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GROUND-WATER RESOURCES OF THE RURAL MUNICIPALITY OF CORY (NO. 344), SASKATCHEWAN

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By

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GROUND-WATER RESOURCES OF THE RURAL MUNICIPALITY OF CORY (No. 344), SASKATCHEWAN

INTRODUCTION

The rural municipality of Cory, No. 344, comprises 324 square miles, or 9 townships, in south-central Saskatchewan. The city of Saskatoon is near its centre. This area and all others mentioned in this report lie west of the third meridian.

Cory is a level, smooth plain lying in a basin, with 75 per cent of its area lying between 1,625 and 1,700 feet above sea-level. This plain is cut in a northeast direction by the South Saskatchewan River which, with its valley, occupies 15 per cent of the municipality. At Saskatoon the South Saskatchewan River is approximately 1,550 feet above sea-level. In the east-central part of the municipality the land level rises from 1,700 feet to more than 1,900 feet above sea-level. The South Saskatchewan River flows northeastward through the municipality. Beaver Creek enters the river at the southern boundary of the municipality and is the only permanent tributary stream in the area.

Great extremes in temperature occur in summer and winter, with highs of over 100°F and lows of below 50°F. The average annual temperature at Saskatoon is 35°F. Annual precipitation ranges between 8 and 22 inches, averaging about 14 inches. Most of it occurs as rain during the summer months.

The surficial sediments can be largely interpreted from a soil map prepared by Mitchell, Moss, and Clayton (1947)[1] on the scale of 1 inch to 6 miles. This map has greatly facilitated the study of surficial geology in the municipality. Yoxall (1958)[2] described the physical geography of the municipality.

This report is a preliminary interpretation of data collected by the writer during the summer of 1959 on water wells of approximately 400 farms and 15 wells in the city of Saskatoon. Detailed information on these and other wells is available at the Saskatchewan Department of Agriculture, Conservation and Development Branch, Water Resources Division, Regina.

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1 Mitchell, John, Moss, H.C., and Clayton, J.S., 1947: Soil Survey of Southern Saskatchewan from Township 1 to 48 inclusive; Sask., Dept. Agriculture, Soil Surv. Rept. 12, 259 pp.

2 Yoxall, W.H., 1958: Geomorphological Survey, Saskatoon, Saskatchewan; City of Saskatoon, Planning and Building Dept., (limited publication).

SURFACE WATER

Saskatoon obtains its water from the South Saskatchewan River. During 1958 the municipally owned waterworks supplied an average of 20,170,000 gallons per day for the domestic requirements of nearly 85,000 people and the industrial needs of an oil refinery, several packing houses, flour mills, and small industrial plants. In addition the city sells water to farmers living nearby.

Surface water is an undependable source of supply; it is plentiful during wet years, but except for the river, it largely disappears during dry years. For instance, there was little surface water in the form of small ponds or sloughs during the summer of 1959. But several years earlier most shallow depressions were filled. There are only a few dugouts in the municipality and in 1959 they contained little or no water. Some farmers obtain soft water by hauling snow meltwater into large basement cisterns during spring thaw. In summer, rainwater is also collected and stored in cisterns.

SPRINGS

Springs found during 1959 are shown on Figure 2. A spring line occurs at approximately the 1,600-foot elevation, but many of these springs, which are used by farmers, have little or no flow during dry periods. During the early summer of 1959 the water from these springs had an average hardness of 300 ppm, a chloride content of 40 ppm, and a temperature range of 44 to 51°F.

GENERAL GEOLOGY

Bedrock does not outcrop in the rural municipality of Cory. At the mine shaft of the Potash Company of America, approximately 10 miles east of Saskatoon, sands at the base of the Cretaceous system extend from 1,550 to 1,950 feet below surface. The top of the mine shaft is 1,750 feet above sea-level. Much salty water under high pressure issued from these sands during the sinking of the shaft. The sands probably extend under the municipality at the same elevations as at the Potash Company mine. No wells in the municipality obtain water from them.

The sands are overlain by Lower and Upper Cretaceous semi-consolidated shales with discontinuous very fine sand lenses. Oil-exploration electric logs and one 680-foot water well in the NE 1/4 of sec. 32, tp. 35, rge. 4, indicate a fairly continuous sand layer at 1,050 to 1,150 feet above sea-level. This is aquifer 10 on Map No. 2, (Fig. 1).

An interpretation of the bedrock surface is shown in section A - B (Fig. 2). This section indicates a depression in the bedrock surface under the South Saskatchewan River, which is probably the course of a preglacial river valley. Well records indicate that east of the South Saskatchewan River, sands and gravels are absent near the drift-bedrock contact, whereas west of the river, deposits ranging from fine sands to gravels occur at or just above the contact. These sands and gravels probably represent deposition in a wide but

shallow preglacial valley near the beginning of the glacial age.

The cross-section A-B reveals the similarity of the bedrock profile to the profile of the present surface. It is not known whether the high land along the eastern boundary of the municipality reflects a high in the bedrock surface or a thickening of the glacial cover.

Drift deposits consisting of till, sand, and gravel, 150 to 300 feet thick, overlie the Cretaceous bedrock. Till, the major drift deposit, contains some water-bearing sands and gravels, as shown in section A-B. This section also shows the position of a fairly continuous layer of sand and gravel at the 1,600-foot elevation (aquifers 6B and 7 on Map No. 1, Fig. 1).

The till surface on both sides of the river is covered by up to 50 feet of clay and silt that modifies its irregularities. In the southern third of the municipality the till surface is overlain by silt, clay, and sand, with the sand as the surface material. At depth the sand is less abundant and is intermixed with the silt and clay.

Near the northern edge of the municipality, reworking of the till surface by glacial waters has partly exposed the surface and locally deposited a coarse, bouldery gravel containing clay balls.

GROUND WATER

Water probability Maps 1 and 2 (Fig. 1) show the location of aquifers and the location and depth of wells in the municipality. The following data supplements aquifer descriptions given in the legends.

Aquifers 1, 2, and 3

Surface sands supply almost all the ground water for farm use in the southern third of the rural municipality of Cory. The surface sand of aquifer 1 is in the flood plain of the South Saskatchewan River and, therefore, is inundated by the river during extremely high water. This sand fills many channels in the underlying till surface, so that its depth is difficult to estimate. Aquifer 2, and intermittent-yield aquifer, consists of fine sand infilling shallow channels in the underlying till. Many wells in this aquifer went dry during the spring of 1959.

The sand of aquifer 3 is continuous over part of the area, (Fig. 1, Map 1; and Fig. 2). The fine surface sand behaves as quicksand when water is encountered, making it difficult to deepen wells in it. Most farmers who obtain water from this surface sand have two or three wells dug at places where they require water. The best location for such shallow wells is in low areas; wells dug in the surrounding high ground are intermittent, and fail in dry years. The low wells, however, are likely to be contaminated from farmyard wastes.

During the summer of 1959 most of the wells in aquifer 3 contained only a few feet of water; the water-table was thus about 20 feet below the surface. In contrast, during the wet years of 1954

and 1955, the water level in many wells was 10 to 15 feet higher, or only 5 to 10 feet below the surface.

Aquifer 4

No prediction can be made as to the depth to water in the area designated as aquifer 4. Map No. 1 (Fig. 1) shows the depths of existing wells, which should aid in locating new wells.

Aquifer 5

It is also difficult to predict depth to water in aquifer 5. Water is generally encountered in gravel lenses in the till within 50 feet of the surface, and it is under sufficient pressure to rise 5 to 10 feet in the wells. The water level is generally lower than in wells in aquifer 4.

Aquifers 6A and 6B

Aquifers 6A and 6B are extensive, and usually produce enough water from 2- to 3-foot-diameter wells to meet all farm requirements. Aquifer 6A normally occurs as a layer of flat-lying boulders surrounded by sand and silt at a depth of approximately 30 feet, and bounded on top and bottom by till. Water rises to within 20 feet of the surface in wells penetrating the boulder layer. In some places the boulder layer is replaced by fine sand or rarely fine gravel. During the drought of the 1930's many of the wells in aquifer 6A went dry, but many continued to supply water when deepened. The deepening of the wells gave fuller penetration of the aquifer and often aquifer 6B was encountered.

In many places there is little or no seepage of water at the 6A-aquifer level about 30 feet below the surface. Deeper boring, for another 15 or 20 feet, encounters a 'hard pan' consisting of well-cemented sand and gravel. Aquifer 6B lies immediately below this 'hard pan' layer, and when the 'hard pan' is penetrated, the water from aquifer 6B will rise to within 20 feet of the surface. Aquifer 6B is a more dependable supply of water than aquifer 6A; it has furnished water on most farms even during the drought of the 1930's.

Aquifer 7

This aquifer is a coarse sand and gravel, about 10 feet thick, that occurs at the 1,600-foot elevation, or at a depth of 85 to 100 feet below the present surface. Its water has a high iron-content. A pumping-test of a test hole on the SW 1/4, sec. 2, tp. 36, rge. 4, indicated a potential pumping capacity of 100 gallons per minute.

Aquifer 8

The till beneath aquifer 6B contains many small lenses of sand and gravel, but these do not yield sufficient water to supply wells. However, extensive layers of sand and gravel occur near the bottom of the till west of the South Saskatchewan River, and these are designated as aquifer 8. Farm wells produce 5 to 10 gallons per minute from this aquifer, whereas wells in the city produce up to 125 gallons per minute. This difference in yield is due to the larger

diameter, longer screen length, and better development of the city wells. The water from aquifer 8 combines the chemical qualities of the hard water obtained from the drift and those of the soft, salty water from the bedrock.

Aquifer 9

The fine, uniform grey sands of aquifer 9 occur as discontinuous lenses within the top several hundred feet of the shale bedrock. The water is mainly from the bedrock and is consequently soft and salty.

Aquifer 10

A 680-foot well drilled on the NE 1/4 of sec. 32, tp. 35, rge. 4, W 3rd mer., is the only one known to penetrate aquifer 10. No log of the well was kept during drilling, but oil-exploration electric logs obtained from nearby test holes indicated a 100-foot-thick sandy zone containing mineralized water at 1,050 to 1,150 feet above sea-level. These electric logs define the boundary of aquifer 10 as shown on Map 2 (Fig. 1).

The water from this well is saltier than that from wells that do not penetrate the bedrock so deeply. Chemical analyses of water from the 680-foot well and from a 40-foot well only several hundred feet away indicate that water from the two wells is mixing. The water in the 40-foot well has a chloride content of 4,800 ppm, whereas the average chloride content of near-surface waters is generally between 100 and 400 ppm, and the water in the deep well is much harder than that from the other bedrock wells.

SUMMARY

Ground water in the rural municipality of Cory is adequate in quantity for farm and domestic uses, but is highly mineralized. Water in all the unconsolidated surficial materials is extremely hard (500 - 2,500 ppm of hardness). Water in the bedrock is soft, but contains much sodium chloride which increases with depth (1,000 - 8,000 ppm NaCl).

Most wells obtain water from sand at depths of less than 65 feet and supply sufficient water for farm requirements — generally 500-1,000 gallons per day.

Wells that penetrate sand and gravel just above bedrock (200 feet +) provide the large amounts of water required for industrial cooling, air conditioning, and livestock. The rate of discharge by such wells is between 5 and 125 gallons per minute. Such aquifers are west of the South Saskatchewan River. Little water is obtained from wells east of the river.

Fine-sand lenses in the shale bedrock yield small quantities of soft, saline water.

Table I

Quality and Potable Limits of Water

Degree of Hardness	Iron Content	Chlorides Content
Very soft..... less than 50 ppm Moderately soft.....50-100 ppm Slightly hard.....100-150 ppm Moderately hard .....150-200 ppm Hard.....200-300 ppm Excessively hard..greater than 300 ppm	0.5 ppm — upper limit for potable water 1-3 ppm — fair more than 3 ppm — poor	400 ppm — brackish taste more than 400 ppm — too salty pH less than 7 — acidic pH more than 7 — basic

Dissolved Solids (ppm)

Use	Potability				
	Good	Fair	Poor	Very Poor	Limit
Humans	0-800	800-1,600	1,600-2,500	2,500-4,000	5,000
Horses					
working.....	0-1,000	1,000-2,000	2,000-3,000	3,000-5,000	6,000
others	0-1,000	1,000-2,000	2,000-4,000	4,000-6,000	10,000
Cattle	0-1,000	1,000-2,000	2,000-4,000	4,000-6,000	10,000
Sheep	0-1,000	1,000-3,000	3,000-6,000	6,000-10,000	15,000