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GROUNDWATER RESOURCES

IN THE GENERAL KEG RIVER AREA, ALBERTA

by

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Alberta
RESEARCH COUNCIL

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Synopsis

A survey of existing wells was conducted in July 1965 for the settled areas near the proposed new Keg River townsite. The survey was followed in August 1966 by an exploration program during which one deep and two shallow aquifers were tested. Only the deep aquifer was found to be capable of sufficiently high production for municipal-supply purposes, but two conflicting chemical analyses suggested that the water from this aquifer may be too high in sulfates to be potable. Before this aquifer can be considered for the municipal water supply another test well will have to be drilled and tested and the water produced will have to be very carefully sampled and analyzed.

The well survey indicated that it is unlikely that groundwater quality will be appreciably better at any other location within 5 or 6 miles of the proposed townsite. If the deep aquifer finally proves unsuitable, a dugout or other type of surface supply will have to be considered.

Results of Well Survey and Test Drilling, 1965-66

A survey of existing wells in the general Keg River area was conducted in July 1965. The survey area was bounded by the Boyer River and the Metis colony on the north, the Keg River on the south, and Highway 35 on the east. Existing shallow wells in alluvial gravels near the Keg River, one mile south of the proposed townsite (N. 1/2, Sec. 12 and S. 1/2, Sec. 13, Tp. 101, R. 23, W. 5th Mer.) yield water which, although hard and, in some cases, with a high iron content, is generally suitable for most domestic purposes. Shallow wells in the vicinity of Keg

River Post (SE. Sec. 28, Tp. 101, R. 24, W. 5th Mer.) yield water which is also generally hard and high in iron content, but still suitable for most domestic uses. In this case the wells are in fluvio-lacustrine or possibly alluvial floodplain silt or sand or, in some instances, in thin gravel. From the Post eastwards the well waters become high in total solids and sulfates, and are generally poor to unusable for domestic purposes.

On the basis of the well survey and local geology it was decided that a test hole should be drilled at the proposed townsite and that the gravels near the Keg River should also be tested. Drilling commenced on August 12 and terminated August 16, 1966. The costs of $1,449.50 were borne by the Department of Municipal Affairs, who had originally requested the groundwater investigation. The logs of the test holes are included in this report as appendix 1, and the electrical log of test hole NAT-66-1 as figure 1. The results of the drilling program are summarized below.

Test Hole No. 1 (NAT-66-1)

This hole was drilled at the proposed townsite to a depth of 500 feet, after which a 2-hour bail test was conducted and recovery measurements taken. The results of the test are shown in figure 2. A low transmissibility of 79 igpd/ft is calculated, but owing to the high head of water in the well (475 feet), the calculated safe yield is quite high, and at 13 igpm (imperial gallons per minute) should be sufficient to supply the needs of a small town. This safe-yield estimate includes a safety factor of 0.7. The water quality is marginal, however. Further testing should be carried out to determine suitability for a town supply (see enclosed letter from Department of Public Health, Division of Sanitary Engineering – Appendix 2, and

chemical analyses, Appendix 3).

One water sample was taken prior to the bail test, and two samples were taken at the termination of the test. The latter two were sent to different laboratories for analysis, one to the Provincial Analyst and one to Western Industrial Laboratories Ltd. The results of the analyses are contradictory, the latter analysis indicating that the water is possibly unsuitable for use as a town water supply, and the former placing the water into a suitable category. The critical constituent is sulfate (expressed in the analyses as SO_3) for which a somewhat arbitrary value of 500 ppm (parts per million) is commonly used as the upper limit which can be tolerated in water supplies for municipal use. Higher amounts can be tolerated but the water is very laxative for those not accustomed to it. The limit recommended by the U.S. Public Health Service where "other more suitable supplies are or can be made available" is 250 ppm (as SO_4 – the equivalent of 208 ppm as SO_3). Removal of sulfates from water is difficult. It is not carried out by any municipalities in Alberta because of high cost.

The iron content of the water is also over the recommended limit in Alberta of 0.3 ppm, but this can be removed at reasonable cost.

Test Hole No. 2 (NAT-66-2)

This hole was drilled at the proposed townsite to test a 10-foot sand lens at 138 to 148 feet. The water is over the acceptable limit in sulfates and iron for a suitable town supply, and the yield is low.

Test Holes Nos. 3 to 6 (NAT-66-3 to -6)

These holes were drilled approximately 1/2 to 1 mile south of the proposed townsite into thin alluvial gravels adjacent to the Keg River. The gravels

are thinner than expected and do not yield much water – less than 1 igpm to a 4 3/4-inch hole. The water is of good quality, although trea ent for hardness and iron would be required (see analysis for Ranger Station well), but of insufficient quantity for municipal-supply purposes. A larger-diameter well would not sufficiently increase the yield to be expected. For example, the yield could be increased to approximately 2 igpm if a 20-foot diameter well were constructed but this is still far short of the need.

It is not expected that the water of the Keg River would add much recharge to the gravels because the gravels are higher or only slightly lower than the level of the river so that during low river stage drainage is out of the gravels into the river.

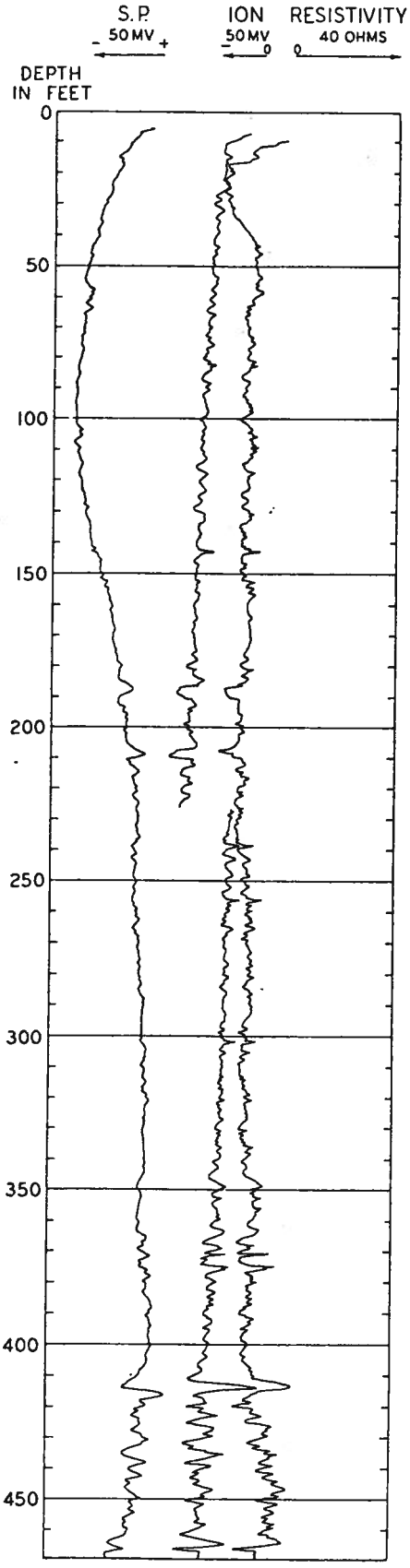
Assuming that the river level did rise high enough to recharge the gravels, there is still not enough gravel thickness to obtain a very large increase in yield, except for a well extremely close to the water's edge, and little or no recharge could be expected during the low-flow stage in the late summer, fall, and winter months. Consequently, if wells were completed into these gravels, water shortages would occur during low river stage.

Summary of Results; Conclusions and Recommendations

Three separate aquifers were tested by drilling. Only one of the three – a deeply-buried sand and gravel – appears capable of a sustained high yield. The quality of the water from this aquifer is marginal, however. Further testing could be carried out to determine its suitability, although it is not expected that the quality will change to any great extent with pumping. I would recommend drilling another hole, casing it down to 410 feet, and careful drilling and sampling beyond this depth to determine exact lithologies and particle sizes of water-bearing materials so that a

proper size screen may be installed at the correct depth. Another pump test should be conducted to determine the yield to be expected from the particular aquifer selected. Further samples for chemical analysis may be taken at this time. Eventual suitability will probably have to be determined through actual use (after treatment for iron removal).

If the water is finally deemed unsuitable, a dugout or similar type of surface reservoir will have to be considered. I would not expect groundwater quality to be much better within a radius of 5 or 6 miles from the proposed townsite. The results of the well survey indicate, however, that slightly better quality water may be expected just north of Keg River Post. This would have to be determined by drilling, and potential aquifers checked for yield as well as quality. In any event, this location is removed from both the railway and the highway.



RESEARCH COUNCIL OF ALBERTA WATER WELL
KEG RIVER

FIGURE 1. Electric log of NAT-66-1 (Keg River)

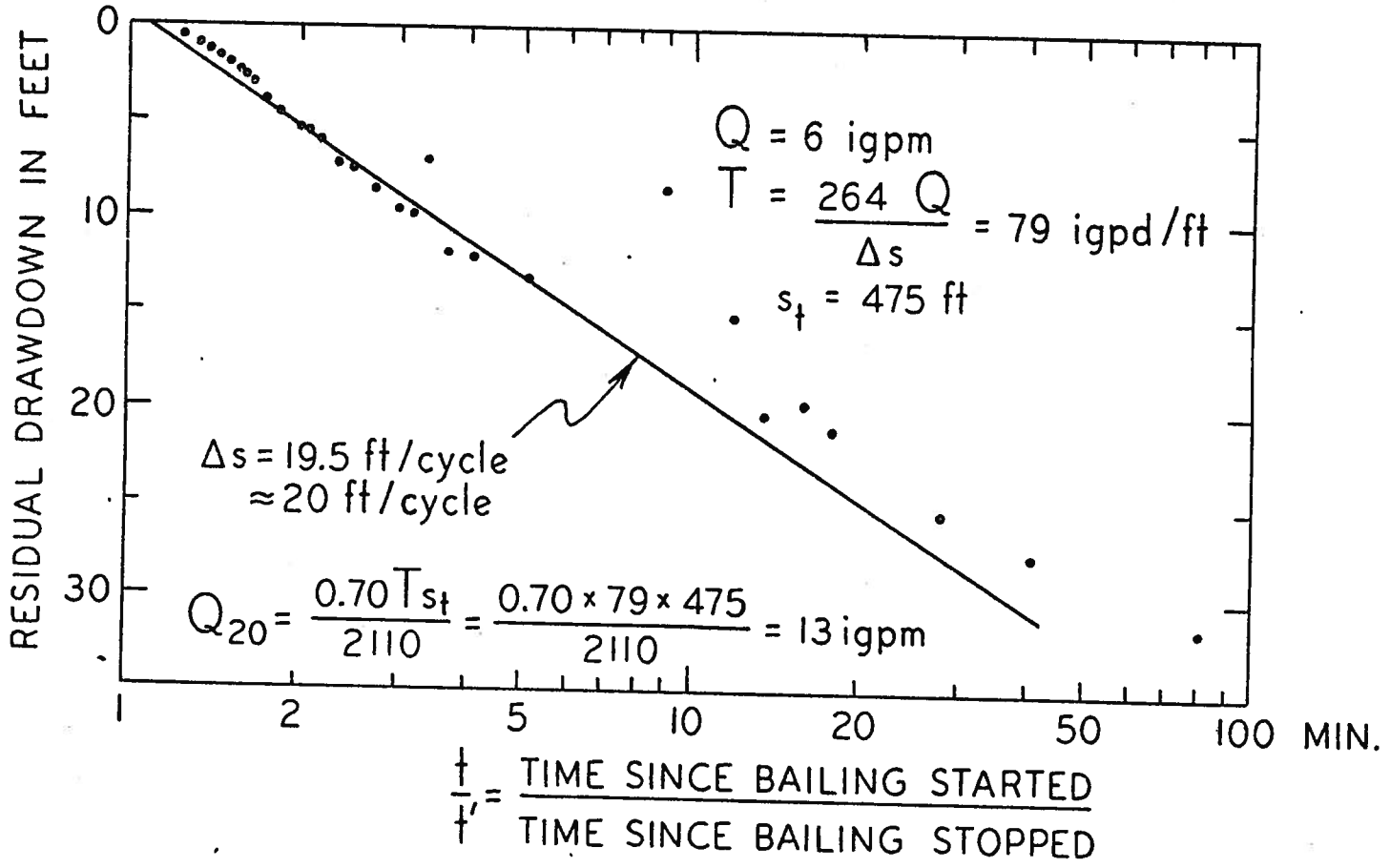


FIGURE 2. Bail test results for NAT-66-1 (Keg River).

Appendix 1. Keg River Area Test drilling (August 12-16, 1966) - Logs of Test Holes (field descriptions only)

NAT-66-1

Location: Approximately 100 feet north and 440 feet west of NE. 12-101-23-W.5
Elevation: 1,328 feet (estimated)

Depth (feet)	Description
0- 17	Alluvial-lacustrine; brownish (oxidized) clay, slightly silty
17- 23	Alluvial-lacustrine; dark brownish grey clay, slightly silty (unoxidized)
23-118	Glacial; till, dark grey
118-119	Glacial; sand, fine to medium grained, fairly well sorted and rounded
119-410	Glacial; till, dark grey; streaks of sand & gravel
410-500 t.d.	Glacial (?); sand & gravel & intercalated clay or till. Water, some gas.

August 14th - Bailed 2 1/2 hours to clean out mud
August 15th - Bailed 2 hours at 6 gallons per minute
Water level drew down from static of 38.15 ft. to 52.50 ft. (measured 1 1/2 mins. after bailing stopped).
Recovered to 38.20 ft. in 90 mins. & 32.10 ft. in 6 hours.
Twenty-year safe yield calculated from test to be 18 gallons per minute.

NAT-66-2

Location: Approximately 70 feet west, 240 feet north of NE. 12-101-23-W.5
Elevation: 1,332 feet (estimated)

0- 20	Alluvial-lacustrine; brownish (oxidized) clay, slightly silty
20- 25	Alluvial-lacustrine; dark brownish grey clay, slightly silty (unoxidized)
25-138	Glacial; till, dark grey 3-ft. gravelly streak at 73 feet
138-148	Glacial; silt & sand, very fine to fine grained
148-150 t.d.	Glacial; till

August 15th - Bailed hole dry in 1/2 hr. at 5 gallons per minute.

NAT-66-3

Location: Approximately 2,800 feet west, 2,600 feet south of NE. 12-101-23-W.5, about 50 feet from bank of Keg River.
Elevation: Approximately 13 feet above river level.

0- 9	Alluvial floodplain; yellowish brown clayey silt
9- 14	Alluvial; gravel with gravelly clay streak at 12 to 12 1/2 feet.
14- 30 t.d.	Glacial; till

Bailed hole dry. Water comes back into hole at about one gallon per minute.

NAT-66-4

Location: Approximately 90 feet southeast of NAT-66-3
Elevation: Approximately 3 feet lower in elevation than NAT-66-3

0- 10	Alluvial; yellowish brown silt & very fine sand
10- 12	Alluvial; gravel
12- 15 t.d.	Glacial; till

NAT-66-5

Location: Approximately 4,000 feet west, 2,700 feet south of NE. 12-101-23-W.5, about 100 feet from river bank.
Elevation: Approximately 14 feet above river level.

0- 8	Alluvial; silty clay
8- 11	Alluvial; coarse sand
11- 14	Alluvial; sandy gravel
14- 15 t.d.	Glacial; till

NAT-66-6

Location: Approximately 4,000 feet south, 3,100 feet west of NE. 12-101-23-W. 5, about 20 feet from river bank.
Elevation: Approximately 13 feet above river level.

0- 12	Alluvial; silt & very fine sand
12- 14	Alluvial; coarse sand & fine gravel
14- 30 t.d.	Glacial; till

GOVERNMENT OF THE PROVINCE OF ALBERTA

DEPARTMENT OF PUBLIC HEALTH

Division of Sanitary Engineering

EDMONTON, ALBERTA

Administration Bldg.

October 19, 1966.

Mr. O. Tokarsky,
Groundwater Geolgist,
Research Council of Alberta,
Peace River Office,
P. O. Box 1865,
PEACE RIVER, Alberta.

Dear Mr. Tokarsky:

Re: Test Drilling Program - Keg River

In reply to your letter of October 3, 1966, and further to our telephone discussion yesterday, we would suggest that further pump testing of the Keg River test well be carried out to clarify the quality of the water. Certainly the quality of the water is border line, and should the quality deteriorate with further pumping, it would rule out the possibility of using the supply as a domestic water source. In particular, the sulfates and iron content detract from the quality of the water. The two analyses which you have made to date indicate that a water treatment plant would have to be installed to remove the iron before the water could be used for domestic purposes.

Yours very truly,

H. L. Hogge, P. Eng., Director,
Division of Sanitary Engineering.

HLH:ad

Appendix 3. Water Analyses (in parts per million)

	NAT-66-1 (depth 500 ft.)				
	Prior to bail test	After 2 hour bail test		Ranger Station well depth 19 ft.	NAT-66-2 depth 150 ft
	Provincial Analyst	Provincial Analyst	Western Industrial Labs		
Total Solids	1184	1438	1520	832	1376
Ignition Loss	204	130	470	256	176
Hardness as $CaCO_3$	470	245	252	350	255
Sulfates (SO_3)	485	256	514	178	566
Chlorides	40	208	176	nil	50
Alkalinity as $CaCO_3$	100	195	189	425	205
Carbonate	nil	nil	tr	nil	nil
Bicarbonate	122	238	230	518	250
Calcium	108	58	68	94	70
Magnesium	48.6	24.3	20.0	30.4	19.5
Sodium	82	175	380	99	200
Potassium	5.0	8.0		5.7	12.0
Iron	4.3	3.5	2.4	0.45	11.5
Fluoride	-	-	0.9	-	-
pH	7.99	8.1	7.9	7.6	8.1

Underlined figures are above recommended limits.