



Docket No: 4

Supporting Hydro Data

Water Resources Division
P.O. Box 340
Rolla, Missouri 65401

[illegible]

cc: Mo. Geol. Survey & Water Resources
P.O. Box 250, Rolla, Mo.



UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Water Resources Division
P.O. Box 340
Rolla, Missouri 65401

January 20, 1971

Mr. Don Barrett
U.S. Department of Interior
National Park Service
Western Service Center
450 Golden Gate Ave., Box 36035
San Francisco, California 94102

Dear Mr. Barrett:

Enclosed are reports of the wells drilled at Round Spring, Alley Spring and Big Spring. Each report consists of:

1. Location map of well with respect to the 50-year flood.
2. Description of the drilling and completion of the well.
3. Insoluble residue log by Missouri Geological Survey.
4. Driller's log.
5. Pump test data and drawdown curves.
6. Water analysis by Missouri Geological Survey.
7. Copy of strip chart from observation well at Round Spring only.

In addition we are furnishing a summary of the data obtained from the ~~six~~ wells drilled to date and their relationships to the knobs area in the vicinity of Eminence and Two Rivers and to the specific capacity map of the southern part of Missouri taken from Mineral and Water Resources of Missouri.

Time spent on the well drilling activities at the three sites consisting of well location, drilling, pump testing and report writing is summarized below:

Walter Oakes	34 days well location, drilling & pump testing.
Gerald Feder	2 days pump testing.
Leo Emmett	4 days pump testing & data analysis.
E. J. Harvey	6 days, drilling, pump testing & report writing.

It has been a pleasure to work with you on the drilling activities. If you have any questions regarding these reports or the data gathered please do not hesitate to write us.

Sincerely,

A handwritten signature in cursive script, appearing to read "E. J. Harvey".

*E. J. Harvey
Assistant District Chief*

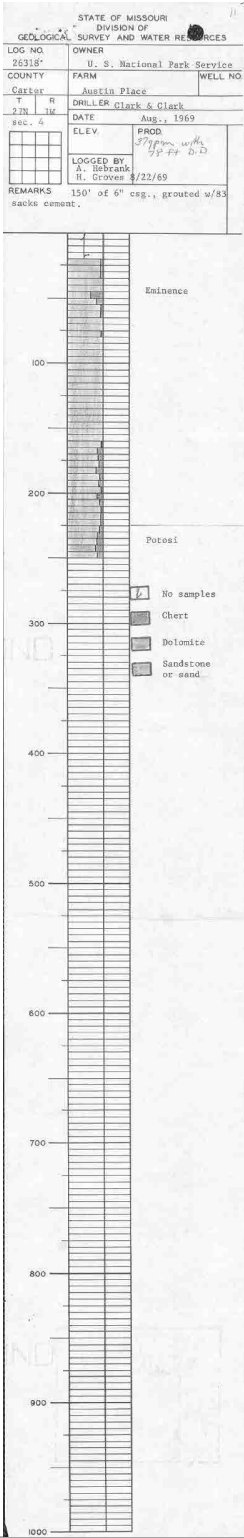
Enclosures

Austin House Well

The first 20 feet of the well was in coarse bouldery alluvium. From 20 feet to 225 feet the hole was in relatively tight Eminence Dolomite of Late Cambrian age. Mud pockets were encountered at 60 and 100 feet. Ten-inch diameter hole was drilled to 150 feet; 8 inch from 150 to 200 feet, and 6 inch from 200 to 250 feet. After drilling to 200 feet casing was installed to 150 feet and cemented. After the cement plug was drilled out and the hole cleaned out to 200 feet a bailer test was run. This indicated a yield of 4 gallons per minute (gpm). The well was then drilled to 250 feet. The last 15 feet of hole produced much water. A preliminary bailer test indicated at least 20 gpm. On August 14 a 5-horsepower submersible pump was set at 225 feet and a step drawdown test was made. The well was pumped for 100 minutes at 6 gpm, 100 minutes at 10 gpm, 100 minutes at 20 gpm, and finally 100 minutes at 37 gpm which was the capacity of the pump. The initial water level was 56.77 feet below the top of the casing. Each of the pumping rates indicated a specific capacity of the well of 0.5 gpm per foot of drawdown. After the step test was stopped the water level in the well recovered to within 0.5 foot of its initial level after 100 minutes. On August 15 the well was again pumped for 7.5 hours at 23 gpm. After one hour of pumping, additional drawdown was negligible, and the water level fluctuated due to slight variations in the pumping rate. Some of the fluctuation in the water level may also be attributed to natural daily water-level changes, and perhaps some additional development of the well during pumping. The results of this pump test also indicate a specific capacity of approximately 0.5 gallons per minute per foot of drawdown. A well 143 feet deep located about 200 feet southeast of the pumped well and presently used for the domestic water supply at Austin House showed no effect from pumping the new well.

Results of the pump test indicate that 20 gpm could be pumped continuously from this well with less than 50 feet of drawdown. The pump bowls should be set at about 150 feet for this pumping rate.

Analyzing the time-drawdown curves for determination of transmissibility gives meaningless results. In this well most of the water was produced in the last 15 feet of the hole. Within the 15 feet probably the water was discharged from openings which can be classified as secondary porosity. In summary, probably 95 percent of the bore had negligible permeability and 5 percent had good permeability.



WELL DRILLER'S REPORT

NATIONAL PARK SERVICE - LWSSC

Permit No. _____

1 WELL OWNER
Name U.S. Park Service PARK Ozark Nat.
Address _____ Owners Well No. _____
Local Site Name Austin Park

2 LOCATION OF WELL STATE MO
County Center Ground Water Basin _____
N/S _____ Ft., E/W _____ Ft. From _____ Corner
of Sec. 4, T. 27 N/S, R. 1 E/W, _____ M
Distance from cities, roads, railroads etc.
7 miles north of Van Buren, Mo

3 TYPE OF WORK (check) New Well ☒
Replacement Well ☐ Deepening ☐ Repair ☐
Destroying ☐ If destroying, describe material & procedure _____

4 NATURE OF USE (check) Testwell ☒
Domestic ☐ Industrial ☐ Municipal ☐
Stockwater ☐ Irrigation ☐ Mining ☐
Others ☐ _____

5 DRILLING METHOD (check)
Rotary ☐ Cable Tool ☒ Other ☐

6 BORE DIAMETER & DEPTHS
10 in. from 0 ft. to 150 ft.
6 " " 150 " " 250 "
" " " " " " "
" " " " " " "

7 CASING SCHEDULE None ☐
Steel ☒ Welded ☐ Threaded ☒
Other ☐ New ☒ Used ☐
6 in. I.D. from 0 ft. to 150 ft. Gage 19.5
" " " " " " "
" " " " " " "
" " " " " " "
" " " " " " "
Casing extends above ground level _____ ft.

8 PERFORATIONS Perforated? Yes ☐ No ☒
Type of perforator used _____
Size of perforations _____ in. by _____ in.
Perforation per row _____ Rows per ft. _____
_____ perforations from _____ ft. to _____ ft.
" " " " " " "
" " " " " " "
" " " " " " "

9 SCREENS Well screen installed? Yes ☐ No ☒
Mfr's name _____
Type _____ Model No. _____
Diam. (in.) Slot size (in. x in.) Placed from (ft.) To (ft.)
_____ x _____ to _____
_____ x _____ to _____
_____ x _____ to _____

10 CONSTRUCTION Gravel Packed? Yes ☐ No ☒
Washed gravel? Yes ☐ No ☐ Gravel Size _____ in.
Gravel placed from _____ ft. To _____ ft.
" " " " " " "
Surface seal provided? Yes ☐ No ☐ Casing Seal? Yes ☒ No ☐
To what depth? 150 ft. Size or Diam. _____
Seal material 82 3/4s cement
Did any strata contain unpotable water? Yes ☐ No ☒
Type of contam. _____ Strata depth _____
Sealing method Pressure grouting
From 0 ft. To 150 ft.
" " " " " " "

11 WATER LEVELS (feet below ground surface)
Depth water first found 93.4 ft. date July 15-69
Static water level before perforating _____ " "
" " " " after _____ " "
" " " " developing 36 " " 8/14/69

12 FLOWING WELL (check) No control ☐
Controlled by? Valve ☐ Cap ☐ Plug ☐
Does well leak around casing? Yes ☐ No ☐
Artesian pressure _____ ft. above ground surface,
Artesian flow _____ g.p.m., date _____

13 WELL TESTS Dd - Drawdown is the distance in feet the water level is lowered below the static level.
Developed? Yes ☒ No ☐
Bailed _____ hrs., rate 18 gpm
Pumped 29 " " 23 "
Surged _____ hrs. method _____ rate _____
Pump test? Yes ☒ No ☐ By whom? Clark & Clark
Pump type Sum H.P. 3 Outlet size 3 1/2
Depth pumped from 231 ft., date 8/14/69
Yield 6 gpm w/ 11 ft. Dd., after 146 hrs
" 10 " " 18 " " 140 "
" 20 " " 37 " " 140 "
Bailer test 18 " " 22 " " 14 "
Recovery 80 ft. in 1 h 40 (Time)
Electric log? Yes ☐ No ☒ Chemical analysis? Yes ☐ No ☒
Water temp. 63 °F Quality Good

14 PUMP Installed? Yes ☐ No ☒
Mfr's name _____ Cap. _____
Type _____ H.P. _____ Model No. _____
Outlet size _____ in. Driven by _____
Depth to pump or bowels _____ ft. date _____

15 WELL DRILLER'S STATEMENT
Date started July 15-69 Date completed 8/14/69
State log filed? Yes ☒ No ☐

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Co. Name Clark & Clark Drilling Co
Name George H. Clark
Address P.O. Box 24, Festina, MO
License No. _____ Date Sept 8, 1969

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Austin House Pump Test
8/14/69

Pumping Rate, 6 gallons per minute (gpm)

<u>Time (minutes)</u>	<u>Depth to water (ft)</u>
0	56.75
1	68.30
2	70.90
3	67.30
4	66.65
5	66.40
6	66.30
7	66.35
8	66.20
9	66.92
10	65.30
15	65.20
20	65.30
25	66.02
30	66.28
35	66.64
40	66.95
45	66.84
50	66.90
55	66.93
60	67.20
65	67.22
70	67.24
75	67.20
80	67.30
85	67.05
90	67.01
95	67.33
100	67.60

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Austin House Pump Test
7/14/69

Pumping Rate, 10 gallons per minute (gpm)

<u>Time (minutes)</u>	<u>Depth to water (ft)</u>
1	69.70
2	70.31
3	70.61
4	71.45
5	71.82
6	72.11
7	72.12
8	72.36
9	72.60
10	72.76
15	73.02
20	73.38
25	73.62
30	73.79
35	73.61
40	73.38
45	73.02
50	75.58
55	73.80
60	73.08
65	75.22
70	74.88
75	74.86
80	74.95
85	74.92
90	74.80
95	74.75
100	74.79

6

Austin House Pump Test
8/14/69

Pumping Rate, 20 gallons per minute (gpm)

<u>Time (minutes)</u>	<u>Depth to water (ft)</u>
1	80.62
2	81.96
3	82.75
4	85.00
5	85.93
6	86.71
7	87.13
8	87.44
9	87.73
10	87.81
15	87.53
20	86.84
25	88.32
30	92.89
35	90.21
40	90.00
45	91.99
50	91.20
55	91.02
60	91.46
65	93.67
70	91.05
75	
80	93.59
85	92.56
90	93.00
95	93.18
100	93.26

7

Austin House Pump Test
8/14/69

Pumping Rate, 37 gallons per minute (gpm)

<u>Time (minutes)</u>	<u>Depth to water (ft)</u>
1	
2	
3	112.75
4	
5	116.47
6	117.82
7	119.32
8	120.35
9	121.40
10	122.25
15	125.54
20	127.36
25	128.47
30	129.68
35	130.55
40	131.20
45	131.69
50	131.93
55	132.10
60	132.43
65	132.66
70	133.03
75	132.99
80	133.28
85	133.55
90	
95	
100	133.82
105	133.82

Austin House Well - Recovery Test
8/14/69

<u>Time (minutes)</u>	<u>Depth to water (ft)</u>	
1	137.27	
2	116.13	
3	98.52	
4	88.70	
5	83.95	
6	80.76	
7	76.92	
8	77.36	
9	75.80	
10	74.47	
15	69.17	
20	64.12	
25	63.68	
30	62.19	
35	61.18	
40	60.37	
45	59.77	
50	59.35	
55	58.92	
60	58.63	
65	58.41	
70	58.23	
75		
80	57.86	
85		
90	57.67	
95		
100	57.52	- W.L. at start of test = 56.75

9

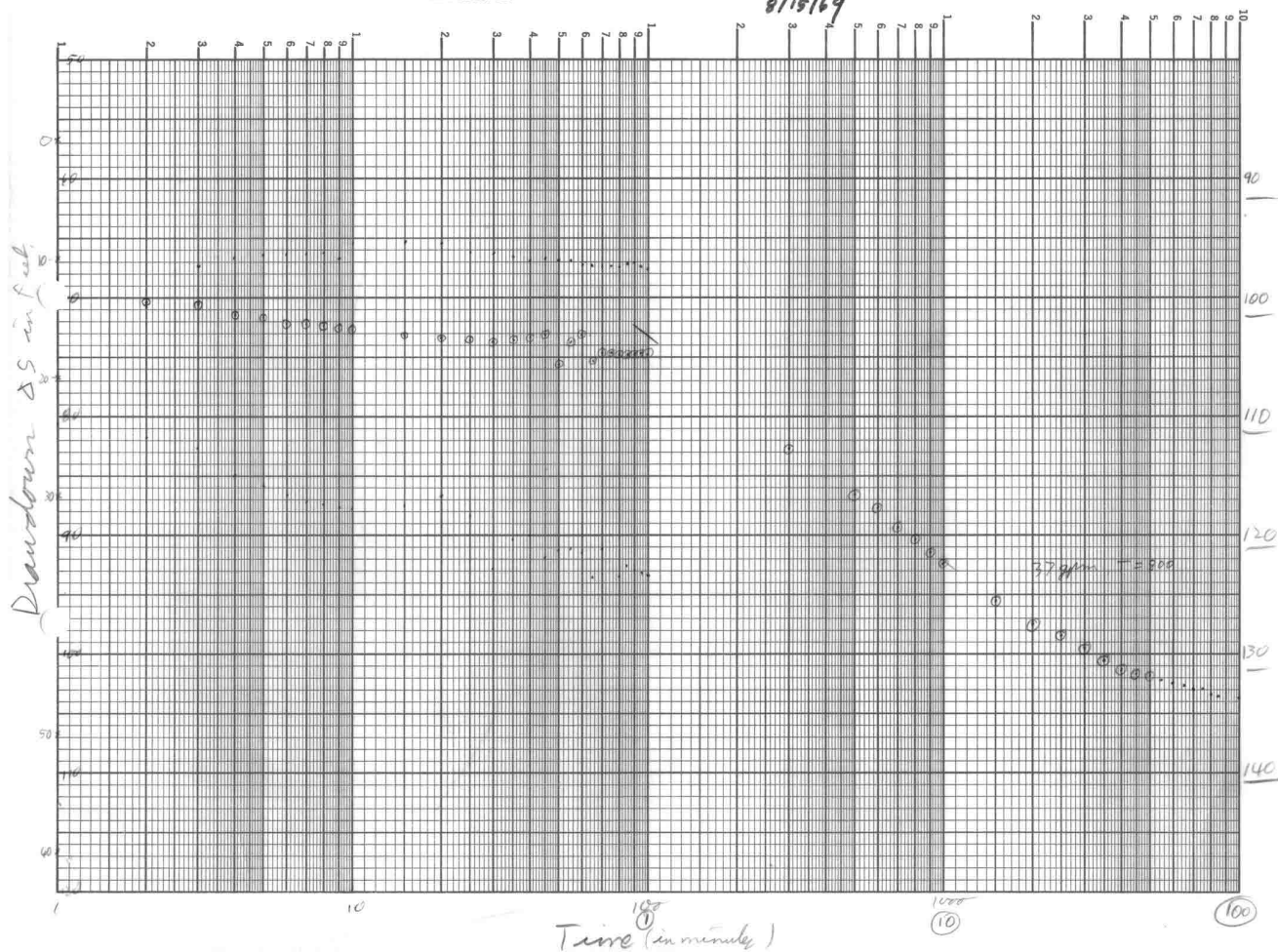
Austin House Well Pump Test
8/15/69

Pumping Rate, 23 gallons per minute (gpm)

<u>Time (minutes)</u>	<u>Depth to water (ft)</u>	<u>Time(minutes)</u>	<u>Depth to water(ft)</u>
0	56.65	105	102.36
1	84.24	110	102.01
2	90.13	120	101.89
3	91.25	125	101.88
4	91.71	135	101.84
5	91.71	140	101.85
6	91.70	160	101.83
7	92.06	171	101.79
8	92.50	180	101.83
9	92.78	195	102.24
10	92.91	210	102.35
15	97.29	225	100.85
20	99.82	240	99.51
25	101.37	255	98.79
30	102.75	270	98.62
35	103.12	300	98.09
40	103.17	306	101.46
45	103.13	310	101.43
50	103.09	315	101.55
55	102.89	330	101.00
60	102.48	345	99.90
65	102.59	360	99.46
70	102.65	365	101.95
75	102.92	380	103.04
80	102.99	395	102.84
85		410	102.18
90	102.81	425	102.20
95	102.80	436	- Motor stopped
100	102.74		

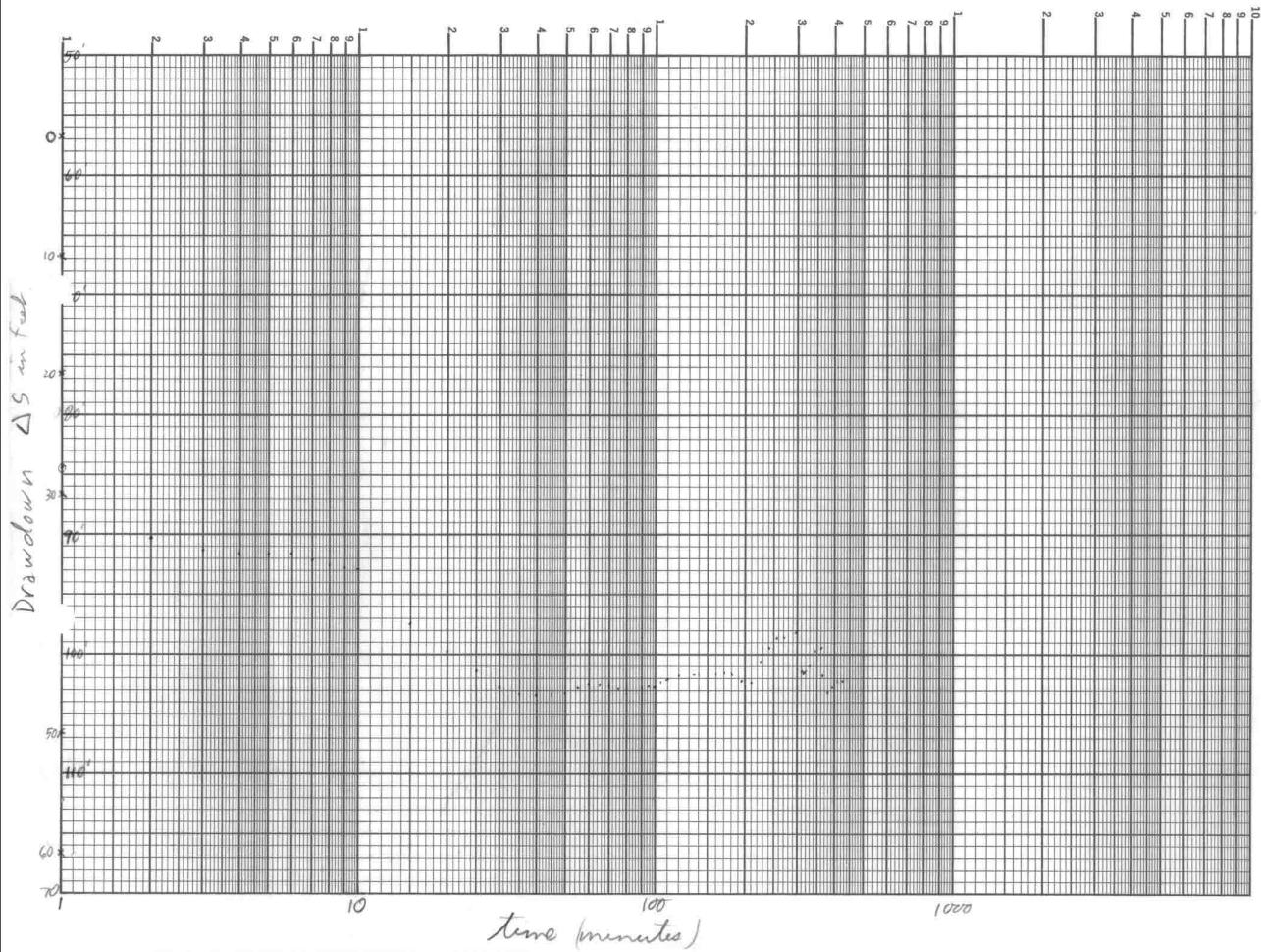
K&E SEMI-LOGARITHMIC 46 6013
4 CYCLES X 70 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.

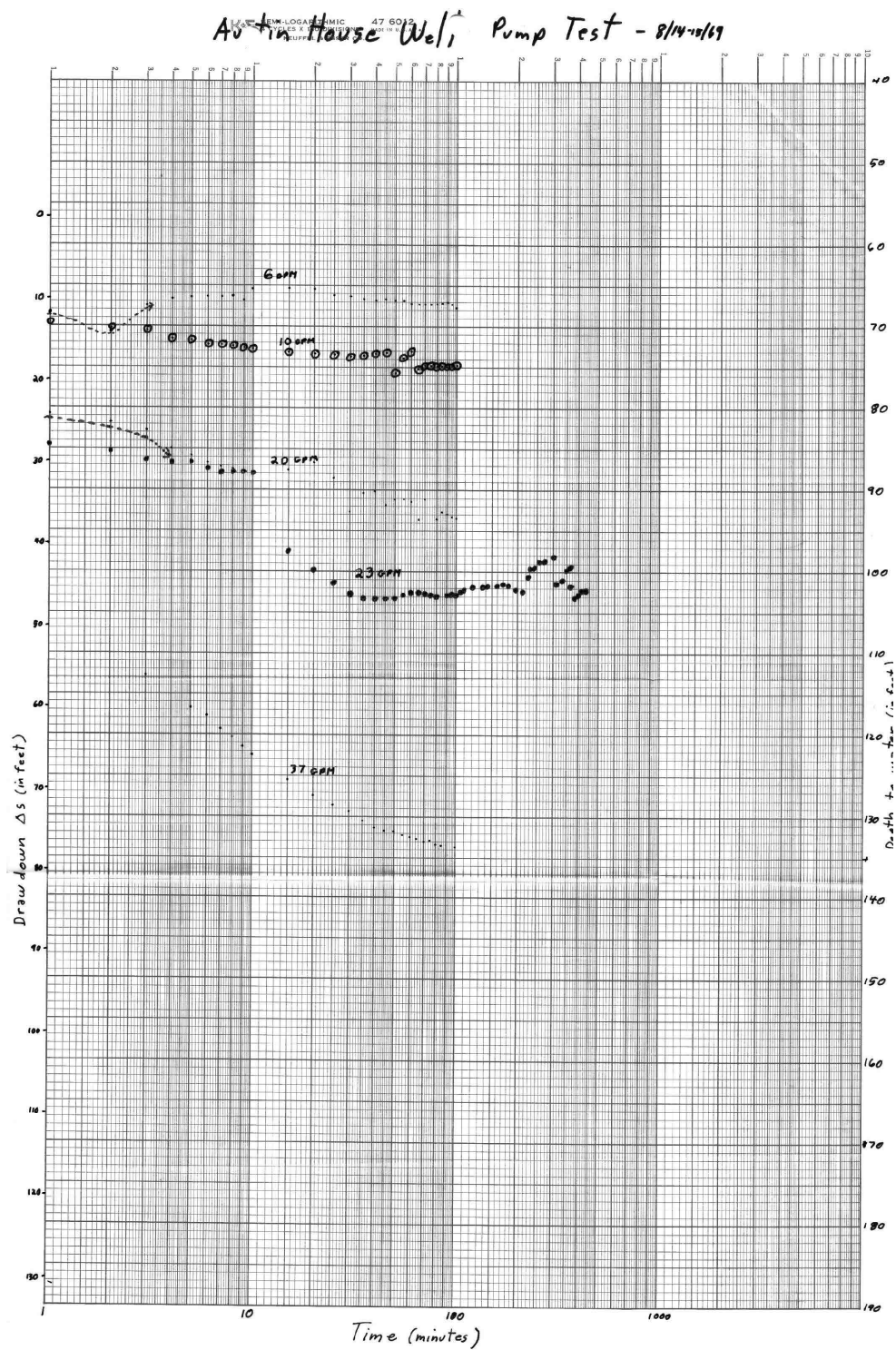
Austin House Well
8/15/69



K&M SEMI-LOGARITHMIC 46 6013
4 CYCLES X 70 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.

Austin House Well (long test)





UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER ANALYSIS

2GW

Location 27N-1W-4 bad: Austin House - N. of Van Buren County Carter
 Source Drilled well Depth (ft) 250 Diam (in.) 6½
 Cased to (ft) 150 Date drilled 8-12-69 Point of coll. at well
 Owner National Park Service
 Treatment None Use
 WBF Cambrian-Potosi WL Yield 20 gpm
 Temp (°F)/°C 16 Appear. when coll. Clear
 Collected 8-15-69 By G. Feder - W. Oakes
 Remarks Cond. 600; pH 7.0; HCO₃ 398

	ppm	epm		ppm	epm
Silica (SiO ₂)	6.2		Bicarbonate (HCO ₃)	396	6.49
Aluminum (Al)			Carbonate (CO ₃)	0	.00
Iron (Fe)	.46				
Manganese	.08		Sulfate (SO ₄)	9.2	.19
			Chloride (Cl)	4.8	.14
			Fluoride (F)	.1	.00
Calcium (Ca)	73	3.64			
Magnesium (Mg)	39	3.21	Nitrate (NO ₃)	4.1	.07
Sodium (Na)	3.7	.16	Phosphorous	.03	
Potassium (K)	2.0	.05			
Total		7.06	Total		6.89

	ppm		
		Specific conductance (micromhos at 25° C)	611
Dissolved solids:		pH	7.7
Calculated	337	Color	1
Residue on evaporation at 180°C	351		
Hardness as CaCO ₃	343		
Noncarbonate	18		

Lab. No. 38233

Field No.

Project



DIVISION ⁰² GEOLOGICAL SURVEY AND WATER RESOURCES ²
DEPARTMENT OF BUSINESS AND ADMINISTRATION
BUEHLER PARK ROLLA MISSOURI 65401 314-364-1752

WILLIAM C. HAYES STATE GEOLOGIST AND DIRECTOR
WALLACE B. HOWE ASSISTANT STATE GEOLOGIST

July 31, 1969

Our File: Carter County
Sec. 4, T. 27 N., R. 1 W.
National Park Service
Austin Place

Mr. Ned Harvey
U. S. Geological Survey
Water Resources Branch
10th Street
Rolla, Missouri 65401

Dear Ned:

We have received and examined cuttings to a depth of 185 feet in the well being drilled for National Park Service by Clark & Clark Drilling Company.

It is believed a satisfactory casing depth has been reached at 150 feet.

I recommend that this well be drilled to 300 feet as at this depth it should provide enough water for the residence.

If we can be of further help, please feel free to call on us.

Yours truly,

A handwritten signature in dark ink, appearing to read "Robert D. Knight".

Robert D. Knight
Geologist

RDK:go

cc: Mr. Lewis F. Garber
Mr. A. R. Baron



Other Supporting Information

SUMMARY

We are including a summary of the drilling to date in the tabulation below. The wells are listed in the order of decreasing specific capacities.

<u>Site</u>	<u>Formation penetrated</u>	<u>T.D.</u>	<u>Casing depth</u>	<u>Open Hole Dia.</u>	<u>Length</u>	<u>Yield</u>	<u>DD</u>	<u>Sp. Cap.</u>
Big Spring	Potosi 190-520	520	370	8	150	230	20	11
Pulltite Spring	Potosi 240-310	308	205	6	103	118	26	4.5
Round Spring	Potosi 180-400	400	200	8	200	120	43	2.8
Austin House	Potosi 225-250	250	200	8	50	6	11	.55 *
Owls Bend	Potosi 75±303	303	202	6	101	50	112	.45
Alley Spring	Eminence 475-650	650	300	8	350	55	214	.26
Two Rivers	Potosi 160-350	350	100	8	250	11	110	.10

Some significance may become apparent from a comparison of the results in the tabulation, the graphs of the wells drilled, and the map showing their locations with respect to the igneous knobs in the area around Eminence. The wells at Big Spring, Pulltite Spring, Round Spring, Owls Bend and Two Rivers penetrated a substantial part of the Potosi section. The Austin House well penetrated a small part of the section. Big Spring well is located farthest from the center of the igneous knobs and had the highest specific capacity (11 gpm per foot of drawdown). Pulltite Spring well is a little closer in and has a good specific capacity (4.5 gpm per foot of drawdown). Austin House well, although it penetrated only a few feet of the Potosi, had a specific capacity that was much lower than those at Pulltite and Round Springs, but was higher than those obtained at Owls Bend and Two Rivers. Owls Bend well near the eastern flank of the knobs area had a rather low specific capacity for the thickness of Potosi penetrated but not as low as that of the Two Rivers well which probably penetrated most of the Potosi section. The Two Rivers well is essentially surrounded by igneous knobs. The well at Alley Spring did not penetrate the Potosi and for this reason is not included in the comparison.

* Rounding of numbers I had done in the past accounts for some small differences in the two tables and the figures shown on the map.

The comparison suggests that circulation of water in the Potosi is slower and retarded in the knobs area perhaps because of lack of fracture and bedding plane openings through which water might travel. Mineralization along fractures may have sealed openings to retard flow. Whatever the cause, lower yields might be expected in the knobs area and higher yields outside the knobs. Of course exceptions to this probably will be found as additional sites are developed.

Projected yields for various pumping levels				
SWL (feet)	PWL (feet)	DD (feet)	Yield (gpm)	Sp. Cap. (gpm/ft)
BIG SPRING				
53	78	25	280	11
	100	47	515	
	150	97	1,007	
	370	317	3,500	
				Bottom of casing
PULLTITE SPRING				
32	58	26	118	4.5
	100	68	306	4.5
	150	118	530	4.5
	200	168	760	4.5
				Bottom of casing
ROUND SPRING				
80	123	43	120	2.8
	150	70	196	2.8
	175	95	266	2.8
	200	120	336	
				Bottom of casing
AUSTIN HOUSE				
57	102	45	23	.51
	150	93	47	
	200	143	73	
				Bottom of casing
OWLS BEND				
45	155	110	50	.45
	200	155	70	
				Bottom of casing
ALLEY SPRING				
55	270	215	58	.27
	300	245	66	
				Bottom of casing
TWO RIVERS				
92	210	118	11	.09
				This pumping level is 110 ft. below bottom of casing.



conado Dolomite at an average depth of 500 to 600 feet. The wells that produce from this section are ideal for clubs, schools, small towns, and industries.

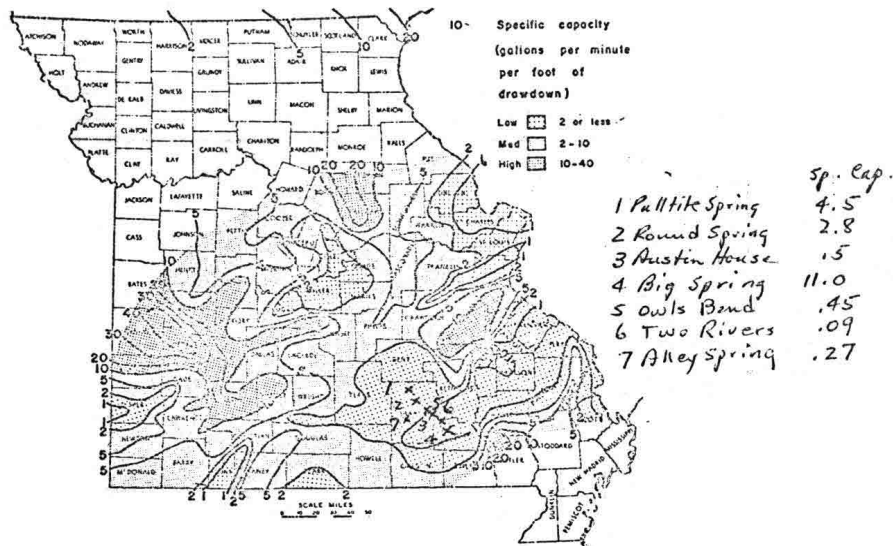


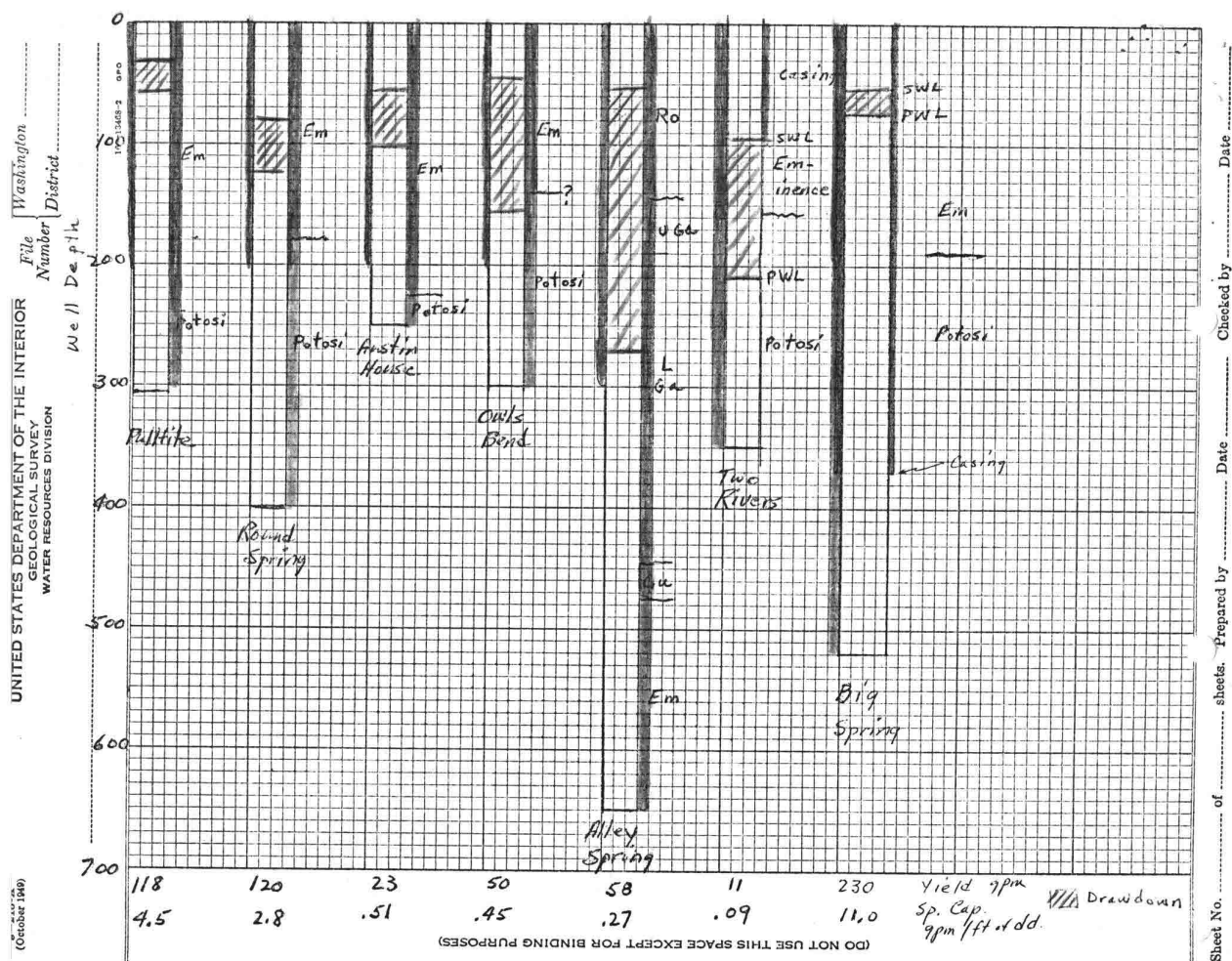
FIGURE 66.—Specific capacities of typical wells in the Ozarks.

Throughout the area numerous municipal and industrial wells yield 500 to 1,000 gallons per minute. These wells vary in depth. Wells that produce 300 to 500 gallons per minute average 1,000 to 1,500 feet in depth. Wells at Springfield in Greene County, for example, average 1,400 to 1,700 feet in depth and produce 500 to 1,000 gallons per minute. Wells at Rolla in Phelps County and Sullivan in Franklin County are 1,000 to 1,200 feet in depth and produce 400 to 600 gallons per minute.

Throughout the area requirements of 15 to 25 gallons per minute can normally be met by drilling to a depth of 300 to 350 feet through the Roubidoux Formation. This is usually an ideal depth for farm wells. Private wells for farms and dwellings in the central Ozarks average 300 feet in depth, whereas in the southwest part of the State the average depth to the Roubidoux is 800 feet.

Descriptions of aquifers

Lamotte Sandstone.—The Lamotte Sandstone is geologically the oldest aquifer in the State and is the basal unit of the Cambrian Sys-



Docket Information

Number of Documents in Docket 26

Documents Dated from 7/14/1969 to 1/20/1971

Docket Compiled: 6/7/2011