74
90	40.66	.56	.75
100	40.64	.57	.76
120	40.77	.58	.77
150	40.82	.60	.78
180	40.80	.61	.80
200	40.77	.61	.80
250	40.75	.62	.81
300	40.77	.63	.82
350	40.74	.64	.83
400	40.77	.64	.83
450	40.93	.65	.83
500	40.86	.65	.84
600	40.91	.65	.84
700	40.96	.65	.84
800	40.94	.65	.83
900	40.90	.64	.82
1000	41.04	.64	.82
1110	41.01	.64	.82
1200	41.04	.64	.82
1300	41.07	.64	.82
1440	41.12	.63	.82

	RECOVERIES (in feet)		
Time (min)	Test well	OW 1	OW 2
0			
.25		0.01	0.02
.33	32.52		.04
.42		.02	.07
.58		.05	.11
.65	37.53	.08	
.83		.10	
.97	39.24		
1		.10	.18
1.5	41.34	.15	.23
2		.18	.32
2.5		.21	.30
2.92	40.69		
3		.23	.32
3.92	40.72		
4		.26	.36
4.5	40.76	.27	.37
5	40.77	.28	.38
5.5	40.77	.29	.39
6	40.79	.31	.40
6.5	40.80	.32	.41
7	40.80	.33	.42
7.5	40.81	.33	.42
8	40.82	.34	.43
9	40.83	.35	.44
10	40.85	.37	.46
12	40.87	.38	.48
15	40.89	.41	.51
17	40.89	.42	.52
20	40.92	.44	.54
25	40.95	.46	.56
30	40.97	.48	.58
35	40.98	.49	.59
40	40.99	.50	.61
50	41.01	.53	.63
60	41.02	.55	.66
80	41.06	.57	.68
100	41.09	.59	.70
120	41.11	.62	.72
150	41.13	.65	.76
180	41.16	.67	.77
200	41.17	.68	.79
250	41.19	.70	.79
300	41.20	.72	.81
400	41.24	.76	.85
500	41.27	.79	.89
600	41.29	.81	.92
700	41.32	.85	.95
800	41.35	.89	.98
900	41.38	.91	1.01
1000	41.41	.93	1.03
1200	41.46	.99	1.08
1400	41.57	1.09	1.16

Table 6.--Chemical analyses of water from wells at the Mendenhall Valley test site.

	Test well			Observation well 1	Observation well 3				
Date	Aug. 9, 1974	Oct. 1, 1979	Feb. 6, 1980	Sept. 10, 1974	Oct. 4, 1979	Oct. 19, 1979	Oct. 23, 1979	Oct. 30, 1979	Nov. 9, 1979
Sample depth (ft)	55-60	78-82	102-106	67-72	63-67	162	192	272	349-360
Spec. conductance (µmho/cm at 25°C)	152	160	155	140	170	200	238	364	23,000
Temperature (°C)	6.0	5.5	5.0	6.0	5.5	5.6	5.8	6.5	6.5
pH (units)	6.4	6.8	6.8	6.4	6.8	---	---	7.7	7.4
CATIONS AND ANIONS (dissolved concentration in mg/L)									
Dissolved solids (calc.)	93	95	85	86	95	---	---	217	14,700
Silica	9.0	7.4	7.3	6.9	7.5	---	---	3.7	23
Hardness (total)	72	72	63	70	74	---	---	49	2,000
Hardness (noncarbonate)	2	3	0	5	6	---	---	0	1,000
Calcium	25	25	22	23	26	---	---	15	120
Magnesium	2.3	2.2	2.0	3.0	2.3	---	---	2.7	410
Sodium	1.7	1.3	1.4	1.1	1.4	---	---	65	5,000
Potassium	2.7	2.9	2.6	2.7	3.0	---	---	6.8	180
Alkalinity	85	84	85	79	84	---	---	110	1,180
Sulfate	7.2	12	4.4	7.0	11	---	---	11	63
Chloride	1.4	.8	1.2	1.3	.7	---	---	56	8,300
Fluoride	.1	.1	0.0	.1	.0	---	---	.1	.4
Nitrite + nitrate as N	.19	.41	.48	.33	.33	---	---	.39	.01
Carbon dioxide	54	21	22	50	21	---	---	3.5	75
METALS (dissolved concentration in µg/L)									
Arsenic	0	0	0	0	0	---	---	1	15
Barium	---	60	50	---	60	---	---	50	600
Cadmium	---	<1	<1	---	<1	---	---	<1	0
Chromium	---	0	0	---	0	---	---	0	0
Copper	0	0	0	0	0	---	---	0	0
Iron	1,100	30	10	40	40	---	---	150	770
Lead	1	0	0	2	0	---	---	0	0
Manganese	30	<1	1	0	1	---	---	190	330
Mercury	---	0.0	0.0	---	.1	---	---	.1	0.0
Selenium	---	0	0	---	0	---	---	0	0
Silver	0	0	0	0	0	---	---	1	0
Zinc	20	20	20	0	20	---	---	10	0

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