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DEPARTMENT OF MINES

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BUREAU OF ECONOMIC GEOLOGY

GEOLOGICAL SURVEY

PRELIMINARY REPORT

GROUND-WATER RESOURCES OF THE RURAL MUNICIPALITY OF ..... No. 43 SASKATCHEWAN

BY

B. R. MacKay, H. H. Beach & J. M. Cameron

Water Supply Paper No. 61

OTTAWA

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GROUND WATER RESOURCES OF THE RURAL MUNICIPALITY

OF ..... NO. 43

SASKATCHEWAN

INTRODUCTION

Lack of rainfall during the years 1930 to 1934 over a large part of the Prairie Provinces brought about an acute shortage both in the larger supplies of surface water used for irrigation and the smaller supplies of ground water required for domestic purposes and for stock. In an effort to relieve the serious situation the Geological Survey began an extensive study of the problem from the standpoint of domestic uses and stock raising. During the field season of 1935 an area of 80,000 square miles, comprising all that part of Saskatchewan south of the north boundary of township 32, was systematically examined, records of approximately 60,000 wells were obtained, and 720 samples of water were collected for analyses. The facts obtained have been classified and the information pertaining to any well is readily accessible. The examination of so large an area and the interpretation of the data collected were possible because the bedrock geology and the Pleistocene deposits had been studied previously by McLearn, Warren, Rose, Stansfield, Wickenden, Russell, and others of the Geological Survey. The Department of Natural Resources of Saskatchewan and local well drillers assisted considerably in supplying several hundred well records. The base maps used were supplied by the Topographical Surveys Branch of the Department of the Interior.

Publication of Results

The essential information pertaining to the ground water conditions is being published in reports, one being issued for each municipality. Copies of these reports are being sent to the secretary treasurers of the municipalities and to certain Provincial and Federal Departments, where they can be consulted by residents of the municipalities or by other persons, or they may be obtained by writing direct to the Director, Bureau of Economic Geology, Department of Mines, Ottawa. Should anyone require more detailed information than that contained in the reports such additional information as the Geological Survey possesses can be obtained on application to the director. In making such request the applicant should indicate the exact location of the area by giving the quarter section, township, range, and meridian concerning which further information is desired.

The reports are written principally for farm residents, municipal bodies, and well drillers who are either planning to sink new wells or to deepen existing wells. Technical terms used in the reports are defined in the glossary.

How to Use the Report

Anyone desiring information about ground water in any particular locality should read first the part dealing with the municipality as a whole in order to understand more fully the part of the report that deals with the place in which he is interested. At the same time he should study the two figures accompanying the report. Figure 1 shows the surface and bedrock geology as related to the ground water supply, and Figure 2 shows the relief and the location and type of water wells. Relief is shown by lines of equal elevation called "contours". The elevation above sea-level

is given on some or all of the contour lines on the figure.

If one intends to sink a well and wishes to find the approximate depth to a water-bearing horizon, he must learn: (1) the elevation of the site, and (2) the probable elevation of the water-bearing bed. The elevation of the well site is obtained by marking its position on the map, Figure 2, and estimating its elevation with respect to the two contour lines between which it lies and whose elevations are give on the figure. Where contour lines are not shown on the figure, the elevations of adjacent wells as indicated in the Table of Well Records accompanying each report can be used. The approximate elevation of the water-bearing horizon at the well-site can be obtained from the Table of Well Records by noting the elevation of the water-bearing horizon in surrounding wells and by estimating from these known elevations its elevation at the well-site.[1] If the water-bearing horizon is in bedrock the depth to water can be estimated fairly accurately in this way. If the water-bearing horizon is in unconsolidated deposits such as gravel, sand, clay, or glacial debris, however, the estimated elevation is less reliable, because the water-bearing horizon may be inclined, or may be in lenses or in sand beds which may lie at various horizons and may be of small lateral extent. In calculating the depth to water, care should be taken that the water-bearing horizons selected from the Table of Well Records be all in the same geological horizon either in the glacial drift or in the bedrock. From the data in the Table

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[1] If the well-site is near the edge of the municipality, the map and report dealing with the adjoining municipality should be consulted in order to obtain the needed information about nearby wells.

of Well Records it is also possible to form some idea of the quality and quantity of the water likely to be found in the proposed well.

GLOSSARY OF TERMS USED

Alkaline. The term "alkaline" has been applied rather loosely to some ground waters. In the Prairie Provinces a water is usually described as "alkaline" when it contains a large amount of salts, chiefly sodium sulphate and magnesium sulphate in solution. Water that tastes strongly of common salt is described as "salty". Many "alkaline" waters may be used for stock. Most of the so-called "alkaline" waters are more correctly termed "sulphate waters".

Alluvium. Deposits of earth, clay, silt, sand, gravel, and other material on the flood-plains of modern streams and in lake beds.

Aquifer or Water-bearing Horizon. A water-bearing bed, lens, or pocket in unconsolidated deposits or in bedrock.

Buried pre-Glacial Stream Channels. A channel carved into the bedrock by a stream before the advance of the continental ice-sheet, and subsequently either partly or wholly filled in by sands, gravels, and boulder clay deposited by the ice-sheet or later agencies.

Bedrock. Bedrock, as here used, refers to partly or wholly consolidated deposits of gravel, sand, silt, clay, and marl that are older than the glacial drift.

Coal Seam. The same as a coal bed. A deposit of carbonaceous material formed from the remains of plants by partial decomposition and burial.

Contour. A line on a map joining points that have the same elevation above sea-level.

Continental Ice-sheet. The great ice-sheet that covered most of the surface of Canada many thousands of years ago.

Escarpment. A cliff or a relatively steep slope separating level or gently sloping areas.

Flood-plain. A flat part in a river valley ordinarily above water but covered by water when the river is in flood.

Glacial Drift. The loose, unconsolidated surface deposits of sand, gravel, and clay, or a mixture of these, that were deposited by the continental ice-sheet. Clay containing boulders forms part of the drift and is referred to as glacial till or boulder clay. The glacial drift occurs in several forms:

(1) Ground Moraine. A boulder clay or till plain (includes areas where the glacial drift is very thin and the surface uneven).

(2) Terminal Moraine or Moraine. A hilly tract of country formed by glacial drift that was laid down at the margin of the continental ice-sheet during its retreat. The surface is characterized by irregular hills and undrained basins.

(3) Glacial Outwash. Sand and gravel plains or deltas formed by streams that issued from the continental ice-sheet.

(4) Glacial Lake Deposits. Sand and clay plains formed in glacial lakes during the retreat of the ice-sheet.

Ground Water. Sub-surface water, or water that occurs below the surface of the land.

Hydrostatic Pressure. The pressure that causes water in a well to rise above the point at which it is struck.

Impervious or Impermeable. Beds, such as fine clays or shale, are considered to be impervious or impermeable when they do not permit of the perceptible passage or movement of the ground water.

Pervious or Permeable. Beds are pervious when they permit of the perceptible passage or movement of ground water, as for example porous sands, gravel, and sandstone.

Pre-Glacial Land Surface. The surface of the land before it was covered by the continental ice-sheet.

Recent Deposits. Deposits that have been laid down by the agencies of water and wind since the disappearance of the continental ice-sheet.

Unconsolidated Deposits. The mantle or covering of alluvium and glacial drift consisting of loose sand, gravel, clay, and boulders that overlie the bedrock.

Water Table. The upper limit of the part of the ground wholly saturated with water. This may be very near the surface or many feet below it.

Wells. Holes sunk into the earth so as to reach a supply of water. When no water is obtained they are referred to as dry holes. Wells in which water is encountered are of three classes.

(1) Wells in which the water is under sufficient pressure to flow above the surface of the ground. These are called Flowing Artesian Wells.

(2) Wells in which the water is under pressure but does not rise to the surface. These wells are called Non-Flowing Artesian Wells.

(3) Wells in which the water does not rise above the water table. These wells are called Non-Artesian Wells.

NAMES AND DESCRIPTIONS OF GEOLOGICAL FORMATIONS, REFERRED TO IN THESE REPORTS

Wood Mountain Formation. The name given to a series of gravel and sand beds which have a maximum thickness of 50 feet, and which occur as isolated patches on the higher parts of Wood mountain. This is the youngest bedrock formation and, where present, overlies the Ravenscrag formation.

Cypress Hills Formation. The name given to a series of conglomerates and sand beds which occur in the southwest corner of Saskatchewan, and rest upon the Ravenscrag or older formations. The formation is 30 to 125 feet thick.

Ravenscrag Formation. The name given to a thick series of light-coloured sandstones and shales containing one or more thick lignite coal seams. This formation is 500 to 1,000 feet thick, and covers a large part of southern Saskatchewan. The principal coal deposits of the province occur in this formation.

Whitemud Formation. The name given to a series of white, grey, and buff coloured clays and sands. The formation is 10 to 75 feet thick. At its base this formation grades in places into coarse, limy sand beds having a maximum thickness of 40 feet.

Eastend Formation. The name given to a series of fine-grained sands and silts. It has been recognized at various localities over the southern part of the province, from the Alberta boundary ~~east~~ to the escarpment of Missouri coteau. The thickness of the formation seldom exceeds 40 feet.

Bearpaw Formation. The Bearpaw consists mostly of incoherent dark grey to dark brownish grey, partly bentonitic shales, weathering light grey, or, in places where much iron

is present, buff. Beds of sand occur in places in the lower part of the formation. It forms the uppermost bedrock formation over much of western and southwestern Saskatchewan and has a maximum thickness of 700 feet or somewhat more.

Belly River Formation. The Belly River consists mostly of non-marine sand, shale, and coal, and underlies the Bearpaw in the western part of the area. It passes eastward and northeastward into marine shale. The principal area of transition is in the western half of the area where the Belly River is mostly thinner than it is to the west and includes marine zones. In the southwestern corner of the area it has a thickness of several hundred feet.

Marine Shale Series. This series of beds consists of dark grey to dark brownish grey, plastic shales, and underlies the central and northeastern parts of Saskatchewan. It includes beds equivalent to the Bearpaw, Belly River, and older formations that underlie the western part of the area.

WATER-BEARING HORIZONS OF THE MUNICIPALITY

Rural municipality No. 43 covers an area of 245 square miles in the central part of southern Saskatchewan. The area is bounded on the north by Twelvemile lake and on the east by the Third meridian. It consists of six full townships and fractions of three others, described as townships 4 and 5, ranges 1, 2, and 3, and those parts of township 5, ranges 1, 2, and 3, that lie to the south of the centre line of Twelvemile lake. Wood Mountain is the principal village of the area and is on the Assiniboia-Mankota branch of the Canadian Pacific railway which crosses the northwestern corner of the area. The Assiniboia-Rockglen branch of the same railway is near the eastern boundary.

The municipality lies on the western slope of Wood Mountain upland. The greater part of the area is rolling and in the northern townships deeply disected by many small valleys and coulées. Weathering of the many exposures of bedrock in these valleys into rugged forms has created characteristic "badlands" topography. The surface of the region rises from an elevation of 2,479 feet above sea-level at Twelvemile lake to approximate elevations of 2,600 feet along the top of the southern slope of the lake valley. From there in a southerly direction the surface rises more gradually to heights exceeding 3,300 feet in the highest part of Wood mountain in the southwestern corner of the municipality. Wood Mountain creek, flowing along the western border and draining into Twelvemile lake, and the headwaters of the southerly flowing Hay Meadow creek in the southeast corner, form the principal drainage features of the area. Several, small, spring-fed creeks occur in the valleys bordering the lake, but the majority of these become dry in late spring and remain so throughout the summer and autumn months.

The waters of Twelvemile lake contain considerable amounts of mineral salts in solution, particularly in the eastern parts where few creeks drain into the valley. The recent drought years caused a decrease in the amount of water in the lake basin with a corresponding increased concentration of dissolved salts in the water. During parts of 1934 and 1935 the lake was almost completely dry, and the small seepages of water to be obtained by digging wells in the silts forming the lake bottom probably would have been too highly charged with sulphate salts in solution to be suitable even for watering stock.

Throughout the upland areas springs and spring-fed creeks form a very important source of water for stock. Very few dams have been constructed to conserve this water supply over dry periods, but many of the coulées possess suitable sites for such structures. In a few places remote from springs and creeks, residents have constructed dugouts for the conservation of surface run-off. Little difficulty has been experienced, however, in obtaining adequate supplies of ground water from wells sunk to moderate depths in nearly all parts of the municipality, so that it is questionable if dugouts need be considered unless several test holes fail to encounter ground water.

Six distinct sources of ground water exist in the area; the Ravenscrag bedrock formation, which underlies the greater part of the municipality and forms the main source of supply on the great majority of the farms; the Recent stream deposits along the valleys; the glacial drift covering the uplands; small, isolated patches of pre-glacial gravels; and the Eastend and Bearpaw bedrock formations, all of which either yield water or are possible sources of water in certain localities.

Water-bearing Horizons in the Unconsolidated Deposits

Thin deposits of sands, silts, and more occasionally gravels occur along the valley of Wood Mountain creek and Hay Meadow creek. These Recent deposits contain small amounts of hard water. No wells are known to have been sunk in these deposits, but to residents along the valleys they present an inexpensive source of water of fairly good quality for domestic use. The silts yield the least water, but very little testing with a 2-inch auger should be required before a more productive sand or gravel bed is encountered within 10 to 20 feet from the surface.

Three general types of glacial deposits have been recognized in this municipality, namely, till, moraine, and glacial outwash gravels. The areal distribution of each type within the area is indicated on Figure 1 of the accompanying municipality map. The glacial drift was laid down partly by the great continental ice-sheet that many thousands of years ago advanced and retreated over southern Saskatchewan and partly by the waters formed from the melting ice. The till, which is composed essentially of buff-yellow boulder clay, covers the greater part of the municipality. It probably nowhere greatly exceeds 20 feet in thickness and in many places is either absent or is represented only by boulders scattered over the surface of the bedrock. So thin is this mantle of till in nearly all parts of the municipality that it cannot be regarded as a source of ground water.

A more porous type of glacial drift called moraine, characterised by a rough, rolling surface, occurs in a zone 3 to 4 miles wide extending through the northern parts of township 5, ranges 1 and 2. Isolated patches of gravel occurring in depressions or forming low, narrow ridges and knolls may provide sufficient water for household supply in places in this

area. It is questionable, however, whether extensive prospecting of these deposits is advisable as water supplies can generally be obtained without difficulty from the underlying Ravenscrag bedrock formation.

More extensive deposits of glacial outwash sands and gravels occur in isolated localities in the southern sections of tp. 4, range 5, and the southwest corner of tp. 4, range 2, in secs. 27 and 35, tp. 4, range 3, and the east-central part of tp. 5, range 3. These deposits although thin are sufficiently porous to permit of the accumulation of large amounts of ground water at shallow depths. Several wells less than 15 feet deep in township 4, ranges 2 and 3, have been dug into these deposits and each yields water of good quality in sufficient quantities for watering 10 to 30 head of stock. Further prospecting of such deposits is recommended.

Water-bearing Horizons in the Bedrock

In several places in the uplands small patches of reddish brown gravels which were deposited in Tertiary time before the advance of the ice-sheets rest on the surface of the Ravenscrag formation. The few shallow wells that have been sunk into these deposits produce moderately large supplies of drinkable water, and like the gravels of glacial origin mentioned above are worthy of further prospecting. The observed occurrences of these gravels are discussed in the section of this report dealing with the individual townships of the municipality.

The porous beds of the Ravenscrag bedrock formation constitute the most consistently productive sources of ground water in the municipality. This formation consists of beds of bluish grey sands, yellow brown clays and shales, and thin seams of lignite coal. In the many places at which it is exposed at the surface it weathers light buff or creamy white.

This formation underlies the uplands of the entire area down to an approximate elevation of 2,750 feet above sea-level along the western border of the area. Due to a slight north-easterly dip of the strata, amounting to about 14 feet to the mile, beds of this formation appearing at the surface in the vicinity of Wood Mountain Station are encountered at increasingly greater depths below the surface to the east and pass below lake-level in the extreme northeast corner of the municipality.

Coal seams and sand beds form the aquifers in the Ravenscrag formation. Since many parts of the area are only sparsely settled comparatively few wells have been sunk and, therefore, much information necessary for a detailed study of underground water conditions is lacking. Sufficient data were obtained, however, to make possible the tracing of four general productive horizons in this formation. At a few places some horizons have proved to be unproductive, necessitating search for water at greater depths. These occurrences are discussed in the section of this report dealing with the individual townships.

The areal extent of each of the four horizons is indicated by means of boundary lines marked A, B, C, and D on Figure 1 of the municipality map. The A horizon, being uppermost, is confined to the areas of highest elevation. It occurs as a bed of sand in the uplands part of the southern half of township 5, range 1, and in the northern sections of township 4, range 1. The horizon rises in elevation from 2,815 feet above sea-level in section 23 to approximately 2,880 feet in the northwest corner of township 4, range 1, and has been tapped by several wells ranging in depth from 30 to 72 feet below the surface.

The "A" horizon is also believed to occur along the southern border of the township increasing from an elevation of 2,835 feet in sec. 9, tp. 4, range 1, to approximately 3,000

feet above sea-level in the extreme southwest corner of the municipality. A lack of wells in the area intervening between these wells makes it impossible to determine whether or not the "A" horizon is productive in the south-central part of the municipality.

The "B" horizon lies approximately 50 feet below the "A" horizon and is believed to be productive over a much larger area. In nearly all wells that have penetrated this horizon the water was found either in a coal seam or in sands lying immediately below the coal. This aquifer was tapped at an approximate elevation of 2,700 feet in the east-central part of township 5, range 1, and has been traced as a gently rising aquifer across the southern half of the municipality, reaching an approximate elevation of 2,900 feet above sea-level at the western border, at a point about 3 miles south of Wood Mountain Station. This horizon probably continues beneath the "A" horizon in the southern uplands, but as yet there has been no necessity to sink wells through the upper water-bearing beds. In areas where the "B" horizon is uppermost, it is seldom necessary to sink wells deeper than 70 feet to obtain a supply of water suitable for household use and adequate for 20 or more head of stock.

The "C" horizon is believed to underlie the entire area south of the C line as shown on Figure 1, and from the evidience of many wells located in the area between the C and B lines and a few sunk to this horizon from greater elevations, it is believed to be water-bearing over a large part of the area. Here, as in the "B" horizon, a coal seam generally forms the water-bearing bed. This coal seam was encountered at an elevation of 2,545 feet in a well in sec. 36, tp. 5, range 1, and occurs at gradually increasing elevations in a southwesterly direction to reach 2,785 feet along the southwestern boundary of the area. This aquifer is believed to underlie the Hay Meadow valley at

shallow depth. At all places where wells have tapped this horizon drinkable water has been found and the supply is adequate for local stock needs.

The lowest water zone in the Ravenscrag lies approximately 75 feet above the base of the formation. It is designated as the "D" horizon and has been tapped at several points immediately south of Twelvemile lake in tp. 6, ranges 1 and 2, at elevations ranging from 2,490 feet in the northeast corner to 2,625 feet in sec. 4, tp. 6, range 2. Due to the dip of the strata it is found at increasingly higher elevations to the west and forms the uppermost productive horizon at an approximate elevation of 2,740 feet in the vicinity of Wood Mountain Station. As in the case of other horizons there has been little or no necessity of drilling wells through upper productive beds of the uplands region to tap the "D" horizon. Hence the southern extent of this aquifer is not known. If, however, water is not struck at the "C" horizon in the area in which it is uppermost the "D" horizon will be encountered at depths of 45 to 55 feet lower. The average depth of wells tapping the "D" horizon is 50 feet, but this figure, of course, depends upon the elevation of the point selected as a well site. The water from the "D" horizon is similar in quality and yield to that derived from the "C" horizon.

It is not to be assumed from the foregoing discussion that beds lying between the horizons are entirely unproductive. Considerable variation exists in the porosity of the beds comprising the Ravenscrag formation from place to place. Sand beds of limited areal extent are by no means uncommon and several wells in widely separated localities have tapped water-bearing beds at elevations that would place them in intermediate positions between the more consistently productive horizons.

All waters from the Ravenscrag in this region contain iron. The quantity varies in different wells, but does not appear

to be in materially greater concentration in the water from one horizon than in that from another.

The Ravenscrag formation is immediately underlain by beds of white clays known as the Whitemud formation. This group of beds averages 40 feet in thickness, but varies considerably from place to place and may be absent over extensive areas. It forms conspicuous exposures along the sides of the valleys in the vicinity of Wood Mountain Station, along an unnamed creek west of Elm Springs, and along the southern slopes of the eastern end of Twelvemile Lake valley. The Whitemud beds are generally too compact to be water-bearing. These beds are readily recognized in drilling and form a fairly consistent horizon marker. Studies of beds underlying the Whitemud would suggest that at depths greater than 50 feet below the base of the white clay only "alkaline" water will be found, and at greater depths the concentration of mineral salts in the water will increase to such an extent as to render it unsuitable for farm use.

Some 30 to 50 feet of fine, grey sands becoming more shaly toward the base occur beneath the Whitemud or immediately beneath the Ravenscrag formation at places where the white clays are absent. These beds are termed the Eastend formation and are believed to underlie the entire municipality with the exception of the extreme northwest corner. In the area north of Wood Mountain Station and in the southeastern part of township 6, range 2, the Ravenscrag formation is too thin to contain any large supply of water and it is necessary to sink wells through the Whitemud beds into the Eastend formation. The water obtained is generally of poorer quality than that from the Ravenscrag, but despite the quantities of dissolved sulphate salts it contains it is usable. Wells sunk below an elevation of 2,460 feet in the vicinity of Flintoft will encounter the dark grey, compact shales of the Bearpaw formation. Thin beds of fine sand are interspersed

through the shales and are water bearing. The water, however, is of even poorer quality than supplies derived from the Eastend formation, and may be unsuitable for drinking or even for watering stock. Residents of this part of the municipality are better advised to prospect thoroughly the glacial drift and Eastend formation at depths within 40 feet of the surface, rather than to sink wells to greater depths in the shales of the Bearpaw formation.

GROUND-WATER CONDITIONS BY TOWNSHIPS

Township 4, Range 1

No wells have been sunk into the thin deposits of silts, sands, and possibly in some places gravels that form the Recent alluvium along Hay Meadow creek. Water of good quality is to be expected at shallow depths, but it is improbable that any large supply will be found, particularly during drought periods when the creek has ceased to flow. The glacial drift covering this area consists largely of patches of boulder clay too thin to form sources of ground water and isolated boulders strewn on the surface.

Isolated patches of Tertiary gravels have been noted at several places on the upper slopes of the hills. A 9-foot well dug into these gravels in the NE.$\frac{1}{4}$, section 33, yields a supply of hard, drinkable water that is sufficient for 200 head of stock. Another well dug 25 feet deep on the NW.$\frac{1}{4}$, section 32, encountered similar gravels from which it derives a supply sufficient for 50 head of stock. Extensive search for such deposits is recommended to residents requiring large supplies of water.

The sand beds and coal seams of the Ravenscrag formation form the most dependable source of ground water in the township.

The "A" horizon is the uppermost continuous aquifer in the area. Two wells located on the NE.$\frac{1}{4}$, section 31, and the NE.$\frac{1}{4}$, section 32, have tapped this horizon at elevations, respectively, of 2,873 and 2,833 feet above sea-level. The well on section 31, is 32 feet deep and penetrates sand, whereas the well on section 32, is sunk 72 feet to a coal seam. The greater depth of the latter well is due not only to the greater elevation of the well site, but the slight downward dip of the water-bearing strata to the northeast. The water from the first

well is soft and the supply is reported as sufficient for 100 head of stock. The 72-foot well yields a much smaller quantity of a slightly harder water. The presence of an aquifer at the "A" horizon beneath the uplands of the southern sections of the township is assumed because a 56-foot well sunk to an elevation of 2,834 feet on the NE.$\frac{1}{4}$, section 9, found water at this depth. The assumed areal extent of this water-producing bed in the southern part of the township is indicated by the "A" line on Figure 1. Drinkable water in sufficiently large quantities for 20 to 40 head of stock should be found within 75 feet of the surface, even in the highest part along the southern border.

The "B" horizon has been tapped in a sufficient number of wells to support the assumption that it forms a fairly continuous aquifer throughout the area with the exception of the lower part of Hay Meadow valley. This horizon was encountered at an elevation of 2,742 feet in a 48-foot well in section 25, and at approximate elevations of 2,770 feet in sections 15, 21, and 34. Wells in sections 18, 19, and 30 tap what is believed to be the western extension of the same horizon and this suggests that this horizon will be reached at an elevation of about 2,800 feet elsewhere along the western border. Wells tapping this horizon yield a moderately hard water of good quality in sufficient amounts for 20 to 40 head of stock. A well bored on the NE.$\frac{1}{4}$, section 8, reached the "B" horizon at an elevation of 2,772 feet, but the supply was small and boring was continued to a depth of 83 feet, where water was obtained at an elevation of 2,717 feet in sandy clay at the "C" horizon. Another well sunk on the SW.$\frac{1}{4}$, section 16, failed to obtain water at the "B" horizon. This well was also continued to the "C" horizon which was reached at a depth of 108 feet below the surface or an elevation of 2,692 feet above sea-level.

The "C" aquifer is believed to form the uppermost productive bed of the Ravenscrag in the lower part of Hay Meadow

valley, in the east-central part of the township. It will be reached at depths considerably less than 100 feet throughout this part of the area. The frequency with which this horizon has been found to be productive in many parts of the municipality suggests that should upper horizons fail to yield water drilling or boring to the "C" aquifer is advisable.

The evidence of the existing wells indicates that with the exception of the one area noted above adequate supplies of drinkable water for farm requirements are to be expected within 100 feet of the surface in all parts of the township.

Township 4, Range 2

Ground water supplies are being derived from glacial sands and gravels covering an area of 3 square miles in the southwest corner of the township, but throughout the rest of the township they come entirely from water-bearing horizons in the bedrock formations. The deposits of glacial sands and gravels are 15 feet or less in thickness and consequently are tapped by shallow wells. They yield sufficient supplies of water for 10 to 30 head of stock. The water is not highly mineralized and is satisfactory for household use. Throughout the remainder of the township the glacial drift forms only a thin veneer and does not constitute a source of ground water.

With the exception of springs and a well that derive their supply from Tertiary gravels, the bedrock supplies come from horizons in the Ravenscrag formation. The well, 8 feet deep, located on the SE.$\frac{1}{4}$, section 12, obtains its supply from a small patch of these gravels lying upon the surface of the Ravenscrag formation. Springs flow from the gravels on the same quarter section. The supply from the well and the springs is sufficient for 85 head of stock. The amount of iron in the water renders it unfit for domestic use.

Throughout the southern half of the township only one well is known to be deriving its water from the Ravenscrag formation. An 18-foot well sunk on the SW.$\frac{1}{4}$, section 4, tapped a bed of sandstone at an elevation of 3,183 feet above sea-level, from which it obtains a supply of soft, drinkable water. Several wells tap what is believed to be the same horizon at slightly greater elevations in the township to the west, and if this is correct it is probable that this aquifer extends at shallow depths beneath the uplands in sections 5 and 6. No further information regarding the water conditions of the "A" horizon in the southern upland half of the area can be given, as no wells have been sunk sufficiently deep to encounter it. It is possible, however, that wells sunk in the central part of the township, south of the "A" line shown on Figure 1, will obtain water within 60 feet of the surface.

The "B" horizon is the most productive water-bearing horizon in the township. It has been tapped at an approximate elevation of 2,800 feet above sea-level in section 25 at the eastern boundary, and at gradually increasing elevations up to 2,870 feet toward the west. Springs occurring in section 19 are considered to derive their supply from this horizon, as the beds forming the aquifer reach even greater elevations in the township to the west. At least five wells have tapped this horizon in the northern sections of the area, and all are less than 40 feet in depth. The water is found either in coal or in coarse sand beds. The yield of individual wells varies from place to place, but it is generally sufficient for at least 30 head of stock. Large amounts of iron are present in the water from this horizon and this tends to restrict the domestic uses of the water.

The "B" horizon is not present in the lower part of the valley in the north-central part of the township. The proximity of the "C" horizon to the surface in this area,

however, ensures the obtaining of an adequate supply of ground water of good quality at depths less than 50 feet from the surface. The records of the existing wells suggest that little difficulty should be experienced in obtaining an adequate water supply at depths less than 50 feet from the surface in any part of the township. Deeper wells in the Ravenscrag formation are advantageous, however, in that water from greater depths has been found to contain less iron than water from the shallower wells in this township.

Township 4, Range 3

Ground water supplies in the southwest corner of this township are derived from glacial sands and gravels, but throughout the remainder of the area they are obtained almost entirely from a water-bearing horizon in the bedrock. Thin beds of Recent sand, silts, and gravels in the valley bottoms of Wood Mountain and the smaller streams remain unprospected. They are a possible source of small supplies of drinkable water to residents along these valleys.

The glacial outwash sands and gravels occur in a belt approximately 1½ miles in width extending across the southern part of the township and in a smaller, isolated area in sections 34 and 35 in the north. Over most of this area the deposits are thin, less than 10 feet, and form a possible source of only small supplies of water. A 10-foot well sunk in these deposits on the SE.¼, section 1, however, obtains a supply of usable water sufficient for the household and stock needs of the resident. Such deposits of gravels are worthy of more extensive prospecting for water for household use as the water generally contains less iron than supplies from the underlying bedrock aquifers.

The supplies from the bedrock formations come from deposits of reddish brown, Tertiary gravels lying above the

Ravenscrag, and from horizons in the Ravenscrag formation itself. The reddish brown gravels occur in isolated pockets rather than as continuous beds over large areas. They lie at or near the surface, at places where wells have tapped them, and are readily distinguishable by their colour. On sections 13, 14, and 19, springs flowing from pockets of these gravels yield supplies of water sufficient for as many as 40 head of stock. The water is of good quality and used for domestic purposes.

The Ravenscrag bedrock formation lies within a few feet of the surface throughout the township.

A 16-foot and an 18-foot well on the NW.$\frac{1}{4}$, and SW.$\frac{1}{4}$, section 2, respectively, and an 18-foot well on the SE.$\frac{1}{4}$, section 3, have encountered small supplies of water of good quality in a sand horizon lying below reddish clay at an elevation of about 3,232 feet above sea-level. This horizon is thought to be a western extension of the horizon tapped at an elevation of 3,183 feet in sec. 4, tp. 4, range 2. If this is so prospecting at shallow depths in sections 1 and 2, of this township should locate moderately large supplies of water at depths within 30 feet of the surface.

The presence of the "A" horizon underlying the southern upland regions of the area is indicated by the soft-water spring occurring at an elevation of 3,010 feet. Similar springs in coulées and on the hill-sides at slightly greater elevations on the central and western uplands may also derive their water from the "A" horizon. No wells have been sunk to the aquifer feeding these springs, but it is probable that fairly large quantities of drinkable water will be found at depths not exceeding 50 feet in the south-central part of the township.

A water-bearing coal seam lying at the "B" horizon has been penetrated in two wells along the lower hill-slopes in the central part of the township. The occurrence of springs in the coulées further supports the assumption that a continuous

aquifer extends from elevations of approximately 2,850 feet in sections 24 and 25 to nearly 2,900 feet along the western border in sections 7, 18, 19, and 30. This aquifer should be encountered at depths less than 40 feet in the area lying between the "A" and "B" lines shown on Figure 1 of the accompanying map. The yield from the 40-foot well on the NW.$\frac{1}{4}$, section 20, is small, but the 15-foot well on section 21 yields an adequate supply of water for local needs.

Farther down the slope in the northern sections of the township two wells sunk to depths of 60 to 90 feet on sections 34 and 35 have reached the "C" horizon at elevations of 2,779 and 2,769 feet, respectively, and the horizon should be reached at about the same depth on section 36. In sections 31 and 32 the westerly rise of the beds and the lower elevations of the ground surface combine to bring the aquifer to within 50 feet of the surface. As in other townships the "C" horizon in this area has been found to be a dependable source of large supplies of ground water, which although contaminated by iron is useable for domestic purposes.

Township 5, Range 1

The Recent alluvial deposits along the stream valley in the eastern part of this township are believed to contain small supplies of water. No wells have been sunk into these deposits, so that the actual yield to be expected from such shallow wells has not been determined. The mantle of glacial drift overlying the remainder of the area is too thin to carry sufficient water for any farm requirements. The entire ground water supply of the area is being derived from four horizons in the Ravenscrag bedrock formation. The uppermost or "A" horizon is known to underlie the central and southwestern uplands part of the area within the "A" line as drawn on Figure 1 of the municipality map. Two wells sunk to depths of 60 and 30

feet on sections 15 and 23 penetrated this horizon at elevations, respectively, of 2,830 and 2,825 feet above sea-level. Other wells located in the northwest corner of township 4, range 1, suggest that this horizon is present at gradually increasing elevations in sections 4, 5, 9, 8, 7, and 6. Two wells sunk to depths of 60 and 42 feet on sections 4 and 9 have encountered what is believed to be a higher aquifer in a coal seam from which they obtain sufficient quantities of soft, drinkable water to satisfy the requirements of the residents.

A sufficient number of wells have reached the "B" horizon, lying approximately 100 feet below the "A", to trace it as a productive aquifer over a considerable area in this township. It is encountered at an elevation of 2,711 feet in section 1, and yields an adequate supply of drinkable water from a coal seam. At a similar elevation on section 23, however, a 97-foot well failed to reach a productive bed, the water in this well being derived wholly by seepage from a pond formed by a dam. A coal seam was also tapped in section 14, in a 64-foot well, and may be represented in the 150-foot well bored to an elevation of 2,730 feet in section 15. This latter well yields a very small supply. Findings in the wells on section 1 and section 14 would suggest, however, that should the "A" horizon prove to be unproductive at any place within the area bounded by the "A" line, drilling to depths of 100 to 200 feet below the surface should reach the "B" horizon, at which depths the possibilities of obtaining sufficient water for 10 to 20 head of stock are fairly good. Large amounts of iron occur in the water from this horizon and render it of poor quality for domestic use.

The "C" horizon lies from 140 to 150 feet below the "B" and forms the uppermost productive bed throughout the greater part of the northern half of the township. Although only two wells located on sections 36 and 31 are known to have tapped the coal seam that forms the aquifer at this horizon, wells in

adjoining areas indicate that this coal seam is of wide areal extent. The 65-foot well on section 36 penetrated the coal at an elevation of 2,545 feet above sea-level. Due to the gradual rise of the strata at the rate of approximately 14 feet to the mile the well on the SW.$\frac{1}{4}$, section 31, on higher land reached the water-bearing coal seam at a similar depth, but at an elevation of 2,649 feet. Several springs occur in the valleys at elevations that suggest that the water comes from this horizon. Little difficulty should be experienced throughout the north-central part of the township in obtaining adequate supplies of drinkable water within 100 feet or, at points of greatest elevation, within 150 feet, below the surface.

A still lower horizon, the areal extent of which is indicated by the "D" line on Figure 1, is known to occur approximately 50 feet below the "C" horizon in the extreme northern sections of the township. Here again a coal seam is the water-bearing bed. In the SE.$\frac{1}{4}$, section 35, a 127-foot well reached the "D" horizon at an elevation of 2,508 feet. The coal seam occurring at an elevation of 2,509 feet in the 40-foot well on the lower land in the NW.$\frac{1}{4}$, section 35, in all probability represents the same aquifer. The continuity of this horizon to the west at increasingly slightly higher elevations is indicated by wells in the township to the north and by the 64-foot well producing a large supply of water from coal at 2,556 feet in section 31. It should be possible to obtain adequate supplies of water within 65 feet of the surface along the lower slopes of northern sections. In a southerly direction greater depths will be necessary, but it is improbable that wells will be sunk to depths greater than 125 feet in any part of the township before water-bearing beds are penetrated.

Township 5, Range 2

The entire ground water supply at the present time is being derived from the bedrock formations which either outcrop

in the valleys or are covered by a thin mantle of glacial drift. No attempts are known to have been made to obtain water from the thin beds of Recent silts and sands forming the valley floors of the larger creeks. To residents bordering the valleys shallow wells sunk in these deposits should yield throughout the year small supplies of water of good quality. The Ravenscrag formation extending over all the township except in the lower parts of the stream valleys is the most consistently productive source of ground water. With decreasing surface elevations in the vicinity of the creek valley along the western border the Ravenscrag is eroded away and the underlying Whitemud and Eastend formations are exposed. In the bottom of the valley surface elevations are lower even than the base of the Eastend and the dark grey shales of the Bearpaw formation immediately underlie the thin veneer of Recent stream deposits.

The information obtained regarding existing wells and studies of conditions to the west and east of this township indicate that the "B", "C", and "D" horizons in the Ravenscrag formation should be found to be productive. No wells have tapped the "B" horizon in the area, but the occurrence of a few springs in the uplands region of the southeastern part of the township suggests that an aquifer occurs at an approximate elevation of 2,800 feet, and is probably the western extension of the "B" horizon found in township 5, range 1.

At least seven wells have tapped the "C" horizon in different sections of this township. These wells indicate that the horizon extends almost continuously throughout the area lying to the west and south of the "C" line shown on Figure 1, of the municipality map. Water was found in a coal seam which is replaced in places by a bed of sand that occurs at gradually increasing elevations in keeping with the northeasterly dip of the strata of the area. Adequate supplies of water were found in the coal at 2,659 feet in section 34, at 2,668 feet in

section 16, and at 2,687 feet in the SW.$\frac{1}{4}$, section 4. The depth of well necessary to tap this horizon is determinable with a fair degree of accuracy from the surface elevation of the proposed well site and the elevation of the aquifer at other places, as there appears to be little variation in the rise of the aquifer at the rate of 14 to 15 feet a mile in a southwesterly direction across the township. Two wells sunk to depths of 26 and 75 feet on the NW.$\frac{1}{4}$ and the NE.$\frac{1}{4}$, section 21, and a spring on the SE.$\frac{1}{4}$, section 21, are believed to derive their water supply from or near the "D" horizon. No other wells have reached this horizon. Should the "C" horizon prove to be unproductive at any point in the central part of the area, deepening the wells by 45 to 55 feet should reach the "D" horizon, from which there is a good possibility of obtaining fairly large supplies of drinkable water.

The fine, grey sands forming the lower part of the Ravenscrag below the "D" horizon are exposed at a few places along the upper part of the valley in the western part of the township. A few wells have obtained adequate supplies of water from this sand. Others have been extended through the white clay of the Whitemud beds to find water in the underlying sands of the Eastend formation. Little difficulty should be experienced in obtaining sufficient water for farm requirements at moderate depths along the lower slopes of the valley. Extensive prospecting at shallow depths is preferable to sinking deep wells in the valley bottom, as the shales of the Bearpaw formation underlying the valley bottom yield only small supplies of water that will probably be too "alkaline" for domestic use, and may even prove to be unsuitable for watering stock. Drilling for water should not be continued below an approximate elevation of 2,475 feet above sea-level in any part of this township.

Township 5, Range 3

The entire township is deeply dissected by stream valleys and narrow ravines, along the sides of which the bedrock is exposed at many places. No attempts have been made to obtain water from the Recent deposits of silts along the larger stream valleys. Throughout the southern and central parts of the area such deposits are worthy of shallow prospecting. Farther down stream in the north-central part of the area, however, the presence of the Bearpaw shales immediately beneath the Recent silts suggests that a water of inferior quality to that obtainable on the uplands will be found.

Many possible sources of water exist on the uplands. The "D" horizon is believed to extend across the southern part of the area with a gradual increase in elevation from 2,674 feet above sea-level as obtained in a 17-foot well in section 13, to an elevation of 2,731 feet in a 50-foot well in section 17. Neither of these wells produces an adequate supply of water for local requirements. Most of the wells in the area derive their supply either from a bed of coarse, grey sand forming the base of the Ravenscrag formation or from the Eastend formation. In sections 7, 8, 9, and 10 wells less than 40 feet in depth have penetrated the basal sand bed of the Ravenscrag formation at elevations varying from 2,648 feet in section 10 to approximately 2,700 feet in section 7, in the vicinity of Wood Mountain post office. The water from these wells is of good quality and satisfactory for domestic use. The yields from individual wells are not large, but generally sufficient for 10 to 20 head of stock.

On the lower slopes in sections 14, 15, and 16, 21, 24, 25, and 26 wells have passed through the white clays of the Whitemud beds and have reached the water-bearing, fine, grey sands of the Eastend formation. The dip of the Eastend beds is similar to that of the Ravenscrag; water was found at an

elevation of 2,540 feet in section 25 but at gradually increasing elevations, exceeding 2,600 feet in section 21. The yields are not large, usually not more than sufficient for 10 to 20 head of stock, but the water although possibly slightly "alkaline" is suitable for domestic use.

Such a preponderance of porous beds underlying all parts of this township indicates that little difficulty should be experienced in obtaining adequate supplies of water at less than 50 feet throughout the greater part of the township. Should the yield from one horizon prove insufficient, deeper drilling offers good possibilities of finding an adequate supply. It is to be noted, however, that on the long, narrow ridges between the valleys only a very small catchment area is present and little opportunity is thus afforded for the replenishing of aquifers occurring in the upper layers of the bedrock. In such areas deeper wells reaching more extensive lower aquifers are essential. The sands of the Eastend formation grade downward imperceptibly into the dark grey shales of the Bearpaw formation. The water from these shales is much inferior in quality to supplies from the overlying formations, and the search for water should not be extended below the lower shaly beds of the Eastend formation. For this reason sinking of wells in the valley bottoms of the central and northern lowlands part of the area deeper than 30 feet is not advisable.

Township 6, Range 1

Only the part of this township lying below the centre line of Twelvemile lake lies within this municipality. The lake itself cannot be considered to be a suitable source of water for farm requirements. The concentration of mineral salts in the water increases with the gradual drying up of the lake in times of drought, so that any supplies obtainable are too "alkaline" to be used for drinking and cannot be considered to be entirely satisfactory for stock use. No water of much better quality is to

be expected at shallow depths in the thin deposits of silts and sands that border the lake.

Despite this condition existing in the surface waters of the area, no difficulty should be experienced in obtaining an adequate supply of water by sinking wells into bedrock on the sloping land south of the lake. A thin coal seam has been traced along the lower slopes through sections 6 and 5 to the central part of section 4, where, due to the northeasterly dip of the strata, it disappears below the level of the lake. Coal seams have proved to be productive of large supplies of water in many parts of the township, and shallow wells on the slopes sunk to this coal seam should find water. Sand beds are numerous in the lower part of the Ravenscrag formation in this area and are probably water bearing. A record of only one well was obtained in this narrow area. This well, 28 feet in depth, draws water from a sandstone bed believed to lie at the "D" horizon, at an elevation of 2,524 feet above sea-level, in the Ravenscrag formation. The supply is sufficient to satisfy the needs of the residents and to water 10 head of stock. The water is not highly mineralized and is used for all domestic purposes. It is believed that similar wells sunk at other points on the uplands will encounter this horizon at depths less than 40 feet on the lower slopes and at slightly greater depths on the highest points along the southern border of the township.

Township 6, Range 2

Only the part of this township to the south of the centre line of Twelvemile lake lies in Municipality No. 43. Due to the concentration of mineral salts in solution in the water of the lake and in the thin sand and silt beds bordering the lake these waters cannot be considered satisfactory for either domestic use or watering stock. Silts and sands deposited along the bottoms of the tributary valleys can be expected to

yield supplies of water of much better quality. The veneer of glacial drift covering the bedrock is too thin to form a source of ground water.

The Ravenscrag formation present throughout the upland part of the township is the most productive source of drinkable water in the area. A 36-foot well sunk on the SE.$\frac{1}{4}$, section 3, derives a small supply of slightly mineralized water from a coal seam at an elevation of 2,664 feet above sea-level. This coal seam was struck at a similar elevation in a 70-foot well on the SW.$\frac{1}{4}$ of the same section. This coal seam lies at the "C" horizon and is believed to continue throughout the area lying to the south of the "C" line, as shown on Figure 1 of the municipality map. Two other wells located in sections 4 and 10, and respectively 42 and 75 feet deep, reached production in sand at elevations of 2,639 and 2,593 feet above sea-level. This aquifer, shown as the "D" horizon on Figure 1, is believed to be fairly continuous as a productive bed throughout the central part of the area, and to extend southward beneath the "C" horizon.

Should both the "C" and "D" horizons prove to be unproductive in any part of the area, there is the possibility of obtaining small supplies of sulphate water in the fine, grey sands of the Eastend formation that lie immediately beneath the white clays of the Whitemud beds. In the northwest lowland part of the township the beds of the Ravenscrag have been entirely removed by stream erosion and only the Eastend beds remain. Deep drilling in the lowland parts is not advisable due to the presence of the underlying, compact, dark shales of the Bearpaw formation. Sulphate salts exist in still greater concentration in the waters from the Bearpaw shales, and the water from this formation will probably be found to be undrinkable, although it can be used for watering stock.

Township 6, Range 3

The part of this township within Municipality No. 43 lies to the south of the northern boundary of sections 7, 8, and 9, and south of the centre line of Twelvemile lake. The glacial drift is sufficiently thick over the northern part of the area in the vicinity of Flintoft to form a source of small supplies of water. Extensive prospecting at shallow depths should locate isolated beds or pockets of sands and gravels that are interspersed through the boulder clay and that will yield a better quality of water than the aquifer in the underlying bedrock. On the uplands the drift is thin and does not constitute a source of ground water. The fine, grey sands of the Eastend formation underlie the slopes of the southern uplands. These sands yield small amounts of water, but it is often necessary to sink wells down to the top of the underlying Bearpaw shales before an adequate supply is obtained. Wells have been sunk as deep as 70 to 100 feet in section 3, before water was found. At other places the Eastend sands have proved to be productive within 25 feet of the surface. The water is only moderately hard, but may contain considerable amounts of sulphate salts in solution.

The Bearpaw formation underlies the Eastend formation in the uplands and occurs immediately beneath the stream silts in the valleys and beneath the glacial drift in the northern lowlands. The upper, sandy part of the Bearpaw formation yields fairly large supplies of water, but at depths of approximately 40 feet from the surface the available supply becomes less and the concentration of dissolved mineral salts greater. A few bedrock wells dug to the east and south of Flintoft yield undrinkable water and better water conditions cannot be expected at greater depths.

STATISTICAL SUMMARY OF WELL INFORMATION IN RURAL MUNICIPALITY OF No. 43, SASKATCHEWAN

West of 3rd meridian — Township / Range	4 / 1	4 / 2	4 / 3	5 / 1	5 / 2	5 / 3	6 / 1	6 / 2	6 / 3	Total No. in Municipality
Total No. of Wells in Township	15	32	38	27	28	36	1	9	10	196
No. of wells in bedrock	15	28	37	27	28	36	1	9	10	191
No. of wells in glacial drift	0	4	1	0	0	0	0	0	0	5
No. of wells in alluvium	0	0	0	0	0	0	0	0	0	0
Permanency of Water Supply										
No. with permanent supply	15	32	38	26	28	34	1	4	10	188
No. with intermittent supply	0	0	0	1	0	1	0	0	0	2
No. dry holes	0	0	0	0	0	1	0	5	0	6
Types of Wells										
No. of flowing artesian wells	0	0	0	0	0	0	0	0	0	0
No. of non-flowing artesian wells	3	1	0	5	10	7	0	0	2	28
No. of non-artesian wells	12	31	38	22	18	28	1	4	8	162
Quality of Water										
No. with hard water	14	30	32	22	20	11	0	2	7	138
No. with soft water	1	2	6	5	8	24	1	2	3	52
No. with salty water	0	0	0	0	0	0	0	0	0	0
No. with "alkaline" water	2	0	0	5	4	5	0	2	4	22
Depths of Wells										
No. from 0 to 50 feet deep	11	32	36	18	23	29	1	7	7	164
No. from 51 to 100 feet deep	3	0	2	7	4	4	0	2	3	25
No. from 101 to 150 feet deep	1	0	0	2	1	3	0	0	0	7
No. from 151 to 200 feet deep	0	0	0	0	0	0	0	0	0	0
No. from 201 to 500 feet deep	0	0	0	0	0	0	0	0	0	0
No. from 501 to 1,000 feet deep	0	0	0	0	0	0	0	0	0	0
No. over 1,000 feet deep	0	0	0	0	0	0	0	0	0	0
How the Water is Used										
No. usable for domestic purposes	13	31	38	25	28	35	1	4	9	184
No. not usable for domestic purposes	2	1	0	2	0	0	0	0	1	6
No. usable for stock	15	32	38	27	28	35	1	4	10	190
No. not usable for stock	0	0	0	0	0	0	0	0	0	0
Sufficiency of Water Supply										
No. sufficient for domestic needs	15	32	37	27	28	35	1	4	10	189
No. insufficient for domestic needs	0	0	1	0	0	0	0	0	0	1
No. sufficient for stock needs	15	31	37	17	18	29	1	4	10	162
No. insufficient for stock needs	0	1	1	10	10	6	0	0	0	28

ANALYSES AND QUALITY OF WATER

General Statement

Samples of water from representative wells in surface deposits and bedrock were taken for analyses. Except as otherwise stated in the table of analyses the samples were analysed in the laboratory of the Borings Division of the Geological Survey by the usual standard methods. The quantities of the following constituents were determined; total dissolved mineral solids, calcium oxide, magnesium oxide, sodium oxide by difference, sulphate, chloride, and alkalinity. The alkalinity referred to here is the calcium carbonate equivalent of all acid used in neutralizing the carbonates of sodium, calcium, and magnesium. The results of the analyses are given in parts per million--that is, parts by weight of the constituents in 1,000,000 parts of water; for example, 1 ounce of material dissolved in 10 gallons of water is equal to 625 parts per million. The samples were not examined for bacteria, and thus a water that may be termed suitable for use on the basis of its mineral salt content might be condemned on account of its bacteria content. Waters that are high in bacteria content have usually been polluted by surface waters.

Total Dissolved Mineral Solids

The term "total dissolved mineral solids" as here used refers to the residue remaining when a sample of water is evaporated to dryness. It is generally considered that waters that have less than 1,000 parts per million of dissolved solids are suitable for ordinary uses, but in the Prairie Provinces this figure is often exceeded. Nearly all waters that contain more than 1,000 parts per million of total solids have a taste due to the dissolved mineral matter. Residents

accustomed to the waters may use those that have much more than 1,000 parts per million of dissolved solids without any marked inconvenience, although most persons not used to highly mineralized water would find such waters highly objectionable.

Mineral Substances Present

Calcium and Magnesium

The calcium (Ca) and magnesium (Mg) content of water is dissolved from rocks and soils, but mostly from limestone, dolomite, and gypsum. The calcium and magnesium salts impart hardness to water. The magnesium salts are laxative, especially magnesium sulphate (Epsom salts, $MgSO_4$), and they are more detrimental to health than the lime or calcium salts. The calcium salts have no laxative or other deleterious effects. The scale found on the inside of steam boilers and tea-kettles is formed from these mineral salts.

Sodium

The salts of sodium are next in importance to those of calcium and magnesium. Of these, sodium sulphate (Glauber's salt, Na_2SO_4) is usually in excess of sodium chloride (common salt, NaCl). These sodium salts are dissolved from rocks and soils. When there is a large amount of sodium sulphate present the water is laxative and unfit for domestic use. Sodium carbonate (Na_2CO_3) "black alkali", sodium sulphate "white alkali", and sodium chloride are injurious to vegetation.

Sulphates

Sulphates (SO_4) are one of the common constituents of natural water. The sulphate salts most commonly found are sodium sulphate, magnesium sulphate, and calcium sulphate ($CaSO_4$). When the water contains large quantities of the sulphate of sodium it is injurious to vegetation.

Chlorides

Chlorides are common constituents of all natural water and are dissolved in small quantities from rocks. They usually occur as sodium chloride and if the quantity of salt is much over 400 parts per million the water has a brackish taste.

Iron

Iron (Fe) is dissolved from many rocks and the surface deposits derived from them, and also from well casings, water pipes, and other fixtures. More than 0.1 part per million of iron in solution will settle as a red precipitate upon exposure to the air. A water that contains a considerable amount of iron will stain porcelain, enamelled ware, and clothing that is washed in it, and when used for drinking purposes has a tendency to cause constipation, but the iron can be almost completely removed by aeration and filtration of the water.

Hardness

Calcium and magnesium salts impart hardness to water. Hardness of water is commonly recognized by its soap-destroying powers as shown by the difficulty of obtaining lather with soap. The total hardness of a water is the hardness of the water in its original state. Total hardness is divided into "permanent hardness" and "temporary hardness". Permanent hardness is the hardness of the water remaining after the sample has been boiled and it represents the amount of mineral salts that cannot be removed by boiling. Temporary hardness is the difference between the total hardness and the permanent hardness and represents the amount of mineral salts that can be removed by boiling. Temporary hardness is due mainly to the bicarbonates of calcium and magnesium and iron, and permanent harness to the sulphates and chlorides of calcium and magnesium. The permanent hardness

can be partly eliminated by adding simple chemical softeners such as ammonia or sodium carbonate, or many prepared softeners. Water that contains a large amount of sodium carbonate and small amounts of calcium and magnesium salts is soft, but if the calcium and magnesium salts are present in large amounts the water is hard. Water that has a total hardness of 300 parts per million or more is usually classed as excessively hard. Many of the Saskatchewan water samples have a total hardness greatly in excess of 300 parts per million; when the total hardness exceeded 3,000 parts per million no exact hardness determination was made. Also no determination for temporary hardness was made on waters having a total hardness less than 50 parts per million. As the determinations of the soap hardness in some cases were made after the samples had been stored for some time, the temporary hardness of some of the waters as they come from the wells probably is higher than that given in the table of analyses.

Analyses of Water Samples from the Municipality No. 43, Saskatchewan.

No.	LOCATION					Depth of Well, Ft.	Total dissvd solids	HARDNESS			CONSTITUENTS AS ANALYSED						CONSTITUENTS AS CALCULATED IN ASSUMED COMBINATIONS								Source of Water
	Qtr.	Sec.	Tp.	Rge.	Mer.			Total	Perm.	Temp.	Cl.	Alkalinity	CaO	MgO	SO_4	Na_2O	Solids	$CaCO_3$	$CaSO_4$	$MgCO_3$	$MgSO_4$	Na_2CO_3	Na_2SO_4	NaCl	
1	NW.	7	4	2	3	10	409																		x-1
2	NW.	13	4	3	3	6	420	400	300	100	11	370	130	65	33	16	409	233		115	30		13	18	x-2

Water samples indicated thus, x-1, are from glacial drift.
Water samples indicated thus, x-2, are from bedrock, Tertiary Gravel.
Analyses are reported in parts per million.
Hardness is the soap hardness expressed as calcium carbonate ($CaCO_3$).
Analysis No. 1, by Provincial Analyst, Regina.
For interpretation of this table read the section on Analyses and Quality of Water.

Water from the Unconsolidated Deposits

No records of analyses of waters from Twelvemile lake were obtained. The water is highly charged with mineral salts in solution and in such concentration as to render the water unfit for domestic use and generally unsatisfactory for watering stock. During periods of ample precipitation streams flowing from the southern uplands into the western end of the lake render the water of this part slightly less "alkaline" than water in the eastern marsh lands. It is improbable that shallow wells sunk in the fine sands and silts covering the eastern part of the lake basin will yield a water sufficiently low in the dissolved sulphates of sodium and magnesium to be used in the household. The waters contained in the thin beds of sands, silts, and gravels in the stream valleys are derived to a large extent from springs issuing from the Ravenscrag formation. Such water is generally of good quality and shallow wells sunk into these valley deposits should provide a moderately hard water suitable for domestic use. With such shallow wells care should be exercised, however, in keeping the wells free from sewage or other decaying organic matter likely to cause pollution.

Only in the extreme northwestern lowlands of the municipality is the glacial drift sufficiently thick to be considered as a source of ground water. Supplies derived from the isolated pockets of sands and gravels interspersed in the blue-grey boulder clay are generally hard and contain sodium sulphate and magnesium sulphate in solution. Such water is mildly laxative to persons unaccustomed to its use. Supplies derived entirely as seepage from boulder clay are generally more highly mineralized and may be unsatisfactory for drinking. The extensive beds of glacial outwash sands and gravels occurring at or near the surface yield a water of much better quality. It is not excessively hard and contains only minor amounts of mineral salts in solution. Water

from this source is considered to be the most suitable for domestic use of all waters found in the municipality. The total dissolved solids in the waters from gravels encountered 10 feet from the surface in sec. 7, tp. 4, range 2, as determined by the Provincial Analyst at Regina, is given on the accompanying table of analyses. The water was found to have only 409 parts per million of dissolved mineral salts; a figure considerably below the general average of wells sunk into the glacial drift in many parts of the province.

Water from the Bedrock

Ground water contained in the patches of reddish brown, Tertiary gravels is similar in quality to supplies from the glacial outwash sands and gravels. This is to be expected in that the supply of both types of deposit is largely derived directly from surface waters. The second analysis given on the accompanying table is of water from a spring dug out to a depth of 6 feet in the red gravels occurring on the NW.$\frac{1}{4}$, sec. 13, tp. 4, range 3. The total solid content of the water is 420 parts per million and is comprised largely of calcium and magnesium carbonate. The only effect of these salts is to make the water moderately hard. Very small amounts of Glauber's salt (Na_2SO_4), Epsom salts ($MgSO_4$), and common salt ($NaCl$), are also present, but these are not in sufficient concentration to give a taste to the water or otherwise render the water unsatisfactory for domestic use.

No samples of ground water from the various productive beds of the Ravenscrag formation in this municipality were collected for analysis, but many analyses have been made of waters from the Ravenscrag in adjoining areas where conditions appear to be similar. The following few generalizations are based upon these analyses, upon observations at the well sites, and upon reports of residents of the municipality. The water from the Ravenscrag

formation is generally of good quality for household use. It is improbable that the dissolved mineral salt content of the average water from aquifers in this formation greatly exceeds 450 parts per million, of which calcium and magnesium carbonate are the dominant salts. Sodium sulphate (Na_2SO_4) is almost invariably present, but does not usually exceed 150 parts per million. The water in wells tapping aquifers more than 100 feet below the surface is generally a carbonate water rather than a sulphate water. Such waters may be quite soft, the hardness being occasionally less than 200 parts per million. The hardness of water from the shallower wells ranges between 400 and 600 parts per million. Common salt is seldom if ever in sufficient concentration in the water from the Ravenscrag of the area to be detectable by its taste.

Iron forms the most objectionable constituent, and it is particularly noticeable in water derived from coal seams. Most of the iron may be removed from the water by allowing it to come in contact with the air; the iron in solution will appear as a brown precipitate, which given sufficient time will settle at the bottom of the container. A simple method that has proved effective in some areas in removing iron is to suspend a sheet of corrugated galvanized iron between the pump and trough. The water is allowed to pass over the sheet in a thin stream thus presenting as great a surface area as possible to the air. The iron upon oxidation settles on the bottom of the trough. Agitation of the water is also effective in removing iron.

No samples of ground water from the Eastend formation were collected for analysis in this or adjoining areas. Reports of residents using wells drawing their supplies from this formation are to the effect that the water is only moderately hard and appreciably more "alkaline" than waters from the Ravenscrag. Supplies from the upper sands of the Eastend will probably be found to be quite suitable for domestic use, but at greater

depths where the sandy shales contain a larger precentage of dissolvable mineral salts a correspondingly more highly mineralized water is to be expected.

Water from the upper sandy shale beds of the Bearpaw formation contain both sodium sulphate and magnesium sulphate in solution, together with appreciable amounts of common salt. Such water is generally found to be unsuitable for domestic use, but has been used for watering stock where better supplies are not available. Water from greater depths into the dark grey shales of this formation generally exhibit such a concentration of dissolved sulphate and chloride salts as to be unfit for any farm use. Such water would have a tendency to produce scour in stock. Water of this quality is almost certainly to be found in the vicinity of Flintoft if wells are carried to depths greatly exceeding 40 feet.

WELL RECORDS—Rural Municipality of NO. 43 SASKATCHEWAN

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
1	SE.	3	4	1	3	Bored	30	2,900	- 15	2,885	30	2,870	Ravenscrag sand	Hard, clear, iron		D, S	Sufficient for local needs. Springs for stock.
2	NE.	8	"	"	"	Bored	83	2,800	- 70	2,730	83	2,717	Ravenscrag blue clay	Hard, clear, iron			
3	NE.	9	"	"	"	Bored	56	2,890	- 45	2,845	56	2,834	Ravenscrag sand	Hard, clear, iron		D, S	Sufficient for 40 head stock.
4	SE.	15	"	"	"	Bored	30	2,800	- 10	2,790	30	2,770	Ravenscrag sand	Hard, clear, iron		D, S	Sufficient for 40 head stock.
5	SW.	16	"	"	"	Bored	108	2,800	- 98	2,702	108	2,692	Ravenscrag gravel	Hard, clear, iron		D, S	Sufficient for 20 head stock.
6	NW.	21	"	"	"	Bored	36	2,800	- 20	2,780	36	2,764	Ravenscrag clay	Hard, clear, "alkaline"	45	S	Sufficient for 60 head stock. A 25-foot similar well.
7	SE.	25	"	"	"	Bored	48	2,790	- 41	2,749	48	2,742	Ravenscrag coarse gravel	Hard, clear, iron		D, S	Sufficient for 20 head stock.
8	NE.	31	"	"	"	Bored	32	2,905	- 15	2,890	32	2,873	Ravenscrag sand	Soft, clear	45	D, S	Sufficient for 100 head stock.
9	NW.	32	"	"	"	Bored	25	2,905	- 20	2,885	25	2,880	Tertiary sand and gravel	Hard, clear	45	D, S	Sufficient for 50 head stock.
10	NE.	32	"	"	"	Bored	72	2,905	- 62	2,843	72	2,833	Ravenscrag coal	Hard, clear, iron	45	D, S	Sufficient for 12 head stock.
11	NE.	33	"	"	"	Dug	9	2,870	- 3	2,867	9	2,861	Tertiary gravel	Hard, clear		D, S	Sufficient for 200 head stock.
12	SE.	34	"	"	"	Dug	30	2,800	- 27	2,773	30	2,770	Ravenscrag sand	Hard, clear		D, S	Sufficient for 20 head stock.
1	SW.	4	4	2	3	Dug	18	3,199	- 16	3,183	16	3,183	Ravenscrag sand	Soft, clear	45	D, S	Sufficient for 10 head stock.
2	SE.	7	"	"	"	Dug	15	3,235	- 13	3,222	13	3,222	Glacial coarse sand	Hard, clear	45	D, S	Sufficient for 25 head stock. Three similar wells.
3	NW.	7	"	"	"	Dug	10	3,159	- 8	3,151	8	3,151	Glacial sand	Hard, clear	45	D, S	Sufficient for 10 head stock. #
4	SE.	12	"	"	"	Dug	8	3,077	- 6	3,071	6	3,071	Tertiary gravel	Soft, clear, iron	45	S	Sufficient for 85 head stock. Another spring and a 9-foot and 35-foot well on this quarter.
5	SW.	19	"	"	"	Spring		2,870	0	2,870	0	2,870	Ravenscrag coal	Hard, clear, iron	45	D, S	Sufficient for 50 head stock.
6	NE.	25	"	"	"	Dug	25	2,829	- 15	2,814	25	2,804	Ravenscrag	Hard, clear		D, S	Sufficient for 30 head stock. Also a spring.
7	NE.	27	"	"	"	Dug	12	2,770	- 8	2,762	8	2,762	Ravenscrag clay	Hard, clear, iron, lime	45	D	Sufficient for local needs. Springs yield a stock supply.
8	SE.	30	"	"	"	Dug	35	2,877	- 20	2,857	35	2,842	Ravenscrag coal	Hard, clear	45	D, S	Sufficient for 32 head stock. Also an 8-foot well and springs.
9	SW.	32	"	"	"	Bored	20	2,916	- 12	2,904	15	2,901	Ravenscrag clay	Hard, clear, iron	45	D, S	Sufficient for 15 head stock. Also 35-foot well.
10	NW.	32	"	"	"	Dug	13	2,850	- 9	2,841	10	2,840	Ravenscrag sand and gravel	Hard, clear, iron	45	D, S	Sufficient for 15 head stock.
11	NE.	34	"	"	"	Dug	16	2,880	- 11	2,869	16	2,864	Ravenscrag blue clay	Hard, clear, lime	45	D, S	Sufficient for 40 head stock. Creek and springs for stock.
12	SW.	35	"	"	"	Dug	25	2,900	- 17	2,883	17	2,883	Ravenscrag clay	Hard, clear, iron, lime	45	D, S	Sufficient for 20 head stock.
1	SE.	1	4	3	3	Dug	10	3,260	- 8	3,252	10	3,250	Glacial sand	Hard, clear		D, S	Sufficient for 10 head stock.
2	SW.	2	"	"	"	Dug	18	3,250	- 16	3,234	18	3,232	Ravenscrag sand	Hard, clear		D, S	Sufficient for 10 head stock only.
3	NW.	2	"	"	"	Dug	16	3,250	- 15	3,235	16	3,234	Ravenscrag sand	Hard, clear		D, S	Sufficient for 30 head stock.

NOTE—All depths, altitudes, heights and elevations given above are in feet.

(D) Domestic; (S) Stock; (I) Irrigation; (M) Municipality; (N) Not used.
(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of NO. 43, SASKATCHEWAN

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
4	SE.	3	4	3	3	Dug	18	3,250	- 16	3,234	18	3,232	Ravenscrag sand	Hard, clear		D, S	Sufficient for 10 head stock.
5	NE.	5	"	"	"	Dug	16	3,209	- 12	3,197	12	3,197	Ravenscrag	Hard, clear		D, S	Sufficient for 20 head stock.
6	SE.	7	"	"	"	Bored	50	3,040	- 35	3,005	50	2,990	Ravenscrag cream clay	Hard, clear		D, S	Sufficient for local needs.
7	NW.	13	"	"	"	Spring	6	2,920	0	2,920	0	2,920	Tertiary gravel	Hard, clear		D	Sufficient for local needs. # Several other springs, stock watered in creek.
8	SW.	14	"	"	"	Spring		3,010	0	3,010	0	3,010	Tertiary gravel	Soft, clear		D, S	Sufficient for 40 head stock.
9	SE.	19	"	"	"	Spring		2,886	0	2,886	0	2,886	Tertiary gravel	Hard, clear		D, S	Sufficient for 30 head stock.
10	NW.	20	"	"	"	Bored	40	2,895	- 25	2,870	36	2,859	Ravenscrag coal	Hard, clear		D	
11	NW.	20	"	"	"	Dug	14	2,890	- 12	2,878	14	2,876	Ravenscrag sand	Hard, clear		D	Insufficient for local needs. Stock watered in creek.
12	NE.	21	"	"	"	Dug	15	2,840	- 5	2,835	10	2,830	Ravenscrag coal	Hard, clear		D, S	Sufficient for local needs. Another similar well and permanent springs.
13	NW.	34	"	"	"	Bored	60	2,839	- 54	2,785	60	2,779	Ravenscrag coal	Clear, iron			Not known; probably sufficient.
14	NW.	35	"	"	"	Dug	90	2,859	- 84	2,775	90	2,769	Ravenscrag coal	Hard, clear, iron		D, S	Sufficient for 12 head stock.
1	NE.	1	5	1	3	Bored	50	2,761	- 45	2,716	50	2,711	Ravenscrag coal	Hard, clear, iron		D, S	Sufficient for 18 head stock; 2 bbls. every 20 minutes.
2	SE.	4	"	"	"	Bored	60	2,980	- 30	2,950	45	2,935	Ravenscrag coal and gravel	Soft, clear	45	D, S	Insufficient; enough for 6 head stock.
3	NE.	9	"	"	"	Bored	42	2,920	- 28	2,892	42	2,878	Ravenscrag sand below coal	Soft, clear		D, S	Sufficient for 20 head stock. Also 8-foot well.
4	NW.	14	"	"	"	Bored	64	2,810	- 60	2,750	60	2,750	Ravenscrag coal	Hard, cloudy, iron		D, S	Sufficient for 12 head stock. Use spring for stock.
5	SW.	15	"	"	"	Bored	60	2,890	- 56	2,834	60	2,830	Ravenscrag sand	Hard, clear, iron		D	Sufficient for local needs. Small supply from 150-foot well.
6	SW.	23	"	"	"	Dug	30	2,845	- 20	2,825	20	2,825	Ravenscrag coal	Soft, clear		D	Sufficient for local needs.
7	SE.	23	"	"	"	Bored	97	2,810	- 93	2,717	93	2,717	Ravenscrag clay	Hard, clear, iron, "alkaline"		S	Insufficient for local needs.
8	SE.	30	"	"	"	Spring		2,746	0	2,746	0	2,746	Ravenscrag	Soft, clear		D, S	Permanent spring.
9	SW.	31	"	"	"	Bored	62	2,700	- 42	2,658	51	2,649	Ravenscrag bluish sand	Hard, clear, iron, "alkaline"		D	Sufficient for 25 head stock.
10	SE.	31	"	"	"	Dug	16	2,650	- 10	2,640	16	2,634	Ravenscrag clay, sand	Soft, clear		D, S	Sufficient for 20 head stock.
11	NE.	31	"	"	"	Bored	64	2,620	- 44	2,576	64	2,556	Ravenscrag coal	Hard, clear, "alkaline"		D, S	Sufficient for 10 head stock.
12	NW.	35	"	"	"	Bored	40	2,529	- 20	2,509	20	2,509	Ravenscrag coal	Hard, clear, iron, "alkaline"		D, S	Sufficient for 50 head stock.
13	SE.	35	"	"	"	Bored	127	2,635	-120	2,515	127	2,508	Ravenscrag coal	Hard, clear, iron, "alkaline"		D, S	Insufficient for local needs.
14	SW.	36	"	"	"	Bored	65	2,610	- 50	2,560	65	2,545	Ravenscrag coal	Hard, clear, iron		D, S	Insufficient; enough for 8 head stock all the time.

NOTE—All depths, altitudes, heights and elevations given above are in feet.

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(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of NO.43, SASKATCHEWAN

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
1	SE.	3	5	2	3	Bored	30	2,750	- 24	2,726	30	2,720	Ravenscrag sand	Hard, clear, iron		D, S	Sufficient for 30 head stock.
2	SW.	4	"	"	"	Dug	16	2,702	- 8	2,694	15	2,687	Ravenscrag coal	Hard, clear, iron		D	Sufficient for local needs. Several similar wells.
3	SW.	4	"	"	"	Spring		2,693	0	2,693	0	2,693	Ravenscrag	Hard, iron			Permanent spring.
4	SW.	9	"	"	"	Dug	30	2,666	- 18	2,648	30	2,636	Ravenscrag white mud	Hard, clear, iron, "alkaline"		D	Sufficient for local needs. Stock watered in creek.
5	NE.	10	"	"	"	Bored	20	2,765	- 16	2,749	20	2,745	Ravenscrag coal	Soft, clear		D, S	Sufficient for 20 head stock. Several dry holes
6	NE.	16	"	"	"	Dug	20	2,688	- 17	2,671	20	2,668	Ravenscrag coal	Soft, clear		D, S	Insufficient for local needs.
7	NE.	19	"	"	"	Spring		2,522	0	2,522	0	2,522	Eastend			S	Furnishes a permanent supply.
8	NW.	20	"	"	"	Bored	105	2,588	- 65	2,523	105	2,483	Eastend whitish sand	Hard, cloudy iron, "alkaline"		D, S	Sufficient for 12 head stock.
9	NW.	21	"	"	"	Dug	26	2,659	- 22	2,637	18	2,641	Ravenscrag sand	Soft, clear		D, S	Insufficient for 12 head stock during 1934.
10	SE.	21	"	"	"	Spring		2,646	0	2,646	0	2,646	Ravenscrag	Soft, clear			Provides a permanent supply.
11	NE.	21	"	"	"	Bored	75	2,690	- 40	2,650	65	2,625	Ravenscrag yellow clay	Soft, clear		D, S	Sufficient for 25 head stock.
12	NW.	22	"	"	"	Bored	30	2,735	- 15	2,720			Ravenscrag	Soft, clear		D, S	Sufficient for 10 head stock.
13	SW.	27	"	"	"	Dug	18	2,753	- 14	2,739	11	2,742	Ravenscrag sand and gravel	Hard, clear		D, S	Insufficient for 11 head stock in 1934.
14	SE.	30	"	"	"	Dug	20	2,532	- 16	2,516	14	2,518	Eastend sandstone	Hard, clear, "alkaline"		D, S	Insufficient; enough for 8 head stock.
15	NE.	34	"	"	"	Bored	65	2,719	- 54	2,665	60	2,659	Ravenscrag sandstone	Soft, clear, iron		D, S	Sufficient for local needs.
16	NW.	35	"	"	"	Bored	70	2,714	- 50	2,664	70	2,644	Ravenscrag coal	Hard, clear, iron, "alkaline"		D, S	Sufficient for 40 head stock.
1	NE.	2	5	3	3	Dug	42	2,800	- 32	2,768	32	2,768	Ravenscrag coal	Soft, clear		D, S	Sufficient for 30 head stock. A similar well gave good supply prior to 1935.
2	SE.	7	"	"	"	Bored	42	2,720	- 22	2,698	20	2,700	Ravenscrag white clay	Hard, clear		D, S	Sufficient for household needs only.
3	SW.	8	"	"	"	Dug	20	2,712	- 10	2,702	10	2,702	Ravenscrag sandy yellow clay	Soft, clear		D	Sufficient for local needs.
4	SE.	8	"	"	"	Bored	18	2,670	- 11	2,659	15	2,655	Ravenscrag sand	Soft, clear, "alkaline"		D, S	Sufficient for local needs.
5	SW.	8	"	"	"	Bored	85	2,708	- 25	2,683	85	2,623	Ravenscrag	Soft, clear		D	Used by hotel.
6	NW.	10	"	"	"	Dug	10	2,666	- 6	2,660	10	2,656	Ravenscrag coal	Soft, clear, iron		D, S	Sufficient for 6 head stock.
7	NW.	10	"	"	"	Spring		2,656	0	2,656	0	2,656	Ravenscrag	Soft.			Several springs provide permanent supply.
8	NE.	10	"	"	"	Dug	30	2,678	- 25	2,653	30	2,648	Ravenscrag coal	Soft, clear		D, S	Sufficient for 11 head stock.
9	NE.	13	"	"	"	Dug	17	2,682	- 8	2,674	8	2,674	Ravenscrag coal	Soft, clear		D, S	Insufficient for 8 head stock; 50-foot dry hole.
10	SE.	14	"	"	"	Bored	105	2,680	- 85	2,595	105	2,575	Eastend sandy material	Soft, cloudy, soda, iron		D, S	Sufficient for 50 head stock.

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(*) Sample taken for analysis.

WELL RECORDS—Rural Municipality of NO. 43 SASKATCHEWAN

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
11	NW.	14	5	3	3	Dug	25	2,590	- 17	2,573	25	2,565	Eastend blue clay	Soft, clear		D, S, I	Sufficient for 25 head stock
12	NE.	15	"	"	"	Dug	28	2,595	- 24	2,571	22	2,573	Eastend sand	Soft, clear		D, S	Sufficient; 4 bbls. at one time.
13	SE.	16	"	"	"	Dug	14	2,571	- 10	2,561	14	2,557	Eastend fine sand	Hard, clear, "alkaline"		D, S	Insufficient for 15 head stock.
14	NW.	17	"	"	"	Bored	51	2,765	- 34	2,731	34	2,731	Ravenscrag coal	Hard, "alkaline"		D, S	Insufficient for local needs. Several similar wells.
15	SW.	21	"	"	"	Bored	115	2,721	-110	2,611	112	2,609	Eastend bluish sand	Hard, clear, "alkaline"		D, S	Insufficient; enough for 12 head stock.
16	NE.	21	"	"	"	Bored	65	2,621	- 61	2,560	61	2,560	Eastend yellow sandy clay	Soft, clear		D, S	Sufficient for 10 head stock.
17	SW.	24	"	"	"	Dug	50	2,583	- 20	2,563	46	2,537	Eastend fine yellow sand	Soft, clear		D, S	Sufficient for 10 head stock.
18	SE.	24	"	"	"	Dug	30	2,644	- 27	2,617	18	2,626	Ravenscrag sandstone	Soft, clear		D, S	Sufficient for 8 head stock.
19	SE.	25	"	"	"	Bored	60	2,614	- 35	2,579			Eastend	Soft, clear, iron		D, S	Sufficient for 50 head stock.
20	SW.	25	"	"	"	Dug	10	2,550	- 6	2,544	10	2,540	Eastend white clay	Soft, clear, iron		D, S	Sufficient for 12 head stock.
21	NW.	25	"	"	"	Spring		2,528	0	2,528	0	2,528	Eastend	Soft			Several springs and shallow wells provide a permanent supply.
22	NE.	26	"	"	"	Dug	16	2,555	- 11	2,544	16	2,539	Eastend sandy blue clay	Soft, clear, "alkaline"		D, S	Sufficient for 12 head stock.
23	NE.	26	"	"	"	Spring		2,544	0	2,544	0	2,544	Eastend	Soft			This is a permanent spring.
24	NW.	27	"	"	"	Dug	20	2,516	- 12	2,504	15	2,501	Eastend sandy blue clay	Hard, clear		D, S	Sufficient for 20 head stock at least.
25	NE.	28	"	"	"	Bored	120	2,624	- 95	2,529	120	2,504	Eastend	Soft, clear		D, S	Sufficient for local needs.
1	SE.	5	6	1	3	Dug	28	2,550	- 25	2,525	26	2,524	Ravenscrag hard sandstone	Soft, clear		D, S	Sufficient usually for 10 head stock.
1	SW.	3	6	2	3	Bored	70	2,703	- 50	2,653	50	2,653	Ravenscrag coal	Hard, clear, red sediment, iron		D, S	Sufficient for 30 head stock.
2	SE.	3	"	"	"	Bored	36	2,688	- 24	2,664	24	2,664	Ravenscrag coal	Hard, clear, "alkaline" iron		D, S	Sufficient for 10 head stock.
3	NE.	4	"	"	"	Dug	42	2,677	- 38	2,639	38	2,639	Ravenscrag sand	Soft, clear		D, S	Sufficient for 20 head stock. other wells of similar depth were dry.
4	SE.	10	"	"	"	Bored	75	2,658			65	2,593	Ravenscrag	Soft, clear, "alkaline"		D, S	Sufficient for 11 head stock.
1	NE.	1	6	3	3	Dug	8	2,462	- 5	2,457	7	2,455	Bearpaw fine sand	Hard, clear		D, S	Sufficient for 60 head stock.
2	NE.	2	"	"	"	Bored	75	2,520	- 63	2,457	75	2,445	Bearpaw clay	Hard, clear		D, S	Sufficient for 20 head stock. 29-foot well provides a good supply.
3	SW.	2	"	"	"	Bored	100	2,590	- 65	2,525	80	2,510	Eastend blue clay	Soft, clear, "alkaline" iron		D, S	Sufficient for 50 head stock. Spring provides an additional supply.
4	SE.	3	"	"	"	Bored	70	2,591	- 60	2,531	70	2,521	Eastend coal?	Hard, darkish, "alkaline"		D, S	Sufficient for 10 head stock.
5	NE.	4	"	"	"	Dug	25	2,505	- 15	2,490	25	2,480	Eastend yellow sandy clay	Soft, clear		D, S	Sufficient for 12 head stock.
6	NE.	9	"	"	"	Dug	22	2,468	- 19	2,449	22	2,446	Bearpaw sand	Soft, clear, "alkaline"		D	Sufficient; used by town.
7	NW.	10	"	"	"	Dug	27	2,505	- 21	2,484	27	2,478	Eastend? blue clay	Hard, clear		D, S	Sufficient: about 4 bbls. per day. 40-foot well yields mineralized water.

NOTE—All depths, altitudes, heights and elevations given above are in feet.

(D) Domestic; (S) Stock; (I) Irrigation; (M) Municipality; (N) Not used.
(#) Sample taken for analysis.