CANADA

DEPARTMENT OF MINES

AND

TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

WATER SUPPLY PAPER No. 252

GROUND-WATER RESOURCES OF THE RURAL MUNICIPALITY OF ELDON NO. 471 SASKATCHEWAN

Records Collected by C. O. Hage

Compilation by G. S. Hume and C. O. Hage

OTTAWA

1947

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MINES AND GEOLOGY BRANCH
BUREAU OF GEOLOGY AND TOPOGRAPHY

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INTRODUCTION

Information on the ground-water resources of east-central Alberta and western Saskatchewan was collected, mostly in 1935, during the progress of geological investigations for oil and gas. The region studied extends from Edmonton in the west to Battleford in the east, and from township 32 on the south to township 59 in western Alberta, township 63 in eastern Alberta, and in part as far north as township 56 in western Saskatchewan.

This region is crossed by North Saskatchewan and Battle Rivers, and includes other more or less permanent streams. Most of the lakes within the area, however, are alkaline, and water is obtained in wells from two sources, namely, from water-bearing sands in surface or glacial deposits, and from sands in the underlying bedrock.

A division has been made in the well records, in so far as possible, between glacial and bedrock water-bearing sands. In investigations for oil and gas, however, the bedrock wells were used to trace the lateral extent of geological formations, with the result that the records deal more particularly with this type of well. No detailed studies were made of the glacial materials in relation to the water-supply, nor were the glacial deposits mapped adequately for this purpose. In almost all of the region investigated in Alberta, and in all but the northeast part of the region studied in Saskatchewan, water can be obtained from bedrock. In a few places, however, the water from the shallower bedrock sands is unsatisfactory, and deeper drilling may be necessary.

The water records were obtained mostly from the well owners, some of whom had acquired the land after the water supply had been found, and hence had no personal knowledge of the water-bearing beds that had been encountered in their wells. Also the elevations of the wells were taken by aneroid barometer and are, consequently, only approximate. In spite of these defects, however, it is hoped that the publication of these water records may prove of value to farmers, town authorities, and drillers in their efforts to obtain water supplies adequate for their needs.

In collecting this information several field parties were employed. These were under the direction of Professors R. L. Rutherford and P. S. Warren of the University of Alberta, C. H. Crickmay of Vancouver, and C. O. Hage, until recently a member of the Geological Survey. The oil and gas investigations of which these water records are a part were undertaken under the general supervision of G. S. Hume.

Publication of Results

The essential information pertaining to ground-water conditions is being issued in reports that in Saskatchewan cover each municipality, and in Alberta cover each square block of sixteen townships beginning at the 4th meridian and lying between the correction lines. The secretary treasurer of each municipality in Saskatchewan and Alberta will be supplied with the information covering that municipality. Copies of the reports will also be available for study at offices of the Provincial and Federal Government Departments. Further assistance in the interpretation of the reports may be obtained by applying to the Chief Geologist, Geological Survey, Ottawa. Technical terms used in the reports are defined in the glossary.

How to Use the Report

Anyone desiring information concering ground water in any particular locality will find the available data listed in the well records. These should be consulted to see if a supply of water is likely to be found in shallow wells sunk in the glacial drift, or whether a better supply may be obtained at greater depth in the underlying bedrock formations. The wells in glacial drift commonly show no regional level, as the sands or gravels in which the water occurs are irregularly distributed and of limited extent. As the surface of the ground is uneven, the best means of comparing water wells is by the elevations of their water-bearing beds. For any particular well this elevation is obtained by subtracting the figure for the depth of the well to the water-bearing bed from that for the surface elevation at the well. For convenience both the elevation of the wells and the elevation of the water-bearing bed or beds in each well are given in the well record tables. Where water is obtained from bedrock, the name of the formation in which the water-bearing sand occurs is also listed in these tables, and this information should be used in conjunction with that provided on bedrock formations, pages 4 to 8, which describes these formations and gives their thickness and sequence. Where the level of the water-bearing sand is known, its depth at any point can easily be calculated by substracting its elevation, as given in the well record tables, from the elevation of the surface at that point.

With each report is a map consisting of two figures. Figure 1 shows the bedrock formations that will be encountered beneath the unconsolidated surface deposits. Figure 2 shows the position of all wells for which records are available, the class of well at each location, and the contour line or lines of equal surface elevation. The elevation at any location can thus be roughly judged from the nearest contour line, and the records of the wells show at what levels water is likely to be encountered. The depth of the well can then be calculated, and some information on the character and quantity of water can be obtained from a study of the records of surrounding wells.

GLOSSARY OF TERMS USED

Alkaline. The term "alkaline" has been applied rather loosely to some ground waters that have a peculiar and disagreeable taste. In the Prairie Provinces, water that is commonly described as alkaline usually contains a large amount of sodium sulphate and magnesium sulphate, the principal constituents of Glauber's salt and Epsom salts respectively. Most of the so called alkaline waters are more correctly termed sulphate waters, many of which may be used for stock without ill effect. Water that tastes strongly of common salt is described as salty.

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 porous bed, lens, or pocket in unconsolidated deposits or in bedrock that carries water.

Buried pre-Glacial Stream Channels. A channel carved into 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.

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

<u>Continental Ice-Sheet.</u> The great ice-sheet that covered most of the surface of Canada many thousands of years ago.

<u>Escarpment.</u> A cliff or a relatively steep slope separating level or gently sloping areas.

<u>Flood Plain.</u> A flat part in a river valley ordinarily above water but covered by water when the river is in flood.

<u>Glacial Drift.</u> 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) <u>Ground Moraine.</u> A boulder clay or till plain (includes areas where the glacial drift is very thin and the surface uneven).

(2) <u>Terminal Moraine or Moraine.</u> 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) <u>Glacial Outwash.</u> Sand and gravel plains or deltas formed by streams that issued from the continental ice-sheet.

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

<u>Ground Water.</u> Sub-surface water, or water that occurs below the surface of the land.

<u>Hydrostatic Pressure.</u> The pressure that causes water in a well to rise above the point at which it is first encountered.

<u>Impervious or Impermeable.</u> 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 ground water.

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

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

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

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

<u>Water-table.</u> 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.

<u>Wells.</u> 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.

(2) Wells in which the water is under pressure but does not rise to the surface.

(3) Wells in which the water does not rise above the water table.

BEDROCK FORMATIONS OF WEST-CENTRAL SASKATCHEWAN AND EAST-CENTRAL ALBERTA

The formations that outcrop in west-central Saskatchewan are an extension of similar formations that occur in east-central Alberta. They are of Upper Cretaceious age, and consist entirely of relatively soft shales and sands, with some bands of hard sandstone and layers of ironstone nodules. The succession, character, and estimated thickness of the formations are shown in the following table:

Formation	Character	Thickness Feet
Edmonton	Grey to white, bentonitic sands and sandstones with grey and greenish shales; coal seams prominent in some areas, as at Castor, Alberta.	1,000 to 1,150
Bearpaw	Dark shales, green sands with smooth black chert pebbles; partly non-marine, with white bentonitic sands, carbonaceous shales or thin coal seams similar to those in Pale Beds; shales at certain horizons contain lobster claw nodules and marine fossils; at other horizons are abundant selenite crystals.	300 to 600 thins rapidly to the north-west
Pale and Variegated Beds	Light grey sands with bentonite; soft, dark grey and light grey shales with selenite and ironstone; carbonaceous shales and coal seams; abundant selenite crystals in certain layers.	950 to 1,000 in Czar-Tit Hills area; may be thinner elsewhere
Birch Lake	Grey sand and sandstone in upper part; middle part of shales and sandy shales, thinly laminated; lower part with grey and yellow weathering sands; oyster bed commonly at base.	100 in west, but less to east and south
Grizzly Bear	Mostly dark grey shale of marine origin, with a few minor sand horizons; selenite crystals and nodules up to 6 or 8 inches in diameter	Maximum, 100
Ribstone Creek	Grey sands and sandstones at the top and bottom, with intermediate sands and shales; thin coal seam in the vicinity of Wainwright; mostly non-marine, but middle shale in some areas is marine.	Maximum, 325 at Viking; thins eastward
Lea Park	Dark grey shales and sandy shales with nodules of ironstone; a sand 70 feet thick 110 feet below the top of the formation in the Ribstone area, Alberta.	950 to 1,100

Edmonton Formation

The name Edmonton formation was first applied to the beds containing coal in the Edmonton area, and later to the same beds in adjoining areas. The formation has a total thickness of 1,000 to 1,150 feet, but is bevelled off eastward and the east edge of the formation follows a northwest line from Coronation through Tofield to a point on North Saskatchewan River about midway between Edmonton and Fort Saskatchewan. No Edmonton beds occur northeast of this line, but the formation becomes progressively thicker to the southwest due to the fact that the beds incline in that direction and the surface bevels across them.

The Edmonton formation consists of poorly bedded grey and greenish clay shales, coal seams, and sands and sandstones that contain clay and a white material known as bentonite. This material when wet is very sticky and swells greatly in volume, and when dry tends to give a white appearance to the beds containing it. Such beds are relatively impervious to water, and at the surface produce the "burns" of barren ground where vegetation is scanty or absent.

Water is relatively abundant in the Edmonton formation, which contains much sand, commonly in the form of isolated lenses distributed irregularly through the formation. Consequently, there is little uniformity in the depth of wells even within a small area. Water also occurs commonly with coal seams and, unlike the sand lenses, these beds are much more regular and persistent. In contrast with the water from the bentonitic sands, which is generally "soft", water from the coal seams, as the water from the shallow surface deposits, may be "hard". The basal beds of the Edmonton formation usually contain fresh water, but this may become brackish locally where the underlying Bearpaw beds contain highly alkaline or salty water.

Bearpaw Formation

In southern Alberta, where the Bearpaw formation is thickest, the beds composing it are mainly shales that have been deposited in sea water. In the area north of township 32 the formation thins to the northwest and becomes a shoreline deposit composed of shales containing bentonite, impure sands, and thin coal seams. In some areas, as at Ryley and near Monitor, and in the Neutral Hills, the Bearpaw contains pebble beds. At Ryley these are consolidated into a conglomerate, but mostly the pebbles are loosely distributed in shale or sandy beds.

In the area immediately north of township 32 the Bearpaw occupies a widespread belt beneath the glacial drift, but farther northwest the belt narrows, and at Ryley and northwestward it is only a few miles wide. This belt crosses North Saskatchewan River about midway between Edmonton and Fort Saskatchewan. Bearpaw beds form the main bedrock deposits of the Neutral Hills. Farther south, where they have an exposed thickness of at least 400 feet, they contain green sands, and beds of marine shale interfinger with the bentonitic shales and sands of the underlying formation. To the north, on the banks of North Saskatchewan River, the division between the Bearpaw and the overlying and underlying formations is indefinite, and the thickness of beds of Bearpaw age is relatively small.

The water in the Ryley area is from the Bearpaw formation, and is salty. In other areas to the south the marine Bearpaw formation carries green sand beds that yield fresh water, but commonly a much better supply is found by drilling through the Bearpaw into the underlying Pale Beds.

In Saskatchewan, Bearpaw beds occur southeast of Maclin and south of Luseland and Kerrobert. Only the basal beds are present, and these contain green sands that are commonly water-bearing.

Pale and Variegated Beds

Underlying the Bearpaw formation is a succession of bentonitic sands, shales, and sandy shales containing a few coal seams. The upper part of this succession, due to the bentonitic content, is commonly light coloured and has been described as the Pale Beds, whereas the lower part is darker, and is known as Variegated Beds. In part, dark shales are present in both Pale and Variegated Beds; others are greenish, grey, brown, and dark chocolate, carbonaceous types. The sands may also be yellow, but where bentonite is present it imparts a light colour to the beds. Both Pale and Variegated Beds are characterized by the presence of thin seams of ironstone, commonly dark reddish, but in part purplish, Selenite (gypsum) crystals are, in places, abundant in the shales.

The best sections of Pale Beds exposed in the region are in the Tit Hills, southwest of Czar. These hills carry a thin capping of Bearpaw shales, beneath which, and around Bruce Lake, more than 200 feet of Pale Beds are exposed. The total thickness of Pale and Variegated Beds in the Tit Hills area is about 970 feet. Variegated Beds outcrop near Hawkins on the Canadian National Railway west of Wainwright, but no area exposes the complete succession, which is considered to comprise about 200 feet of beds.

Records of wells drilled into the Pale and Variegated Beds do not, in general, indicate lateral persistence of sands for long distances, nor any uniform average depth to water-bearing sands in a local area. This points to the conclusion that the sands are mainly local lenses, but as such lenses are numerous, few wells fail to obtain water. In the Cadogan area many flowing wells have been obtained from sands about midway in the succession. In western Saskatchewan Paleland Variegated Beds occur over a wide area from Maclin and Kerrobert northeast through Wilkie to the Eagle Hills, south of Battleford. Numerous outcrops occur in the area south of Unity at Muddy Lake, but south and east around Biggar these beds are almost wholly concealed by glacial drift.

The water from the sands of the Pale and Variegated Beds is generally soft. The supply, apparently, is dependent in part on the size of the sand body that contains the water and in part on the ease with which water may be replenished in the sand. Small sand lenses surrounded by shales may be filled with water that has infiltrated into them, but when tapped by a well the supply may be very slowly replenished. In many instances such wells yield only a small supply, although this is commonly persistent and regular.

Birch Lake Formation

The Birch Lake formation underlies the Variegated Beds, but in many areas the division is not sharp. The type area of the formation is along the north shore of Birch Lake south of Innisfree, where a section 65 feet thick, composed mostly of sand, is exposed. The total thickness of the formation in this area is about 100 feet, and although this is dominantly sand a central part is composed of alternating thin sand and shale beds. At the base of the formation, in a number of places, is an oyster bed, and this is exposed in a road cut in a section 73 feet thick on the east side of Buffalo Coulée in sec. 3, tp. 47, rge. 7, W. 4th mer. In both upper and lower parts of the formation the sand is commonly massive and outcrops tend to consolidate into hard, nodular masses from a foot to a few feet in diameter. Apparently these are formed through the deposition of salts from the water that finds an outlet at the outcrops. In fact, in some areas the sand may be traced along the side of a hill by the presence of small springs or nodular masses of sandstone.

The Birch Lake formation occurs under the drift and in outcrops in a large area south of North Saskatchewan River and northeast of a line from Willingdon to Innisfree and Minburn. East of this area the southwest boundary is more irregular, but outcrops are persistent on the banks of Battle River from a few miles north of Hardisty to and beyond the mouth of Grizzly Bear Coulée in tp. 47, rge. 5. It is believed, too, that a large area near Edgerton and Chauvin is underlain by the Birch Lake formation and that it extends southeastward into Saskatchewan around Manitou Lake and southeast to Vera.

It is thought that the Birch Lake formation thins eastward from its type section at Birch Lake, and that it loses its identity in western Saskatchewan. Deep wells drilled at Czar, Castor, and elsewhere no longer show the Birch Lake as a clearly recognizable sand formation, so that its southern limit beneath younger formations is unknown. Wherever it occurs as a sand, however, it is water-bearing, although in some areas the sand is apparently too fine to yield any considerable volume of water. In other areas, however, it persistently yields good wells. There is no apparent uniformity in the character of the water, which is either hard or soft in different wells in the same general area. Direct contact with surface waters that contain calcium sulphates may in time change a "soft" water well to a "hard" water well, and many wells are not sufficiently cased to prevent the percolation of water from surface sands into the well, and hence into the deeper, soft water producing sands. In part this accounts for the change in character of the water in a well, a feature that has been noticed by many well owners.

Grizzly Bear Formation

The type locality for the Grizzly Bear formation, which underlies the Birch Lake beds, is near the mouth of Grizzly Bear Coulée, a tributary of Battle River with outlet in tp. 47, rge. 5. The formation is mainly composed of dark shales that were deposited in sea water. At the mouth of Grizzly Bear Coulée two shale sections, each about 100 feet thick, are separated by a zone of thin sand beds. It is now recognized that the upper section is the Grizzly Bear shale, and that the lower one, very similar in character and also deposited in sea water, occurs in the next lower formation, the Ribstone Creek. The Grizzly Bear shale contains a thin nodular zone about 50 feet above the base, that is, at about the centre of the formation. This zone is sandy, and is believed to yield water in various wells. Other thin sands, in places water-bearing, are also present. The impervious nature of the Grizzly Bear shales makes the overlying Birch Lake sand a strong acquifer, as water collects in the sand above the shale. The contact of the Birch Lake and Grizzly Bear formations can be traced in some places by the occurrence of springs issuing from the base of the Birch Lake sand even where this is not exposed.

Grizzly Bear shales occur in a road cut on the south side of Battle River near the highway bridge at Fabyan. The shales in this area are about 100 feet thick. It is thought they extend as far west as the Viking gas field, where they have been recognized in samples from deep wells. It is probable, however, that the shales thin westwardrand thicken eastward so that their general form is a wedge between both higher and lower sand beds. The position of the thin edge of the wedge to the west is unknown, but evidently the Grizzly Bear marine shale underlies a large area in east-central Alberta extending into Saskatchewan mainly in the area south of Battle River.

Ribstone Creek Formation

The type area of the Ribstone Creek formation is on Ribstone Creek near its junction with Battle River in tp. 45, rge. 1, W. 4th mer. At this place the lower sand beds of the formation are well exposed. The upper part of the lower sand member of this formation outcrops on the north side of Battle River, in the northeast part of sec. 26, tp. 47, rge. 5, near the mouth of Grizzly Bear Coulée. Above it, higher on the bank and at a short distance from the river, there is a 12 foot zone of carbonaceous and coaly beds in two layers, each about 2 feet thick, separated by 8 feet of shale. Above this are 90 feet of dark shales that are thought to have been deposited in sea water, that is, they are marine shales. These marine shales in turn are overlain by a sandy zone about 20 feet thick containing oysters in the basal part. This sandy zone is the upper sand member of the Ribstone Creek formation.

It thickens to the east and west from the Grizzly Bear area but is probably at no place much more than 50 feet thick.

The lower sand member of the Ribstone Creek formation also varies in thickness from a minimum of about 25 feet. On the banks of Vermilion Creek, north of Mannville, the basal sand is at least 60, and may be 75, feet thick. It is overlain by shaly sand and sandy shale beds, which replace the shale beds in the central part of the formation as exposed at the mouth of Grizzly Bear Coulée. In the Wainwright area, where the formation has been drilled in deep wells, the basal sand is 60 feet thick, with the central part composed of shale containing sand streaks. The upper sand member is about 20 feet thick in this area. The total thickness of the formation in the Wainwright area is 100 to 200 feet, but this increases to the west and in the Viking area exceeds 300 feet.

The Ribstone Creek formation is widely exposed in a northwest-trending belt in east-central Alberta. The southwest boundary of this northwest-trending belt passes through the mouth of Grizzly Bear Coulée in tp. 47, rge. 5, and beyond to the Two Hills area in tp. 54, rge. 12, whereas the northeast boundary crosses North Saskatchewan River southwest of Elk Point and extends northwest to include an area slightly north of St. Paul des Metis and Vilna to tp. 60, rge. 14. Within this belt water wells are common in the Ribstone Creek sands, which are almost without exception water-bearing in some part of the formation. The limits of the belt to the northeast determine the limits of water from this source, but to the southwest of the belt, as here outlined, water may be obtained in this formation by drilling through the younger beds that overlie it. The Ribstone Creek sands are a prolific source of water in many places and hence the distribution of this formation is of considerable economic importance. Where the formation consists of upper and lower sands with a central shale zone only the sands are water-bearing, although thin sand members may occur in the shale. Where the formation is largely sand the distribution of water may be in any part of the formation, although the upper and lower sands are perhaps the better aquifers. To the east of Alberta, along Battle River and Big Coulée in Saskatchewan, the Ribstone Creek sands are marine. Marine conditions apparently become more prevalent to the southeast and it is believed that in this direction the sands are gradually replaced by marine shales. Thus at some distance southeast of Battleford the Ribstone Creek formation loses its identity and its equivalents are shales in a marine succession.

Lea Park Formation

The Lea Park formation is largely a marine shale, and only in the upper 180 feet is there any water. In the Dina area south of Lloydminster the upper beds of the Lea Park consist of silty shales about 110 feet thick underlain by silty sands 70 feet thick. Below these sands are marine shales only, and these yield no fresh water either in east-central Alberta or west-central Saskatchewan. The sand in the upper Lea Park formation is thus the lowest freshwater aquifer within a very large area. The extent of this sand in the Lea Park, particularly to the northeast, is not known, but as the strata in east-central Alberta have a southwest inclination, progressively lower beds occur at the surface to the northeast. Thus at a short distance beyond the northeast boundary of the Ribstone Creek formation, as previously outlined, the sand in the upper Lea Park reaches the surface, and represents the last bedrock aquifer in that direction. Farther northeast water must be obtained from glacial or surface deposits only. In Alberta this area without fresh water in the bedrock includes the country north of North Saskatchewan River in the vicinity of Frog Lake and a large area extending to and beyond Beaver River. In this area, however, more fresh water streams are present than farther south, and bush lands help to retain the surface waters. The area northeast of North Saskatchewan River in Saskatchewan is almost wholly within the Lea Park formation, where water can be found only in surface deposits.

WATER ANALYSES

Introduction

Analyses were made of water samples collected from a large number of wells in west-central Saskatchewan. Their purpose was to determine the chemical characteristics of the waters from different geological horizons, and thereby assist in making correlations of the strata in which the waters occur. Although this was the main objective of the analyses, it was also realized that a knowledge of the mineral content of the water is of interest and value to the consumer. The analyses were all made in the laboratory of the Water Supply and Borings Section of the Geological Survey, Ottawa.

Discussion of Chemical Determinations

The dissolved mineral constituents vary with the material encountered by the water in its migration to the reservoir bed. The mineral salts present are referred to as the total dissolved solids, and they represent the residue when the water is completely evaporated. This is expressed quantitatively as "parts per million", which refers to the proportion by weight in 1,000,000 parts of water. A salt when dissolved in water separates into two chemical units called "radicals", and these are expressed as such in the chemical analyses. In the one group is included the metallic elements of calcium (Ca), magnesium (Mg), and sodium (Na), and in the other group are the sulphate (SO_4), chloride (Cl), and carbonate (CO_3) radicals.

The analyses indicate only the amounts of the previously mentioned radicals, thus neglecting any silica, alumina, potash, or iron that may be present. It will be noticed that in most instances the total solids are accounted for by the sum total of the radicals as shown by the analyses. Actually, the residue when the water is completely evaporated still retains some combined water of crystallization, so that the figures for the "total solids" are higher than the sum total of the radicals as determined. These radicals are also "calculated in assumed combinations" to indicate the theoretical amounts of different salts present in the water. The same method was followed in each analysis, so that the table presents a consistent record of the different compounds present.

Mineral Constituents Present

Calcium. Calcium (Ca) in the water comes from mineral particles present in the surface deposits, the chief source being limestone, gypsum, and dolomite. Fossil shells provide a source of calcium, as does also the decomposition of igneous rocks. The common compounds of calcium are calcium carbonate ($CaCO_3$) and calcium sulphate ($CaSO_4$).

Magnesium. Magnesium (Mg) is a common constituent of many igneous rocks and, therefore, very prevalent in ground water. Dolomite, a carbonate of calcium and magnesium, is also a source of the mineral. The sulphate of magnesia ($MgSO_4$) combines with water to form "Epsom salts" and renders the water unwholesome if present in large amounts.

Sodium. Sodium (Na) is derived from a number of the important rock-forming minerals, so that sodium sulphate and carbonate are very common in ground waters. Sodium sulphate (Na_2SO_4) combines with water to form "Glauber's salt" and excessive amounts make the water unsuitable for drinking purposes. Sodium carbonate (Na_2CO_3) or "black alkali" waters are mostly soft, the degree of softness depending upon the ratio of sodium carbonate to the calcium and magnesium salts. Waters containing sodium carbonate in excess of 200 parts per million are unsuitable for irrigation purposes[1]. Sodium sulphate is less

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1 "The extreme limit of salts for irrigation is taken to be 70 parts per 100,000, but plants will not tolerate more than 10 to 20 parts per 100,000 of black alkali (alkaline carbonates and bicarbonates)" Frank Dixey in "A Practical Handbook of Water Supply", Thos. Murby & Co., 1931, p. 254,

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harmful.

Sulphates. The sulphate (SO_4) salts referred to in these analyses are calcium sulphate ($CaSO_4$), magnesium sulphate ($MgSO_4$), and sodium sulphate (Na_2SO_4).

Chloride. Chlorine (Cl) is with a few exceptions, expressed as sodium chloride (NaCl), that is, common table salt. It is found in all of the analyses, most of the waters containing less than 200 parts per million, but some as much as 2,000 or 3 ,000 parts. These waters have a brackish taste.

Alkalinity. The alkalinity determined in these water analyses is based on the assumption that the only salts present in the samples that will neutralize acids are carbonates, and that, consequently, the degree of alkalinity is proportional to the amount of the carbonate radical (CO_3) present.

Hardness. The hardness of water is the total hardness, and has been determined by the amount of a standard soap solution required to form a lather that will stand up (persist) for 2 minutes. Hardness is of two kinds, temporary and permanent. Temporary hardness is caused by calcium and magnesium bicarbonates, which are soluble in water but are precipitated as insoluble normal carbonates by boiling, as shown by the scale that forms in teakettles. Permanent hardness is caused by the presence of calcium and magnesium sulphates, and is not removed by boiling. The two forms of hardness are not distinguished in the water analyses. Waters grade from very soft, to very hard, and can be classified according to the following system[2]:

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2 The "Examination of Waters and Water Supplies", Thresh & Beale, page 21, Fourth Ed. 1933 .

- A water under 50 degrees (that is, parts per million) of hardness may be said to be very soft.
- A water with 50 to 100 degrees of hardness may be said to be moderately soft.
- A water with 100 to 150 degrees of hardness may be said to be moderately hard.
- A water with more than 200 and less than 300 degress of hardness may be said to be hard.
- A water with more than 300 degrees of hardness may be said to be very hard.

Hard waters are usually high in calcium carbonate. Almost all of the waters from the glacial drift are of this type, especially those not associated with sand and gravel deposits that come close to the surface.

In soft water the calcium carbonate has been replaced by sodium carbonate, due to natural reagents present in the sand and clays. Bentonite and glauconite are two such reagents known to be present. Montmorillinite, one of the clay-forming minerals, has the same property of softening water, owing to the absorbed sodium that is available for chemical reaction[1].

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1 Piper, A. M. "Ground Water in Southwestern Pennsylvania", Penn. Geol. Surv., 4th series.

If surface water reaches the lower sands by percolating through the higher beds it may be highly charged with calcium salts before reaching the bedrock formations containing bentonite or glauconite. The completeness of the exchange of calcium carbonate for sodium carbonate will, therefore, depend upon the length of time that the water is in contact with the softening reagent, and also upon the amount of this material present. The rate of movement of underground water will, consequently, be a factor in determining the extent of the reaction.

The amount of iron present in the water was not determined, owing to the possibilities of contamination from the iron casings in the wells. Iron is present in most waters, but the amount may be small. Upon exposure to air a red precipitate forms, the water becomes acid, and, hence, has a corrosive action. When iron is present in large amounts the water has an inky taste.

WATER ANALYSES IN RELATION TO GEOLOGY

Glacial Drift

The quality of the water from glacial drift depends largely on the nature of the deposit from which it comes and on the depth of the aquifer below the surface. Glacial deposits may be divided roughly into three types.

(1). Sand and gravel beds that form the surface deposit, such as outwash material and glacial lake sands.

(2). Buried outwash and interglacial deposits between two tills of boulder clay.

(3). Pockets or lenses of sand and gravel irregularly distributed through the till.

Water from surface sand deposits is normally low in dissolved salts, the total being generally less than 1,000 parts per million. Where large amounts of limestone occur in the glacial sand and gravel beds a characteristic constituent of the glacial water is calcium carbonate, the amount present varying from 300 to 700 parts per million.

Water from buried outwash deposits contains more dissolved salts than the surface sands, as the water in order to reach them has to percolate through overlying till. Rain water contains carbonic acid, which acts as a solvent and dissolves a great deal of calcium, magnesium, and sodium from the rock-forming minerals. Sulphate salts are commonly present, though their proportions vary greatly in the different waters. The shales that are incorporated in the drift are high in calcium sulphate, so that the amount of shale present will modify the quality of the water. The oxidized upper part of the drift contains less sulphate than the deeper, less oxidized boulder clay. The character of the water in the buried outwash deposits will, therefore, depend largely on the composition and amount of till that overlies it.

Water from irregularly distributed sand and gravel beds will vary in its content of dissolved salts depending upon the character of the material surrounding the reservoir beds. As the water in this type of deposit does not flow to any marked extent, it is apt to be more highly impregnated with soluble salts than where the underground movement is more rapid. Soft water in the drift is mostly confined to shallow wells in sands low in calcium carbonate. Waters from glacial lake clays are sometimes high in soluble salts. The sample from a well in glacial lake clay on N.W. $\frac{1}{4}$ sec. 27, tp. 42, rge. 17, has 11,040 parts per million of soluble salts, largely magnesium sulphate and sodium sulphate. The sample from SE. $\frac{1}{4}$ sec. 13, tp. 42, rge. 16, which is believed to come from glacial lake silts, has a very different composition. The total solids in it are only 440 parts per million, of which 250 are calcium carbonate. The great difference in these waters is due to the high soluble salt content that is associated with the lake clays but absent in the silts. Average drift water contains between 1,000 and 3,000 parts per million of dissolved mineral salts.

Bearpaw Formation

The Bearpaw formation consists of dark marine shales and beds of green sand. Water from these sands has a total solid count ranging from 300 to 1,600 parts per million and a hardness of more than 300 degrees. Calcium carbonate is very marked in all samples, due, perhaps, to the proximity of the water sands to the glacial drift. Sodium sulphate is the chief salt present, followed by calcium carbonate, magnesium sulphate, magnesium carbonate, and sodium chloride in decreasing amounts. These waters are distinguished from the overlying drift waters by being relatively low in total dissolved solids, and in containing no calcium sulphate and only moderate amounts of sodium sulphate, magnesium sulphate, and magnesium carbonate.

Pale Beds

Pale Beds underlie the Bearpaw formation. Total solids in waters from these beds vary from 700 to 1,300 parts per million. The water is, in most instances, soft, as it contains sodium carbonate in excess of calcium and magnesium carbonates, but when mixed with surface water high in calcium carbonate, it will become hard. The high concentration of sodium salts, especially sodium carbonate, in contrast with the calcium and magnesium salts distinguishes this water from that in Bearpaw sands. The Pale Beds include much bentonite, and it is this mineral that acts as a water softener within the formation. The following analyses are typical of waters from the Pale Beds:

Salts	SE. sec. 16, tp.38, rge. 21	NE. sec. 3, tp.39, rge. 25,	SW. sec. 7, tp.37, rge.24,	SE. sec. 21 tp. 38, rge.23
$CaCO_3$	73	18	53	35
$CaSO_4$	-	-	-	-
$MgCO_3$	52	14	45	38
$MgSO_4$	-	-	-	-
Na_2CO_3	297	679	464	562
Na_2SO_4	297	158	266	437

NaCl	31	45	46	130
Total solids	760	1,020	940	1,260
Hardness	100	20	30	75

Variegated Beds

In Senlac Rural Municipality, Saskatchewan, are a number of wells that have water very similar in character to that found in the Bearpaw formation. These wells tap an horizon that corresponds with the Variegated Beds in Alberta, although they have not been separated from the Pale Beds. They are less bentonitic than the Pale Beds and darker in colour. The water is hard and has a low dissolved solid content. The three analyses given below show a great deal of similarity and suggest a common horizon.

Salts	NW. sec. 21, tp.41, rge.26	NW. sec. 3, tp.41, rge.28	SE. sec. 28, tp.40, rge.28
$CaCO_3$	250	305	125
$CaSO_4$	–	–	–
$MgCO_3$	1109	80	155
$MgSO_4$	149	104	69
Na_2CO_3	–	–	–
Na_2SO_4	98	132	386
NaCl	12	12	18
Totalmsolids	640	640	780
Hardness	600	600	500

Ribstone Creek Formation

Chemical analyses of water from the Ribstone Creek formation vary more than in the Pale Beds, the reason being that at several different horizons the sediments show considerable lateral variation. The formation includes both marine and non-marine beds, thin coal seams being present in the basal part of the formation around Paynton, whereas south of Lashburn, on Battle River, marine fossils were found in strata considered to be at approximately the same horizon. The water analyses show similarities within limited areas, but long distance correlations cannot be made safely except for the saline waters that occur in the flowing wells at Vera, Muddy Lake, and at the south end of Tramping Lake. Analyses of these waters are given in the following table:

Salts	SE.sec.25, tp.41, rge. 24	SE.sec.22, tp.41, rge. 24,	NE.sec.36, tp.41, rge. 24,	SW.sec.7 tp.41, rge 24,	SE.sec.30, tp.38, rge. 22,	SW.sec10, tp.35, rge.20.
$CaCO_3$	73	73	73	198	108	90
$CaSO_4$	–	–	–	–	m–	–
$MgCO_3$	38	38	38	52	69	52
$MgSO_4$	–	–	–	–	–	–

Na_2CO_3	129	119	129	11	106	125
Na_2SO_4	55	55	61	61	49	43
NaCl	2,929	3,036	2,690	2,863	3,531	3,861
Total solids	3,840	3, 460	3,120	3,200	3,860	4,460
Hardness	135	90	110	100	130	130

The similarity in these anlayses suggests a common source bed. The distance between the Tramping Lake well and the Vera wells is about 40 miles. This water, which is thought to come from the basal sand of the Ribstone Creek formation, is not typical of water from the same stratigraphical horizon in the vicinity of Battle River, one reason being, possibly, that at Battle River the stream has cut through the Ribstone Creek formation exposing the sand members along its banks. This may cause a more rapid movement of the underground water in this area than farther south, and it is known that the rate of flow is a controlling factor that governs the change of calcium carbonate to sodium carbonate when the softening reagents of bentonite or glauconite are present in the sand.

Some of the soft waters from the Ribstone Creek formation cannot be distinguished from those of the Pale Beds, whereas others are quite different. The following analyses illustratetsome of the different types of water from this formation:

Salts	Se.sec. 11, tp. 46, rge. 28	Ind.Agent Little Pine I.R.	SW.sec. 24, tp. 46, rge. 21	NE.sec. 36, tp. 43, rge. 18	Se.sec. 26. tp. 43, rge. 18	NE.sec. 36. tp. 41, rge. 24	NW.sec. 22. tp. 42. rge. 23
$CaCO_3$	90	90	410	73	35	73	125
$CaSO_4$	-	-	-	-	-	-	-
$MgCO_3$	97	59	168	38	31	38	97
$MgSO_4$	-	-	64	-	-	-	-
Na_2CO_3	217	392	-	283	592	129	196
Na_2SO_4	1,644	777	2,518	225	522	61	1,541
NaCl	249	63	76	12	83	2,690	71
Total solids	2,220	1,340	3,000	620	1,280	3,120	1,900
Hardness	280	160	750	110	35	110	600

The above chemical analyses show such a wide range in the dissolved salts present in the different waters in the Ribstone Creek formation that they cannot be used for correlation purposes over a large area.

Conclusions

(1) In most instances water from glacial drift is quite different from water from bedrock.

(2) Some of the bedrock horizons carry waters that show definite chemical characteristics.

(3) Most waters from glacial till carry total solids amounting to between 1,000 andn3,000 parts per million.

(4) Bedrock waters are commonly low in dissolved salts. Exceptions to this are to be found in water from the Ribstone Creek formation.

(5) Water from the Bearpaw formation is hard. An average of ten wells gave a total solid content of 1,100 parts per million.

(6) Water from the Variegated Beds resembles that from the Bearpaw formation.

(7) Waters from the Pale Beds is mostly soft. An average of ten wells gave a total solid of 1,000 parts per million.

(8) All soft waters contain sodium carbonate (Na_2CO_3), which is present in water from the Pale Beds and Ribstone Creek formations but absent from the Bearpaw formation and Variegated Beds.

RURAL MUNICIPALITY OF ELDON, NO. 471, SASKATCHEWAN

Physical Features

Eldon municipality lies between Saskatchewan River on the north and northeast and Battle River on the southwest. Big Gully Creek flows from west to east through township 49 into Saskatchewan River.

Saskatchewan River flows in a valley that is more than 200 feet deep. This valley has a very youthful appearance, as the river bed completely occupies the bottom of the valley; the banks are as steep as the material through which they are cut will allow, and the gradient of the river is quite steep. The river flows southeast, with some bends, one of these, on the south side of tp. 51, rge. 24, turning sharply through almost 90 degrees. This bend is caused by a range of hills that trends northeasterly, and has deflected the stream in that direction. These hills are in part morainal, but as they are known to have a core of bedrock they must be regarded as erosional remnants of strata that once covered the whole country, but were subjected to erosion before the advance of the continental ice-sheet.

Battle River forms the boundary on the southwest of the municipality for only a few miles. The river, which now is only a small stream in contrast with the broad deep valley in which it flows, must have been large at one time.

Big Gully Creek lies in a broad, deep valley, which at one time carried a large volume of water. The water that eroded this channel came from the retreating ice-sheet, the streams from which were subsequently diverted to other natural drainage systems, leaving this channel almost dry.

The surface deposits, which are all of glacial material, originated in different ways. The large sand and sandy area, which lies south of Big Gully Creek and extends south to Battle River and beyond the municipal boundaries, was once occupied by a shallow lake. This was a glacial lake, dammed by the ice until it had retreated far enough to permit resumption of natural drainage and, with it, the disappearance of the lake. A large deposit of lake sand has since been blown into dunes in this basin. Along the west side of the old lake, terraces marking its different levels are easily recognized. In the vicinity of Maidstone these trend north and south. A large amount of water entering this lake may have drained down Big Gully Valley, but as the present channel has been eroded below the level of the sandy plain a large amount of water must have continued to flow through this valley after the glacial lake had ceased to exist. Further proof of this is apparent from a large gravel deposit south of Big Gully Creek, extending for several miles to the south. The elevations of the present lakes in the sandy area are highest along the northern limit of this area, and fall gradually to the south and southeast.

The country to the west of the sandy plain is largely a ground-moraine deposit of boulder till, with a gently rolling surface. Along the southern edge of this deposit, paralleling Battle River, is a northwesterly trending recessional moraine of considerable relief.

North of Big Gully Creek the surface becomes hilly. Many of these hills are quite large, with gentle slopes. Some of them trend northeasterly, and others are at right angles to these. Some are known to have a core of bedrock, but most of them are covered with a thick deposit of boulder till. Standard Hill, a prominent topographic feature, is mantled to a considerable depth by boulder till, giving it the appearance of a moraine. No outcrops of bedrock are known on this hill. In tp. 50, rge. 24, outcrops of bedrock indicate a comparatively thin deposit of drift. These hills, nevertheless, are part of the large moraine trending in a northwest and southeast direction.

Along Saskatchewan River are several well-developed flood-plains or terraces that constitute moderately good farming land, but the soil is somewhat sandy. The largest of these, in tp. 51, rge. 23, in the vicinity of Milleton post office, extends along the river in varying widths to Big Gully Creek.

Geology

The surface deposits of this municipality have already been described and outlined in a general way. The underlying bedrock strata are exposed along the drainage channels of Big Gully Creek and Saskatchewan River and on some of the hills in tp. 50, rges. 23 and 24. These consist of hard sandstone ledges and soft, fine-grained, dark grey shales. The sandstone members form part of the Ribstone Creek formation, which overlies the thick deposit of dark, impervious, marine shale of the Lea Park formation. The elevation of the contact between these two formations varies somewhat within the limits of the municipality, but so far as known the regional dip is gentle. The elevation of the contact in sec. 21, tp. 49, rge. 24, is very nearly 1,875 feet. Seven miles north, on sec. 28, tp. 50, rge. 24, sandstone outcrops at an elevation of 1,911 feet, and the contact with the shale is believed to be between 1,875 and 1,900 feet. Along the south part of the municipality and in the vicinity of Maidstone this contact is placed at 1,850 feet. These points are almost in a straight line north and south and show very little difference in elevation. From the information available there appears to be a slight dip of the strata to the east or southeast, as on sec. 10, tp. 48, rge. 22, a sandstone, probably of the Ribstone Creek formation, was struck in a well at an elevation of 1,790 feet. Neither sand beds nor the contact between the formations can be traced eastward, as in that direction much of the bedrock sand was eroded prior to glaciation. It is now replaced by drift that rests directly on Lea Park shale.

Because of the limited information available, the exact boundary between the Ribstone Creek and Lea Park formations is in many places difficult to locate. However, it is known that the Ribstone Creek formation underlies only part of the municipality, namely an area including tps. 47, 48, and 49, rge. 24, and roughly the west half of the same townships in range 23. Farther east the bedrock sand is doubtfully present, except for small isolated areas or erosional remnants on the higher land. Where the Ribstone Creek sand is absent the drift rests on Lea Park shale.

Water Supply

The water supply in Eldon municipality is obtained from wells in the glacial drift and from the bedrock sand in those areas that are underlain by the Ribstone Creek formation. The limits of these sand beds have been previously outlined. The sand is extremely fine in places, limiting its usefulness as an aquifer. For this reason bored wells are usually more successful than drilled wells, and are recommended in preference to the latter where the depth is within the limits of the boring machines. The basal sand is commonly the aquifer of the formation, but on the higher land along the west side a higher sand is present within a limited area.

The water supply in glacial deposits varies with the character of the deposit. Sand and gravel beds of limited lateral extent occur within the boulder clay deposits of ground and recessional moraines in the western half of the township. In the sandy areas south of Big Gully Creek and along Saskatchewan River water is more easily obtained at a relatively uniform elevation. The sand is mostly underlain by boulder till, and if very firm prevents a downward movement of the water, which is then retained in the sand. In the area underlain by the Lea Park formation the water supply must be obtained within the drift. In many places the base of the drift provides a seepage supply that is adequate, especially where this is retained to best advantage by the impervious shale surface below.

Township 47, Range 23. The gradual slope to the east and south, which is so pronounced in this township, marks the recessions of a glacial lake that extended in these directions. The slope is interrupted by a series of terraces that mark the various lake levels. The soil in this area has a very light texture. Along the west side of the township the soil is a boulder till of a ground moraine deposit. Maidstone Lake extends from east to west along the south boundary, and lies in the basin of the once larger lake, which, as mentioned above, has an elevation of 1,836 feet.

There are no outcrops of the underlying bedrock in the township, but from regional geology and information obtained from well records it is believed that the Ribstone Creek formation underlies the western part but thins eastward and disappears to the east of the town of Maidstone, due to increasingly deeper erosion of the formation in that direction. The thickness of the drift deposit seems to be relatively uniform, so that the bedrock surface is believed to correspond very closely with the easterly slope of the drift surface. The strata may also dip slightly in the same direction, but not enough to allow the sand bed to extend far to the east. This sand, presumably of Ribstone Creek age, has been encountered in a number of wells along the western side of the township. The material from the well on SE. section 19 was examined during the summer of 1936. A summary log of this well is as follows: surface loam and brown subsoil, 18 feet; blue boulder clay, 60 feet; dark shale, 22 feet; fine pepper and salt sand, 10 feet. The dark shale overlying the sand has the appearance of typical Lea Park shale. The sand is rather fine and the upper part is mixed with some clay; as a water sand it is rather fine, and the rate of flow will, therefore, be somewhat slow.

The water supply is obtained from wells in the drift and also from the bedrock sand where present. Because of the limited extent of these lower sands the problem of an adequate water supply has been of great concern at Maidstone and to the southeast. These lower sands are definitely known to be present on SE. section 19 at an elevation of 1,860 feet. Two miles farther east, on NE. section 21, glacial sand was encountered at an elevation of 1,830 feet, and if bedrock sand is present it must lie at greater depth, which would indicate a marked east dip. On NW. section 23 a little water was encountered in a fine blue sand at an elevation of 1,812 feet. There is, however, a possibility that this sand is at the base of the Ribstone Creek formation. Owing to the small amount of sand present and its fine texture the supply of water is very limited. If the sand is Ribstone Creek, an east dip of 16 feet to the mile would be indicated. This, however, should provide a hydrostatic head for the water to the east, and the well on section 23 should flow. Instead of this, however, its water level is 92 feet lower than the well on SE. section 19, and hence the evidence does not support the above interpretation. The alternative, and more logical explanation is that this well and the one on SW. section 24 obtain a little water at the contact between the shale and drift, the higher sands having been eroded prior to the deposition of the glacial material. In this case the only source of water for the greater part of the township will be in the drift deposits. On the supposition of an average thickness of about 90 feet for the drift, the eastern limit of the bedrock sand will follow very closely the 1,950-foot contour though isolated knobs still farther east may carry the sand.

The higher land on sections 11 and 12 may be such a knob, and the well on NW. section 11 may be in the bedrock sand. It does not appear, however, to be connected with the main beds to the west, as the water does not rise nearly as high.

The base of the drift does not afford a continuous aquifer for the area not underlain by the Ribstone Creek formation, but several wells at this horizon yield a good supply. One of these is on NE. section 21 at an elevation of 1,830 feet. Wells that produce a limited supply of seepage water on top of the shale are found on SE. section 21 and SW. section 24. Where water must be obtained from the drift it appears that shallow wells in the upper part may be as successful as deeper ones. In the town of Maidstone, where the water supply is poor, the following recommendations are made. West of the town the lowest water sand in the bedrock occurs at elevations ranging from 1,830 to 1,860 feet, and it should lie at approximately the same level at Maidstone provided the base of the drift is above this elevation. The drift is distinguished from the shale by the presence of angular pebbles, chiefly of granite and limestone. The depth to the bedrock horizon will be between 80 and 110 feet, but drilled wells are not recommended, as the sand, if present, is very fine. If the material encountered at this depth is glacial there is the possibility of obtaining a seepage at the top of the shale. Failing this, shallow wells in the upper part of the drift are the remaining possibility. These lenses of sand and gravel are irregularly distributed, and locating one is largely a matter of chance.

Township 47, Range 24. The southern half of this township is marked by very rolling country with a maximum relief of 600 feet, from the high hill on section 16 to Battle River in the south. The high, rolling country along Battle River is part of a northwesterly trending recessional moraine. Between the hill on section 16 and the town of Waseca the relief is 300 feet. The slope in this direction is gentle, and the land is slightly rolling. The mantle of drift that covers the surface is believed, from an interpretation of the well logs, to be from 100 to 150 feet thick. Below the drift is the Ribstone Creek formation, which underlies the entire township except along Battle River Valley, which has been eroded through the sands into the marine shales below. The elevations of the water horizon in these sands is between 1,850 and 1,883 feet, with the base of the formation close to the same elevation. The difference in elevation between these lower sands and the top of the hill in section 16 is 450 feet. It does not seem possible that the drift deposit could be this thick, and higher aquifers may be present in the bedrock formation.

The water supply comes from wells ranging in depth from only a few feet to 200 feet. Most of them are shallow and in the upper part of the drift. Records of these wells are few, but enough information is available to show that a considerable amount of the water supply will continue to come from this source. Because of the great relief, attempts to correlate these wells is not considered advisable. There are, however, deeper wells that can be correlated with a fair degree of certainty. The lowest aquifer encountered is the best one for this purpose. In five wells that have obtained water between elevations of 1,850 and 1,883 feet, the water does not rise to the same level. On section 18 its level is 1,879 feet, whereas on section 24 it is 1,990 feet, a difference of 111 feet. The reason for this variation is difficult to understand, unless the wells on sections 18 and 19 are cut off from the main deposit by an old drainage channel. This aquifer can be considered as a source of water supply for the entire township. On the higher land, however, the drilling depth would be too great, but there should be an aquifer about 80 feet higher, as on sections 8 and 16 a good supply was obtained in sand at elevations of 1,934 and 1,930 feet. It is uncertain whether or not this aquifer is in the glacial drift or in bedrock. Its value as an aquifer would be much better if it is in bedrock, but its extent in this case is limited to the higher land in the central part of the township. A still higher horizon at an elevation of 2,000 feet is, as shown by the wells on sections 19, 21, and 34, in glacial drift, but the possibilities of sand bodies occurring elsewhere at this level are very good.

Township 48, Range 22. This township was once part of a large glacial lake that extended over a considerable area to the south, and is covered with a deposit of sand and sandy soil. The sand was laid down under water in almost horizontal beds, and has since been blown into dunes, resulting in a rolling topography. Under the deposit of sand is a till of boulder clay that has an irregular surface and has been encountered in several wells at shallow depths.

There are no outcrops of the bedrock in this township, but several of the wells encountered a sandstone that was considered to belong to the Ribstone Creek formation. Two wells on NE. section 2 struck a hard ledge that resembled the bedrock sandstone, but contained very little water. On NE. section 10 a hard ledge was also struck above the water horizon. This rock was not examined, but as it was also encountered in another well on the same farm and at about the same level, it is very probable that it is bedrock sandstone. The amount of Ribstone Creek sand beneath the glacial material is not thought to be very great, and there may be none over a considerable part of the area, as on section 7 water was encountered in gravel at an elevation of 1,772 feet, which is lower than the sandstone ledge referred to above. Where the Ribstone Creek formation is absent the Lea Park shale will lie immediately below the drift.

Most of the land in this township is unsuitable for farming and so there are few water wells. Most of these, however, are fairly deep for such a sandy deposit, with the water horizon lying below the elevations of the larger lakes. On section 6 the elevation of the water-bearing sand is 1,830 feet. Water is reported in a blue sand that may or may not be bedrock. As the presence of the Ribstone Creek sand under the drift is uncertain, it is almost impossible to predict with any degree of accuracy the locations and elevations at which it will be found.

Township 48, Range 23. The eastern half of this township is covered with a very light sandy soil. This marks the higher levels of the glacial lake that covered a large area to the south and east. The western half is covered by boulder till. It is very difficult to define the exact geological boundaries between the bedrock formations that underlie the drift, as the only information available is from well records that are somewhat indefinite. The Ribstone Creek formation to the west has a basal sand member that is usually considered a good water horizon, but close to Maidstone this sand is mixed with a considerable amount of shale, which greatly decreases its effective porosity. Furthermore, it is very difficult to follow the formation laterally and trace its boundaries when it no longer has the same water possibilities. Lea Park shale underlies the Ribstone Creek sand or, where this is absent, it underlies the drift.

The fact that many dry holes have been sunk in this township may be partly explained by the low porosity of the Ribstone Creek sands, but as the surface slopes to the east it may be possible that the bedrock surface does the same, cutting off the higher sand beds that are known to be present along the western side and leaving only isolated masses to the east of the main contact. Because of this it is difficult to predict the exact nature of the water possibilities at depth. On SE. section 7 water was struck at elevations of 1,868 and 1,843 feet in a fine sand and sandy shale. The water came in quite slowly. It is believed, however, that this represents the basal sand in the Ribstone Creek formation, and that deeper drilling is not likely to yield more water. The basal sand must dip to the east at about 6 feet to the mile, because 9 miles to the east, on NE. sec. 10, tp. 48, rge. 22, a hard sandstone ledge was struck that is believed to represent a band close to the base of the Ribstone Creek formation at an elevation of 1,790 feet. Bored wells in this lower aquifer have been more successful than drilled ones, as the former allow for larger reservoirs and there is much less danger of passing through the water horizon without detecting it. It can be said with a fair degree of certainty that the bedrock sand underlies a strip on the west side 2 miles wide, increasing in width towards the north. In part of this strip along the west more than one aquifer may be present in the bedrock sand, because on NW. section 31 a good aquifer that is believed to be in the Ribstone Creek formation was encountered at an elevation of 1,920 feet.

Many wells in the glacial drift yield a good supply of water. It does not seem feasible, however, to try to segregate them into definite horizons, as it appears that the aquifers present follow the elevations of the surface, which slopes to the east.

<u>Township 48, Range 24.</u> The topography of this township is that of a gently rolling ground-moraine deposit that rises from an elevation of 2,050 feet on the east side to more than 2,200 feet along the western side. This forms the crest of a north-trending ridge that slopes off gently to the west. The thickness of the drift is not definitely known for all the township, but on NE. section 12 it is 150 feet thick and on section 14 it is at least 120 feet thick. Elsewhere it probably is as thick or thicker. No outcrops of the underlying bedrock appear anywhere in the township, but from regional information and interpretations of well logs it is believed that the Ribstone Creek formation underlies the drift.

The water supply is obtained from shallow and deep wells that tap sand and gravel deposits in the drift and the underlying bedrock. Records of all the shallow wells were not obtained, and correlation cannot be made. From the well records available there appear to be four horizons, two of which are in the drift, the other two in the underlying bedrock sand. The highest horizon has an elevation between 2,097 and 2,122 feet on sections 28, 32 and 33, at depths from 40 to 57 feet. It is quite possible that this horizon extends southward along the western side of the township. Water occurs at an elevation of 2,034 feet on sections 3 and 20, and at 2,038 and 2,037 feet on sections 15 and 22. From the uniformity in the water level it seems reasonable to expect that this horizon has considerable lateral extent and that water may be encountered in the drift at this elevation. This horizon is well within the drift, but at some distance above the base.

Two water horizons occur in the Ribstone Creek formation beneath the greater part of the township. The lowest one has an elevation of 1,860 feet on SE. section 12. This is considered to be the basal sand of the Ribstone Creek formation, and in the township to the west this same sand has a slightly higher elevation, indicating an east dip of less than 5 feet to the mile. This aquifer should, therefore, be encountered at elevations between 1,880 feet on the west and 1,860 feet on the east. On the higher land in the township a sand member about 80 feet above the lower sand is thought to have a fairly wide lateral extent, as indicated in four wells whose aquifers have elevations between 1,935 and 1,954 feet. This horizon should furnish a good supply of water for those who have not found sufficient within the drift.

Township 49, Range 22. The main physical features in this township are: Saskatchewan River, which forms part of the eastern boundary; Big Gully Creek, which flows from west to east in a broad valley into Saskatchewan River; and Standard Hill to the northwest, which stands isolated as a pronounced rise.

The mantle of glacial material that covers the surface is of various types. Boulder till, some very rocky, with morainal characteristics, is typical of the surface deposit of Standard Hill, and surrounding country south to Big Gully. East of Standard Hill and paralleling the river the land is flat and sandy, and apparently represents an old flood-plain deposit formed during the early stages of the river. The same applies to the sandy deposits along Big Gully Creek.

Outcrops of Lea Park shale are found along Saskatchewan River and Big Gully Creek. Except within a limited area around Standard Hill, sand beds of the overlying Ribstone Creek formation are doubtfully anywhere present between the drift and the shale. In a well 40 feet deep on NE. section 32 a firm sand that may be in the bedrock was struck at an elevation of 1,901 feet. On section 22 a well obtained water from a sand shale at an elevation of 1,830 feet. This well is definitely in bedrock. If the well on section 22 is in the basal sand of the Ribstone Creek formation the contact between this formation and the underlying Lea Park shale is very close to this level, namely 1,830 feet. The extent of the sand is difficult to determine owing to the fact that a deep dry hole was sunk to a low level on SE. section 32 without encountering a sand bed. For this reason it has not been shown as an outlier on the geological map. It is,however, important as a water horizon for the surrounding district, although the shale and sand may, in places, be replaced laterally by glacial material.

The water supply comes from comparatively shallow wells, only one having been sunk more than 50 feet. All of these wells, with the exception of one on section 22 and another on section 32, are in glacial drift. This surface deposit must, however, be relied on to produce the necessary water, as the underlying bedrock is very impervious shale except, as previously described, in a limited area north of the gully,

The strip of flat sandy country west of Saskatchewan River offers very good water possibilities in a river-deposited sand that occurs at shallow depths. The elevation of this horizon is about 1,860 feet in the north and 1,830 feet on section 14. At intermediate points it should lie between these two levels.

In the area to the northwest, where boulder till mantles the surface, the water-bearing sands and gravels occur as small separate deposits rather than as large continuous beds, thus making it impossible to predict the depth to the water horizon with any degree of accuracy at any particular location. A typical example of this is the deep dry hole on section 32 where no sand nor gravel was encountered. These sand and gravel deposits in the upper part of the till may be numerous, but it is possible to miss them altogether, as shown by the deep dry hole.

South of the gully water is easily obtained in gravel and sand within 30 feet of the surface. These sands and gravels are believed to be associated with the large surface deposit of sand to the south. The presence of this extensive gravel bed would suggest that it was deposited by water flowing from the northwest, possibly before the valley of Big Gully Creek was eroded to any great depth. The deposit is probably continuous, at very shallow depths, throughout the area south of the gully. Boulder till underlies the sand and gravel, and may also contain sorted material in varying amounts.

Bedrock does not offer the same possibilities for water as the drift. The evidence for a sand member is limited to a small area between Standard Hill and Big Gully. A good supply of water is obtained in a sand bed on NW. section 22 at an elevation of 1,830 feet. The lateral extent of this aquifer is limited to the higher land to the northwest, as it is replaced by boulder till on the lower land to the south and east. Digging below an elevation of 1,830 feet is not considered advisable, as the chances of encountering other sand lenses or beds are very limited.

Township 49, Range 23. Drainage in this township is provided by Big Gully Creek, which trends southeast across the northern part. This creek lies in a deep, broad valley from which the land rises gently on either side to afford a maximum relief of from 300 to 400 feet. The surface deposit of ground moraine is mainly boulder till.

No bedrock outcrops are known in the township, but from a regional study of the geology and information on water wells, it is believed that except for the channel of Big Gully Creek, the Ribstone Creek formation, with beds of sand close to its base, underlies the drift in the western half. In the eastern half of the township this formation is absent, and the drift rests directly on Lea Park shale, the elevation of the contact being probably between 1,850 and 1,900 feet, with a small dip to the southeast. Pre-glacial erosion removed the Ribstone Creek sands from this eastern area, whose surface beneath the drift much resembles that of the present topography.

The water supply is obtained from wells ranging in depth from 12 to 108 feet. Most of these are less than 40 feet deep and are in glacial deposits, although some of the deeper wells in the western half of the township are in Ribstone Creek sand. The records show that nowhere in the area does the water supply offer any serious problem, and few if any holes are dry. On sections 31 and 32 the wells are 66, 108, and 72 feet deep, respectively, and are thought to be in the bedrock sand beneath the drift. On SW. section 1 a well 100 feet deep is reported to be in gravel, from which it is naturally supposed that this aquifer is an unconsolidated, surface deposit. This location, however, is considered to be east of the area underlain by the Ribstone Creek sand. On section 20 the drift is thought to be less than 30 feet thick. From these figures it is concluded that the thickness of the drift varies considerably within the township. As was previously stated the bedrock surface is irregular, and shows considerable relief, making it difficult to correlate water wells in the overlying drift deposit. On the whole, however, the elevations of the aquifers decrease towards Big Gully Creek. As the land surface slopes in the same direction, the indicated dip of the water horizon is largely due to the presence of much sand and gravel in the upper part of the drift rather than to a single bed of sand of large lateral extent, for, if otherwise, the wells would all flow on the lower land. To this there is only one exception, namely the well on NE. section 4, which rises to the surface at an elevation of 1,928 feet. The wells immediately to the north on sections 9 and 10 obtain water from the same horizon, which appears to be a sand bed several miles in extent. To the east and north of this area and adjoining Big Gully Creek a water horizon at an elevation of between 1,820 and 1,860 feet occupies roughly a triangular area between section 35 on the north, section 1 on the south, and section 21 on the west. This horizon, which is reached at a shallow depth, appears to be an extensive deposit of sand and gravel adjacent to the old drainage channel and part of the large deposit at about the same elevation in the township to the east. The well on SW. section 1 indicates the possibility of a lower aquifer at an elevation of 1,782 feet. This may represent a sand at or close to the base of the drift, in which case it may be fairly widespread.

Water is obtained on sections 33, 34, and 35 in a gravel deposit at elevations between 1,949 and 1,943 feet, within 20 to 25 feet of the surface. It is considered to be a separate deposit from that previously mentioned to the south, and is confined to higher land extending to the north and west.

The glacial deposit along the west side of the township and south of the gully has not been tested to the same degree as on the lower land to the east. It is believed, however, that as the land is higher the chances of finding extensive deposits of sand and gravel are limited, and aquifers will be local deposits encountered by digging to various depths and elevations. The chances of finding water in the drift are fairly good, and if the drift should fail the underlying Ribstone Creek sand will serve as a good source.

The water supply in the bedrock is limited to that part of the township underlain by the Ribstone Creek sand, and, roughly, is the western half except for Big Gully Creek Valley. North of Big Gully the horizon has an elevation of very nearly 1,900 feet. South of Big Gully several horizons appear to be represented. The highest one was struck on SW. section 7 at an elevation of 1,991 feet. Due to the thickness of the drift this aquifer will only be found where the surface elevation approaches 2,100 feet. A lower one was encountered at 1,883 feet on SE. section 20. This underlies the Ribstone Creek area as previously outlined, and is believed to be the same horizon as that encountered north of Big Gully.

<u>Township 49, Range 24.</u> The ground moraine deposit that covers the surface slopes towards Big Gully Creek, which flows from west to east across the northern half of the township. The drainage is fairly well developed, especially on the north side of the valley, but the thickness of the mantle of glacial material varies greatly, increasing away from the valley, the average thickness being about 75 feet.

Outcrops of the underlying strata occur along Big Gully Creek. These consist of sandstone and shale of the Ribstone Creek and Lea Park formations respectively. On section 21 sandstone ledges occur between elevations of 1,971 and 1,903 feet, and the top of the Lea Park shale has an elevation of 1,845 feet. The actual contact between the shale and sand, which also marks the division between the two formations, was not observed but will fall between the two previously mentioned levels, or at approximately 1,875 feet.

The importance of the Ribstone Creek formation lies in the fact that its sand members act as good aquifers, yield an abundant supply of water, and have a wide lateral extent. The impervious shale of the Lea Park formation is very similar in character to the shale separating the sand members of the overlying Ribstone Creek formation. The only practical distinction between the two is the fact that above the basal Ribstone Creek sand the shale beds are not thick, rarely exceeding 20 feet, and this necessitates digging into the shale a limited distance to determine its stratigraphic position.

The water supply in this township is obtained from glacial deposits, as well as from the underlying bedrock sand. The ground-moraine deposit supplies the greatestamount from shallow wells, and unlike most such deposits, appears to show marked uniformity in the elevations of the water horizons within limited areas, indicating sand and gravel deposits of considerable lateral extent.

The highest horizon occurs at depths ranging from 10 to 35 feet at elevations between 2,103 and 2,133 feet. This deposit is limited to the higher land on sections 9, 10, 11, and adjoining sections. A lower horizon was encountered in sections 1 and 2 at elevations of 2,059 and 2,063 feet. This aquifer is in sand, and is thought to be fairly extensive as water was encountered at about the same levels in sections 10 and 14. The possibilities of water at this level in the southwest part of the township are fairly good. North of Big Gully this horizon appears to be present, and hence its wide distribution increases its importance as an aquifer.

Several wells have obtained water in glacial material below the level of the sandstone outcrops along Big Gully Creek. One of these wells, on NW. section 16, is in gravel at an elevation of 1,976 feet. This indicates an uneven surface of the bedrock, and makes it impossible to predict where the base of the drift will occur. Three horizons in the underlying bedrock serve as good aquifers. The base of the lower sand is placed at 1,875 feet on section 21. This horizon probably extends through the rest of the township at about the same level. It has been encountered in wells on sections 18 and 36, and will serve as a good water horizon for the lower land along Big Gully. The middle horizon lies between elevations of 1,925 and 1,950 feet, and the highest one at about 2,000 feet. If the drift fails to yield an adequate supply it is certain that the bedrock sand will supply this need at the above-mentioned levels. The depth to water will depend on the thickness of the drift and on which of the sands is encountered below its base. Most of the present wells into the bedrock sand are more than 100 feet deep.

<u>Township 50, Range 22.</u> This is a triangular area of about 12 square miles bounded by Saskatchewan River on the north and Standard Hill on the south. A flat plain, from 1 to 2 miles wide, parallels the river, and is an old flood-plain formed during the early stages of the river. The surface soil is light to sandy. The remaining part of the area rises towards Standard Hill and is covered with boulder till.

Lea Park shale outcrops along Saskatchewan River and underlies the drift in this part of the township. It is also possible that part of the overlying Ribstone Creek formation, which contains sand beds, may be present beneath the higher part of Standard Hill, but definite information is lacking.

The glacial till must, therefore, supply the water needs, as the underlying Lea Park shale is very impervious, and contains little, if any, sand. The amount of sand and gravel present in the glacial till is, therefore, very important. The present supply is obtained from shallow wells in the upper part of the drift. Within the flat plain along the river a water-bearing zone has been found between elevations of 1,868 and 1,832 feet, and, if not a single continuous bed of sand and gravel, is represented by so many smaller bodies that the chances of encountering one close to the surface with a good supply of water are exceedingly good. Not much is known about aquifers at lower elevations, as no wells have penetrated or reached the lower part of the drift. However, the base of the drift is usually considered to be a good horizon when sand or gravel is present, as the underlying bedrock shales are impervious and prevent further downward movement of water. Drilling into these shales in this area is not recommended, as no sand beds were observed in them where exposed along Saskatchewan River.

In the drift-covered area north of Standard Hill water conditions are very much the same as those previously described, except that the sand bodies present in the drift may be more irregularly distributed. On section 32 in the township to the south the water horizon is at an elevation of 1,901 feet, and will probably extend into sections 4 and 5.

Township 50, Range 23. The southern part of this township is rolling, but is not the typical knob and kettle topography of a moraine. The hills are large, with gentle slopes and fairly well developed drainage. A gravel bed on sections 19 and 20 is part of a large deposit that extends to the northwest. It was laid down by running water shortly after the retreat of the ice from this area. Farther north and paralleling Saskatchewan River, the flat country, which was once a flood-plain, was developed during the early stages of the river. This plain is covered with drift and water-deposited materials, except on sections 31 and 32 where a hard sandstone ledge caps some of the hills along the higher terrace. These exposures constitute the only known outcrops of bedrock in the township, the rock consisting of hard siliceous sandstone similar in texture to that at the base of the Ribstone Creek formation. It is believed that these outcrops are very near the base of the formation, and that the contact is at an elevation of about 1,900 feet. As these exposures are on the tops of small hills the extent of the sand members present is limited to very small areas. Nine miles to the southwest, on section 21, tp. 49, rge. 24, along Big Gully Creek the drift contact is estimated to be at an elevation of about 1,875 feet, which is very close to the elevation mentioned above. It is assumed, therefore, that the bedrock strata between these two areas is essentially flat-lying. Ribstone Creek strata are thought to occupy the higher land in sections 3, 4, 5, and 6, and may also occur on the high land in sections 16, 17, and 18, whereas in the remaining part of the township Lea Park shale is expected to be found immediately below the drift.

The water supply for this township must be obtained from the glacial drift, except in those areas previously mentioned where bedrock sand is present. The depth of the wells in the drift ranges from only a few feet to 45 feet, and the thickness of the drift deposit will vary considerably from place to place. On the flat plain adjoining Saskatchewan River, where erosion has removed a large part of the deposit, it will not be as thick as on the higher land to the southwest. Most of the wells on this old flood-plain are in sand and gravel below boulder till. From the amount of gravel present it seems logical to expect that the reworked material extends over a considerable area, and that the water horizon between elevations of 1,814 and 1,844 feet represents the same aquifer. This horizon can, therefore, be expected to yield a good supply of water on the flat plain paralleling the river.

On the higher land to the southwest the water horizon does not appear to occur at such a uniform level as found on the land to the northeast. The elevations of the wells on sections 16, 17, and 18 suggests a common aquifer at elevations between 1,940 and 1,950 feet. This aquifer is at least 30 feet from the surface, and may continue southward at much the same elevation. In the southwest part of the township, where the drift resembles a moraine, prospecting for water is limited to the discovery of sand and gravel lenses irregularly scattered through the drift. The drift is not thought to exceed 75 feet in thickness, as the well on SW. section 6 is believed to be in Ribstone Creek sand at that depth at an elevation of 1,934 feet. If the upper parts of the drift do not yield the required amount of water the possibilities of a seepage at the base should be very good.

The extent of the Ribstone Creek sand is difficult to determine accurately. It is believed to be present in the well on section 6. The dry hole, 70 feet deep, on section 18 reached an elevation of 1,912 feet without encountering sand. As this elevation is about that at which the bedrock sand would be expected, if present, it may be that digging ceased just above the aquifer, and thus cannot be considered a definite test. Water can be obtained in the bedrock sand in sections 3, 4, 5, and 6. Farther north the possibilities of water in the strata below the drift are not as good.

The quality of the water from the wells on section 31 is poor, as the sand lens is small and the water comes in contact with marine shale carrying soluble salts. These wells are believed to be in the Lea Park rather than in the Ribstone Creek formation. The well on NW. section 32 obtained very good water, and may be in a different sand to that on section 31. The lateral extent of the sand, however, is thought to be very limited.

Township 50, Range 24. The rolling topography of this township suggests a moraine, but as the only outcrops in the township are found on the slopes of some of the hills the conclusion is that some, if not all, of these hills have a core of bedrock. Sandstone exposures are found on sections 9, 28, and 33, and shale is exposed along the creek on section 36. The elevation of the contact between the Ribstone Creek formation, carrying the sand beds, and the underlying Lea Park shale was not determined. The lowest sand bed has an elevation of 1,911 feet, whereas the shale outcrop is at an elevation of 1,791 feet. It is believed, however, that the shale outcrop is much farther from the contact than the sandstone exposures. The elevation of the lowest aquifer encountered in any of the wells is very nearly 1,900 feet, and as the contact between the two formations on section 21 in the township to the south is at an elevation of 1,875 feet, it is probable that this represents the basal sand in the Ribstone Creek formation. If so, the contact should lie between 1,875 and 1,900 feet, and almost all of the township would be underlain by the sand and sandstone beds, except for a strip along the east side and a small area on the west side centering around section 7, where they were removed by erosion prior to glaciation. Here the Lea Park shale rests directly below the drift.

The mantle of boulder till varies greatly in thickness from place to place, and its actual thickness can only be determined by testing. In a well on section 16 water was encountered in gravel at a depth of 86 feet, indicating that the drift is at least that thick in this vicinity. This is the deepest well in the township, except for one drilled well on section 10. On sections 9 and 28, where bedrock outcrops, the drift is very thin.

The best supply of water in this township comes from shallow wells in the glacial drift. This deposit is distributed over what appears to be an irregular bedrock surface, and includes several water-bearing horizons of local importance. The highest of these has an elevation of about 2,060 feet, and is encountered on sections 16 and 20. The extent of this horizon will be limited to the high land on which these two wells are located. Another horizon, between elevations of 1,970 and 2,000 feet, extends along the west side of the township. Here the wells are shallow, the aquifer is in the upper part of the drift, and it seems reasonable to expect that it will continue to yield a good supply of water. It is also probable that lower aquifers will be found in the glacial drift in this part of the township.

The lowest aquifer in the drift is found along the east side of the township at an elevation of about 1,936 feet. This horizon extends for several miles in a north-south direction, but cannot be considered to extend very far west due to the rise in the bedrock surface in that direction. Lower aquifers in this area may be found, but it is very probable that they are in the drift deposit, as the eastern limit of the bedrock sand is believed to lie farther west.

The bedrock sand is considered to be a good aquifer. On section 28, where a ledge of sandstone 5 feet high is exposed, several large springs emerge from the bank at an elevation of about 1,911 feet. On NE. section 10 the elevation of the aquifer is 1,904 feet, and at intermediate points water is struck at about the same level, It is, therefore, concluded that these wells tap the same aquifer, and, furthermore, that this aquifer is the only one in the bedrock strata. The depth at which this sand will be encountered will naturally depend upon the surface elevation where digging is commenced.

Township 51, Range 23. The part of this township in Eldon municipality consists of 10 square miles south of Saskatchewan River. The country here is very flat, being part of an old river terrace that formed during the early stages of the river. The surface soil varies in texture from very light to heavy.

The glacial material is not very thick. On NE. section 4 it is less than 30 feet thick, and on section 6 Lea Park shale was encountered only a few feet below the surface. This shale does not contain good water in sufficient quantity, so that the drift deposits are the only useful source. Several deep dry holes were dug on section 6 without encountering an aquifer, and the water supply problem may thus become acute if a sand or gravel deposit is not encountered above the shale. Trouble of this kind has been experienced on section 6, and several efforts were made before a good well was obtained in gravel at a shallow depth. If no gravel or sand can be found above the shale the contact between the glacial material and shale should yield a fair seepage supply if a low area in the shale can be located. These low areas can generally be detected by systematic testing, if the overlying drift is not too thick. As the drift contains irregularly distributed sand and gravel bodies, several wells may be sunk before a good supply of water is obtained.

Township 51, Range 24. The small part of this township that lies in Eldon municipality is marked by high rolling country on its south side and a well-developed terrace to the north of the elevated land and west of Saskatchewan River. The high land deflected the course of Saskatchewan River to the northeast, resulting in a large bend.

An outcrop of Lea Park shale is exposed on the west bank of Saskatchewan River in section 16 at an elevation of 1,872 feet. This formation is believed to underlie the whole area, with the possible exception of a narrow strip along the south side where the elevation of its contact with overlying Ribstone Creek sand is about 1,900 feet.

The water supply in this township must, therefore, be obtained in the glacial materials that overlie the shale. Records in this area are limited to only two wells, both of which are shallow. The elevation of the aquifer of the well on section 5 is 2,028 feet, more than 100 feet above the supposed Lea Park-Ribstone Creek contact, so that lower aquifers may also occur. On the flat terrace to the north water must be obtained in the surface deposits or at the contact with them and the Lea Park shale. The thickness of the drift is not considered to be very great, as the shale is exposed at an elevation of 1,872 feet, which is higher than some of the surrounding country. Good indications of this thickness and of the possibilities of a water supply can be obtained from natural springs along the river, as they generally indicate the top of the shale and occur at low points on its surface. It must be borne in mind that sand and gravel generally occur as small irregular bodies or lenses within the drift, and can very easily be missed in digging. This accounts for the fact that wells within a small area may encounter quite different deposits.

ANALYSES OF WATER SAMPLES FROM RURAL MUNICIPALITY OF ELDON, NO. 471, SASKATCHEWAN

						CONSTITUENTS AS ANALYSED							CONSTITUENTS AS CALCULATED IN ASSUMED COMBINATIONS							
No.	Sect.	Tp.	R.	Depth of well in ft.	Total diss'd solids	Ca	Mg	Na	SO_4	Cl	Alkal-linity	Total hard-ness	$CaCO_3$	$CaSO_4$	$MgCO_3$	$MgSO_4$	Na_2CO_3	Na_2SO_4	NaCl	Remarks
1	NW 18	47	23	168	2620	222	92	493	1358	156	370	1200	370	252		455		1210	257	Glacial ?
2	SE 18	47	24	168	2120	100	57	573	1090	107	445	700	250		164	50		1555	177	Ribstone Creek.
3	SE 7	48	23	190	1780	179	81	300	721	108	530	1100	448		69	302		710	178	Ribstone Creek.
4	SW 32	49	23	108	1440	200	89	117	685	10	396	1050	395	143		440		324	17	Ribstone Creek. ?
5	NE 32	49	23	55	4800	386	414	299	2550	29	620	3000	620	470		2048		864	48	Glacial
6	NW 32	49	23	72	1280	229	98	56	410	86	550	1200	550	31		485			142	Ribstone Creek. ?
7	SW 6	50	23	75	2020	257	126	200	1013	11	540	1400	540	140		624		610	18	Glacial
8	SW 31	50	23	70	4760	322	139	919	2960	19	275	1900	275	735		688		2800	31	Top of Shale.
9	NE 28	50	24	Spring	62[illegible]	143	50	6	127	41	370	650	358		10	149			17	$MgCl_2$ Ribstone Creek
10	NE 9	51	23	Spring	1000	150	59	119	385	18	450	700	375		63	203		330	30	Top of Shale

WELL RECORDS—Rural Municipality of Eldon No. 471, 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
	SW	8	47	23	3	bored	40	1942	20	1922	40	1902	Ribstone Creek	Hard		D.S.	Good supply in black sand.
	SW	11				bored	70	1890	-14	1876	70	1820	Ribstone Creek	Hard		D.S.	Good supply in blue sand.
	NW	12				bored	75	1881	-20	1861	75	1806	glacial ?	Med. hard		D.S.	Good supply. Water gets murky before a storm.
	NE	14				bored	62	1896	-35	1861	62	1834	glacial	hard		D.S.	Limited supply
	SE	17				bored	130	1952	+12	1964	130	1822	Ribstone Creek	hard alk.		D.S.	Good supply in black sand.
	NW	18				bored	168	2022	-30	1992	168	1854	Ribstone Creek	hard iron		D.S.	Good supply in coarse sand
	NW	19				bored	130	2010	- 8	2002	127	1883	Ribstone Creek	hard alk.		D.S.	Abundant supply
	SE	19				bored	110	1970	- 4	1966	110	1860	Ribstone Creek	hard		D.S.	Good supply but comes in rather slowly
	NW	20				bored	126	1961	- 6	1955	126	1835	Ribstone Creek	hard iron		D.S.	Abundant supply
	NE	21				bored	128	1950	-112	1838	120	1830	glacial	hard		D.S.	Good supply in yellow sand
	SE	21				bored	160	1925			130	1795	glacial			N.	Poor supply. Seepage above shale
	NW	23				drilled	300	1924	- 50	1874	112	1812	Ribstone Creek?	hard		S.	Limited supply in fine blue sand
	SW	24				bored	92	1886			90	1796	Glacial	hard		S.	Soakage on top of shale. Water supply from shallow wells.
	NW	27				drilled	1760	1941			170	1771	Top of shale				Dry hole. Drilled beside Maidstone Hotel. Gas reported at 800 feet.
	SW	27				bored	108	1950	- 40	1910	108	1842	Ribstone Creek	hard iron		D.S.	Good supply in blue rock.
	NW	29				bored	110	1942			110	1832	Ribstone Creek	hard iron		D.S.	Good suply in black sand
	SE	36				dug	14	1898	- 12	1886	14	1884	glacial	hard iron		D.S.	Good supply in fine sand
	NE	8	47	24	3	bored	103	2034	- 10	2024	100	1934	glacial	hard		D.S.	Good supply
	NE	12	47	24		drilled	148	1992	- 60	1932	146	1846	glacial	hard iron		D.S.	Good supply in coarse gravel.
	SW	13				dug	28	2077	- 24	2053	28	2049	glacial	hard		D.S.	Water in yellow sand
	SW	14				bored	65	2070			60	2010	grey sand				Limited supply from seepage
	SE	15				bored	27	2082	- 18	2064	27	2055	glacial	soft		D.S.	Good supply in sand
	SE	16				drilled	150	2080	-110	1970	150	1930	glacial	hard		D.S.	Good supply in grey sand
	SW	16				bored	87	2034	- 60	1974	87	1947	glacial	hard		D.S.	Good supply in greenish sand
	SW	17				bored	100	2010	- 60	1950	100	1910	glacial	hard		D.S.	Good supply
	SE	18				drilled	168	2029	-150	1879	168	1861	Ribstone Creek	hard		D.S.	Good supply in sandstone
	NW	19				drilled	200	2069	-175	1894	200	1869	Ribstone Creek	hard		D.S.	Good supply in dark sandstone
	SE	19				bored	40	2010	- 20	1990	20	1990	glacial	hard		D.S.	Good supply in coarse sand
	NE	21				bored	82	2071	- 10	2061	82	1989	glacial	hard iron		D.S.	Good supply
	NE	24				bored	160	2020	- 30	1990	160	1860	Ribstone Creek	hard iron		D.S.	Good supply below hard pan.
	SE	25				bored	175	2025	- 40	1985	175	1850	Ribstone Creek	hard iron		D.S.	Good supply in black sand
	NE	34				bored	80	2080	- 70	2010	80	2000	glacial	hard iron		D.S.	Water reported in black sand
	NE	36				bored	180	2060	- 5	2055	177	1883	Ribstone Creek	hard		D.S.	This well flows during winter
	NW	2	48	22	3	bored	40	1839					Ribstone Creek				Dry hole-hard sandstone ledge struck in several wells.
	NW	6	48	22	3	bored	68	1898	- 28	1870	68	1830	Ribstone Creek?	hard, alk.		D.S.	Good supply in blue sand
	SE	6				bored	68	1898	-48	1850	68	1830	Ribstone Creek?	hard, alk.		D.S.	Good supply in blue sand
	SE	7				bored	85	1857			85	1772	glacial gravel	hard		D.S.	Good supply
	NE	10				bored	46	1836	- 16	1820	46	1790	Ribstone Creek	hard, alk.		D.S.	Good supply
	NE	12				bored	60	1862	- 20	1842	60	1802	glacial	hard		D.S.	Good supply in sand.

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 Eldon No. 471

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	HEIGHT TO WHICH WATER WILL RISE: Elev.	PRINCIPAL WATER-BEARING BED: Depth	PRINCIPAL WATER-BEARING BED: Elev.	PRINCIPAL WATER-BEARING BED: Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
	SW	4	48	23	3	drilled	218	1981			100	1881	Ribstone Creek?	hard		D.	Limited supply in black sand
	SE	7	48	23		bored	205	2048			180	1868	Ribstone Creek	hard			Poor supply - seepage supply
	NW	9				bored	202	1961			180	1781	bedrock	hard		D.S.	Poor supply
	NW	12				bored	84	1940									Dry hole in glacial material
	NW	13				bored	70	1921	- 40	1881	70	1851	Ribstone Creek	hard		D.S.	Good supply in sandy shale
	NW	13				bored	110	1926			110	1816	Ribstone Creek	hard		D.S.	Good supply in grey sand
	SE	14				bored	43	1936	- 42	1894	43	1893	glacial	hard		D.S.	Poor supply above shale
	SE	14				bored	47	1936	- 30	1906	47	1889	glacial ?	hard		D.S.	Good supply below shale bed
	SE	16				bored	70	1906	- 55	1851	14	1892	glacial	hard		D.S.	Poor supply
	NW	18				bored	125	2048	- 40	2008	120	1928	glacial ?	hard		D.S.	Good supply in black sand.
																	Dry hole 190 feet deep.
	NE	18				bored	115	1988	- 3	1985	105	1883	glacial ?	hard alk.		D.S.	Good supply in black sand
	SE	21				bored	70	1951	- 10	1941	70	1881	glacial?	hard		D.S.	Good supply in sand
	SE	22				bored	28	1936	- 14	1922	28	1908	glacial ?	hard		D.S.	Good supply in sandy shale
	SW	24				bored	84	1901	- 36	1865	84	1817	glacial ?	hard		D.S.	Good supply in black sand
	NW	25				bored	65	1871	- 60	1811	65	1806	glacial	hard		D.S.	Poor supply, Seepage
	SE	25				bored	80	1878	- 60	1818	80	1798	blue sand	hard		N.	Supply exhausted
	SW	26				bored	60	1901	- 8	1893	60	1841	glacial gravel	soft		D.S.	Good supply
	NE	27				bored	150	1921	- 50	1871	54	1867	glacial	hard, alk.		D.S.	Good supply in black sand
	NE	27				dug	13	1921	- 8	1913	13	1908	glacial	hard, alk.		D.S.	Good supply. Dry hole 90 feet deep
	NW	31				bored	140	2060	- 60	2000	140	1920	Ribstone Creek	hard		D.S.	Good supply
	NW	34				dug	20	1971	- 2	1969	20	1951	glacial	hard		D.S.	Good supply of water in dark sand
	NE	34				bored	76	1921	- 60	1861	76	1845		hard		D.S.	
	NE	35				bored	30	1881	- 18	1863	30	1851	glacial ?	hard		D.S.	Good supply
	SE	35				bored	18	1881	- 2	1879	18	1863	glacial	hard		D.S.	Good supply
	NW	2	48	24	2	bored	180	2121	-120	2001	180	1941	Ribstone Creek	hard		D.S.	Good supply in fine hard dark sand.
	SE	3				drilled	340	2080			126	1954	Ribstone Creek	hard		D.S.	Limited supply in coarse sand,
																	Shale below 128 feet.
	SW	3				bored	66	2080	- 46	2034	46	2034	glacial	hard		D.S.	Good supply in coarse sand
	NE	12				bored	201	2090	-125	1965	175	1915	Ribstone Creek	soft		D.S.	Good supply. Boulder till at 150 feet
	SE	12				drilled	225	2081	-100	1981	221	1860	Ribstone Creek	hard		D.S.	Good supply in sandstone
	SE	14				bored	206	2126	-110	2016	191	1935	Ribstone Creek	hard alk.		D.S.	Good supply in dark sand. Drift 120
																	feet thick
	NE	15				bored	120	2148	- 60	2088	110	2038	glacial ?	hard		D.S.	Good supply in black sand
	SE	15				bored	290	2150+			80	2070	glacial	hard		N.	Dry hole - Water seepage at 80 feet
	SE	20				bored	68	2100	- 20	2080	66	2034	glacial	hard		D.S.	Good supply in coarse sand
	SE	22				drilled	130	2167	-126	2041	130	2037	glacial	hard		D.S.	Sand lenses at 40, 65, 80 and 130 feet
	NW	23				bored	196	2128			186	1942	Ribstone Creek	hard		D.S.	Water in green sand
	NW	26				bored	95	2077									Dry hole. Elevation of bottom 1982 feet
	SE	28				bored	45	2167	- 25	2142	45	2122	glacial	hard		D.S.	Water in coarse sand
	NE	32				bored	60	2153	- 50	2103	57	2096	glacial	soft		D.S.	Water in coarse sand
	SW	33				bored	40	2153	- 36	2117	40	2113	glacial	soft		D.S.	Limited supply in coarse dark sand.

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(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of Eldon No. 471, 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	HEIGHT TO WHICH WATER WILL RISE: Elev.	PRINCIPAL WATER-BEARING BED: Depth	PRINCIPAL WATER-BEARING BED: Elev.	PRINCIPAL WATER-BEARING BED: Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
1	SE	4	49	22	3	bored	8	1850			8	1842	glacial	soft		D.S.	poor supply in sand
2	SW	4	49	22	3	"	10	1850			10	1840	"	soft		D.S.	Good supply in fine sand
3	SW	5				"	30	1852			30	1822	"	hard		D.S.	Good supply in fine sand
4	NW	6				"	16	1857			16	1841	"	hard		D.S.	Good supply in gravel
5	SE	10				"	3	1742			3	1739	"	soft		D.S.	Good supply in sand
6	SE	13				"	22	1840	- 18	1822	22	1818	"	hard		D.S.	Good supply in sand
7	NE	14				"	20	1850			20	1830	"	hard		D.S.	Good supply
8	SW	18				"	20	1841			20	1821	"	soft		D.S.	Good supply in gravel
9	NW	18				"	20	1824			20	1804	"	hard		D.	Limited supply in sand
10	NE	18				"	36	1828			36	1792	"	hard		D.S.	Just sufficient
11	NW	22				"	40	1870	- 16	1854	40	1830	Lea Park ?	hard		D.S.	Good supply
12	NW	25				"	18	1858	- 15	1843	18	1840	glacial	soft		D.S.	Good supply in gravel
13	NW	28				"	18	1877	- 15	1862	18	1859	glacial	hard		D.S.	Good supply in sand
14	SW	30				"	20	1870	- 18	1852	20	1850	glacial	soft		D.S.	Limited supply
15	NW	32				"	40	1936	- 33	1903	35	1901	Ribstone Creek?	hard		D.S.	Good supply in fine hard sand
16	SE	32				"	125	1906									Dry hole. Shale at elevation 1806
17	SW	33				dug	87	1944	- 60	1884	60	1884	glacial	hard		D.S.	Good supply in gravel
18	NE	34				dug	20	1823	- 17	1806	20	1803	glacial	hard		D.S.	Good supply in sand
19	SE	35				dug	12	1861			12	1849	glacial	hard		D.	Another similar well for stock
20	SW	36				dug	10	1872	- 8	1864	10	1862	glacial	hard		D.S.	Limited supply in sand
1	SW	1	49	23	3	bored	100	1882			100	1782	glacial	hard		D.S.	Good supply in gravel
2	NE	1	49	23	3	dug	20	1851			20	1831	glacial	hard		D.S.	Good supply in gravel
3	NW	2	49	23	3	dug	30	1913			30	1883	glacial	hard		D.S.	Good supply in gravel
4	NE	4				dug	20	1928		1928	20	1908	glacial	hard		D.S.	Abundant supply
5	SW	4				dug	27	1974	- 25	1949	27	1947	glacial	hard		D.S.	Good supply
6	SE	5				dug	80	2001			80	1921	glacial	hard, salty		D.S.	Insufficient supply
7	SW	7				drilled	101	2092	- 60	2032	101	1991	Ribstone Creek	hard iron		D.S.	Good supply in dark sand
8	NE	7				bored	40	2004			40	1964	glacial	hard iron		D.S.	Good supply
9	SE	9				dug	30	1920			30	1890	glacial	hard iron		D.S.	Good supply in sand
10	NE	10				bored	32	1929			32	1897	glacial	hard iron		D.S.	Good supply in fine sand
11	SW	10				dug	32	1925			32	1893	glacial	hard iron		D.S.	Limited supply
12	NW	10				bored	65	1925			65	1860	glacial	hard iron		D.S.	Good supply
13	SW	12				dug	25	1884			25	1859	glacial	hard iron		D.S.	Good supply in gravel
14	NE	14				dug	30	1874			30	1844	glacial	hard iron		D.S.	Good supply in sand
15	SW	14				dug	20	1861	- 12	1849	20	1841	glacial	soft		D.S.	Good supply
16	SW	15				dug	45	1895			45	1850	glacial	hard		D.S.	Good supply in sand
17	NE	16				dug	12	1844			12	1832	glacial	hard		D.S.	Good supply in sand
18	SW	16				dug	38	1945			38	1907	glacial	hard iron		D.S.	Good supply
19	SE	20				dug	30	1913			30	1883	Ribstone Creek	hard		D.S.	Limited supply in sand
20	NW	20					40	1877			40	1837	Ribstone Creek	hard		D.S.	Good supply
21	NE	21				dug	13	1846			13	1833	Ribstone Creek	hard		D.S.	Good supply in fine sand
22	SE	21					33	1864			33	1831	glacial	hard		D.S.	Good supply in sand
23	NE	23					40	1837			40	1797	glacial	hard		D.S.	Good supply in sand

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WELL RECORDS—Rural Municipality of Eldon No. 471, 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
24	SW	25	49	23	3		32	1853			32	1821	glacial	hard		D.S.	Good supply in sand
25	SW	31					66	1968			66	1902	Ribstone Creek	hard		D.S.	Good supply in blue sand
26	SW	32					108	2020			108	1912	Ribstone Creek	hard		D.S.	Good supply
27	NW	32					72	1975			72	1903	Ribstone Creek	hard		D.S.	Good supply
28	NE	32					55	1963			55	1908	glacial	hard alk.		S.	Good supply in gravel
29	NE	33				dug	20	1969			20	1949	glacial	soft		D.S.	Good supply in gravel
30	SE	34				"	60	1983			60	1923	glacial	hard alk.		D.S.	Good supply in fine sand
31	SE	35				"	20	1842			20	1822	glacial	soft		D.S.	Good supply in gravel
32	SW	35				"	25	1968			25	1943	glacial	hard		D.S.	Good supply in gravel
1	NE	1	49	24	3	dug	50	2109			50	2059	glacial	hard		D.S.	Good supply in sand
2	SW	2	49			"	65	2128			65	2063	glacial	hard		D.S.	Good supply in dark sand
3	SE	4				drilled	190	2136	- 150	1986	190	1946	Ribstone Creek	hard		D.S.	Good supply
4	NW	4				"	184	2181			184	1997	Ribstone Creek	hard		D.S.	Good supply in sand
5	NE	4				dug	12	2145			12	2133	glacial	hard		D.S.	Good supply in gravel
6	SE	6				"	38	2132			38	2094	glacial	hard		D.S.	Sufficient
7	NW	7				drilled	126	2049			126	1923	Ribstone Creek	hard		D.S.	Good supply in black sand
8	NE	7				dug	35	2044			35	2009	glacial	hard		D.S.	Good supply in sand
9	NE	8					80	2029			80	1949	Ribstone Creek	hard		D.S.	Good supply
10	SW	9					35	2140			35	2105	glacial	hard		D.S.	Good supply in sand
11	SE	9				dug	10	2113			10	2103	glacial	hard		D.S.	Good supply in sand
12	NE	9					127	2045			127	1918	Ribstone Creek	hard		D.S.	Good supply in sand
13	SE	10				dug	12	2126	- 10	2116	12	2114	glacial	hard		D.S.	Good supply in gravel
14	SE	10				drilled	87	2135	- 60	2075	87	2048	glacial	hard		N.	Limited supply in fine sand
15	SW	11				dug	20	2129			20	2109	glacial	hard		D.S.	Good supply
16	SW	12				drilled	72	2015			72	1943	Ribstone Creek	hard		D.S.	Good supply in sand
17	NW	12				drilled	140	2075			140	1935	Ribstone Creek	hard		D.S.	Good supply in sand
18	SW	13					30	2047			30	2017	glacial	soft		D.S.	Good supply in sand
19	SE	14					24	2035			24	2011	glacial	hard		D.S.	Good supply in gravel
20	SW	14					20	2078			20	2058	glacial	soft		D.S.	Good supply in sand
21	NW	14				dug	14	2037			14	2023	glacial	hard		D.S.	Good supply in sand
22	SE	16				dug	12	2010	- 8	2002	12	1998	glacial	soft		D.	Poor supply
23	NW	16				dug	33	2009	- 27	1982	33	1976	glacial	hard		D.S.	Good supply in gravel
24	SW	17				drilled	100	1984			100	1884	Ribstone Creek	soft		D.S.	Good supply
25	SE	18					65	1976			65	1911	Ribstone Creek	hard		D.S.	Good supply in black sand
26	NW	18					50	1978			50	1928	glacial	hard		D.S.	Good supply
27	NE	20					26	2074			26	2048	glacial	soft		D.	Water in gravel
28	SW	22				drilled	125	2027			125	1902	Ribstone Creek	hard		D.S.	Good supply in fine sand
29	NE	22					18	1987			18	1969	glacial	hard		D.S.	Good supply
30	NE	24					30	1973			30	1943	Ribstone Creek	hard		D.	Sufficient
31	SW	28				bored	30	2096			30	2066	glacial	hard		D.S.	Good supply
32	SE	29					25	2084			25	2059	glacial	soft		D.	Limited supply in gravel.
33	SE	31				drilled	140	2063			140	1923	Ribstone Creek	hard		D.S.	Good supply in blue sand
34	NE	32				drilled	100	2103			100	2003	Ribstone Creek?	hard		N.	Water supplied by shallow well
35	SW	32					12	2086	- 8	2078	12	2074	glacial	hard		D.	Good supply in sand
36	NE	34					113	2040	- 100	1940	113	1927	Ribstone Creek	hard		D.S.	Good supply below hard rock
37	NW	34					84	2132			84	2048	glacial	hard		D.S.	Good supply in gravel
38	SE	36					128	1994	- 30	1964	128	1866	Ribstone Creek	hard		D.S.	Good supply in fine sand.

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WELL RECORDS—Rural Municipality of Eldon No. 471, 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	50	22	3	dug	18	1858	- 14	1844	18	1840	glacial	hard		D.S.	Good supply in gravel
2	SW	6	50	22	3	dug	10	1862	- 8	1854	10	1852	glacial	soft		D.S.	Good supply in sand and gravel
3	SW	10				dug	12	1843	- 10	1833	12	1831	glacial	hard		D.S.	Good supply in fine sand
4	SE	18				dug	28	1860			28	1832	glacial	hard		D.S.	Limited supply in dark sand
5	SW	18				dug	10	1878	- 5	1873	10	1868	glacial	hard		D.S.	Good supply in sand
1	SE	1	50	23	3	dug	8	1862			8	1854	glacial	hard		D.S.	Good supply in sand and gravel
2	SW	4				dug	28	2012			28	1984	glacial	hard		D.S.	Limited supply in gravel
3	SW	6				bored	75	2009			75	1934	Ribstone Creek	hard alk.		D.S.	Good supply in blue sand
4	NE	12				dug	14	1909	- 12	1897	14	1895	glacial	hard		D.S.	Good supply in sand and gravel
5	NW	12				dug	12	1841	- 10	1831	12	1829	glacial	hard		D.S.	Good supply in sand
6	SE	15				dug	9	1850	- 5	1845	9	1841	glacial	hard		D.S.	Good supply in fine sand
7	SW	16				bored	30	1974	- 20	1954	30	1944	glacial	hard		S.	Good supply in sand
8	SE	17				bored	45	1986	- 20	1966	45	1941	glacial	hard		D.S.	Good supply in sandy clay
9	SW	18				bored	30	1982	- 25	1957	30	1952	glacial	hard		D.S.	Limited supply in sandy clay (Dry hole 70' in blue clay)
10	NE	21				dug	26	1869	- 25	1844	26	1843	glacial	hard		D.S.	Limited supply. Dry hole 50 feet deep in blue clay
11	SW	26				dug	40	1854	- 38	1816	40	1814	glacial	hard		S.	Good supply in gravel.
12	SE	28				dug	12	1865			12	1853	glacial	hard		D.	Limited supply in gravel
13	NE	31				dug	60	1908	- 40	1868	60	1848	glacial	hard		D.S.	Good supply
14	SW	31				dug	25	1915	- 18	1897	25	1890	Ribstone Creek?	hard		D.S.	Limited supply of poor water
15	SW	31				bored	70	1915			70	1845	Lea Park	hard		N.	Poor water
16	NW	32				dug	40	1924	- 32	1892	40	1884	Ribstone Creek?	hard		D.S.	Good supply in sand.
17	SE	33				dug	29	1873	- 15	1858	29	1844	glacial	hard		D.S.	Abundant supply
18	NW	34				dug	40	1872	- 24	1848	40	1832	glacial	hard		D.	Good supply in samd and gravel
1	SW	5	50	24	3	dug	18	1966			18	1948	glacial	hard		D.	Good supply
2	NE	10				drilled	165	2069	-150	1919	165	1904	Ribstone Creek	hard		D.S.	Good supply in sand
3	SW	12				dug	50	1987	- 30	1957	50	1937	glacial ?	hard		D.S.	Good supply in sand
4	SE	14				bored	20	1956	-10	1946	20	1936	glacial	hard		D.S.	Good supply in sand
5	NW	16				dug	86	2149	- 36	2113	86	2063	glacial	hard		D.S.	Good supply in gravel
6	NE	19				dug	20	1999	- 17	1982	20	1979	glacial	hard		D.S.	Good supply in sand
7	SE	20				dug	30	2087			30	2057	glacial	hard		D.S.	Good supply in sand
8	NW	24				bored	53	1959	- 25	1934	24	1935	glacial	hard		D.S.	Limited supply in sand
9	NW	28				dug	15	1951			15	1936	glacial	hard		D.S.	Good supply
10	NE	28					Spring	1911				1911	Ribstone Creek	hard		D.S.	Spring comes out of ledge of hard sandstone 5 feet thick.
11	NE	31				dug	11	2000	- 5	1995	11	1989	glacial	hard		D.S.	Good supply in sand and gravel
12	NW	31				dug	12	2014	- 8	2006	12	2002	glacial	hard		D.S.	Good supply in sand

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(D) Domestic...

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WELL RECORDS—Rural Municipality of Eldon No. 471, Saskatchewan.

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1	NE	4	51	23	3	dug	55	1888	- 30	1858	30	1858	Lea Park. Shale	hard		D.S.	Another well 4 feet in gravel with abundant supply.
2	SE	4				dug	45	1908	- 40	1868	45	1863	glacial	hard		D.S.	Good supply in fine sand
3	NE	5				"	15	1886	- 12	1874	15	1871	glacial	hard		D.S.	Good supply in gravel
4	SW	6				bored	12	1819			12	1807	glacial	hard		D.S.	Good supply in gravel
5	NE	9				spring		1797				1797	glacial	hard		D.S.	Flows continuously at 4 gal. per min.
6	SW	10				dug	10	1859	- 8	1851	10	1849	glacial	hard		D.S.	Good supply in gravel

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	5	51	24	3	dug	8	2033	- 5	2028	8	2025	glacial	hard		D.S.	Good supply
2	SW	17					15	1825			15	1810					Limited supply

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.