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GROUNDWATER PROSPECTS OF THE ANDREW AREA

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TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

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INTRODUCTION

General statement

The survey carried out in the summer of 1958 had as its specific objective to locate, or to determine the prospects of locating, a suitable and sufficient supply of groundwater for the village of Andrew. In its wider approach the work embraced a study of the groundwater resources of the area covering townships 55 to 57 and ranges 14 to 17, west of the 4th meridian. The area is included on the Edmonton topographic sheet (Canada Sheet 83 H, scale 1:250,000).

The Village of Andrew (Long. 112 degrees 15 minutes West, Lat. 53 degrees 45 minutes North; S. E. 1/4 Sec. 32, Tp. 56, R. 16, W. 4th Meridian), which has a population of about 650 persons, is situated one mile to the south of highway 45, and is approximately 70 miles northeast of the City of Edmonton.

The present source of water supply in the village comes from many shallow wells in the drift cover and the bedrock. There is no evidence that an assured municipal supply is available from the aquifers now in use, for wells in these aquifers seem only capable to supply domestic requirements.

With the installation of a sewerage system some private wells were found inadequate to meet the additional need for water and many residents could not make use of the system. The operation of the sewerage system thus became uneconomic and the installation of a water-supply system is desired not simply for its own advantages, but also to make the sewerage system self-supporting.

The aids used in looking into the groundwater prospects were aerial photographs, geologic reports, geologic maps, lithologic logs and information from test

drilling programs of previous years. Geophysical prospecting consisting of seismic and resistivity surveys was used to gain information about the bedrock topography and the location of buried sand and gravel. A survey was made of many farm wells in the area to obtain data on the depths of water and the piezometric surface. On the basis of the information collected several test holes were drilled. Information on the chemical quality was obtained from the results of analyses by the Provincial Industrial Laboratory.

Acknowledgments

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GEOLOGY

The geology of an area and the character of the subsurface material exert the controlling influence upon the availability of groundwater supplies. Both surficial deposits and bedrock geology are relevant.

Description

The geologic map (Geol. Surv. Can. Map 505A, Tofield, Alberta) shows the bedrock sub-outcrops to consist of the Oldman, Birch Lake and Grizzly Bear members of the Belly River formation. The Birch Lake member occurs as a narrow north-south sub-outcrop running almost through the centre of townships 56 and 57, range 15, west of the 4th meridian, and as outliers capping the higher relief features in the eastern part of the area. The Grizzly Bear Shale is shown to the east of the north-south zone and as surrounding the outliers of Birch Lake. To the west of this zone and underlying most of the area is the Oldman member.

However, in contrast to the above map, the work of Shaw and Harding (1949: Lea Park and Belly River formations east-central Alberta; Am. Assoc. Petrol. Geol. Bull., V. 33, p. 487 - 499) reveals the upper portion of the Belly River formation is not divisible. Consequently, only a very brief description of the local bedrock geology is given below.

The evidence available from drilling records and the examination of outcrops shows the strata to consist of light-grey to blue and black sandy clay, coal seams, carbonaceous shale, ironstone bands and thin soft and hard sandstone beds.

Stratigraphy

Two reports have been written which cover the general geology of the area. The work of Shaw and Harding is preferred in considering the stratigraphy.

The only relevant formation for the purposes of this report is the Belly River, and in the area under discussion, lithologic subdivision of this formation is not possible. A vertical section at any location records a sequence of alternating soft and hard sandstone layers, silty sand, sandy clay, carbonaceous shale and coal seams. The sands are usually thin, fine grained, poorly sorted, and have low porosity and permeability. The evidence available does not indicate any extensive and important bedrock aquifer.

Structure and bedrock topography

The regional dip of the beds is to the southwest at 15 feet to 20 feet per mile, but this exerts no influence upon hydrostatic pressure in the shallow water wells. From the map of the piezometric surface it can be seen that the hydraulic gradient closely follows the relief of the area, and the pressure head is consequent upon local variations in topography.

A map of the bedrock topography drawn from seismic shot hole logs, mostly for the southern part of the area, shows this to coincide very closely with the present day surface.

Glacial deposits

Lithologic logs from closely-spaced drilling for the southern part of the area, and from scattered information in the northern part, reveal the glacial cover is generally quite thin. The thickness of the glacial drift ranges from zero to more than 100 feet, but averages about 40 feet in thickness.

Aerial photographic coverage shows the glacial drift to have a uniform appearance apart from a small area in the northwest, township 57, range 17, which is covered by windblown sand. This uniformity in the appearance of the Pleistocene cover is produced by a deposit of ground moraine. This consists chiefly of till, which is an unsorted and unstratified deposit of sand, silt and clay with broken rock fragments varying in size from small pebbles to large boulders. Locally it may contain isolated pockets of sand and gravel.

The ground moraine is broken only by several glacial or preglacial drainage channels, which have little or no present-day drainage, e.g. Whitford Creek. Stream trench systems, which may contain sorted sand and gravel, were formed by the activity of glacial meltwater flowing through valleys which had one or both sides supported by ice. These stream trenches can be divided into two types: (a) those which are filled with moraine and are recognized on air photos by the alignment of kettle lakes in the base of the valleys, and (b) those which are broad open troughs. The latter type is most common in areas of thin ground moraine, and bedrock is frequently exposed in the valley walls. It is this type which is relevant to the purposes of this report (Gravenor, C. P. and Bayrock, L. A., Stream

trench systems in east-central Alberta; Res. Coun. Alberta Prelim. Rept. 56-4, 1956).

Although parts of some of these stream trenches contain no sorted granular deposits, information from some of the drilling logs reveals sand and gravel in places in others. Only along portions where these deposits are sufficiently thick, continuous and porous, is the Pleistocene cover likely to be a major source of groundwater supply.

GEOPHYSICAL PROSPECTING

Seismic

Seismic profiles were run along the north-south roads one and two miles west of Andrew, and also along east-west roads to the north and south of Andrew.

The purpose of this work was twofold. One, the major aim, was to obtain a cross-section of the bedrock topography and thereby find any buried glacial or preglacial drainage channels in the area. The other aim was to fill in the large gaps where no lithologic logs were available. However, the results of the work gave no indication of the presence of buried channels.

Resistivity

A resistivity survey was limited to testing short profiles and isolated points. The purpose of this work was to gain some idea of the depth and extent of surface sand and gravel at the places tested. Analysis of the results again confirmed previous indications that porous and permeable materials were likely to be shallow and confined laterally.

Test drilling was carried out at two of the locations nearer to town to ascertain the value of the resistivity readings. At the following locations - N. E. 1/4 Sec. 30, Tp. 56, R. 16, W. 4; and N. W. 1/4 Sec. 28, Tp. 56, R. 16, W. 4 - the depth of sand and gravel was 11 feet and 14 feet respectively.

GROUNDWATER HYDROLOGY

Groundwater in the glacial drift

Drilling logs show the ground moraine to consist chiefly of clay and boulders, and the rate of movement of water through this material is extremely slow. Locally there are pockets of sand and gravel but large supplies of water must not be expected from them. Though the water table may be continuous where the ground moraine is sufficiently thick and permeable, wells finished in this material cannot be expected to yield more than domestic supplies of water.

The windblown sand in the northwest of the area is a more important source of water supply. This sand is saturated from depths of 8 feet to 15 feet below the surface, but the thickness of this sand and the likely capacity of wells drawing water from it are unknown. To determine the likely yield of this aquifer, test drilling for thickness, pump testing for capacity, and chemical analyses on the water supply are necessary. However, domestic wells in this sand obtain a plentiful supply of water.

The other source of water supply from the glacial drift is confined to the stream trench systems containing outwash silt, sand and gravel. Detailed discussion of these is important, for they appear to contain the only good aquifers in the area.

Lithologic logs record thick deposits of sand and gravel at depths from 20 to 160 feet. The more extensive deposits occur in a stream trench which runs south from Cucumber Lake and southeast from Willingdon. The logs for the village wells at Willingdon reveal these deposits are dirty, and pump test results indicate low permeability. However, further test drilling is necessary to discover locations where there are clean sands and gravels, with the possibility of a major source of water supply. See Plate 3 for locations where the occurrence of sand and gravel has been recorded.

In the vicinity of Andrew the best prospect for large supplies of groundwater appears to exist in the stream trench systems about 4 miles south of the village. It

was already known from a previous flowing hole that a good aquifer had been struck in one of these trenches located in the N. W. 1/4, Sec. 5, Tp. 56, R. 16, W. 4. Attempts were made to find this supply of water one mile to the east. Although sand and gravel was encountered for 35 feet from the surface down (Research Council test holes #1 and #12), and in one hole from 57 to 59 feet (Research Council test hole #11), the gravel was dirty. Very little circulation water was lost during drilling and indications of large supplies of water were not apparent. These stream trench systems and drilling locations are shown in Plate 3. A farm well on the S. W. 1/4, Sec. 8, Tp. 56, R. 16, W. 4, which obtains water from an aquifer at 54 feet to 55 feet probably has a low safe yield. This is very likely sited in the same deposits as those encountered in Research Council test hole #11.

To ascertain the exact depth of the aquifer on the N. W. 1/4, Sec. 5, Tp. 56, R. 16, W. 4, a test hole was put down on the opposite side of the road from the present flowing hole. The water was encountered in sand and gravel between 45 feet and 50 feet, and the rate of flow 8 inches above ground level was 8 gallons per minute. Compared with yields obtained at other locations in the area, this appears to be a very good aquifer. Also, the water is chemically suitable and would require no treatment.

Information collected about farm wells on the S. W. 1/4, Sec. 34, and the N. W. 1/4, Sec. 35 in Tp. 55, R. 16, W. 4, indicates promising prospects for groundwater supplies. (The two wells in this stream trench system are 55 feet and 60 feet deep).

Research Council test hole #8, location S. E. 1/4, Sec. 24, Tp. 57, R. 17, W. 4, produced a small flow of water from sand at 21 to 24 feet. An attempt to find this sand much nearer Andrew was unsuccessful.

The water-bearing sands and gravels in the glacial drift within and near Andrew are thin. Research Council test holes #5, #6, and #3, to the west, south and southeast of the village, encountered sand and gravel to only 11 feet, 14 feet, and 15 feet, respectively. The problem of getting water is not one of porosity and permeability but of the shallow depth of the sand and gravel. This does not allow for a drop in the water table in dry years, nor for heavy demands likely to be made upon the aquifer in supplying the village. This probably accounts for the very large dimensions of the C. P. R. well (16 feet x 16 feet) which is 15 feet deep and draws water from this aquifer.

Groundwater in bedrock aquifers

As there is little lateral continuity of any particular stratum, prospecting for large supplies of groundwater is rendered extremely difficult. The evidence available indicates most of the water-bearing sands recorded and tested are poor producers and yield only domestic supplies of water. It is almost certain that yields of wells above a few gallons per minute are not likely to be obtained from water-bearing zones in the bedrock in the immediate vicinity of Andrew.

The lower limit for prospecting for chemically suitable supplies of water seems to be around 200 feet. Below 200 feet, water too salty to drink is often obtained, but a well on the S. E. 1/4, Sec. 25, Tp. 56, R. 17, W. 4, two miles southwest of Andrew, is reported to be 315 feet deep and supplies water which is suitable for drinking.

From the survey of farm wells it was discovered that many of the shallow wells can be pumped dry at rates up to 5 gallons per minute.

Piezometric surface

The piezometric surface is the pressure surface formed by the height to which water will rise in wells tapping aquifers under confined or artesian conditions.

The shape and slope of this surface indicate the directions of movement of groundwater, and this is shown to be from local centres of high relief to areas of low relief.

From the accompanying map of the piezometric surface it can be seen that the piezometric surface closely follows the topography of the area, which means that the source of recharge is by local precipitation. Where this surface intersects the land surface springs may occur, forming lakes, or feeding creeks.

Some of the springs in the area occur on the S. W. 1/4 Sec. 15, S. W. 1/4 Sec. 16, N. W. 1/4 Sec. 25, N. 1/2 Secs. 33 and 34, S. W. 1/4 Sec. 35, in Tp. 56, R. 17, W. 4. These springs have small flows of up to 5 gallons per minute.

The water levels used in drawing the piezometric surface are mostly from wells ranging in depth from 20 feet to 60 feet. Information collected about deep wells, those which are deeper than 150 feet, is too scant for any worthwhile analysis and discussion.

Pump test results

The data available from pump test results are very inadequate but may give an indication of the likely yield of the water-bearing sands in the area.

The information supplied to the Village council includes data from tests run on bedrock and drift aquifers.

(a) Bedrock aquifers: Information from test drilling showed that bedrock aquifers are not likely to yield large supplies of groundwater, and even domestic supplies may cause serious problems. A well finished in bedrock can be expected to have a safe yield of approximately 1 to 5 gallons per minute.

Although there is no detailed information about the hydrologic properties of the bedrock, it is believed that transmissibility figures for the average aquifer range from 10 to 100.

Transmissibility (Theiss, C. V., 1935, The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage: Am. Geophys. Union Trans., pt. 2, p. 519 - 524, August) may be defined as the number of gallons of water that will move in one day through a vertical strip of the aquifer 1 foot wide, having a height equal to the full thickness of the aquifer, under a hydraulic gradient of 100 per cent, or 1 foot per foot.

More simply stated, transmissibility is a hydrologic term used to express the water supply prospects of an aquifer. The figures given here are so low that they can only be interpreted as meaning the bedrock aquifers are not a suitable source for large supplies of groundwater.

(b) Drift aquifers: The most promising water-bearing strata in the drift are to be found in the glacial or preglacial drainage channels previously mentioned. The occurrence of flowing wells in the area is limited to these drainage channels, and their yield may often be less than 5 gallons per minute. However, a short test at a pumping rate of 60 gallons per minute was run at location N. W. 1/4 Sec. 5, Tp. 56, R. 16, W. 4, during previous prospecting for the village.

Because of technical difficulties involved in conducting flow or recovery tests on these wells, there are no reliable values for transmissibility. However, from the small amount of information available, transmissibility figures range from 150 to 1500.

Water level fluctuations

After the initial survey of farm wells in June, 1958, several wells were selected and measured at the end of August to observe the effects of the dry summer. These wells are listed below, together with two observation wells for which regular monthly readings were begun in September, 1958.

Location W. 4th Mer. Sec.	Tp.	R.	Depth of well in feet	Depth to water June	August	Sept.	Oct.	Nov.
SW 1/4 2	57	16	34.0	8.6		10.8	10.74	10.77
NW 1/4 23	56	15	70.9			7.29	7.29	7.30
NW 1/4 22	55	15	46.7	11.7	11.08			
SW 1/4 6	56	14	24.6	11.7	14.00			
SW 1/4 7	56	14	16.7	3.7	5.54			
SE 1/4 10	56	15	38.2	13.8	14.50			
NW 1/4 24	57	15	36.0	5.60	11.14			
NW 1/4 5	57	16	62.0	7.0	9.65			
SE 1/4 5	58	15	42.3	6.1	8.21			
SW 1/4 2	58	16	80.0	20.0	15.7			
SW 1/4 3	58	17	44.8	6.25	13.3			

In conjunction with the above readings the following figures for temperature and precipitation are supplied for a weather station at Vegreville which is in an adjacent area.

Month	Temperature (in degrees F) Maximum	Minimum	Average	Precipitation (in inches)
May	84	28	56.5	1.16
June	87	34	57.6	1.34
July	93	37	62.0	0.96
August	92	36	63.5	1.91
September	79	30	49.8	4.33
October	67	18	42.3	0.13

Quality of groundwater

The groundwater obtained from shallow wells in the area ranges in hardness from 125 to 1000 parts per million. The hardening agents are bicarbonates of lime and magnesium.

The chloride content has a range from zero to 125 parts per million. Iron ranges from 0.1 to 5.0 parts per million.

The soda content is expressed in grains per gallon and ranges from 0 to 39. Though below the harmful limit for human consumption and livestock, it will usually corrode aluminum and harm plants.

The alkalinity and sulphate content is too high in some wells and causes undesirable laxative effects.

If contamination occurs it is mostly caused by the nitrate content which has been reported to be as high as 140 parts per million. The presence of nitrates is due to the location of wells with respect to surface contamination.

Apart from the very high iron content of 5 parts per million in the water sample taken from the C. P. R. well, this water is suitable for drinking.

Variation in the chemical quality of the water is shown in Figure 1.

Well completion

The shallow wells in the area can be divided into two categories: dug and bored. Preference for shallow wells appears to have been influenced by three factors, - thequantity of water which can be obtained at any one particular time, the cost of such wells, and the equipment possessed by local water-well drillers. It is easy to obtain small supplies of water for domestic and farm purposes and large bored wells are preferred for storage.

Most bedrock wells do not present boring and completion problems. Caving is rare, due to the argillaceous nature of the strata.

Wells finished in drift aquifers may present difficulties due to caving quicksand. Because of this problem they seldom completely penetrate the aquifer for the well driller usually terminates the well as soon as the sand and water are encountered.

Both types of wells are lined with wooden cribbing, but some have cement cribbing for about 8 feet near the surface, as a prevention against surface seepage.

CONCLUSIONS

According to the information collected during this investigation, the following statements can be made.

In looking for a municipal water supply in the Andrew area, the bedrock aquifers do not come into consideration.

The only promising source for a larger water supply can be expected in glacial or preglacial drainage channels.

Groundwater in the area appears to be artesian. As the piezometric surface closely follows the topographic surface, recharge is believed to be due to local precipitation.

Possible transmissibility figures for bedrock aquifers show these to be poor producers.

The quality of water obtained from deep wells is soft and often salty, but water from shallow wells is hard.

RECOMMENDATIONS

The best aquifers in the area are to be found in the stream trench systems to the south of the village.

At the location N. W. 1/4 Sec. 5, Tp. 56, R. 16, W. 4th Meridian is the only definitely known spot where a plentiful supply of water is available. At this

site, screening and gravel packing of the wells would be necessary. However, to bring water from this location would require 4 1/2 miles of pipeline.

There is little encouraging evidence to justify further drilling in the bedrock for large supplies of fresh water.

GENERAL REFERENCES

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DATA RE DISTRICT WELLS

Location W. 4th Mer. Qr. Sec Tp. R.	Type	Diameter	Elevation	Depth of well (feet)	Depth to water (feet)	Hard or soft	Reported supply	Ever dry	Remarks
NW 16 55 14	bored	2 ft.	2030	60	15	hard	fair	yes	
SW 19 55 14	bored	2 ft.	2055	53	25	soft	good	no	
SW 20 55 14	bored	2 ft.	2040	43.8	7.9	-	-	-	
SW 22 55 14	bored	-	2000	25	surface	-	fair	yes	Water yellow in color, from quicksand
SE 28 55 14	bored	2 ft.	2020	49.7	13.2	-	-	-	
SE 29 55 14	bored	2 ft.	2025	68.3	7.15	-	-	-	
NW 29 55 14	drilled	2 in.	2050	215	54	soft	excellent	no	water-bearing bands at 30ft, 70 ft, 109 ft, 215 ft.
	-	-		30	18	hard	good	no	Water from sand
SW 31 55 14	bored	2 ft.	2070	68	30	soft	good	no	
	bored	2 ft.		25	-	hard	good	no	
NW 34 55 14	bored	2 ft.	2080	16.5	13.8	-	-	-	
SW 32 55 14	drilled	-	2025	175	45	soft	excellent	no	Pumping rate 6 gallons/minute
NW 34 55 14	bored	2 ft.	2090	30	12	hard	good	no	Water from quicksand
	dug	-		25	20	hard	fair	yes	
NW 14 55 15	bored	2 ft.	2080	46.3	11.0	-	-	-	
NE 15 55 15	bored	2 ft.	2080	68	40	hard	good	no	Copy of chemical analysis
NW 17 55 15	dug	-	2085	60	40	hard	-	yes	Water from coal
NE 20 55 15	dug	2 1/2ft. x 2 1/2ft.	2085	24.1	9.9	-	-	-	
NW 21 55 15	dug	4 ft. x 4 ft.	2085	24	16	soft	fair	yes	
SW 21 55 15	-	-	2085	24	16	-	-	-	
SE 22 55 15	bored	2 ft.	2075	90	19	soft	good	no	
SW 22 55 15	dug	3 ft. x 3 ft.	2080	16.7	6.0	-	-	-	
SW 24 55 15	bored	2 ft.	2060	9.3	6.0	-	-	-	
SW 26 55 15	bored	2 ft.	2065	49.8	2.75	-	-	-	
NE 28 55 15	bored	2 ft.	2075	67.8	12.6	-	-	-	
SE 28 55 15	bored	-	2080	70	-	soft	fair	yes	
	-	-		40	35	-	-	-	
NE 29 55 15	bored	2 ft.	2080	36.3	24.6	soft	fair	yes	Water from coal, water level fluctuates with rainfall
NW 30 55 15	dug?	3 ft.	2080	5.15?	4.45	-	-	-	Water frozen
NE 30 55 15	bored	2 ft.	2080	26.3	8.0	-	-	-	
NE 31 55 15	bored	2 ft.	2075	60	7	hard	fair	yes	Water from quicksand at 20 ft. chemically suitab

Location 6th Mer. Sec. Tp. R.	Type	Diameter	Elevation	Depth of well (feet)	Depth to water (feet)	Hard or soft	Reported supply	Ever dry	Remarks
NW 34 55 15	dug	-	2060	30	10	hard	-	yes	Copies of chemical analysis recorded
	bored	2 ft.		40	30	hard	-	yes	
NE 34 55 15	dug	4 ft. x 4 ft.	2060	24.7	2.7	-	-	-	
SE 34 55 15	bored	2 ft.	2065	70	16	soft	good	no	
	drilled	6 ins.		200	30	soft	good	no	Water salty; from sand
SW 35 55 15	bored	2 ft.	2060	32.1	8.0	-	-	-	
NE 35 55 15	bored	2 ft.	2060	140	30	hard	fair	-	Color of water-yellow
	bored	2 ft.		60	-	hard	fair	-	Copies of chemical analyses supplies
SE 36 55 15	dug?	3 ft. x 3 ft.	2075	14.3	2.85	-	-	-	
NW 14 55 16	dug	3 ft.	2130	30	25	hard	fair	yes	Dry in Feb.&March
	dug	3 ft.		60	45	hard	fair	yes	Dry in Feb.&March
NE 14 55 16	dug	-	2130	26	18	hard	poor	yes	Water from coal
NE 15 55 16	bored	2 ft.	2125	38.3	19.2	hard	fair	yes	
NE 16 55 16	dug	4 ft. x 4 ft.	2130	40	15	hard	good	no	
NW 18 55 16	bored	2'6"	2180	46	20	hard	good	-	
NW 20 55 16	bored	2 ft.	2180	90	28	soft	good	no	
NW 21 55 16	bored	2 ft.	2170	30	22	hard	fair	no	
NE 21 55 16	-	-	2135	45.7	3.0	-	-	-	
NW 22 55 16	dug?	3 ft.	2135	46.7	11.7	-	-	-	
SE 23 55 16	dug	-	2100	22.5	11.5	hard	good	no	
SE 24 55 16	bored	3 ft.	2095	18	9	hard	fair	yes	Goes dry in winter
SE 25 55 16	dug	3 ft.	2090	9.5	4.55	hard	good	no	Water from quick-sand
NW 26 55 16	drilled	6"	2125	235	70	soft	good	no	Drilled in 1924
NE 27 55 16	drilled	4"	2125	278	35	soft	good	no	Drilled in 1954
NE 28 55 16	bored	2 ft.	2130	55	25	hard	fair	yes	
SE 28 55 16	bored	2 ft.	2145	-	28.0	hard	good	no	
NW 31 55 16	bored	2 ft.	2160	54	31.8	hard	good	no	Water from quick-sand
SE 31 55 16	bored	2 ft.	2165	45?	32.5	hard	fair	-	
SE 32 55 16	dug	3 ft.	2125	35	surface	-	good	no	Chemically suitable
SW 34 55 16	bored	2 ft.	2105	60	3	soft	good	no	
SE 34 55 16	dug	-	2115	14	8	hard	good	no	Chemically suitable Water level fluctuates with rainfall.
NW 35 55 16	bored	2 ft.	2100	55	45	hard	good	no	Water from coal
SE 35 55 16	bored	2 ft.	2090	70	10	hard	fair	yes	Chemically suitable
SW 35 55 16	dug	3 ft. x 3 ft.	2110	30	10	soft	good	no	Water level fluctuates with rainfall
SE 36 55 16	dug	-	2080	14	10	hard	good	no	Water from quick-sand

Location W. 4th Mer. Qr. Sec. Tp. R.	Type	Diameter	Elevation	Depth of well (feet)	Depth to water (feet)	Hard or soft	Reported supply	Ever dry	Remarks
SW 22 55 17	bored	2 ft.	2185	42.8	11.5	-	-	-	
SE 24 55 17	bored	2 ft.	2170	32	22	hard	fair	yes	
SW 24 55 17	dug	3 1/2 ft. x 3 1/2 ft.	2175	-	15.1	-	-	-	
NE 25 55 17	bored	2 ft.	2150	70	20	soft	fair	no	
SW 25 55 17	bored	2 ft.	2175	57.2	18.08	-	-	-	
NW 29 55 17	bored	2 ft.	2200	51.4	7.1	-	-	-	
SE 32 55 17	bored	2 ft.	2190	16.4	1.37	-	-	-	
SW 36 55 17	dug	4 ft. x 4 ft.	2150	4.0	3.8	-	-	-	
NW 3 56 14	bored	2 ft.	2035	13.2	2.0	-	-	-	
SW 3 56 14	bored	2 ft.	2075	40	18	soft	good	no	
NE 4 56 14	dug	3 ft. x 3 ft.	2065	17.5	2.6	-	-	-	
SW 4 56 14	dug	3 ft. x 3 ft.	2055	4.5	2.85	-	-	-	
NE 5 56 14	bored	2 ft.	2070	39.2	12.1	-	-	-	
SW 6 56 14	bored	2 ft.	2040	24.6	11.1	-	-	-	
NE 6 56 14	drilled	4 ins.	2000	135	18	-	-	-	Drilled June 1955
SW 7 56 14	bored	2 ft.	2020	16.7	3.7	-	-	-	
NW 8 56 14	bored	2 ft.	2105	28.0	8.0	-	-	-	
NE 16 56 14	bored	2 ft.	2180	30	20	hard	fair	yes	
SW 17 56 14	drilled	-	2125	158	-	soft	good	-	Chemical analyses supplied for both wells.
	drilled	6 ins.		337	-	soft	good	-	drilled in Feb. 1958
NW 18 56 14	bored	2 ft.	2085	90	15	hard	good	no	Water from sand
SW 20 56 14	-	-	2130	64	8.6	-	-	-	
SE 21 56 14	bored	2 ft.	2150	42.5	9.8	-	-	-	
SW 27 56 14	-	-	2140	20	15	-	-	yes	
	-	-		16	8	-	-	yes	
NW 28 56 14	dug?	3 ft. x 3 ft.	2225	13.9	3.1	-	-	-	
SE 29 56 14	bored	2 ft.	2125	22.6	19.6	-	-	-	
NE 31 56 14	bored	2 ft.	2060	26.6	7.3	-	-	-	
SW 31 56 14	bored	2 ft.	2030	21.2	6.6	-	-	-	
NW 33 56 14	bored	2 ft.	2100	60	8	hard	fair	-	
	bored	2 ft.		45	12	hard	fair	-	
SW 34 56 14	bored	2 ft.	2410	52.3	12.6	-	-	-	
NW 1 56 15	bored	3 ft.	2055	29.4	12.2	hard	good	no	
NW 2 56 15	bored	2 ft.	2050	60	20	soft	good	no	Water from coal
SW 3 56 15	-	-	2060	23.7	10.7	-	-	-	
NW 6 56 15	dug?	3 ft. x 3 ft.	2070	20.7	8.0	-	-	-	
SW 9 56 15	bored	2 ft.	2070	26.5	12.9	soft	fair	yes	Bored to 80 ft. Water struck at 40 ft.

Location W. 4th Mer. Qr. Sec. Tp. R.	Type	Diameter	Elevation	Depth of well (feet)	Depth to water (feet)	Hard or soft	Reported supply	Ever dry	Remarks
SE 10 56 15	bored	2 ft.	2060	38.2	13.8	-	-	-	
SW 11 56 15	bored	2 ft.	2055	50	23.8	hard	good	no	
SW 12 56 15	bored	2 ft.	2050	35	20	hard	good	no	Water from sand
NW 13 56 15	bored	2 ft.	2020	19.9	1.2	-	-	-	
SE 14 56 15	drilled	-	2015	210	5	-	-	-	Tested at 7 gpm for 52 hrs. Drawdown 5 ft. Willingdon School well
NE 15 56 15	bored	2 ft.	2055	45.2	4.6	-	-	-	
NW 21 56 15	bored	2 ft.	2070	40.5	23.0	-	-	-	
NW 24 56 15	-	-	2025	30	18	-	-	-	
NW 29 56 15	-	-	2075	60	52	-	-	-	
NW 34 56 15	bored	2 ft.	2065	26.1	2.2	-	-	-	
SW 1 56 16	dug?	3 ft.	2075	14.5	6,5	-	-	-	
NE 2 56 16	dug	4 ft. x 4 ft.	2065	15.30	10.15	-	-	-	
NW 2 56 16	bored	2 ft.	2080	32	-	hard	fair	no	Water level fluctuates with rainfall
NE 4 56 16	bored	2 ft.	2100	24.6	11.7	hard	fair	yes	
SE 4 56 16	dug	-	2110	12	4	hard	good	no	Water level fluctuates with rainfa"
NW 5 56 16	bored	2 ft.	2140	36	9	hard	good	-	
NE 5 56 16	bored	2 ft.	2110	70	-	hard	fair	yes	Water level fluctuates with rainfall
SE 5 56 16	bored	2 ft.	2125	30	13.4	hard	good	no	Water level fluctuates with rainfall
SW 8 56 16	bored	2 ft.	2085	57	4.4	soft	good	-	
SE 8 56 16	bored	2 ft.6in.	2100	-	5.0	hard	good	no	Water level fluctuates with rainfall
SE 11 56 16	dug	4 ft. x 3 ft.	2065	4.0	3.55	-	-	-	
SW 12 56 16	dug	3 1/2 ft.	2065	5.4	4.4	-	-	-	
SE 15 56 16	-	-	2070	22	6	hard	good	no	Water level fluctuates with rainfall
NW 17 56 16	bored	2 ft.	2120	62	14.75	soft	good	no	
NE 17 56 16	dug	-	2100	-	9	hard	good	no	Chemically suitable
SE 17 56 16	bored	2 ft.	2100	30	21.0	hard	good	no	Water from quicksand
NE 18 56 16	dug	3 ft.	2120	-	9.0	hard	good	no	
NW 18 56 16	bored	2 ft.	2140	-	20.5	-	-	-	
SE 18 56 16	bored	2 ft.	2125	60	25.5	-	-	-	
SW 19 56 16	bored	2 ft.	2120	55	12.3	-	good	no	
NE 20 56 16	bored	3 ft.	2075	28	12	hard	fair	yes	Water level fluctuates with rainfall

Location W. 4th Mer. Qr. Sec. Tp. R.	Type	Diameter	Elevation	Depth of well (feet)	Depth to water (feet)	Hard or soft	Reported supply	Ever dry	Remarks
SE 20 56 16	bored	2 ft.	2100	45	15	hard	good	no	Water from gravel. Water level fluctuates with rainfall
NE 25 56 16	bored	2 ft.	2065	23.0	4.0	-	-	-	
SE 30 56 16	bored	2 ft.	2075	20	11.74	hard	good	no	
SW 30 56 16	bored	2 ft.	2100	55	17.92	soft	fair	yes	
NW 34 56 16	drilled	3 ins.	2065	100	14	hard	fair	yes	Well drilled to 235 ft. but water was too salty for human consumption
	(drilled	3 ins.		235	8	-	good	-	
NW 35 56 16	bored	2 ft.	2065	52.0	9.5	-	-	-	
SE 36 56 16	bored	2 ft.	2070	9.0	8.3	-	-	-	
NW 1 56 17	bored	2 ft.	2125	47.4	7.6	-	-	-	
SE 1 56 17	bored	2 ft.	2155	35	10.3	hard	good	no	
NE 2 56 17	bored	2 ft.	2125	85	20	hard	good	yes?	Water from sand?
NW 2 56 17	dug	3 ft.6in.	2135	16.0	6.2	-	-	-	
NE 3 56 17	dug	3 ft.	2140	18	14	hard	good	no	Water from quicksand
NW 4 56 17	dug	-	2145	20	8	hard	good	no	
NE 4 56 17	dug	4 ft. x 4 ft.	2150	17.5	10.6	-	-	-	
NW 10 56 17	-	-	2120	59.2	31.15	-	-	-	
SW 11 56 17	bored	2 ft.	2135	14.7	7.35	-	-	-	
SE 13 56 17	dug	3 ft.	2125	45	16.2	hard	good	no	Water from coal
NW 14 56 17	bored	2 ft.	2125	42	15	hard	good	no	Water from coal
NE 14 56 17	dug	3 1/2ft. x 3 1/2ft.	2100	26.3	18.7	-	-	-	
NW 15 56 17	dug	-	2195	11.0	5.75	-	-	yes	Water level fluctuates with rainfall
NE 16 56 17	bored	2 ft.	2125	70	-	hard	good	no	
SW 16 56 17	dug	3 ft.	2100	50	40	soft	-	no	Water from coal
NE 17 56 17	bored	2 ft.	2115	43.7	9.2	-	-	-	
SE 17 56 17	cable	6 ins.	2130	319	309	-	poor	yes	
NE 21 56 17	dug?	3 ft.	2125	31.7	19.52	-	-	-	
NE 23 56 17	dug	3 ft.	2125	22.9	15.3	hard	fair	yes	
SE 24 56 17	bored	-	2125	-	14.5	-	-	-	
NW 24 56 17	dug	3 ft.	2125	24.9	15.15	hard	fair	yes	
SW 25 56 17	dug	3 ft.	2125	21	19	hard	good	no	Water from coal at 20 ft.
	dug	4 ft. x 4 ft.		22.9	20.7	hard	good	no	
SE 25 56 17	drilled	4 ins.	2130	325	-	soft	excellent	no	Copy of chemical analysis recorded
SE 27 56 17	bored	2 ft.	2105	32.3	10.65	-	-	-	
	bored	2 ft.		46.2	10.2	-	-	-	

Location W. 4th Mer. Qr. Sec. Tp. R.	Type	Diameter	Elevation	Depth of well (feet)	Depth to water	Hard or soft	Reported supply	Ever dry	Remarks
NW 29 56 17	dug	3 ft.	2105	28.6	9.8	-	-	-	
	dug	3 ft.		29.7	7.94	-	-	-	
SE 29 56 17	dug	3 1/2 ft. x 3 1/2 ft.	2110	34.3	7.13	-	-	-	
NE 33 56 17	bored	2 ft.	2095	45.3	6.5	-	-	-	
NW 34 56 17	dug	3 ft.	2095	8.8	1.1	-	-	-	2 ft. of coal at 6 ft.
SW 35 56 17	dug	3 ft.	2110	14.5	7.75	-	-	-	
SW 36 56 17	bored	2 ft.	2095	22.4	6.8	-	-	-	
NW 4 57 14	-	-	2075	26.8	19.4	-	-	-	
SW 8 57 14	-	-	2010	22	16	-	-	-	
	-	-		18	10	-	-	-	
NW 20 57 14	bored	2 ft.	2100	44.8	25.0	-	-	-	
SW 21 57 14	dug?	3 ft.	2125	30.1	7.2	-	-	-	
NW 2 57 15	bored	3 ft.	2050	120	30	soft	fair	no?	Water from [illegible]
NE 4 57 15	bored	2 ft.	2100	28.3	5.0	-	-	-	
NW 4 57 15	dug	-	2100	56	12	hard	good	no	Water from coal
NW 5 57 15	bored	2 ft.	2075	55	20	soft	fair	yes?	Water from coal?
NE 6 57 15	dug	-	2075	50	36	-	fair	yes	Water from coal
	dug	-		40	30	-	fair	yes	Water from coal
NW 8 57 15	bored	2 ft.	2080	42.2	17.2	-	-	-	
SW 10 57 15	drilled	6 ins.	2125	130	65	soft	good	no	Drilled in 1957
SW 12 57 15	bored	2 ft.	2025	32.5	10.5	hard	good	no	
NE 12 57 15	bored	2 ft.	2100	75	14	hard	fair	no	Water from coal
	drilled	4 ins.		240	27.8	-	fair	-	Water from sand at 225' & 235'
NW 14 57 15	bored	2 ft.	2030	62	30	hard	fair	yes	
SW 14 57 15	Drilled	4 ins.	2055	230	43	soft	good	no	Water from sand
	drilled	4 ins.		157	35	soft	good	no	Water from sand
	bored	2 ft.		80	20	hard	fair	yes	
	bored	2 ft.		70	24	hard	fair	yes	
	bored	2 ft.		43	20	hard	fair	yes	
SE 15 57 15	bored	2 ft.	2030	30	8	hard	fair	yes	Water from coal
NW 15 57 15	bored	2 ft.	2060	50	16	hard	fair	yes	
	bored	2 ft.		55	10	hard	fair	yes	
NE 17 57 15	bored	2 ft.	2075	30.8	9.8	-	-	-	
SW 18 57 15	bored	2 ft.	2075	16.4	5.8	-	-	-	
NE 19 57 15	bored	2 ft.	2095	21.4	5.6	-	-	-	
SE 20 57 15	bored	2 ft.	2100	40	25	hard	fair	yes?	Water from coal
NE 21 57 15	bored	2 ft.	2100	63	10	hard	good	no	
SE 23 57 15	bored	2 ft.	2065	30.8	10.5	-	-	-	
NW 24 57 15	bored	2 ft.	2075	36.0	5.6	-	-	-	
NE 24 57 15	bored	2 ft.	2100	30	20	hard	fair	yes	Water from coal
	bored	2 ft.		57	20	hard	fair	yes	Water from coal
SW 28 57 15	dug	4 ft. x 4 ft.	2095	21.0	4.5	-	-	-	

Location W. 4th Mer. Qr. Sec. Tp. R.	Type	Diameter	Elevation	Depth of well (feet)	Depth to Water (feet)	Hard or soft	Reported supply	Ever dry	Remarks
SE 30 57 15	dug	-	2100	37.8	9.8	hard	fair	yes	Dry after 600 gal. approx.
NE 31 57 15	bored	-	2110	35	15	hard	fair	yes	Bored in 1918
NE 32 57 15	drilled	6 ins.	2055	30	-	hard	fair	yes	Chemically suitable
NW 1 57 16	bored	2 ft.	2075	67.7	47.7	-	-	-	
SW 2 57 16	bored	2 ft.	2065	34.0	8.6	-	-	-	
NW 4 57 16	bored	2 1/2 ft.	2065	19.0	7.0	hard	fair	no	
SE 5 57 16	bored	2 ft.	2065	45	20	hard	fair	yes	
	bored	2 ft.		60	6	hard	fair	yes	
NE 6 57 16	bored	2 ft.	2055	40.9	6.3	-	-	-	
	dug	6 ft. x 6 ft.		19.8	5.6	-	-	-	
SW 6 57 16	bored	2 ft.	2065	44.4	5.8	-	-	-	
	dug	5 ft. x 5 ft.		29.1	8.0	-	-	-	
	dug	5 ft. x 5 ft.		15.3	5.0	-	-	-	
SE 7 57 16	bored	2 ft.	2050	30	6	hard	fair	yes	Chemically suitable
SE 9 57 16	bored	2 ft.	2070	18.0	6.9	-	-	-	
SW 9 57 16	bored	2 ft.	2065	41.8	9.0	-	-	-	
SW 9 57 16	bored	3 ft.	2065	50	15	hard	poor	yes	Chemically suitable
SE 10 57 16	bored	2 ft.	2070	25.5	7.57	-	-	-	
NW 12 57 16	bored	2 ft.	2070	13.5	4.8	-	-	-	
SE 12 57 16	bored	2 ft.	2075	65	30	hard	good	no	Water from sand
NE 13 57 16	bored	2 ft.	2070	20	9	hard	good	no	Water from sand
NE 14 57 16	dug	4 ft. x 4 ft.	2070	39.4	9.2	-	-	-	
SW 14 57 16	bored	2 1/2 ft.	2075	14.5	8.15	-	-	-	
NW 15 57 16	bored	2 ft.	2060	62.0	7.0	-	-	-	
NE 16 57 16	bored	2 ft.	2055	26.6	12.4	-	-	-	
SW 16 57 16	bored	2 ft.	2060	40	10	hard	poor	yes	
SE 17 57 16	bored	2 ft.	2060	59	18	hard	poor	yes	
SE 19 57 16	bored	2 ft.	2050	90	70	hard	poor	yes	
	bored	2 ft.		30	25	hard	poor	yes	
SW 19 57 16	dug	3 ft. x 3 ft.	2045	8.3	5.1	-	-	-	
NW 20 57 16	bored	2 ft.	2040	24.9	11.4	-	-	-	
SW 21 57 16	dug?	3 ft.	2045	24.0	9.0	-	-	-	
SW 23 57 16	bored	2 ft.	2070	51.1	7.2	-	-	-	
NE 23 57 16	bored	2 ft.	2075	27.3	7.3	-	-	-	
NE 24 57 16	bored	2 ft.	2120	60	20	hard	good	no	Water level fluctuates with rainfall
NE 25 57 16	bored?	2 1/2 ft.	2085	24.7	6.4	-	-	-	
NE 26 57 16	bored	-	2080	19	8	Soft	poor	no	Water from quicksand

Location W. 4th Mer. Qr. Sec. Tp. R.	Type	Diameter	Elevation	Depth of well (feet)	Depth to water (feet)	Hard or soft	Reported supply	Ever dry	Remarks
NW 26 57 16	-	-	2070	66	5	-	-	-	
SW 27 57 16	bored	2 ft.	2060	73.4	46.4	soft	fair	no	Water from quicksand. Water level fluctuates with rainfall
NE 29 57 16	bored	2 ft.	2050	62.5	22.7	-	-	-	
SE 29 57 16	bored	2 ft.	2045	34.4	20.0	-	-	-	
SW 30 57 16	bored	2 ft.	2035	-	7.4	-	-	-	Water frozen
SW 32 57 16	bored	2 ft.	2045	56	25	hard	good	no	Water from coal
NE 32 57 16	bored	2 ft.	2050	66.0	32.2	-	-	-	
	bored	2 ft.		47.8	15.6	-	-	-	
SW 34 57 16	dug	2 1/2 ft. x 2 1/2 ft.	2055	22	15	hard	fair	no	Water from sand
NW 35 57 16	-	-	2050	14.8	7.5	-	-	-	
NW 36 57 16	bored	2 ft.	2050	26.8	10.3	-	-	-	
NE 36 57 16	bored?	-	2100	28.5	3.0	-	-	-	
NW 1 57 17	bored	-	2070	65	30	-	-	-	
	dug	-		15	-	-	-	-	
NE 2 57 17	bored	2 ft.	2070	33.6	7.5	-	-	-	
	bored	2 ft.		36.5	8.53	-	-	-	
NE 4 57 17	dug	-	2070	10.8	7.08	-	-	-	
	dug	3 ft. x 3 ft.		6.7	5.8	-	-	-	
SW 10 57 17	dug	3 ft.	2070	15	8	hard	fair	yes	
SE 10 57 17	dug	3 ft.	2075	14	8	hard	good	no	
NE 11 57 17	bored	2 ft.	2070	18	8	hard	good	no	Water from quicksand
	bored	2 ft.		50	15	hard	fair	yes	Water from coal
NE 12 57 17	bored	2 ft.	2060	28.5	24.6	soft	-	-	
SW 14 57 17	dug	-	2070	20	13	hard	good	no	Water from quicksand. Water level fluctuates with rainfall
SW 15 57 17	dug	-	2075	14	11	soft	good	no	Water from quicksand. Water level fluctuates with rainfall
SW 16 57 17	dug	3 ft.	2070	10.6	4.5	soft	good	no	
NE 21 57 17	dug	-	2070	11	7	-	-	-	Water from sand
SE 21 57 17	dug	-	2075	12	7	soft	good	no	Water from sand
NE 24 57 17	bored	2 ft.	2040	21.8	6.7	-	-	-	
NE 25 57 17	bored	2 ft.	2030	49.0	4.4	-	-	-	
NW 34 57 17	bored	2 ft.	2040	35	20	hard	fair	-	
NE 36 57 17	bored	2 ft.	2030	82	25	hard	fair	no	
NW 36 57 17	bored	2 ft.	2035	82.3	16.55	-	-	-	

Location W. 4th Mer. Qr. Sec. Tp. R.	Type	Diameter	Elevation	Depth of well (feet)	Depth to water (feet)	Hard or soft	Reported supply	Ever dry	Remarks
SW 4 58 14	dug	-	2095	6	3	soft	fair	no	
SW 6 58 14	bored	2 ft.	2110	24	12	hard	good	no	
NE 1 58 15	bored	2 ft.	2110	52	16	hard	good	no	Water from sand
SE 2 58 15	dug	-	2000	35	25	soft	fair	yes	
SW 5 58 15	dug?	3 ft.	2100	21.5	11.5	-	-	yes	Water from quicksand
SE 5 58 15	bored	2 ft.	2015	42.3	6.1	-	-	-	
NE 6 58 15	bored	2 ft.	2125	53.6	16.0	-	-	-	
SE 10 58 15	dug	-	2025	12	6	hard	good?	no	Water from sand
SW 2 58 16	bored	2 ft.	2030	80.0	20.0	-	-	-	
SW 3 58 16	bored	2 ft.	2055	40	15	hard	good	no	Chemically suitable
NE 3 58 16	bored	2 ft.	2060	30.2	8.2	-	fair	-	
NW 5 58 16	bored	2 ft.	2055	40	20	hard	good	no	
SE 5 58 16	bored	2 ft.	2055	34.4	8.9	-	-	-	
SE 7 58 16	bored	-	2055	56	35	hard	poor	yes	Water from sand
	-	-	-	40	20	-	-	-	Water level Fluctuates with rainfall
SW 9 58 16	bored	2 ft.	2050	42	30	hard	good	no	
SE 9 58 16	bored	2 ft.6 in.	2040	38.0	9.2	-	-	-	
SW 10 58 16	bored	2 ft.	2035	40	28	hard	fair	yes	Water from sand
SE 1 58 17	bored	2 ft.	2030	58.8	52.05	-	-	-	
SE 3 58 17	bored	2 ft.	2025	44.8	6.25	-	-	-	
SE 5 58 17	bored	2 ft.	2035	25	9	hard	good	no	

Lithologic Logs for Research Council of Alberta Test Holes

Depth (in feet)	Description

R.C.A. Test Hole #1 Location: S. W. 1/4 Sec. 4, Tp. 56, R. 16, W. 4 Mer.

0 - 5	White and light-grey clay
5 - 15	Sand
15 - 21	Fine sand
21 - 25	Coarse gravel and some clay
25 - 40	Gravel and some clay
	Caving hole - abandoned

R.C.A. Test Hole #2 Location: S. W. 1/4 Sec. 22, Tp. 56, R. 16, W. 4

0 - 15	Brown sandy clay, some pebbles
15 - 90	Alternating sequence of grey clay, purplish-brown clay, white sandy clay and carbonaceous shale

R.C.A. Test Hole #3 Location: S. W. 1/4 Sec. 27, Tp. 56, R. 16, W. 4

0 - 5	Black silty sand and pebbles
5 - 10	Sand and gravel with some clay
10 - 15	Coarse sand and fine gravel
15 - 20	Grey sandy clay, grey silt, some pebbles
20 - 80	Alternating sequence of grey clay, purplish-brown clay, grey silt, light-brown clay, white sandy clay and thin sandstone bands.

R.C.A. Test Hole #4 Location: N. W. 1/4 Sec. 15, Tp. 56, R. 16, W. 4

0 - 15	Yellowish-brown clay
15 - 40	Grey clay, light-brown clay, some pebbles
40 - 90	Alternating sequence of white sandy clay, light-brown clay, dark-brown clay and carbonaceous shale

R.C.A. Test Hole #5 Location: N. E. 1/4 Sec. 30, Tp. 56, R. 16, W. 4

0 - 10	Coarse gravel
10 - 50	Alternating sequence of white sandy clay, light-brown clay, grey clay and carbonaceous shale

R.C.A. Test Hole #6 Location: N. W. 1/4 Sec. 28, Tp. 56, R. 16, W. 4

0 - 5	Coarse gravel, sandy brown clay
5 - 15	Sand and fine gravel
15 - 25	Drilling in clay but no samples
	Caving hole - abandoned

Depth (in feet)	Description
R.C.A. Test Hole #7	**Location: N. E. 1/4 Sec. 6, Tp. 56, R. 16, W. 4**
0 - 45	Yellowish-brown clay, light-brown sandy clay and white sandy clay partly oxidized, purplish-brown clay, carbonaceous shale, some pebbles
45 - 50	Gravel and fine sand - water flowed from 45 to 50 feet
50 - 60	Light-grey silt
R.C.A. Test Holes #8 and 8A	**Location: S. E. 1/4 Sec. 24, Tp. 57, R. 17, W. 4**
0 - 30	Light-brown clay, grey clay partly oxidized
35 - 100	Alternating sequence of light-grey sandy clay, light-brown clay, soft sandstone, white sandy clay and carbonaceous shale
R.C.A. Test Hole #9	**Location: N. W. 1/4 Sec. 33, Tp. 56, R. 16, W. 4**
0 - 5	Sandy brown clay, partly oxidized, some pebbles
5 - 50	Alternating sequence of light-grey clay, brown clay, white sandy clay, carbonaceous shale and coal
R.C.A. Test Hole #10	**Location: S. E. 1/4 Sec. 32, Tp. 56, R. 16, W. 4**
0 - 10	Grey sandy clay, partly oxidized, some pebbles
10 - 100	Alternating sequence of light-grey clay, white sandy clay, light-brown clay, siltstone and soft sandstone
R.C.A. Test Hole #11	**Location: N. E. 1/4 Sec. 8, Tp. 56, R. 16, W. 4**
0 - .5	Sand and fine gravel, dark-brown sandy clay
5 - 20	Yellowish-brown sandy clay, grey sandy clay, whitish sandy clay
20 - 57	Brown sandy clay, some pebbles
57 - 59	Gravel and clay
59 - 70	White sandy clay, light-grey sandy clay, carbonaceous shale and silt
R.C.A. Test Hole #12	**Location: S. W. 1/4 Sec. 4, Tp. 56, R. 16, W. 4**
0 - 40	Yellowish-brown sand
40 - 45	Light-grey silty sand, light-grey sandy clay, some pebbles
45 - 60	Light-grey sandy clay, light-grey silt, white sandy clay, some pebbles
60 - 70	White sandy clay, light-grey clay, and carbonaceous shale

Depth (in feet)	Description

R.C.A. Test Holes #13 and 13A Location: S.E. 1/4 Sec. 15, Tp. 56, R. 16, W. 4

0 - 30	Grey sandy clay, partly oxidized, grey clay, fine sand, some pebbles
30 - 55	Alternating sequence of grey clay, light-brown clay, white sandy clay, coal, and soft sandstone

R.C.A. Test Hole #14 Location: S. E. 1/4 Sec. 12, Tp. 56, R. 17, W. 4

0 - 15	Yellowish-brown clay, some pebbles, coarse and fine sand, coal
15 - 100	Light-grey sandy clay, some pebbles
100 - 105	Gravel, grey sandy clay, partly oxidized
105 - 115	Sandy grey clay, some pebbles
115 - 230	Alternating sequence of light- and dark-brown clay, grey clay, white sandy clay, carbonaceous shale and coal.

Lithologic Logs for Previous Test Drilling, 1952 - 1954

Depth (in feet)	Description
Number 1	Location: S. E. 1.4 Sec. 32, Tp. 56, R. 16, W. 4
0 - 4	clay
4 - 22	coarse sand and gravel
22 - 35	clay with coal
35 - 65	sticky clay
65 - 76	brown shale ledges of sandstone
76 - 104	blue shale
104 - 108	blue sandstone
108 - 110	grey shale
Number 2	Location: S.E. 1/4 Sec. 32, Tp. 56, R. 16, W. 4
0 - 5	brown clay
5 - 25	sand
25 - 35	clay with thin coal
35 - 55	brown shale with thin coal
55 - 70	shale
90 - 93	green shale
93 - 100	sticky clay
Number 3	Location: S.E. Sec. 32, Tp. 56, R. 16, W. 4
0 - 12	fine sand
12 - 18	sand and fine gravel
18 - 35	soft sandstone
35 - 47	shale
47 - 48	coal
48 - 53	sandy clay
53 - 72	brown shale
72 - 100	shale
Number 4	Location: S.E. 1/4 Sec. 32, Tp. 56, R. 16, W. 4
0 - 5	clay
5 - 10	coarse sand
10 - 16	coarse sand and gravel
16 - 18	fine gravel
18 - 32	clay
32 - 40	soft sandstone
40 - 50	shale

Depth (in feet)	Description
Number 5	Location: N.E. 1/4 Sec. 32, Tp. 56, R. 16, W. 4
0 - 5	clay
5 - 8	sand
8 - 25	sand and gravel
25 - 45	shale
45 - 46	coal
46 - 60	sticky clay
60 - 65	green shale
65 - 100	green shale with thin brown shale
Number 6.	Location: S.E. 1/4 Sec. 32, Tp. 56, R. 16, W. 4
0 - 6	clay
6 - 10	sand
10 - 14	coarse sand
14 - 19	fine gravel
19 - 20	gravel and blue sand
20 - 30	brown shale
30 - 32	clay
32 - 55	sandstone
55 - 102	shale
102 - 112	sandstone
112 - 153	shale
153 - 159	sandstone
159 - 180	shale
180 - 200	shale - green
Number 7	Location: N.E. 1/4 Sec. 29, Tp. 56, R. 16, W. 4
0 - 25	gravel and sand
25 - 31	sand and gravel
31 - 40	shale
Number 8	Location: N.W. 1/4 Sec. 32, Tp. 56, R. 16, W. 4
0 - 26	brown clay
26 - 45	blue shale
45 - 60	brown shale
60 - 72	green shale
72 - 80	sandstone
80 - 93	green shale
93 - 110	brown shale and sandstone
110 - 143	shale
143 - 156	soft sandstone
156 - 170	shale
170 - 174	blue sandstone
174 - 200	shale

Depth (in feet)	Description
Number 9	Location: N.E. 1/4 Sec. 28, Tp. 56, R. 16, W. 4
0 - 4	clay
4 - 18	coarse sand
18 - 35	clay
35 - 42	blue shale and sandstone
42 - 62	brown shale
62 - 66	blue sandstone
66 - 83	shale
83 - 85	sandstone
85 - 100	shale
Number 10	Location: S.E. 1/4 Sec. 32, Tp. 56, R. 16, W. 4
0 - 5	clay
5 - 18	sand and gravel
18 - 23	soft sandstone
23 - 49	shale
49 - 52	coal
52 - 54	sandy clay
54 - 68	brown shale
68 - 110	shale and sandstone
Number 11	Location: S.E. 1/4 Sec. 32, Tp. 56, R. 16, W. 4
0 - 8	brown clay
8 - 32	grey clay with thin coal
32 - 42	soft shale with thin coal
42 - 65	shale
65 - 68	sandstone
68 - 83	green shale
83 - 88	blue shale
88 - 100	grey shale
Number 12	Location: S.W. 1/4 Sec. 33, Tp. 56, R. 16, W. 4
0 - 8	clay
8 - 17	sand and gravel
17 - 35	clay with thin coal
35 - 63	shale
63 - 68	sandstone
68 - 73	shale
73 - 80	brown shale
80 - 100	shale and sandstone
100 - 106	sandstone
106 - 110	shale

Depth (in feet)	Description
Number 13	Location: N.W. 1/4 Sec. 29, Tp. 56, R. 16, W. 4
0 - 6	brown clay
6 - 12	sand and gravel
12 - 50	grey shale
Number 14	Location: N.W. 1/4 Sec. 9, Tp. 56, R. 16, W. 4
0 - 4	brown clay
4 - 11	sand
11 - 21	sandy clay
21 - 56	clay
56 - 67	shale
67 - 70	sand and gravel
70 - 98	shale
98 - 101	sandstone
101 - 110	shale
Number 15	Location: N.W. 1/4 Sec. 9, Tp. 56, R. 16, W. 4
0 - 6	clay
6 - 26	clay
26 - 72	shale
72 - 80	bluish green shale
80 - 82	brown shale
82 - 100	shale
Number 16	Location: N.W. 1/4 Sec. 5, Tp. 56, R. 16, W. 4
0 - 6	clay
6 - 28	sand
28 - 34	sand
34 - 56	clay
56 - 67	shale
67 - 72	clay and sandstone
72 - 74	sandstone
74 - 76	clay
76 - 79	sandstone
79 - 82	brown shale
82 - 86	sand
86 - 90	shale

Depth (in feet)	Description
Number 17	Location: N.E. 1/4 Sec. 16, Tp. 56, R. 16, W. 4
0 - 22	clay
22 - 26	sand
26 - 56	clay
56 - 76	shale
76 - 80	sandstone
80 - 83	sand
83 - 100	shale
Number 18	Location: N.E. 1/4 Sec. 16, Tp. 56, R. 16, W. 4
0 - 8	clay
8 - 15	sand
15 - 22	clay
22 - 28	sand and gravel
28 - 62	clay
62 - 72	shale
72 - 75	clay
75 - 100	shale
100 - 110	green shale
Number 19	Location: S.E. 1/4 Sec. 32, Tp. 56, R. 16, W. 4
0 - 3	sandy top soil and fine gravel
3 - 14	coarse sand - fine gravel streeks (W.B.)
14 - 23	hard stony grey clay
23 - 27	fine glacial till - soft sandstone
27 - 41	fine glacial till - hard
41 - 46	dark grey shale - hard - sticky
46 - 88	grey clay - hard - dark
88 - 92.5	fine glacial till
92.5 - 93	sandstone - hard
Number 20	Location: N.E. 1/4 Sec, 29, Tp. 56, R. 16, W. 4
0 - 3	top soil - sandy
3 - 9	fine and medium gravel (W. B.)
9 - 22	stony grey clay thin gravel streaks
22 - 27	grey clay - hard
Number 21	Location: N.E. 1/4 Sec. 29, Tp. 56, R. 16, W. 4
0 - 19	coarse gravel - sharp - (W.B.) swamp odour
19 - 23	sand and black muck
23 - 28	grey clay - dark

Depth (in feet)	Description
Number 22	Location: S.W. 1/4 Sec. 33, Tp. 56, R. 16, W. 4
0 - 7	Top soil - muck - sandy grey clay
7 - 8	fine gravel
8 - 33	hard grey clay
33 - 34	soft sandstone
34 - 42	hard grey clay
Number 23	Location: S.W. 1/4 Sec. 33, Tp. 56, R. 16, W. 4
0 - 5	sandy muck and clay
5 - 8	sand and fine gravel - W.B.
8 - 32	hard grey clay
32 - 34	sandstone - soft
34 - 38	grey clay - hard
38 - 43	fine sand - clay streaks (W.B.)
43 - 47	hard sandstone, used dynamite
47 - 61	hard sandy grey clay - occ. sand streaks
Number 24	Location: S.W. 1/4 Sec. 33, Tp. 56, R. 16, W. 4
0 - 16	top soil and dirty organic type soil
16 - 17	little streak of sand - minute quantity of water
17 - 20	clay
20 - 30	shale
Number 25	Location: S.W. 1/4 Sec. 33, Tp. 56, R. 16, W. 4
0 - 16	top soil and dirty organic type soil
16 - 18	sandy soil - small domestic supply of water only
18 - 20	clay
20 - 67	shale
Number 26	Location: S.E. 1/4 Sec. 32, Tp. 56, R. 16, W. 4
0 - 14	fine sand and silt - considerable organic matter. Hole drilled open hole to 14'.
14 - 16	coarse sand - water bearing sufficiently for a good domestic well
16 - 21	silty clay and gravel - no water
21 - 36	light grey sandy clay. Only 21' of casing set for hole
36 - 37	brown sticky clay - hole completed - definitely no suitable water supply

Depth (in feet)	Description
Number 27	Location: N.E. 1/4 Sec. 26, Tp. 56, R. 17, W. 4
0 - 4	top black soil
4 - 36	grey sticky clay
36 - 43	brown sticky clay
43 - 60	grey sticky clay - quite hard
60 - 89	blue clay
89 - 99	brown clay
99 - 101	hard boulder
101 - 102	blue clay - hole completed. No casing used in hole. No indication from log for correlation with minor Resistivity curve
Number 28	Location: S.E. 1/4 Sec. 29, Tp. 56, R. 16, W. 4
0 - 3	black top soil
3 - 9	blue clay
9 - 22	silty gravel and clay - water saturated - set 12' of 7" casing
22 - 25	blue clay (built up bit)
25 - 45	blue clay - silty and water saturated - caving slightly
45 - 60	continued in silty blue clay - still caving
60 - 65	blue clay - caving from above - added more 7" - then pulled all of 7" and set 6" to 60' which shut off water and cave
65 - 100	continued blue clay - some hard ledges 1' to 2' thick
100 - 120	brown clay with a few pebbles
120 - 150	blue clay with some gravel
150 - 160	blue clay with gravel - water saturated and caving - slow drilling. can't drive 6" this far as formation too tight and hard. Pulled 6" casing and set 57' of 8". Reamed hole to 160'
160 - 220	Blue clay with gravel - saturated and caving but did not set casing
220 - 227	continued blue clay and gravel - saturated and caving. Hole filled in 20' at start of shift. Bailed hole dry at 227' - finished
Number 29	Location: N.E. 1/4 Sec. 16, Tp. 56, R. 16, W. 4
0 - 5	black top soil
5 - 9	blue clay - very soft
9 - 13	sand - water bearing
13 - 22	blue clay
22 - 45	sand with a little gravel. Water bearing

Lithologic Logs for some Water Wells in the Andrew Area

Depth (in feet)	Description
	Location: N.E. 1/4 Sec. 12, Tp. 57, R. 15, W. 4
0 - 50	-
50 - 240	Alternating sequence of light-grey clay, light- and dark-brown clay, carbonaceous shale, coal and white sandy clay. Thin silty sands at 225 feet and 235 feet; quicksand from 101 to 107 feet
	Location: S.W. 1/4 Sec. 17, Tp. 56, R. 14, W. 4
0 - 50	(dug and cribbed)
50 - 167	Sandy clay and some coal
167 - 186	Hard clay and some coal
186 - 196	Soft clay
196 - 290	Hard clay
290 +	Sandstone
	Location: N.W. 1/4 Sec. 21, Tp. 55, R. 15, W. 4
0 - 4	Brown clay
4 - 7	Gravel
7 - 24	Clay and some coal
	Location: S.W. 1/4 Sec. 10, Tp. 58, R. 16, W. 4
0 - 25	Grey and blue clay
25 - 30	Sand
30 - 36	Hard clay
36 - 40	Sand
	Location: S.W. 1/4 Sec. 16, Tp. 56, R. 17, W. 4
0 - 15	Brown clay
15 - 44	Grey clay
44 - 45	Coal
	Location: S.W. 1/4 Sec. 19, Tp. 55, R. 14, W. 4
0 - 49	Brown and blue clay
49 - 50	Coal
	Location: N.E. 1/4 Sec. 6, Tp. 56, R. 14, W. 4
0 - 25	Brown clay and gravel
25 - 85	Grey clay and gravel
85 - 88	Coal
88 - 102	Sand
102 - 105	Fine sand and gravel
105 - 135	Grey clay
Willington Well #1	Location: Sec. 11, Tp. 56, R, 15, W. 4
0 - 32	Sand and sandy clay
32 - 44	Soft clay
44 - 68	Clay and gravel
68 - 72	Sandy clay and coal

Depth (in feet)	Description
Willingdon Well #2	Location: Sec. 11, Tp. 56, R. 15, W. 4
0 - 60	Silty clay and gravel
60 - 70	Fine sand and gravel
70 - 73	Coal
73 - 79	Clay
79 - 81	Fine and coarse sand
81 - 96	Gravel, sand and clay
Willingdon Well #3	Location: Sec. 11, Tp. 56, R. 15, W. 4
0 - 13	Brown clay
13 - 113	Alternating layers of dirty sand and blue clay
113 - 115	Clay and gravel
115 - 160	Blue clay and sandy clay

Groundwater Prospects of the
Andrew Area
32-56-16-W4

by

E.G. LeBreton

June 59

Instructions for Riley's

Publication: Groundwater Prospects for the Andrew Area

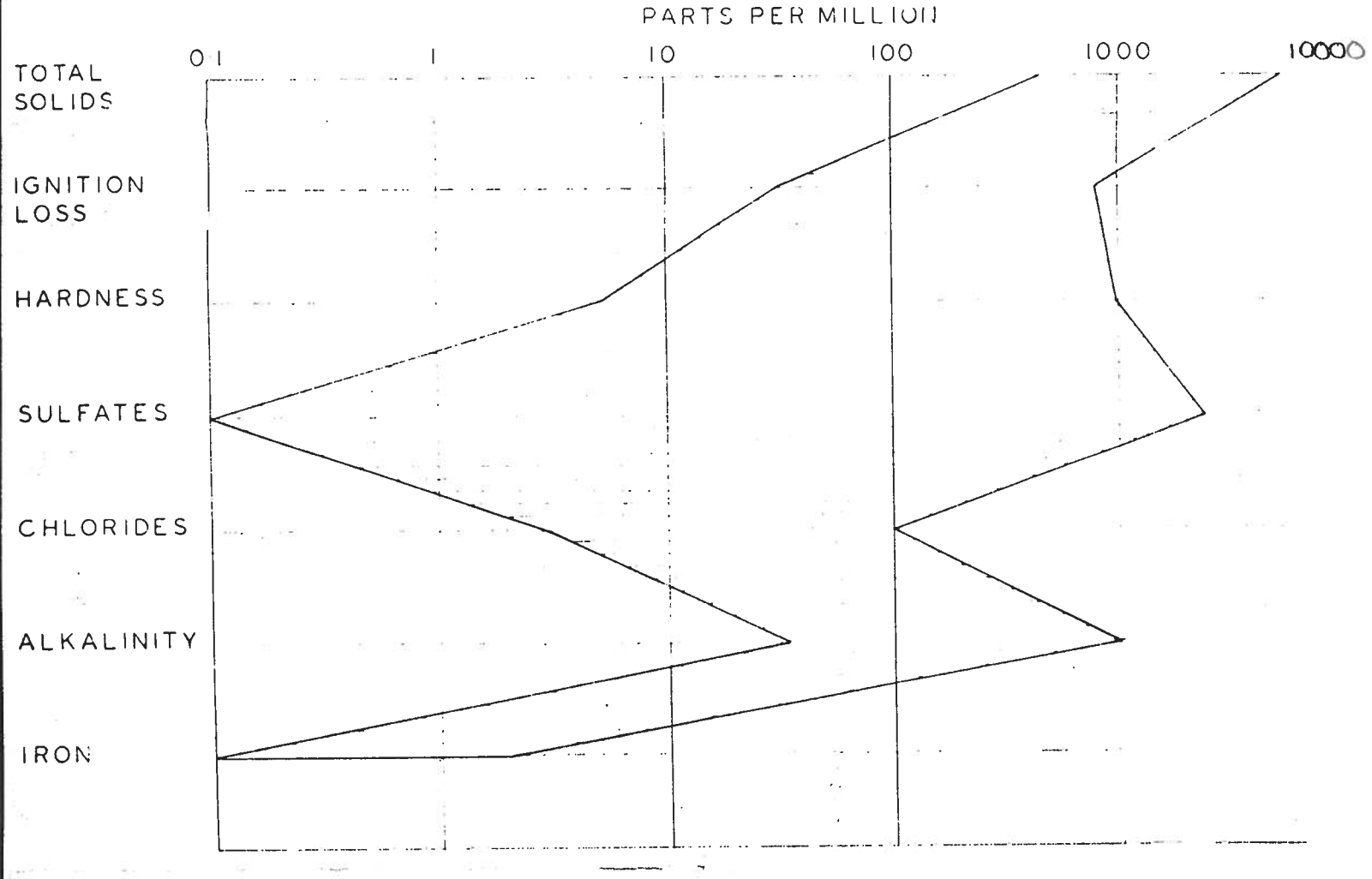
Details:

No. of pages:	39	$8\frac{1}{2}$" x 11"
No. of maps, figures:	1	$11\frac{1}{2}$" x 13"
	2	$27\frac{1}{2}$" x 29"
	1	28" x $27\frac{1}{2}$"

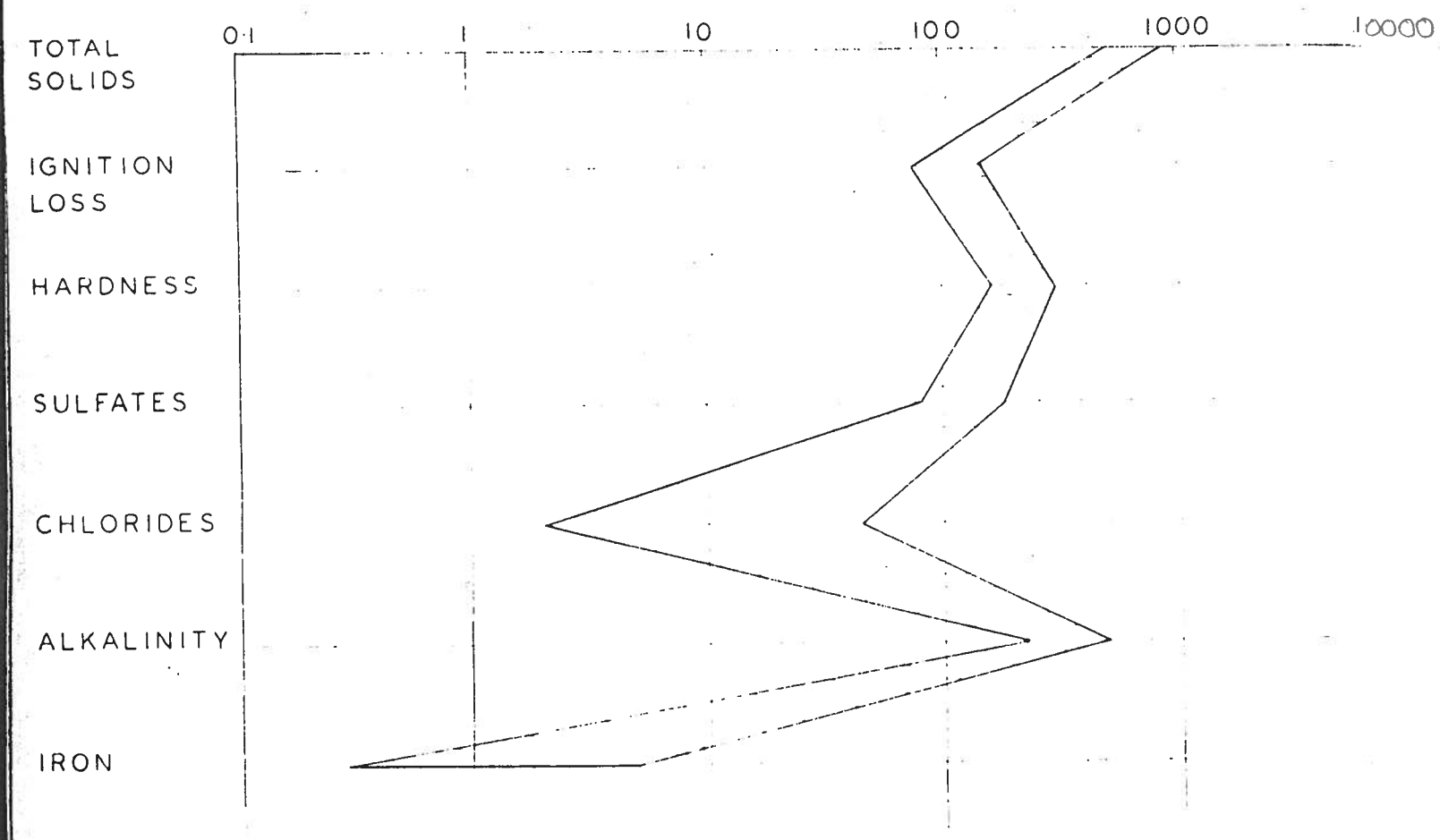
Fig. 1

ANDREW AREA

LIMITS OF CHEMICAL COMPOSITION OF BELLY RIVER FORMATION WATERS.



LIMITS OF CHEMICAL COMPOSITION OF WATERS FROM UNCONSOLIDATED DEPOSITS.



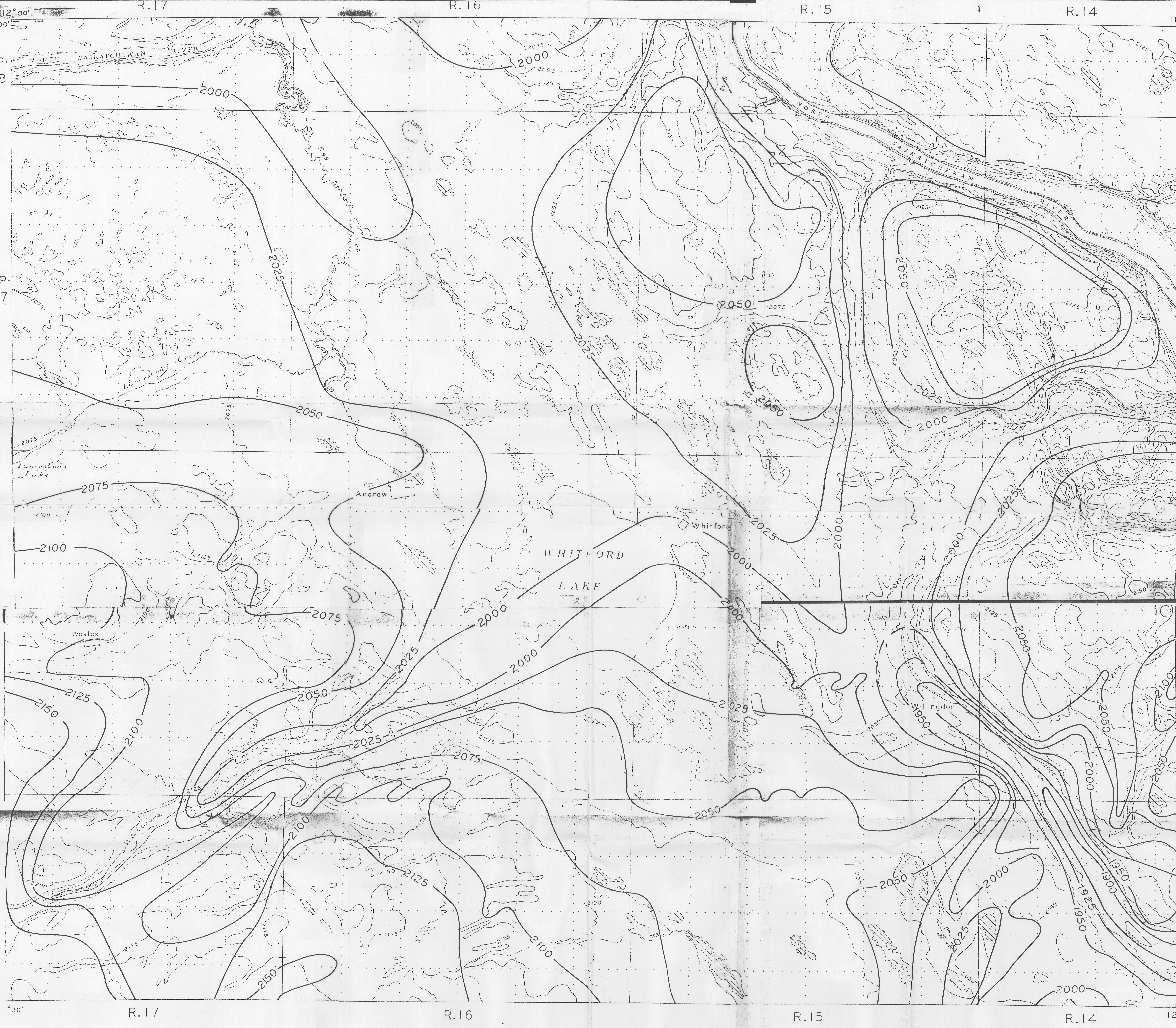


PLATE I

Base map compiled from Willingdon sheet 83 H 16 east and west, Department of Mines and Technical Surveys. 1958.

BEDROCK TOPOGRAPHY

ANDREW AREA, ALBERTA

WEST OF FOURTH MERIDIAN

SCALE IN MILES

1 0 1 2 3

Contour interval 25 ft

LEGEND

Lake, intermittent, indefinite

Streams, intermittent

Bedrock surface contours

Surface contours 2000

Depression contours

OFR 1959-2

1/3

R.17 R.16 R.15 R.14

112°30′ 112°00′

54°00′

Tp. 58

Tp. 57

Tp. 56

Tp. 55

53°45′

NORTH SASKATCHEWAN RIVER

Limestone Creek

Limestone Lake

Andrew

Whitford

WHITFORD LAKE

Wostok

Willingdon

Eagle Creek

PLATE 2

PIEZOMETRIC SURFACE

ANDREW AREA, ALBERTA

WEST OF FOURTH MERIDIAN

SCALE IN MILES

1 0 1 2 3

Contour interval 25 ft

Dug and bored wells

Drilled wells

Contours of piezometric surface

Base map compiled from Willingdon sheet 83 H 16 east and west, Department of mines and Technical Surveys. 1958

LEGEND

Lakes, intermittent, indefinite

Streams, intermittent

Surface contours 2000

Depression contours

OFR 1959-2

2/3

FIG. 4 - Single Page
Red-outlined area only

LEGEND

Research Council test holes
~~Water well logs~~
Test holes for the village of Andrew
~~Nos. 1-18 drilled in 1952.~~
~~" 19-25 " 1953.~~
~~" 26-28 " 1954.~~
~~Copies of Chemical Analyses of Groundwater~~
~~Seismic shot hole logs recording sand and gravel~~
~~Seismic survey~~
~~Resistivity stations~~
Stream trench — centre

PLATE 3
LOCATION OF TEST HOLES, LITHOLOGIC LOGS, GEOPHYSICAL SURVEY AND CHEMICAL ANALYSES OF GROUNDWATER.
ANDREW AREA, ALBERTA
WEST OF FOURTH MERIDIAN

SCALE IN MILES
0 1 2 3

Contour interval 25 ft.

LEGEND

Lakes, intermittent, indefinite
Streams intermittent
Surface Contours.
Depression contours

Base map compiled from Willingdon sheet 83 H 16 east and west, Department of Mines and Technical Surveys. 1958.

OFR 1959-2 3/3