

FINAL RESULTS, GRANDE PRAIRIE

DEEP TEST HOLE

S $\frac{1}{2}$ -23-70-6-W6

by

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Edmonton, Alberta
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FINAL RESULTS, GRANDE PRAIRIE DEEP TEST HOLE

(Research Grovedale WTH 11-24-70-6-W6 - Well License No. 29822)

Since the interim report of April 1966 (Appendix B), the deep test hole south of Grande Prairie has been extended from 845 to 1,300 feet in order to explore the groundwater possibilities to the base of the Wapiti Formation. The hole, which has been subsequently abandoned, is thought to be bottomed in Smoky River (Lea Park) shale first encountered at 1,270 feet so that the full extent of the Wapiti has been tested at this location.

In deepening the hole only one aquifer of note - at 875 to 890 feet - was encountered. The test hole flowed at 17 igpm when this aquifer was first encountered but the flow declined to 5 igpm over a 19-day period. The aquifer contained oil and gas as well as water and this, together with the low flow rates, made it obviously unsuitable as a source of a sustained large supply of potable water. It was therefore not tested for yield.

A possible aquifer expected to be encountered at about 1,100 feet proved disappointing. A sandstone interval was encountered at 1,097 to 1,134 feet, but was fine grained and relatively impermeable due to argillaceous (kaolinitic?) cement.

In summary, three major bedrock aquifers were encountered during the drilling of this test hole. Of these, the first contained gas, and the other two oil and gas, as well as water. The first supply may be considered potable but is too low in yield to be considered for a large municipal supply; the other two are probably not potable because of the oil.

The three aquifers are:

- (1) Sandstone at 330 to 345 feet - water and gas - 20-year safe yield of less than 10 igpm.
- (2) Sandstone at 805 to 811 feet - water, gas and oil - 20-year safe yield of about 100 igpm.
- (3) Sandstone at 875 to 890 feet - water, gas and oil - not pump tested; rate of yield expected to be much lower than that for the second aquifer

Further details on the first two aquifers and on tests conducted on them are to be found in the interim report dated April 1966, and here enclosed as Appendix B. Also enclosed is a summary of progress (Appendix A), a log of the hole showing fluid potential measurements (Fig. 1), a sketch showing completion and abandonment details (Fig. 2), and a table of water analyses (Table 1).

With the completion of this test hole, all groundwater possibilities in this locality, from ground level to the base of the Wapiti Formation, have been tested and have been found lacking for the needs of a city the size of Grande Prairie.

Costs

The total cost of the test hole has not yet been tabulated, but should lie in the neighbourhood of \$27,000. This is extremely high, and considerably more than was initially estimated. The following factors contributed greatly to the cost of the hole:

- (1) Loss of efficiency in working in below-zero conditions.
- (2) Necessity of hauling almost all equipment and supplies as needed from Edmonton or Calgary.
- (3) Necessity of hauling large equipment to wellsite by Caterpillar tractor.
- (4) A great amount of standby time caused by (a) waiting on cementing truck, and (b) waiting on equipment and materials for pump and pressure testing.
- (5) Fishing for steel bar at the bottom of the hole.
- (6) Three cement jobs, using a total of 435 sacks of cement.
- (7) Cost and installation of 831 feet of casing.
- (8) Inconvenience of working under flowing-hole conditions.

These factors were either unexpected, greater than expected, or much more troublesome than expected. It is felt that in future operations, the costs of some of these factors could be reduced due to experience gained from this test hole.

Table 1. Results of Analyses of Water Samples
(parts per million)

Depth of hole (in feet) when sample collected	45	267	319	330	398	520	570	780	812	845	1,105
Total Solids	524	638	940		638	438	311		588	662	
Ignition Loss	94	126	170		60	22	37		232	182	
Hardness	140	30	nil	nil	40	nil	nil	50	5	5	
Sulfates	36	5	80		10	nil	nil		8	tr	
Chlorides	nil	20	2	25*	5	2	2	35*	14	20	
Alkalinity	420	460	590	548	540	380	250	544	380	544	
Nitrite	nil	nil	nil		nil	nil	nil		nil		
Nitrate	nil	nil	nil		nil	nil	nil		nil		
Iron	3.3	1.8	nil	0.1	0.3	2.0	2.0	2.5	0.15	0.2	
Fluorine					2+	4.2	2.45		3.2	3.4	
Soda	280	430	590	548	500	380	250	494	375	539	
pH	7.2	8.0	8.6		8.7	8.2	7.1		7.9	8.3	
Carbonate	nil	48	72		108	60	48		-	48	
Bicarbonate	512	464	573		439	342	208		464	566	
Calcium	35	6	nil		7	nil	nil		2	2	
Magnesium	13	4	nil		6	nil	nil		tr	tr	
Sodium	127	213	316		11	181	118		} 186	251	
Potassium	3.7	1.5	3.5			0.7	0.5				
Analysis conducted by:**	P	P	P	H	P	P	P	H	W	W	
Comments:				Aquifer 330-345 ft.					Aquifer 805-811 ft.		

* NaCl

**H = Hach kit; P = Provincial Analyst; W = Western Industrial Labs.

APPENDIX A. SUMMARY OF PROGRESS

(Research Grovedale WTH 11-24-70-6-W6 - Well License No. 29822)

Hole started December 11, 1965 and abandoned August 3, 1966

Dec. 11th to Dec. 20th	Webster Cable Tool Drilling - drilled to 330 feet; first major water zone encountered at 330 feet.
Dec. 21st to Jan. 3rd	No work
Jan. 4th to Jan. 9th	Hole deepened to 356 feet and pump tested
Jan. 10th to Jan. 11th	Hole deepened to 398 feet
Jan. 12th to Jan. 17th	E-logged hole and set 6 5/8" O.D. casing to 398 feet
Jan. 18th to Jan. 31st	Waiting on cementers to cement casing into hole; rig on standby
Feb. 1st to Feb. 24th	Hole deepened to 812 feet; second major water zone encountered at 805 feet
Feb. 25th to Mar. 1st	Hole deepened to 830 feet and pump tested
Mar. 2nd to Mar. 8th	Making up well-head assembly for pressure testing
Mar. 9th to Mar. 24th	Hole deepened to 845 feet; taking pressure tests, flow tests, and pump tests
Mar. 25th to June 16th	Rig released; well flowing
June 17th to June 27th	McAuley (rotary) drilling - pulled 6 5/8" casing and reamed hole to 7 5/8"
June 28th to July 4th	Cased hole to 831 feet with 6 5/8" O.D. casing and cemented, 340 to 831 feet
July 5th to July 13th	Fishing. Finally got fish with Hollier basket
July 14th to July 23rd	Drilled to 1,300 feet (total depth of hole); E-logged; rig released
July 24th to Aug. 3rd	Cemented hole and abandoned; 6 5/8" casing cemented 830 feet to surface and with 240-foot cement plug on inside

APPENDIX B.
INTERIM REPORT ON THE GRANDE PRAIRIE
DEEP TEST HOLE

by

C. Tokarsky and D. H. Lennox

Research Council of Alberta
Edmonton, Alberta
April 1966

SUMMARY OF DRILLING PROGRESS

Number of holes drilled: One, listed with the Oil and Gas Conservation Board as

Research Grovedale WTH11-24-70-6, located in NW 1/4, Sec. 24, Tp. 70,
R. 6, W. 6th Mer.

Driller: Webster Drilling of Black Diamond; cable tool rig

Total depth: 845 feet

Drilling started: December 11th, 1965

Drilling terminated: March 24th, 1966

Cost to date:

Results of program thus far:

Two promising aquifers encountered and tested. Both flowed at over 100 gallons per minute when first encountered, but rate of flow declined steadily with time. Both have gas associated with the water, and the lower, more promising one contains oil as well.

Aquifer #1 is a medium-grained sandstone at 330 to 345 feet. Water quality → suitable for domestic use although soda content is high and fluoride is over 2 ppm. Pumped for 2 hours at 60 gallons per minute, shows boundary effects and a low transmissibility. Twenty-year safe pumping rate is probably less than 10 gallons per minute.

Aquifer #2 is a coarse-grained, pebbly sandstone at 805 to 811 feet. Water quality essentially same as above; fluorides 3.2 to 3.4 ppm. Conducted three pump

tests, a number of shut-in pressure tests, and one flow test. The pump tests indicate continually diminishing transmissibility with time. The shut-in tests and the flow test give even lower values of transmissibility, and a 20-year safe pumping rate of about 100 gallons per minute. The high cost of pumping from 800 feet and of treating the water to remove the oil renders this unsuitable for a municipal supply. A summary of test results for this aquifer by D. H. Lennox is included in the next section.

Recommended next step:

Deepening of hole to an estimated 1,100 feet by rotary rig to test a possible aquifer at that depth as indicated by nearby exploratory test wells drilled for oil.

Cost of this phase of the program estimated at \$3,500 to \$5,000. Drilling is scheduled to start on May 9 and the program should be completed by mid-June.

O. Tokarsky,
April 20, 1966.

AQUIFER TEST SUMMARY

The seven tests summarized below were all for the Wapiti Formation aquifer whose main permeable zone lies in the depth interval 805 to 811 feet. Two prior tests were conducted for shallower, less promising aquifers but the results are not given there.

The 20-year safe-yield estimates for tests 3, 4B, and 5B were each based on the assumption that the stabilized nonpumping level was 250 feet above ground surface, so that the total available drawdown in each case was $805 + 250 = 1,055$ feet. It was felt that the test data did not justify the calculation of safe yields for tests 4, 5, 5C, and 6. It should be noted, however, that the calculated transmissibilities for these tests are in every case appreciably lower than those for the preceding pump tests. If these low transmissibilities are significant, the estimated safe yield in the case of test 6 could be as low as 100 igpm (imperial gallons per minute).

Date	Test		Trans. T (igpd/ft)	Safe yield Q_{s20} (igpd/ft)	Estimated stabilized nonpumping level (feet)		Natural flow (igpm)
	No.	Type			1/t' method	t/t' method	
27/2/66	3	P	3,300	440-550	—	—	>100
11/3/66	4	S	730	—	-180	250	68
12/3/66	4B	P	2,300	370	—	—	68
18/3/66	5	S	—	—	-99.5	—	—
18/3/66	5B	P	910	220	—	—	—
19/3/66	5C	R,S	600	—	-199	-200	—
20/3/66	6	F	450(?)	—	—	—	-46

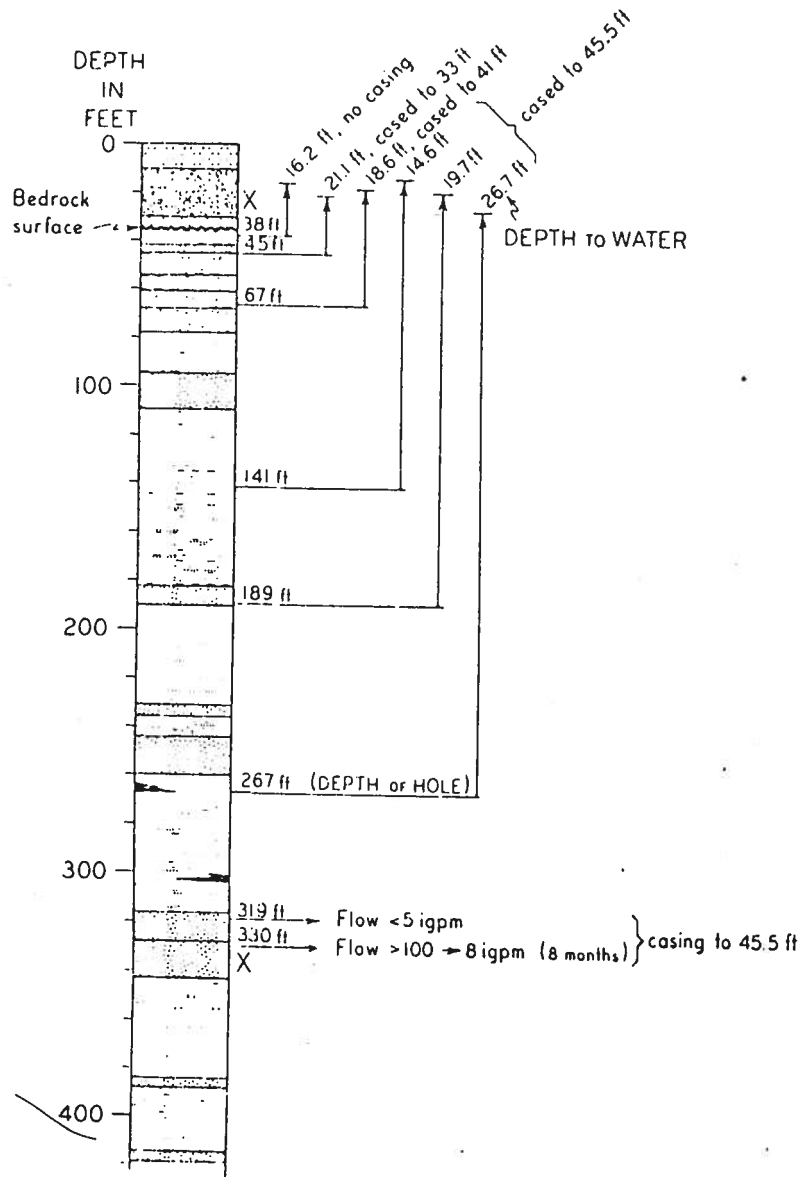
*P = Pump, S = Shut-in, R = Recovery, F = Flow

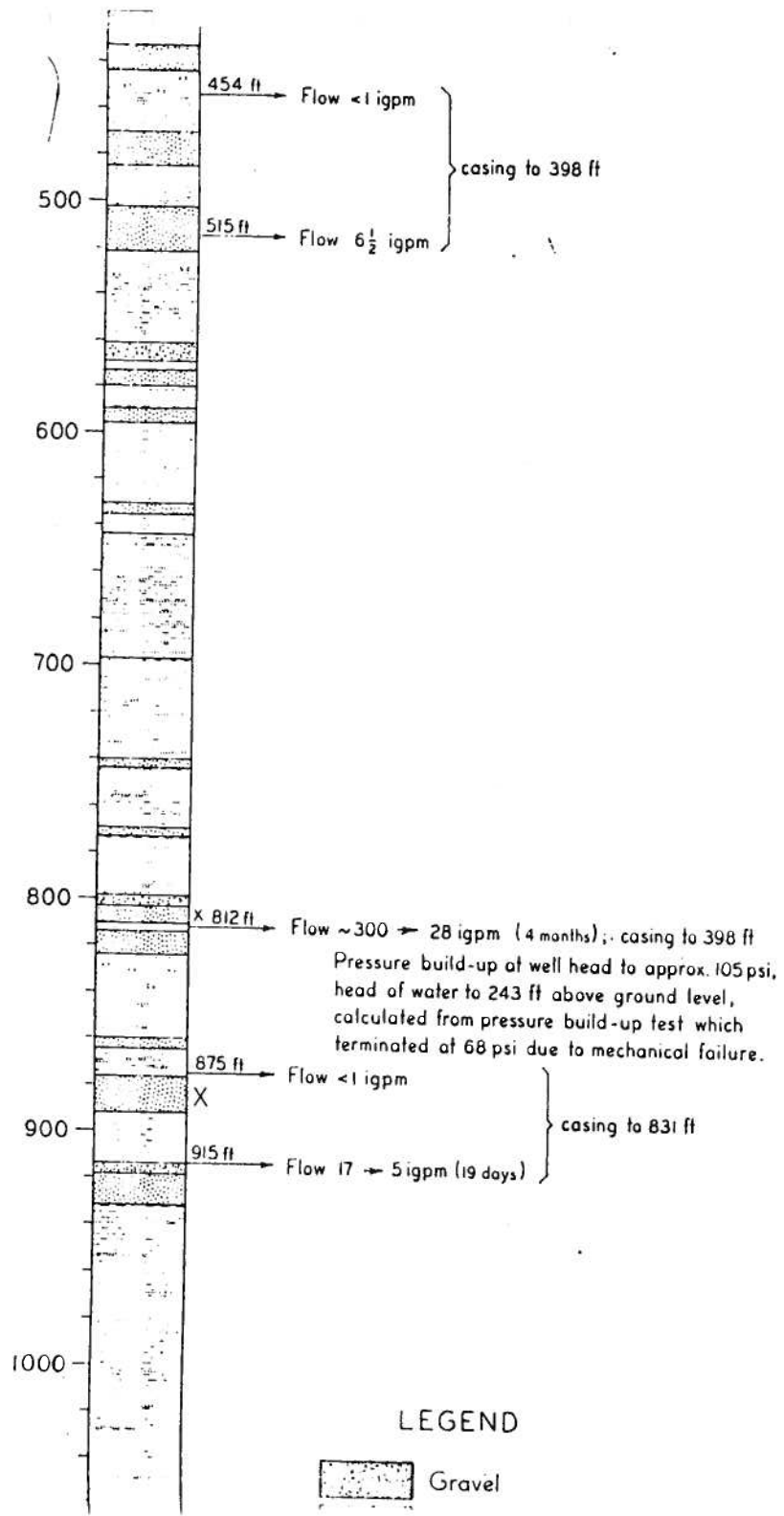
The declining values for transmissibility, stabilized nonpumping level, natural flow, and estimated 20-year safe yield all indicate the aquifer to be of marginal suitability as a source of municipal water supply for Grande Prairie. The changes

in transmissibility values and in estimated safe yields are particularly significant in this respect. They may be related to actual changes in aquifer properties, such as reduction in permeability due to aquifer collapse. An alternative explanation can be based on the observed release of gas that accompanied both natural flow and pumping from the aquifer. Under these conditions a gradually diminishing "gas drive" could have influenced the rate of flow of water toward the production well.

Both of the causes suggested above - aquifer change and gas drive - should result in declines in measured transmissibilities and in estimated safe yields with time. Whatever the cause the important result is that the estimated yields are declining and show no signs of levelling off. When it is considered that oil is also produced, in addition to gas and water, so that there is also a treatment problem, the suitability of the aquifer becomes very dubious.

D. H. Lennox,
April 6, 1966.





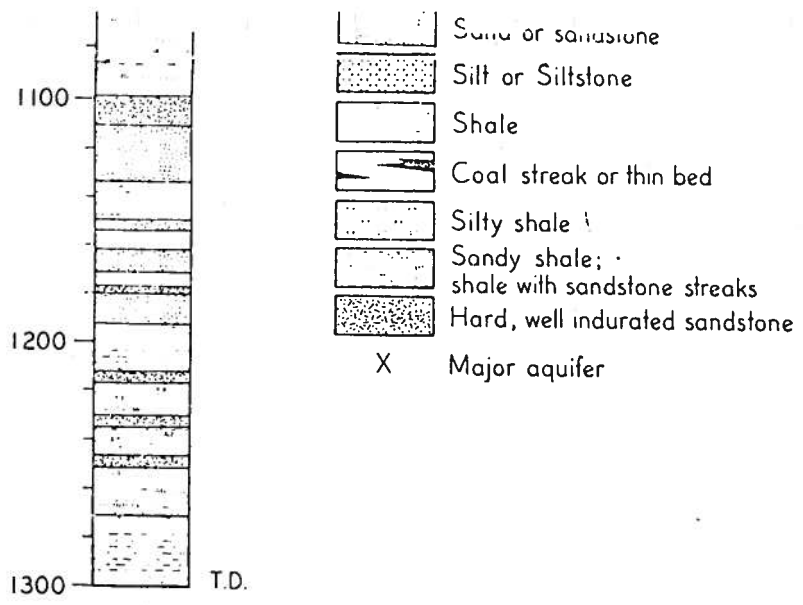


FIGURE 1. LOG OF HOLE SHOWING FLUID POTENTIAL MEASUREMENTS
 (From field descriptions only)
 Research Grovedale WTH 11-24-70-6 W6

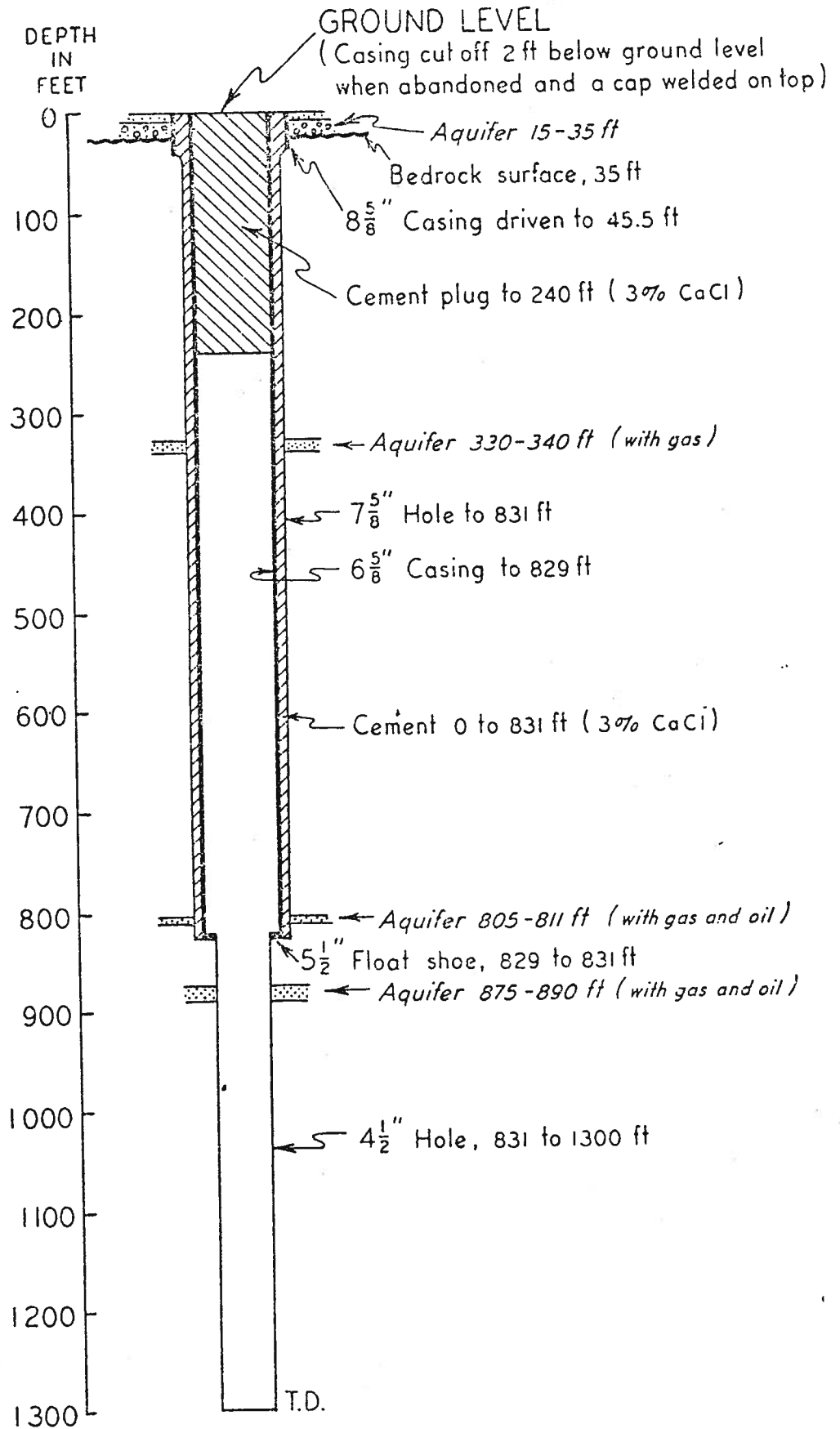


FIGURE 2. DETAILS OF CONSTRUCTION AND ABANDONMENT
 Research Grovedale WTH 11-24-70-6 W6
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