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DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

AQUIFER TEST, SOLDOTNA, ALASKA

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Prepared in cooperation with the city of Soldotna
and the Kenai Peninsula Borough

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INTRODUCTION

The results of an aquifer test on a production well drilled by Soldotna Drilling Company for the city of Soldotna are presented in this report. The well was tested on July 23, 1971, by Adams, Corthell, Lee, Wince and Associates. The U.S. Geological Survey, in cooperation with the city of Soldotna and the Kenai Peninsula Borough, assisted in the test as a part of a boroughwide water-resources study.

METHOD OF TEST

The production well (fig. 1) used for the test had been drilled to 202 feet and was finished by using knife perforated casing from 99 to 123 feet (table 1). Two existing wells, the unused Parker well and the Soldotna test well, located 680 and 529 feet, respectively, from the production well (fig. 1), were measured to determine water-level changes during the test (tables 2 and 3). The Parker well was equipped with an automatic water-level stage recorder. Head measurements on the Soldotna test well, a flowing artesian well, were made by extending the casing by use of a transparent potentiometric tube in which water level could be directly read.

During the 10-hour test, the average pumping rate of the production well was 410 gpm (gallons per minute). Water levels prior to pumping were obtained from the Parker well. Extension of these data through the pumping cycle indicate that adjustments were not necessary.

SUMMARY OF TEST RESULTS

Drawdown and recovery data (tables 4-7) obtained by measuring water levels in the Parker well and the Soldotna test well during and following the pumping period were plotted against time on logarithmic paper. The time-drawdown and recovery graphs (figs. 2-3) were analyzed by the modified leaky-aquifer method developed by Hantush (1960). Recovery was calculated by subtracting the residual drawdown from the theoretical drawdown determined by extending the observed drawdown curve beyond the pumping period (tables 5 and 7).

The geologic and hydrologic setting of the Soldotna test well and the results of the aquifer test indicate leaky artesian conditions. The production well is deriving water from storage in the main aquifer, storage in the semiconfining units, and induced leakage through the semiconfining units.

The values of the leakage and storage parameter (β), and the transmissivity (T) and storage coefficient (S) of the main aquifer determined in the analysis are summarized in table 8.

The leakage and storage parameter (β) is a complex term characterizing the thickness, permeability, and storage coefficient of the semiconfining units. The data from this hydraulic test are not adequate to determine a unique solution for the leakage and storage parameter (β), or the individual components of this parameter. An average or best fit for β is given together with the range of probable β's for each test.

Because of the range of probable β values, ranges are also given for transmissivity and storage coefficient. The transmissivity is the rate at which water of the prevailing kinematic viscosity is transmitted through a unit width of the main aquifer under unit hydraulic gradient. The storage coefficient is the volume of water an aquifer releases from or takes into storage per unit of surface area of the aquifer per unit change in head.

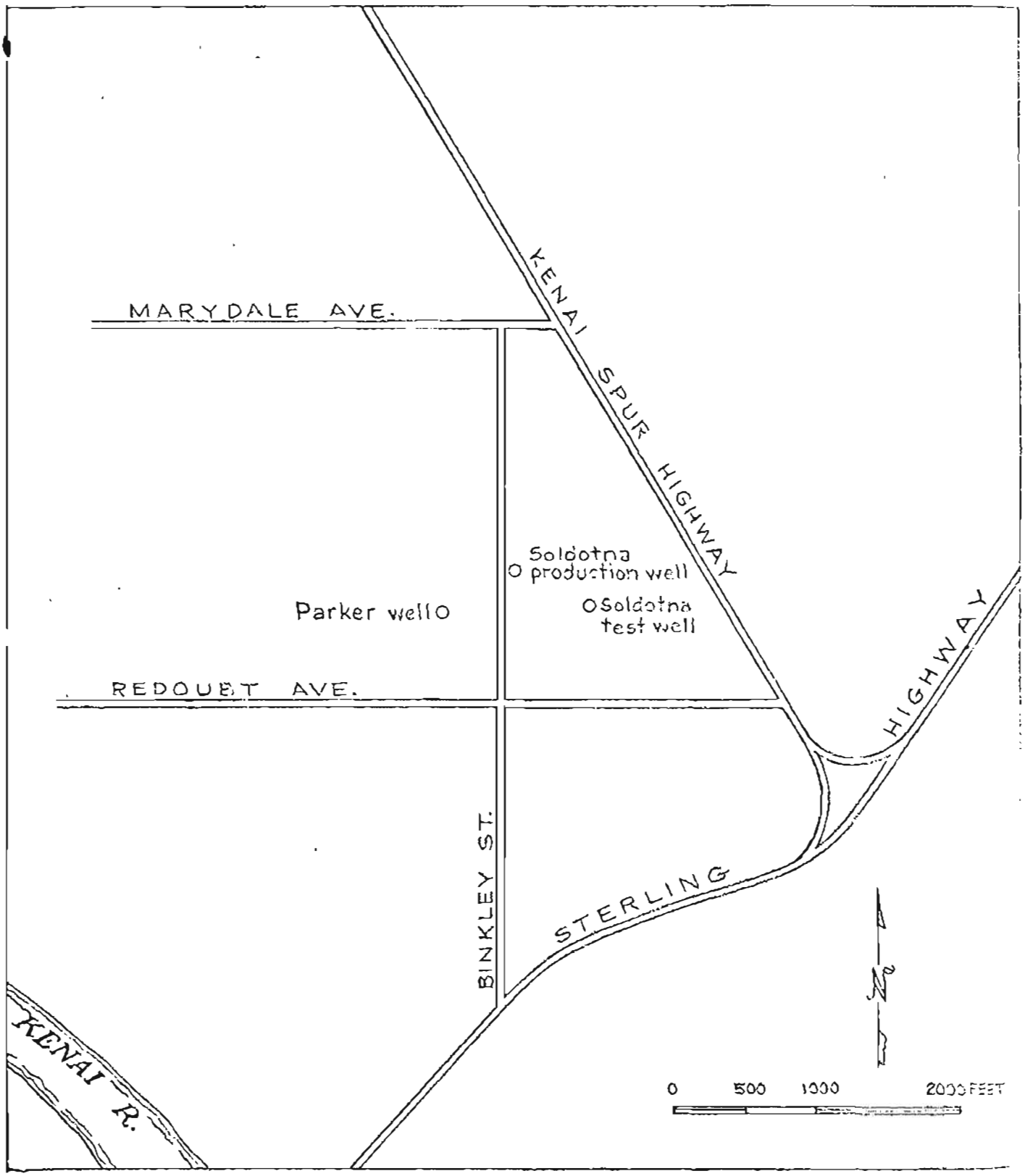

Figure 1.--Location map of test, production, and observation wells.

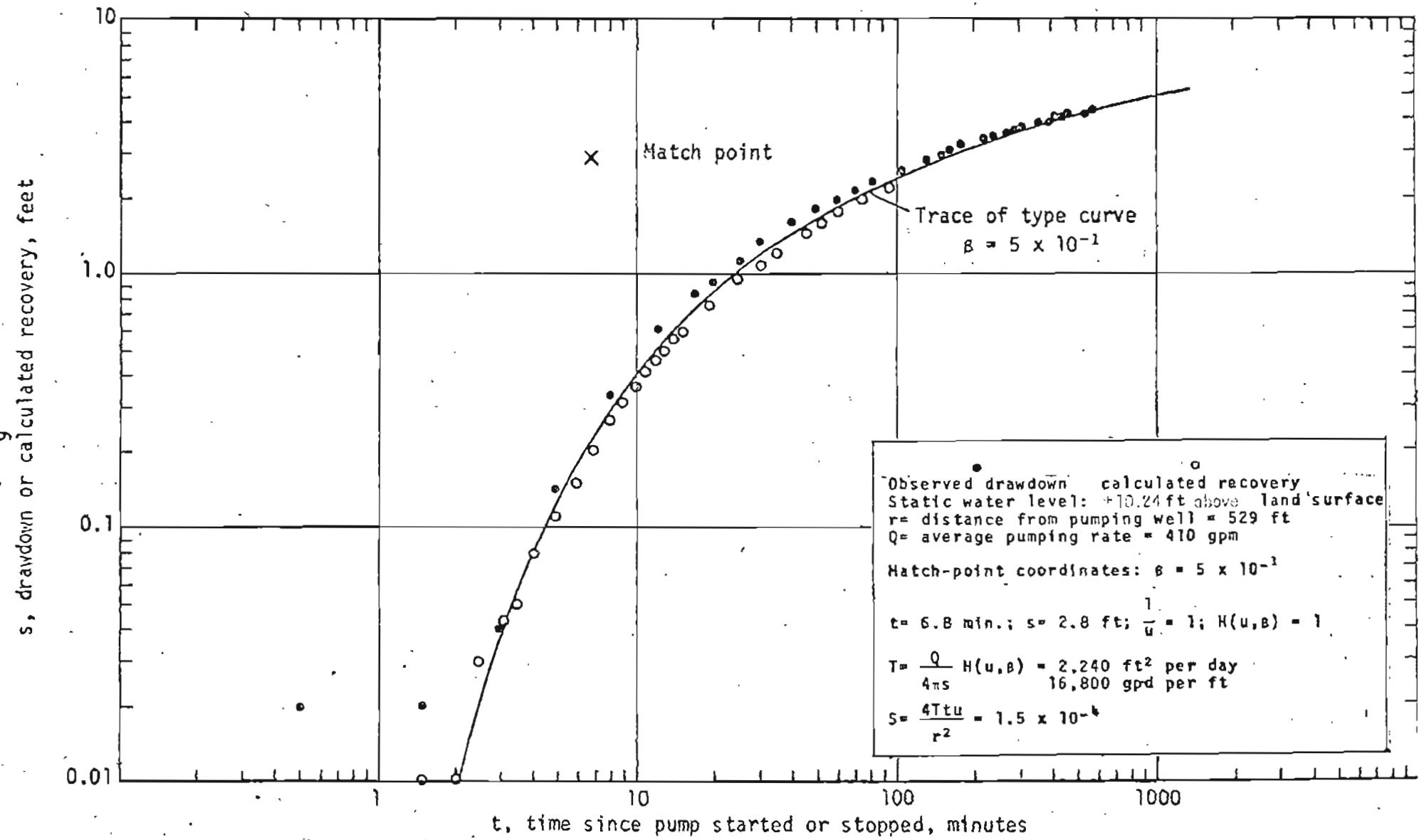

Figure 2.--Logarithmic plot of drawdown and recovery in Soldotna test well during pumping of Soldotna production well, July 23, 1971.

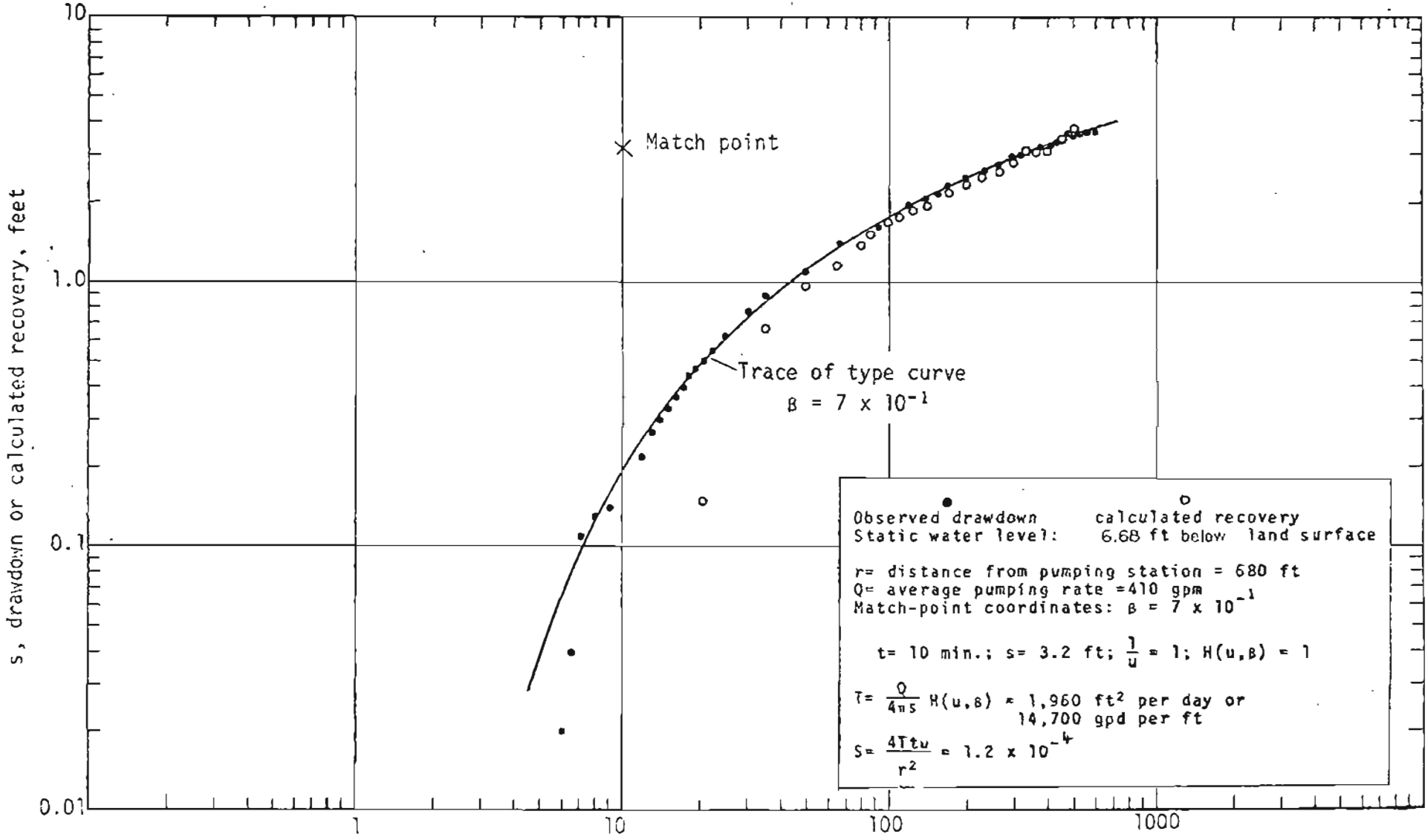

Figure 3.--Logarithmic plot of drawdown and recovery in Parker well during pumping of Soldotna production well, July 23, 1971.

Table 1.--*Driller's log of Soldotna production well.*

[Drilled 1971, by the Soldotna Drilling Co., Soldotna, Alaska. Diameter, 10 inches, cased from surface to 165 feet, perforated 99 to 123 feet.]

Material	Thickness (feet)	Depth (feet)
Backfill, soil and gravel mix.	16	16
Gravel, medium to coarse, solid.	19	35
Clay, blue-gray, hard, and some boulders	10	45
Clay, solid.	6	51
Clay, soft, sticky	7	58
Sand, fine to medium, and a few small gravels; water-bearing, very silty, static level 11 ft.	12	70
Clay and gravel, very hard	4	74
Gravel, medium to coarse, and clay lenses; water-bearing.	5	79
Clay and gravel; dry	19	98
Sand, silty, gravel, and clay; water-bearing	9	107
Sand, medium to coarse, loose and heaving, water-bearing, static level 8 ft	3	110
Sand, medium to coarse, and gravel, poorly graded with loose pieces of siltstone; water-bearing.	4	114
Sand, medium to coarse, and gravel, loose and heaving, water-bearing	4	118
Sand, fine to medium and gravel; water-bearing	7	125
Clay, soft, gray-brown	13	138
Sand, fine, gray, compact; water-bearing	16	154
Clay, soft	6	160
Clay, very hard, blue	26	186
Clay, silty, solid	24	210
Sand, fine, gray; water-bearing.	1	211

Table 2.--*Driller's log of Soldotna test well.*

[Drilled 1968, by the Thorn Drilling Co., Soldotna, Alaska. Diameter, 6 inches, cased from surface to 158 feet; perforated 57 to 63.5, 77 to 91, 94 to 96, and 101 to 106 feet.]

Material	Thickness (feet)	Depth (feet)
Gravel and sand	5	5
Gravel, cemented	11	16
Gravel with some clay	6	22
Clay, blue	3	25
Gravel and clay, hard	6	31
Clay, blue, and some gravel	18	49
Clay, silt, and sand	3	52
Boulders	1	53
Silt and sand, water-bearing	3.5	56.5
Sand, coarse, water-bearing	7.5	64
Gravel, cemented	3	67
Sand, medium, water-bearing	2	69
Clay and gravel	8	77
Silt, sand, and some gravel, loose, water-bearing	12	89
Pea gravel and coarse sand	2	91
Sand, coarse, water-bearing	10	101
Silt, sand, and gravel	5	106
Sand, medium, and some gravel	6	112
Silt and clay, no water	3	115
Silt and some clay, water-bearing	4	119
Silt, sand, and fine gravel	1	120
Silt, water-bearing	17	137
Sand, fine, water-bearing	7	144
Sand, medium, and some gravel	2	146
Sand, medium	8	154
Clay, blue	2	156

Table 3.--*Driller's log of Parker well.*

[Drilled by Western Drilling Co. Diameter, 8 inches, perforated 80 to 97 feet.]

Material	Thickness (feet)	Depth (feet)
Topsoil	2	2
Gravel	21	23
Clay	3	26
Silt and rock	55	81
Gravel; water-bearing	16	97
Sand	3	100

Table 4.--*Time-drawdown data, Soldotna test well.*

Date	Clock time	Time since pump test started, t, *minutes*	Water level, feet above land-surface datum	Drawdown, s, feet	Remarks
7-23-71	8:10	0	+10.24	0	Test started
		0.5	10.22	0.02	Q = 450 gpm at 8:10
		1.5	10.22	.02	
		3.0	10.22	.04	
		5.0	10.10	.14	
		8.0	9.91	.33	
		12.0	9.64	.64	
		15.0	9.40	.84	
		17.0	9.40	.84	
		20.0	9.32	.92	
		25.0	9.13	1.11	
		30.0	8.93	1.31	
		40.0	8.64	1.60	
	9:00	50.0	8.44	1.80	
		60.0	8.27	1.97	Reduced Q to 400 gpm at 9:10
		70.0	8.14	2.10	
		82.0	7.97	2.27	
		105	7.74	2.50	
		130	7.47	2.77	
		150	7.32	2.92	
		160	7.24	3.00	
		180	7.10	3.14	
		220	6.89	3.33	
		240	6.79	3.45	
		270	6.66	3.58	
	13:00	290	6.56	3.68	
		310	6.47	3.77	
		355	6.34	3.90	
		380	6.25	3.99	
	15:00	410	6.19	4.05	
		440	6.10	4.14	Pump stopped at 17:40
		460	6.04	4.20	Average Q for period pumped
		540	5.90	4.34	was 410 gpm
		568	5.85	4.39	

Table 5.--*Time-recovery data, Soldotna test well.*

Date	Clock time	Time since pump stopped, t', minutes	Water level, feet above land-surface datum	Residual drawdown, s', feet	Drawdown, s, from pumping curve, feet	Calculated recovery (s-s'), feet
7-23-71	17:40	0	+5.85	4.39	4.39	0
		0.5	5.85	4.39	4.39	0
		1.0	5.85	4.39	4.39	0
		2.0	5.85	4.39	4.40	0.01
		2.5	5.86	4.38	4.41	0.03
		3.0	5.87	4.37	4.41	0.04
		3.5	5.88	4.36	4.41	0.05
		4.0	5.90	4.34	4.42	0.08
		5	5.93	4.31	4.42	0.11
		6	5.97	4.27	4.42	0.15
		7	6.02	4.22	4.42	0.20
		8	6.07	4.17	4.43	0.26
		9	6.12	4.12	4.43	0.31
	17:50	10	6.17	4.07	4.43	0.36
		11	6.22	4.02	4.43	0.41
		12	6.26	3.98	4.43	0.45
		13	6.30	3.94	4.43	0.49
		14	6.35	3.89	4.44	0.55
		15	6.39	3.85	4.44	0.59
		19	6.55	3.69	4.44	0.75
	18:00	20	6.58	3.66	4.44	0.78
		25	6.74	3.50	4.46	0.96
		30	6.87	3.37	4.46	1.09
		35	6.98	3.26	4.47	1.21
		45	7.18	3.06	4.48	1.42
		52	7.31	2.93	4.50	1.57
		60	7.44	2.80	4.52	1.72
		75	7.62	2.62	4.54	1.92
	19:15	95	7.82	2.42	4.57	2.15

Table 6.--*Time-drawdown data, Parker well.*

Date	Clock time	Time since pump test started, t, minutes	Water level, feet below marking point	Drawdown, s, feet	Remarks
7-22-71	18:10	-	10.74	-	
7-23-71	8:10	0	9.68	0	
		4.0	9.68	0	Test started
		5.0	9.68	0	Q = 450 gpm at 8:10
		6.0	9.68	0	
		6.5	9.69	0.01	
		7.0	9.76	.08	
		8	9.78	.10	
		9	9.79	.11	
		10	9.84	.16	
		12	9.87	.19	
		13	9.93	.25	
		14	9.95	.27	
		15	9.98	.30	
		16	10.01	.33	
		17	10.05	.37	
		18	10.09	.41	
		19	10.12	.44	
		20	10.15	.47	
		22	10.20	.52	
		25	10.28	.60	
		30	10.43	.81	
		35	10.54	.86	
	9:00	50	10.75	1.07	
		60	-	-	Reduced Q to 400 gpm at 9:10
		65	11.00	1.32	
		80	11.10	1.42	

Table 6.--*Time-drawdown data, Parker well*--Continued.

Date	Clock time	Time since pump test started, t, minutes	Water level, feet below marking point	Drawdown, s, feet	Remarks
7-23-71	9:45	95	11.30	1.62	
		120	11.62	1.94	
		140	11.70	2.02	
		155	11.80	2.12	
	11:00	170	12.00	2.32	
		200	12.15	2.47	
	12:00	230	12.30	2.62	
		260	12.45	2.77	
	13:00	290	12.60	2.92	
		320	12.75	3.07	
		350	12.80	3.12	
		380	12.90	3.22	
		410	13.00	3.32	
		440	13.10	3.42	
		470	13.21	3.53	
		500	13.25	3.57	
		530	13.30	3.62	
		560	13.35	3.57	
	17:40	570	13.38	3.70	Pump off

Table 7.--*Time-recovery curve, Parker well.*

Date	Clock time	Time since pump stopped, t', minutes	Water level feet below land-surface datum	Residual drawdown, s', feet	Drawdown, s, from pumping curve, feet	Calculated recovery (s-s'), feet
7-23-71	17:40	0	13.38	3.70	3.70	0
	18:00	20	13.30	3.62	3.77	0.15
	18:15	35	12.80	3.12	3.79	.67
	18:30	50	12.55	2.87	3.83	.96
	18:45	65	12.40	2.72	3.86	1.14
	19:00	80	12.22	2.54	3.88	1.34
	19:05	85	12.07	2.39	3.89	1.50
	19:15	95	11.95	2.27	3.91	1.64
	19:30	110	11.85	2.17	3.94	1.77
	19:45	125	11.80	2.12	3.97	1.85
	20:00	140	11.70	2.02	3.99	1.97
	20:30	170	11.50	1.82	4.04	2.22
	21:00	200	11.40	1.72	4.09	2.37
	21:30	230	11.30	1.62	4.13	2.51
	22:00	260	11.20	1.52	4.18	2.66
	22:30	290	11.07	1.39	4.22	2.83
	23:00	320	10.95	1.27	4.27	3.00
	23:30	350	10.90	1.22	4.30	3.08
	24:00	380	10.85	1.17	4.36	3.19
7-24-71	1:00	440	10.70	1.02	4.42	3.40
	2:00	500	10.58	.90	4.45	3.55
	3:00	560	10.48	.80	4.47	3.67
	4:00	620	10.38	.70	4.49	3.79

Table 8.--*Summary of aquifer tests of Soldotna production well, July 23, 1971.*

Observation well	Leakage and storage parameter (β)	Transmissivity (feet^2 day^{-1})	Storage coefficient
Soldotna test well			
Best fit	5×10^{-1}	2,240	1.5×10^{-4}
Range of fit	(1×10^{-1} to 7×10^{-1})	(4,170 to 1,840)	(3.1×10^{-4} to 1.2×10^{-4})
Parker well			
Best fit	7×10^{-1}	1,960	1.2×10^{-4}
Range of fit	(4×10^{-1} to 1)	(2,620 to 1,650)	(1.8×10^{-4} to 8.2×10^{-5})

REFERENCE CITED

Hantush, M. S., 1960, Modification of the theory of leaky aquifers: Jour. Geophys. Research, v. 65, no. 11, p. 3713-3725.