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DEPARTMENT OF MINES

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BUREAU OF ECONOMIC GEOLOGY

GEOLOGICAL SURVEY

PRELIMINARY REPORT

GROUND-WATER RESOURCES OF THE RURAL MUNICIPALITY OF HILLSBURGH No. 289 SASKATCHEWAN

BY

B. R. MacKay, H. N. Hainstock & G. Graham

Water Supply Paper No. 203

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GROUND WATER RESOURCES OF THE RURAL MUNICIPALITY OF HILLSBURGH, NO. 289 SASKATCHEWAN

INTRODUCTION

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

Publication of Results

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

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

How to Use the Report

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

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

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

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

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

GLOSSARY OF TERMS USED

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

WATER-BEARING HORIZONS OF THE MUNICIPALITY

The rural municipality of Hillsburgh, No. 289, consists of nine townships, described as tps. 28, 29, and 30, ranges 19, 20, and 21, W. 3rd mer., and covers an area of 324 square miles. The centre of the municipality lies approximately 17 miles east of the town of Kindersley, a divisional point on a branch-line of the Canadian National railways. The hamlet of D'Arcy and the villages of Brock and Netherhill in the southern part of the municipality are located on this railway. No well-developed drainage system occurs within the area but a number of small ravines and gullies, and a few broad, shallow valleys, carry the surface water towards Kiyiu or Eagle lake, a large, marshy flat, in the northwestern corner of the municipality. This swampy area marks the site of an old glacial lake basin. A small area surrounding the lake, and a narrow area extending in a southeasterly direction to Brock, are covered by glacial lake clays. The eastern part of the municipality is mantled by a moraine and the remainder of the municipality is overlain by boulder clay or glacial till. The land surface throughout the greater part of the area is hilly and rolling. The elevation rises from less than 2,200 feet above sea-level at Kiyiu lake to more than 2,400 feet in the eastern and southwestern parts of the municipality. In the northeastern part ground water is largely obtained from the glacial deposits, whereas in the remainder of the area about one-half the wells are drawing their supply from aquifers in the bedrock.

Water-bearing Horizons in the Unconsolidated Deposits

The glacial lake clays do not contain any well-defined water-bearing horizons. A few wells have been dug into these deposits, but it is very unusual that a good supply of water is obtained from them in this municipality. In the glacial lake clay-covered area it is generally necessary to pass into the sand

and gravel deposits in the underlying glacial till in order to obtain an adequate supply of water for farm needs.

The deposits of glacial till and moraine contain scattered pockets of sand and gravel that are water-bearing. The till and moraine are composed of a few feet of top soil, 20 to 30 feet of oxidized or yellow clay that contains scattered pockets of sand and gravel at or near its base, and a compact, dark-coloured, impervious clay that extends down to the underlying bedrock. This latter heavy boulder clay in places has a thickness in excess of 200 feet, but over most of the municipality is approximately 100 feet thick. It contains pockets of sand and gravel that may be found at any depth within the boulder clay.

A number of wells scattered throughout the area tap the sand and gravel pockets that occur at or near the base of the upper weathered zone of the drift. Over small areas these deposits appear fairly continuous, but they do not form a general water-bearing horizon. In the southwestern part of the municipality the pockets are sparsely distributed and the deposits in the underlying unweathered drift are used more extensively. Some of the wells that tap the shallow aquifers do not yield an adequate supply of water for farm needs, but from most of the wells the yield is sufficient for domestic needs, and a number of stock. If the supply from such a well is supplemented by the use of a dugout for retaining run-off water for stock use, an adequate supply for farm needs should be obtained even in years of continued drought. Before digging a shallow well, farmers are advised to test with a small auger, as by this means a water-bearing deposit may be encountered with a minimum amount of effort and expense.

The scattered pockets of sand and gravel that occur throughout the clays located below the weathered zone, form a second source of ground water supply in the glacial drift. These

pockets are located at depths ranging from 30 to more than 200 feet below the surface, although the majority of the wells that tap them range from 50 to 100 feet deep. Over small areas some correlation in the occurrence of the pockets can be established, but no large area can be outlined in the municipality within which there appears to be a continuous water-bearing horizon. Dry holes will doubtless be encountered in some areas before a producing pocket is tapped. The supply from some of the wells tapping these deposits in the lower part of the drift is inadequate for farm requirements. The water is of poor quality, being generally highly mineralized, although the water from most wells is being used for drinking as well as for stock. The use of dugouts is recommended when the yield from the wells is inadequate for farm needs. In a number of sections in the municipality, where the topography is favourable, dams can be readily constructed at small cost, and the supply of run-off water retained may be used for stock. The supply of water from springs that occur along some of the ravines may be considerably increased by the use of a cribbed reservoir or by constructing a small collecting gallery.

Water-bearing Horizons in the Bedrock

The bedrock is not known to outcrop in this municipality, but in many localities in the southwestern part of the area it is reported to occur at depths of less than 75 feet below the surface; over the remainder of the area it is thought to occur at considerably greater depths. The approximate geological boundary between the Bearpaw and Belly River formations is shown on Figure 1 of the accompanying map. The Bearpaw formation, however, is thought to be very thin and the water that is being derived from the bedrock in this municipality is believed to come from the underlying Belly River formation. It is possible, however, that some of the aquifers may be in the lower part of the Bearpaw formation.

GROUND WATER CONDITIONS BY TOWNSHIPS

Township 28, Range 19

The western third of this township is covered with boulder clay or glacial till and the remainder is mantled by moraine. The glacial drift is composed of 2 to 5 feet of top soil, 18 to 28 feet of a light-coloured clay, and blue boulder clay which often extends to a depth of 200 feet below the surface. The thickness of the heavy blue clay increases towards the east where the elevation of the land surface is approximately 100 feet higher than along the western boundary. At the contact of the light-coloured clay and the heavy blue clay small pockets of sand and gravel are sometimes encountered that yield small quantities of water. When these pockets yield a sufficient supply for household needs, dugouts can be advantageously employed for stock requirements.

A fewwells have tapped scattered pockets of sand and gravel in the blue clay and yield a supply of water that is sufficient for local needs, but the water from some of the wells is highly mineralized and has a laxative effect on those not accustomed to its use. A small group of wells on sections 23, 27, and 28, apparently tap pockets of gravel in the blue clay. This group of wells obtains water at depths ranging from 50 to 100 feet below the surface. Two wells, on sections 4 and 5, were sunk through 95 feet of blue clay and then approximately 12 feet of a lighter coloured clay before a deposit of water-bearing gravel was encountered. It is probable that the same aquifer feeds both wells and it may be encountered by other wells should they be sunk in the immediate vicinity. The aquifer is not thought to be of large areal extent. The water is under slight hydrostatic pressure and the supply available is sufficient for local needs.

The "B" boundary line on Figure 1 of the accompanying map outlines an area in which a few wells tap an aquifer that is thought to be in the Belly River formation which immediately underlies the Bearpaw formation. However, as the Bearpaw formation immediately underlies the glacial drift in this area, the aquifer may be in this formation. The aquifer is a bed of fine, blue sand, and appears to be continuous over the area outlined. Its extent to the northeast is probably limited as the wells on sections 14 and 16 had to be drilled to considerably greater depths before encountering water. The aquifer occurring in the outlined area is tapped at depths ranging from 110 to 125 feet below the surface, or at elevations of 2,155 to 2,190 feet above sea-level. In the western third of the township only one well is obtaining water from a depth of less than 110 feet. It does not appear advisable in this area to prospect deeper than the upper 30 feet of the glacial drift in a search for water, unless one is prepared to drill to depths in excess of 110 feet below the surface. The water is under some hydrostatic pressure and rises to points varying from 2,175 to 2,220 feet above sea-level in the different wells. The yield is sufficient for local needs, and the water is hard and is used for drinking.

A drilled well, located on section 16, passed through 200 feet of heavy boulder clay, before tapping a coarse sand aquifer at an elevation of 2,112 feet above sea-level. This aquifer is believed to be in the Belly River formation, the overlying Bearpaw formation apparently having been passed through. The well on section 14 seems to preclude the possibility of this aquifer extending in that direction, as no water was struck in the drift, but it may be of considerable areal extent in the other directions. The water in the well on section 16 is under sufficient hydrostatic pressure to rise to a point 40 feet below the surface. This water has a laxative

effect on humans and is said to cause scour in stock, and although the yield is large it is only used when water of better quality is not available.

A well on section 14 was drilled through 350 feet of heavy blue clay and tapped an aquifer at an elevation of 2,020 feet above sea-level. The Bearpaw formation probably was passed through and the aquifer is formed by sand in the Belly River formation. This aquifer is thought to be of considerable areal extent and should be tapped by other wells sunk to the same elevation. The water is under sufficient hydrostatic pressure to rise 90 feet above the aquifer, and the yield is more than adequate for local needs. Although the water is quite highly mineralized it is being used for drinking.

Township 28, Range 20

This township is mantled by boulder clay or glacial till and the ground surface is gently undulating. A large coulée approximately ½ mile wide, runs through sections 24 and 25. The boulder clay consists of a few feet of top soil, 20 to 30 feet of a light-coloured clay, below which a heavy blue clay is encountered. In the northern half of the township approximately 60 feet of this clay must be passed through before pockets of water-bearing sand and gravel are encountered. In the southern part of the township the depth to the water-bearing pockets is considerably greater. There does not appear to be any extensive sand and gravel deposits at the contact of the weathered zone of clay and more compact, blue clay, which occurs at approximate depths of 25 feet below the surface. No doubt more extensive prospecting will show the presence of such pockets, but the data at hand indicates that these deposits are of very scattered distribution. A few wells have tapped scattered pockets of sand and gravel within the blue clay, and yield varying quantities

of hard, usually "alkaline", water. Dry holes will probably be put down before a producing well is obtained. In the southern half of the township these pockets are particularly sparsely distributed, and in this area aquifers in the underlying bedrock will have to be tapped before an adequate water supply is obtained.

A well, located on the SE.$\frac{1}{4}$, section 15, was dug through 70 feet of chocolate-coloured clay and 10 feet of blue clay before a white sand aquifer was tapped. The water from this well is reported to be fairly soft, and the aquifer may be in the Bearpaw formation. Its areal extent is thought to be very limited. The supply of water from this well is insufficient for local requirements.

In the area outlined by the "B" boundary line on Figure 1 of the accompanying map the wells passed through approximately 100 feet of heavy blue clay before an aquifer was tapped. This sand aquifer is assumed to be in the Belly River formation. The wells range from 110 to 190 feet deep and the aquifer is reached at elevations of 2,155 to 2,218 feet above sea-level. This aquifer appears to slope towards the north so that, assuming that the surface elevation is constant, wells drilled in the northern part of the area will be considerably deeper than those in the south. Two wells, located on sections 2 and 5, believed to tap the aquifer that occurs in the area outlined by the "B" boundary line, yield an insufficient supply of water. The supply could probably be increased by deepening the wells. The remainder of the wells that tap this aquifer yield a supply that is more than sufficient for local requirements. The water from these wells is quite highly mineralized, but with one exception it is being used for drinking.

It is possible that water can also be obtained from the bedrock at an elevation ranging from 2,020 to 2,080 feet above sea-level, but no wells have been drilled to that elevation in this township.

Township 28, Range 21

This township is mantled with glacial till or boulder clay. In an area adjacent to the valley in the south-western part of the township erosion by water has formed many gullies and ravines. The land surface in the remainder of the township is quite level. The glacial drift is not thought to exceed 150 feet in thickness.

The drift mantle consists of a few feet of top soil, followed by 20 to 25 feet of weathered clay, and then a more compact boulder clay, usually referred to as blue clay. Scattered pockets of sand and gravel occur at the contact of the weathered or yellow clay and the blue clay. These deposits are sparsely distributed and only two wells are thought to be obtaining water from this source. Other wells may encounter similar pockets, but dry holes will doubtless be dug before a producing well is obtained. Before digging a well to this depth farmers are advised to test with a small auger, as by this means a water-bearing deposit may be encountered with a minimum of effort and expense.

A number of wells have also encountered pockets of water-bearing sand and gravel in the blue clay and they yield a fair supply of hard water. These pockets, however, are so sparsely distributed that it is inadvisable to drill wells in an attempt to locate them. The well on the NE.$\frac{1}{4}$, section 36, is assumed to have encountered a gravel pocket in the blue clay, but the areal extent of the aquifer is not large. The supply of water from this well is sufficient for local needs.

The "A" boundary line on Figure 1 of the accompanying map outlines an area in which a number of wells tap an aquifer in the bedrock which forms the chief source of water supply in this township. The aquifer appears to be fairly continuous and is encountered at depths ranging from 69 to 160 feet, depending upon the elevation of the land

surface, or at elevations of 2,252 to 2,280 feet above sea-level. It is formed chiefly by a fine, blue sand and may occur in the lower part of the Bearpaw formation, but is believed to occur in the Belly River formation. Little difficulty should be experienced in obtaining water from this aquifer within the outlined area. The water-bearing horizon is known to extend towards the north and it may extend towards the west. The supply of water from the wells in this area is sufficient for farm needs. It is under some hydrostatic pressure, the water-level ranging from an elevation of 2,265 to 2,305 feet above sea-level. The water, however, is highly charged with mineral salts in solution, and that from a few wells is unfit for drinking.

The well located on section 13, and included with the wells in the outlined area, was drilled through approximately 200 feet of clay before a water-bearing sand was tapped at an elevation of 2,160 feet above sea-level. This aquifer is assumed to be in the Belly River formation. The areal extent of this aquifer is not large and it was not encountered by a deeper well on section 12. The water is under hydrostatic pressure, rises to a point 60 feet below the surface, and the supply is more than sufficient for local needs. The water is not as highly mineralized as that from other wells in the township, and it is being used for drinking as well as for stock.

The well located on section 12 was drilled through 100 feet of blue clay, two layers of rock, and then more clay to a depth of 280 feet, where a water-bearing sand was tapped. The blue clay lying below the two layers of rock is probably part of the Bearpaw formation, and the aquifer is thought to be in the underlying Belly River formation. The extent of the aquifer is unknown, but it is assumed to be of considerable areal extent and may underlie the greater part of this township. The water is hard and under sufficient

hydrostatic pressure to rise to a point 100 feet below the surface. It has a "soda" taste and is highly mineralized and suitable only for stock.

In a large part of this township the topography is suitable for the construction of small dams for the retention of run-off water that could be used for stock. The impervious nature of the sub-soil is also suitable for the retention of run-off water by dugouts. These dugouts should be excavated at least 12 feet deep so as to ensure a supply sufficient for winter use. The dugout should be fenced off and a pump used instead of allowing cattle to drink out of it. No doubt the flow of water from the springs that occur along the coulées and ravines could be considerably increased by the use of small collecting galleries or by digging out the springs.

Township 29, Range 19

The surface of this township is very uneven. With the exception of the southwestern corner, and a strip along the northern boundary, that are mantled by boulder clay or glacial till, the remainder of the area is covered by moraine. There does not appear to be any notable difference in the composition of the till and the moraine. Twenty to 30 feet of weathered or yellow clay underlies the top soil and it is underlain by a compact blue boulder clay containing a few scattered pockets of sand and gravel. Sand and gravel deposits also occur at the contact of the yellow and blue clays. The blue clay extends in some localities to a depth of more than 200 feet.

A few wells obtain small supplies of water from the gravel and sand pockets that occur at the contact of the yellow and blue clays. These pockets appear to be fairly continuous in the vicinity of D'Arcy and in the northeastern corner of the township, but over the remainder of the area they are of local occurrence.

Providing that an adequate supply of water for domestic purposes can be obtained from shallow wells the use of dugouts for collecting and storing run-off water for stock use is recommended. In some localities it might be more feasible to construct small dams for the retention of run-off water for stock use.

In the northern part of the township a few wells at widely separated localities obtain water from pockets of sand and gravel at depths of 60 to 85 feet below the surface. These pockets occur in the compact blue boulder clay and are not continuous. No dry holes were recorded in this area, so that the possibilities of tapping one of these water-bearing pockets appear very good. The yield from the producing wells is not large, but most of them give a sufficient supply for local needs and the water is used for drinking. If the supply from these wells becomes depleted to such an extent that it is insufficient for stock needs, dugouts can be advantageously employed to supplement the supply.

A number of wells, on sections 3, 9, 11, 15, and 16, tap sand and gravel deposits in the blue clay at depths ranging from 80 to 160 feet below the surface, or at elevations from 2,230 to 2,320 feet above sea-level. If the wells in this group tap a common aquifer, it must slope towards the southeast as it is reached at a considerably greater depth in section 3 than in section 16, The areal extent of this aquifer is unknown, but it is improbable that it extends much farther to the east or west than sections 11 and 16. Since the supply from the wells on section 11, and the west half of section 16, is insufficient, it appears that the aquifer becomes thin near the sites of these wells. The water in most of the wells is under some pressure and with the exception of the well on section 11 it is being used for drinking.

Four wells, located on the SW.$\frac{1}{4}$, section 7, SE.$\frac{1}{4}$, section 18, SW.$\frac{1}{4}$, section 19, and SW.$\frac{1}{4}$, section 24, tap aquifers at elevations ranging from 2,190 to 2,212 feet above sea-level, or at depths ranging from 142 to 225 feet below the surface, depending upon the elevation of the ground surface. These wells were drilled through blue clay until the water-bearing sand was reached. In the well on section 24, 7 feet of dry sand was encountered before the quicksand aquifer was reached. It is not definitely known if the aquifers tapped by these wells form a continuous horizon, but should other wells be drilled to the elevations given above the possibilities of obtaining water are good. The supply of water from the well on section 19 is barely sufficient for local needs. This supply might be increased by deepening the well 10 to 20 feet. The other wells yield a sufficient supply for local requirements. The water from all the wells is mineralized and that from three is recorded as being "alkaline", but it is being used for drinking as well as for stock.

When a sufficient supply of water for domestic needs can be obtained, the use of dugouts for the retention of run-off water for stock use is recommended. The impervious nature of the sub-soil over most of this township renders it particularly suitable for the excavation of dugouts.

The Bearpaw formation immediately underlies the glacial drift in this township, but it is improbable that it will prove a source of ground water supply as it is thought to be quite thin. It is probable, however, that the Belly River formation that underlies the Bearpaw in this area will contain one or more water-bearing horizons, but no wells have been drilled into this formation. Should water be obtained from it, however, it will probably be highly mineralized and suitable only for stock.

Township 29, Range 20

The greater part of this township is mantled by boulder clay or glacial till, but in a wide area extending from the northwestern corner to the south-central part the boulder clay is overlain by a veneer of glacial lake clay. The ground surface of the till-covered area is slightly rolling and in some localities is cut by a number of ravines and coulées. Stones and boulders are common on the surface in some parts of the township.

The glacial lake deposits consist largely of heavy, silty clay that yields relatively little water, but small quantities of water are obtained from deposits of sand and gravel that in places occur at the contact of the glacial lake clay and the boulder clay. Two wells in section 9 and 10, thought to be deriving their supply from the contact of the lake clay and boulder clay, are 60 feet deep, but in the remainder of the glacial lake clay-covered area the clay is not thought to be over 40 feet thick. The water that is derived from the contact of the lake clay and the boulder clay is suitable for all farm purposes, and the yield is sufficient for local requirements.

The glacial till usually consists of 2 to 5 feet of top soil, 20 to 30 feet of a light-coloured, weathered clay, and a hard, compact, dark clay, that in some parts of the township extends to a depth of 250 feet. A few scattered pockets of sand and gravel are found at the contact of the weathered or yellow clay and the heavy blue clay, and these pockets sometimes yield small supplies of ground water. The yield from wells that tap such pockets is greatly affected by periods of drought. These pockets cannot be correlated from place to place, and they do not form a continuous water-bearing horizon over a large area. In some localities dry holes will doubtless be dug before a producing pocket is tapped. Many springs occur along the

ravines or coulées and in small marshy areas. The yield from these springs can be appreciably increased by excavating and cribbing a small reservoir around their source, or by the use of small collecting galleries.

A number of wells have tapped scattered deposits of sand and gravel at depths of 100 feet or less in the blue clay underlying the upper weathered zone of the drift. The pockets may be continuous over small areas, but over most of the area they are of local occurrence. On sections 28, 33, 34, and 35, a number of wells have tapped the pockets at depths ranging from 53 to 95 feet below the surface, or at elevations of 2,229 to 2,305 feet above sea-level. In sections 11 and 14, however, holes were sunk to depths of 116 and 140 feet without encountering water. The yield from most of the wells is sufficient for local needs and the water, with the exception of that obtained from a well on section 15, and a well on the NW.$\frac{1}{4}$, section 35, is being used for drinking.

A few wells in the area outlined by the "A" boundary line in the southwestern part of the township are assumed to be deriving their supply from an aquifer in the bedrock. This aquifer is tapped at depths ranging from 100 to 128 feet below the surface, or at elevations of 2,226 to 2,280 feet above sea-level. In these wells approximately 100 feet of clay was passed through before the water-bearing deposit was tapped. It is thought that some of the material passed through was shale of the Bearpaw formation, and the wells are assumed to be drawing their supply from the Belly River formation that underlies the Bearpaw, but it is possible that the aquifer is in the glacial drift. This aquifer probably thins out or disappears a short distance beyond the outlined area. The well on section 20 obtained only a small seepage of water at an elevation of 2,175 feet above sea-level, and it is possible that the aquifer slopes towards the northwest. The water from the wells is under some hydrostatic pressure and the supply is sufficient for farm requirements, but the water is very highly mineralized and only that from two wells is being used for drinking.

Two wells, located on sections 13 and 20, were drilled to depths of 354 and 305 feet, respectively, and tap aquifers at elevations of 2,040 and 2,110 feet above sea-level. The well on section 13 passed through 300 feet of clay and 50 feet of fine sand before a black sand aquifer was tapped. The water rose 121 feet above the aquifer. The well on section 20 passed through 300 feet of blue clay before a dark-coloured sand aquifer was tapped. Small seepages of water were also encountered at depths of 100 and 225 feet below the surface. The water in the latter well rises 165 feet above the aquifer. It is not known if both wells tap a common aquifer. The aquifers are assumed to be in the Belly River formation. The areal extent of the aquifers is not known, but the possibilities of obtaining water at similar depths should be reasonably good. These wells yield an abundant supply of hard water and although it is highly charged with iron and other mineral salts in solution it is being used for drinking as well as for stock.

The ravines in this township offer locations for the construction of small dams, and in most areas the impervious nature of the sub-soil renders it suitable for the excavation of dugouts. By these methods a supply of run-off water can be collected and retained for stock use.

Township 29, Range 21

The ground surface in this township is gently rolling and the elevation decreases from 2,400 feet in the south to approximately 2,200 feet in the north. Glacial till or boulder clay forms the surface material over most of the township, but in a small area in the northeastern corner the boulder clay is overlain by approximately 50 feet of glacial lake clay. No deposits of water-bearing sands or gravel occur at the contact of the lake clay and boulder clay in this township. The lake clay yields little water to wells.

The glacial till or boulder clay generally consists of 2 to 6 feet of top soil, 20 to 30 feet of oxidized or weathered, light-coloured clay, which may contain scattered pockets of sand and gravel, and heavy, blue clay that may also contain scattered deposits of sand and gravel. At no place in this township do the deposits of sand and gravel found in the glacial till show any evidence of continuity, and their distribution is thought to be particularly localized. Dry holes will no doubt be encountered before a producing pocket is tapped. As a rule the water from the drift in this township is of very poor quality, and the quantity is insufficient for local needs. Some of the water may be too highly mineralized for stock use. In some areas slough waters are used for stock. Farmers residing in this township are advised to excavate dugouts for the collection of run-off water for stock use. These dugouts should be dug at least 12 feet deep in order to retain a supply that will last for the greater part of the year.

The bedrock provides the chief source of ground water supply for this township. A number of wells in the area outlined by the "A" boundary line on Figure 1 what is believed to be an aquifer in the bedrock at depths ranging from 64 to 108 feet below the surface, or at elevations of 2,220 to 2,280 feet above sea-level. This aquifer is formed by a fine, dark-coloured sand, assumed to be in the Belly River formation. The areal extent of the aquifer is not known, but in the area outlined on Figure 1 it should be reached between the depths given above. The supply of water obtained from this aquifer is sufficient for all farm needs. The water from all the wells is hard, but that from the well on section 10 was soft when the well was first drilled. It is quite highly mineralized, but is being used for drinking without any apparent ill effects.

A well located on the NE.$\frac{1}{4}$, section 22, tapped an aquifer at a depth of 150 feet, or at an elevation of 2,160 feet above sea-level. The log of this well was not obtained, but it is probable that the aquifer is formed by a sandy bed in the Belly River formation. A well on section 36 is assumed to tap a similar aquifer, but it may be the same water-bearing horizon as that tapped by the wells in the area outlined by the "A" boundary line (Figure 1). The water from these two wells is hard, suitable for drinking, and sufficient for local needs.

Two wells, which may tap a common aquifer in the bedrock, are located on sections 27 and 30. They were drilled 260 feet below the surface and encountered the water-bearing sand at elevations of 2,010 and 2,032 feet above sea-level. In the well on section 27, 100 feet of clay and 80 feet of sand were drilled through, but the materials passed through between 180 feet from the surface and the top of the aquifer were not recorded; the aquifer was formed by fine sand. The Bearpaw formation was probably passed through in this well and the water is assumed to be coming from the Belly River formation. This aquifer may underlie the greater part of this township. The water from the well on section 30 is unfit for use. The water from the well on section 27 is being used for all farm purposes, but the supply is small. A 690-foot hole was drilled on section 10, but no water-bearing horizons were tapped below a depth of 115 feet.

Township 30, Range 19

The eastern half of this township is mantled by a moraine, whereas the remainder is covered by glacial till or boulder clay. There does not appear to be any difference in the ground water conditions in the two types of glacial deposits. These deposits usually consist of 2 to 6 feet of top soil, 20 to 30

feet of weathered or oxidized clay in which a few scattered pockets of sand and gravel are located, and heavy, dark-coloured, or unweathered clay that also contains discontinuous deposits of sand or gravel, usually in the form of pockets or lenses.

A few wells are obtaining water from the scattered pockets of sand and gravel that occur at or near the base of the weathered zone of the glacial drift. Along the eastern part of the township these pockets appear to be more numerous than elsewhere, but they cannot be said to form a general water-bearing horizon. The yield of these wells is greatly reduced in times of drought. In years of normal rainfall, however, they yield a supply that is sufficient for local needs and the water can be used for all farm purposes. Before digging a shallow well farmers are advised to test with a small auger, as by this means a water-bearing deposit may be encountered with a minimum amount of effort and expense. This type of well, supplemented by the use of a dugout for the retention of run-off water for stock use, should ensure an adequate supply of water for most farms in this area.

The remainder of the wells in this township tap pockets of sand and gravel in the glacial drift at depths ranging from 50 to 145 feet below the surface. These pockets do not form a continuous water-bearing horizon, but in small areas the water-bearing beds struck in different wells occur at about the same depth and may be connected. No doubt some holes will fail to strike a water-bearing deposit, but little difficulty should be experienced in obtaining water at most places in this township. The supply of water from most of the wells tapping these pockets is sufficient for local needs, and a few wells yield an abundant supply. The water is hard and usually highly mineralized, but in most instances it is used for drinking as well as for stock.

The underlying bedrock has not been prospected for water-bearing deposits but it is probable that it will prove a source of supply. It is improbable, however, that the water from the bedrock will be of better quality than that obtained from the drift.

Township 30, Range 20

This township is mantled throughout by glacial till or boulder clay. In some of the southern sections the ground surface is quite rolling, but throughout the remainder of the township it is gently undulating. A large number of boulders occur on the surface, and in some areas the top-soil is sandy. The till or boulder clay consist of 2 to 6 feet of a sandy loam top-soil, 20 to 30 feet of yellow or weathered clay that contains scattered deposits of sand and gravel at or near its base, and 70 to 80 feet of compact dark clay. In the southern part of the township, the glacial drift is underlain by the Bearpaw formation and it in turn by the Belly River formation. In the northern part of the township the Belly River formation immediately underlies the glacial drift.

A few wells obtain water from the scattered pockets of sand and gravel that occur at or near the base of the upper weathered zone of the drift. These pockets show little relationship in their occurrence and they do not form a continuous water-bearing horizon. They appear to be more numerous in the proximity of depressions and ravines. Prospecting for these shallow water-bearing deposits can be most economically done by means of a small-bore auger. The water that is obtained varies from comparatively soft to hard, and it is used for all farm requirements. The yield from all the recorded wells that tap these deposits is sufficient for local needs.

Most of the remaining wells in the township tap scattered pockets of sand or gravel that occur within the lower part of the glacial drift at depths ranging from 44 to 85 feet below the surface. These pockets appear to be sparsely distributed, although no dry holes were recorded. The yield from most of the wells that tap these aquifers is insufficient for local needs and must be supplemented by supplies conserved by dugouts and dams, or by hauling. The water from the wells is suitable for stock and it can usually be used for drinking.

Two wells on section 6, one on section 7, and one on section 10, appear to tap a common aquifer at depths ranging from 45 to 126 feet below the surface, or at elevations of 2,158 to 2,190 feet above sea-level. The aquifer is formed by a dark sand assumed to be in the Belly River formation. It is not thought that this aquifer is of large areal extent, but it may be tapped by other wells in this immediate locality. The supply of water is sufficient for local needs, but the water is highly mineralized and from two of the wells is used only for stock.

Township 30, Range 21

The surface of this township is gently rolling. Kiyiu or "Eagle" lake occupies a depression in the northern part of the township and a shallow valley extends southeast from the lake. This lake is dry during the greater part of the year. Glacial lake clay covers the valley and an area surrounding the lake. Glacial till or boulder clay underlies the lake clays and covers the remainder of the township. The lake clay is probably 20 to 40 feet thick, and the boulder clay may be over 125 feet thick. The Bearpaw formation immediately underlies the glacial drift in the south-eastern corner of the township and the Belly River formation underlies the glacial drift over the remaining part.

The glacial lake deposits consist of 2 to 6 feet of a light top soil and 15 to 35 feet of compact, dark-coloured clay. The clay does not contain any extensive deposits of sand or gravel and is a poor source of ground water supply. Small, scattered deposits of sand and gravel, however, occur at the contact of the lake clay and glacial till, and these may yield small quantities of water. The areal extent of these buried deposits is unknown, and testing with a small auger is advised prior to sinking a well. The glacial till or boulder clay consists of 2 to 5 feet of top soil, approximately 20 feet of yellow or weathered clay, which may contain sand or gravel in non-continuous beds at or near its base, and a compact, blue clay which may or may not contain scattered pockets of sand and gravel.

A few wells obtain water from sand and gravel pockets that occur at or near the base of the weathered zone of the drift, at depths ranging from 18 to 37 feet below the surface. In the northeastern corner of the township these deposits are fairly continuous, but over the remainder of the area they are of local distribution. The wells that tap these deposits generally yield a supply of water that is sufficient for 25 to 30 head of stock. During drought periods, however, the supply from these wells is noticeably depleted.

Some wells in this township tap scattered pockets of sand and gravel that occur in the blue clay. Dry holes may be dug before one of these pockets is struck as the pockets are not continuous. The wells generally yield a sufficient supply for local needs, but the water is highly mineralized and is not always suitable.for drinking.

Four wells, located on sections 4, 5, 6, and 18, have apparently passed through the mantle of glacial drift and tap a fine sand aquifer in the Belly River formation. These wells are

sunk to depths ranging from 60 to 125 feet below the surface, and the aquifers pierced are at elevations ranging from 2,140 to 2,180 feet above sea-level. It is not proved that the same aquifer is common to all four wells, but it appears to be so as the water rises to approximately the same elevation in each well. This aquifer may be of considerable areal extent but it does not appear to extend to the northeast, as a well on section 15 had to be drilled to an elevation of 2,060 feet above sea-level before a deposit of water-bearing sand was encountered. The yield from the wells is sufficient for local needs. The water is hard, under considerable pressure and is being used for drinking as well as for stock although it contains a considerable amount of mineral salts in solution.

Two wells located on sections 11 and 15, encounter a water-bearing, fine, blue sand at elevations of 2,090 and 2,060 feet above sea-level. The logs of these wells were not obtained, but it is assumed that the aquifers are in the Belly River formation and that the material overlying them consists chiefly of a compact blue clay. The wells are 150 and 180 feet deep respectively. It seems reasonable to assume that both wells are deriving their supply from a common aquifer and that the aquifer is of considerable areal extent. The wells on sections 11 and 15 yield an abundant supply of water which is under hydrostatic pressure and which rises to an elevation of approximately 2,220 feet above sea-level. The water is hard and that from the well on section 15 is so highly mineralized as to be rendered unsuitable for drinking. It is possible that the aquifer tapped by the four wells in the southwestern corner of the township dips towards the northeast and is the same aquifer as pierced by the wells on sections 11 and 15. If this is so it will be necessary to sink wells in excess of 180 feet in the northeastern part of the township in order to encounter the same aquifer. However, little

difficulty should be experienced in obtaining water if wells are sunk into the Belly River formation.

Dugouts could be advantageously used in this township to retain a supply of run-off water for stock use. These in conjunction with the producing wells should assure an adequate supply of water even during periods of drought.

STATISTICAL SUMMARY OF WELL INFORMATION IN RURAL MUNICIPALITY OF HILLSBURGH, NO. 289, SASKATCHEWAN

Township	28	28	28	29	29	29	30	30	30	Total No. in Muni-
West of 3rd mer. Range	19	20	21	19	20	21	19	20	21	cipality
Total No. of wells in Township	16	26	19	26	31	35	24	23	20	220
No. of wells in bedrock	6	14	13	0	6	14	0	4	6	63
No. of wells in glacial drift	10	12	6	26	25	21	24	19	14	157
No. of wells in alluvium	0	0	0	0	0	0	0	0	0	0
Permanency of Water Supply										
No. with permanent supply	16	23	18	26	29	34	24	23	18	211
No. with intermittent supply	0	0	1	0	0	0	0	0	0	1
No. dry holes	0	3	0	0	2	1	0	0	2	8
Types of Wells										
No. of flowing artesian wells	0	0	0	0	0	0	0	0	0	0
No. of non-flowing artesian wells	12	17	13	16	25	25	18	17	13	156
No. of non-artesian wells	4	6	6	10	4	9	6	6	5	56
Quality of Water										
No. with hard water	14	18	17	25	28	32	22	21	17	194
No. with soft water	2	5	2	1	1	2	2	2	1	18
No. with salty water	0	0	0	0	0	0	0	0	1	1
No. with "alkaline" water	6	8	11	7	15	19	8	7	7	88
Depths of Wells										
No. from 0 to 50 feet deep	4	3	5	10	6	3	13	12	9	65
No. from 51 to 100 feet deep	4	12	2	7	17	23	7	9	8	89
No. from 101 to 150 feet deep	6	7	9	5	6	6	4	2	2	47
No. from 151 to 200 feet deep	1	4	1	2	0	0	0	0	1	9
No. from 201 to 500 feet deep	1	0	2	2	2	2	0	0	0	9
No. from 501 to 1,000 feet deep	0	0	0	0	0	1	0	0	0	1
No. over 1,000 feet deep	0	0	0	0	0	0	0	0	0	0
How the Water is Used										
No. usable for domestic purposes	15	20	16	25	23	21	22	20	13	175
No. not usable for domestic purposes	1	3	3	1	6	13	2	3	5	37
No. usable for stock	16	23	19	26	29	34	24	23	18	212
No. not usable for stock	0	0	0	0	0	0	0	0	0	0
Sufficiency of Water Supply										
No. sufficient for domestic needs	16	23	18	26	29	34	24	23	18	211
No. insufficient for domestic needs	0	0	1	0	0	0	0	0	0	1
No. sufficient for stock needs	16	17	18	20	27	23	22	19	15	177
No. insufficient for stock needs	0	6	1	6	2	11	2	4	3	35

ANALYSES AND QUALITY OF WATER

General Statement

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

Total Dissolved Mineral Solids

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

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

Mineral Substances Present

Calcium and Magnesium

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

Sodium

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

Sulphates

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

Chlorides

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

Iron

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

Hardness

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

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

Analyses of Water Samples from the Municipality of Hillsburgh, No. 289, Saskatchewan

LOCATION						Depth of Well, Ft.	Total dis'vd solids	HARDNESS			CONSTITUENTS AS ANALYSED						CONSTITUENTS AS CALCULATED IN ASSUMED COMBINATIONS								Source of water
No.	Qtr.	Sec.	Tp.	Rge.	Mer.			Total	Perm.	Temp	Cl.	Alka-linity	CaO	MgO	SO_4	Na_2O	Solids	$CaCO_3$	$CaSO_4$	$MgCO_3$	$MgSO_4$	Na_2CO_3	Na_2SO_4	NaCl	
1	SE.	16	28	20	3	140	1,160	700	650	50	21	145	100	133	591	173	979	145	46		396		357	35	* 2
2	SW.	10	29	20	3	60	1,040	800	750	50	29	95	160	133	664	130	1,039	95	260		396		240	48	* 1
3	NE.	30	29	21	3	260	13,186												(4)		(2)	(3)	(1)	(5)	* 2
4	SW.	24	30	20	3	44	1,500	360	180	180	12	485	50	94	751	596	1,589	90		196		171	1,112	12	* 1

Water samples indicated thus, * 1, are from glacial drift.

Water samples indicated thus, * 2, are from bedrock, Belly River formation.

Analyses are reported in parts per million; where numbers (1), (2), (3), (4), and (5) are used instead of parts per million, they represent the relative amounts in which the five main constituents are present in the water.

Hardness is the soap hardness expressed as calcium carbonate ($CaCO_3$).

Analysis No. 3 by Provincial Analyst, Regina.

For interpretation of this table read the section on Analyses and Quality of Water.

Water from the Unconsolidated Deposits

Two samples of water from wells in the glacial drift in the municipality of Hillsburgh were taken for analysis. These samples are numbered 2 and 4 in the accompanying table. Sample 2 appears to be more representative of the waters derived from the glacial drift in this area than does Sample 4, and it does not contain an unduly high amount of mineral salts in solution. Such waters should prove suitable for domestic as well as stock use. Although $MgSO_4$ (Epsom salts) is the most highly concentrated salt in solution in the sample, the water should not prove harmful to those accustomed to its use. Na_2SO_4 (Glauber's salt) when highly concentrated may give the water a laxative effect, but it is not sufficiently concentrated in Sample 2 to render the water harmful. Sample 4 has a total dissolved solid content of 1,500 parts per million and a total hardness of 360 parts. It contains a large amount of Glauber's salts, 1,112 parts per million, but the water is being used for drinking without any noticeable ill effects.

As a rule the water from the deeper wells is more highly mineralized than that from the shallower wells. The water from a number of wells in this municipality was reported as having a laxative effect on humans. The water from a well on sec. 33, tp. 29, range 21, is so highly mineralized that its use is reported to be harmful for stock. In general the deep well waters from the glacial drift in this municipality are hard, highly mineralized, and often "alkaline". Most of them are suitable for stock, but they may prove to be undesirable for drinking.

Water from the Bedrock

Samples 1 and 3 are from wells that are believed to be deriving their water from the Belly River formation. Sample 1 is thought to be fairly representative of the type of water being

obtained from the wells in the area outlined by the "B" boundary line on Figure 1 of the accompanying map, and may be similar to that derived from the wells in the area outlined by the "A" boundary line. The water represented by Sample 1 does not differ greatly from that derived from the drift. It is used for drinking as well as for stock without any apparent ill effects.

Sample 3, taken from a well tapping an aquifer at a depth of 260 feet, has a total dissolved solid content of 13,186 parts per million. This water is unfit for farm use. Although the water from other wells that tap the Belly River formation was reported as having a laxative effect on humans, much of it probably does not contain such a large amount of mineral salts in solution.

In general, the waters from the bedrock in this municipality are suitable for stock use, but some of them may be too highly mineralized to be used for drinking. They will probably be unsuitable for irrigation.

WELL RECORDS—Rural Municipality of HILLSBURGH NO. 289, 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	SW.	4	28	19	3	Bored	120	2,320	-104	2,216	120	2,200	Glacial gravel	Hard, clear, "alkaline"	42	D, S	Sufficient for local needs.
2	SE.	5	"	"	"	Bored	110	2,320	- 94	2,226	106	2,214	Glacial gravel	Hard, clear, "alkaline"	42	D, S	Sufficient for local needs.
3	SW.	10	"	"	"	Bored	120	2,285	-110	2,175	120	2,165	Belly River? grey sand	Hard, cloudy, iron, "alkaline"	42	D, S	Sufficient for 10 head stock.
4	NW.	14	"	"	"	Drilled	350	2,370	-260	2,110	350	2,020	Belly River? sand	Hard, clear	42	D, S	Sufficient for local needs.
5	SW.	16	"	"	"	Drilled	200	2,312	-140	2,172	200	2,112	Belly River sand	Hard, clear, "alkaline"	42	S	Sufficient for stock needs.
6	SW.	17	"	"	"	Bored	125	2,300	-109	2,191	125	2,175	Belly River? sand	Hard, clear, iron, "alkaline"	42	D, S	Sufficient for local needs.
7	SW.	18	"	"	"	Bored	110	2,300	- 80	2,220	110	2,190	Belly River? blue sand	Hard, clear	42	D, S	Sufficient for local needs.
8	NE.	18	"	"	"	Bored	56	2,290	- 41	2,249	56	2,234	Glacial gravel	Hard, clear	42	D, S	Sufficient for local needs.
9	NW.	19	"	"	"	Bored	115	2,270	- 60	2,210	115	2,155	Belly River blue sand	Hard, clear	42	D, S	Sufficient for local needs.
10	S½.	22	"	"	"	Bored	30	2,340	- 18	2,322	30	2,310	Glacial drift	Soft, clear	42	D, S	Sufficient for local needs.
11	NE.	23	"	"	"	Dug	50	2,380	- 35	2,345	50	2,330	Glacial gravel	Hard, clear	42	S	Sufficient for local stock needs; also a similar well for domestic use.
12	SE.	27	"	"	"	Bored	60	2,330	- 54	2,276	54	2,276	Glacial sand and gravel	Hard, clear	42	D, S	Sufficient for local needs.
13	E½.	28	"	"	"	Bored	100	2,315	- 80	2,235	80	2,235	Glacial gravel	Hard, clear, iron, "alkaline"	42	D, S	Sufficient for local needs.
14	SW.	28	"	"	"	Bored	80	2,340	- 75	2,265	75	2,265	Glacial sand	Hard, clear, iron	42	D, S	Sufficient for local needs.
15	SW.	30	"	"	"	Dug	20	2,260	- 14	2,246	14	2,246	Glacial sand	Hard, clear	42	D, S	Sufficient for local needs.
1	NW.	2	28	20	3	Bored	110	2,320	-100	2,220	100	2,220	Belly River? sand	Hard, clear		D, S	Insufficient for local needs.
2	SE.	3	"	"	"	Bored	112	2,330	-100	2,230	100	2,230	Belly River? sand	Hard, clear		D, S	Sufficient for local needs.
3	NE.	5	"	"	"	Drilled	140	2,316	-125	2,191	140	2,176	Belly River? sand	Hard, cloudy, iron, "alkaline"	42	D, S	Insufficient for local needs.
4	NE.	8	"	"	"	Drilled	180	2,360	-110	2,250	180	2,180	Belly River sandstone	Hard, clear, iron		D, S	Sufficient for local needs.
5	NE.	10	"	"	"	Drilled	196	2,370	-150	2,220	196	2,174	Belly River black sand	Hard, clear, iron		D, S, I	Oversufficient for local needs.
6	S½.	12	"	"	"	Bored	112	2,300	- 77	2,223	100	2,200	Belly River? sand	Hard, clear		D, S	Sufficient for local needs.
7	E½.	15	"	"	"	Bored	80	2,325	- 72	2,253	80	2,245	Bearpaw? sand	Soft, clear, iron		D	Insufficient for local needs; also two 80-foot dry holes.
8	NW.	15	"	"	"	Drilled	177	2,325	- 97	2,228	177	2,148	Belly River sand	Hard, clear, iron		D, S	
9	SE.	16	"	"	"	Bored	140	2,340	- 90	2,250	120	2,220	Belly River silt	Hard, clear, "alkaline" sulphur		D, S	Sufficient for local needs. #
10	NE.	17	"	"	"	Bored	120	2,300	- 60	2,240	120	2,180	Belly River blue sand	Hard, clear, iron	42	D, S	Sufficient for local needs.

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 HILLSBURGH NO. 289, SASKATCHEWAN

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
11	SE.	18	28	20	3	Bored	50	2,300	- 45	2,255	45	2,255	Glacial drift	Soft, clear		D, S	Sufficient for 8 head stock.
12	S½.	20	"	"	"	Bored	35	2,330	- 30	2,300	30	2,300	Glacial sand	Soft, clear	42	D, S	Sufficient for local needs; another hole plugged with sand.
13	S½.	20	"	"	"	Bored	113	2,330	- 70	2,260	113	2,217	Belly River sand	Hard, iron, cloudy	42	S	Sufficient for local needs.
14	NE.	20	"	"	"	Bored	88	2,340	- 68	2,272	88	2,252	Glacial sand and gravel	Hard, yellow iron, "alkaline"		S	Insufficient for local needs.
15	NE.	20	"	"	"	Bored	80	2,320	- 64	2,256	80	2,240	Glacial gravel	Soft, clear		D, S	Insufficient for local needs; also another well.
16	N½.	21	"	"	"	Drilled	190	2,355	- 65	2,290	115	2,240	Belly River sand	Hard, clear, "alkaline" iron	42	D, S	Sufficient for local needs; also a 12-foot well caved in.
17	NE.	21	"	"	"	Bored	65	2,310	- 60	2,250	60	2,250	Glacial gravel	Soft, clear, iron		D, S	Sufficient for local needs.
18	SW.	30	"	"	"	Bored	60	2,340	- 30	2,310	60	2,280	Glacial gravel	Hard, clear	42	D, S	Sufficient for local needs.
19	N½.	30	"	"	"	Bored	60	2,300	- 50	2,250	60	2,240	Glacial sand	Hard, clear, "alkaline" iron		D, S	Oversufficient for local needs.
20	NW.	33	"	"	"	Bored	60	2,325	- 35	2,290	60	2,265	Glacial drift	Hard, clear, iron, "alkaline"		D, S	Sufficient for local needs.
21	SE.	34	"	"	"	Bored	65	2,260	- 53	2,207	65	2,195	Glacial sand	Hard, clear, iron, "alkaline"		S	Insufficient for local needs.
22	SE.	34	"	"	"	Bored	100	2,270									Dry hole, base in glacial drift.
23	NE.	34	"	"	"	Bored	48	2,260	- 45	2,215	45	2,215	Glacial sand	Hard, iron, cloudy	40	D, S	Insufficient for local needs.
24	SW.	36	"	"	"	Bored	75	2,270	- 60	2,210	75	2,195	Glacial sand	Hard, clear, "alkaline"		D, S	Oversufficient for local needs.
1	SE.	4	28	21	3	Bored	126	2,378	-113	2,265	126	2,252	Belly River formation	Hard, clear, "alkaline" iron	43	D, S	Sufficient for 20 head stock.
2	SW.	9	"	"	"	Dug	6	2,237	0	2,237	0	2,237	Glacial sand	Hard, clear, "alkaline"	40	D, S	Oversufficient for 100 head stock.
3	S½.	10	"	"	"	Bored	29	2,305	- 15	2,290	29	2,276	Glacial drift	Soft, clear	43	D, S	Sufficient for 100 head stock.
4	NW.	12	"	"	"	Drilled	280	2,365	-100	2,265	280	2,085	Belly River blue sand	Hard, clear, soda, "alkaline"		S	Oversufficient for local needs; also a 30-foot seepage well.
5	NW.	13	"	"	"	Bored	205	2,365	- 60	2,305	205	2,160	Belly River sand	Hard, clear	42	D, S	Sufficient for 40 head stock. #
6	SW.	14	"	"	"	Bored	148	2,400	-130	2,270	148	2,252	Belly River blue sand	Hard, clear "alkaline" iron		S	Oversufficient for 40 head stock.
7	NE.	15	"	"	"	Bored	135	2,390	-105	2,285	105	2,285	Belly River? sand	Hard, clear, "alkaline"	43	D, S	Sufficient for 50 head stock.
8	SE.	16	"	"	"	Bored	160	2,425	-140	2,285	160	2,265	Belly River? formation	Hard, clear, "alkaline"	43	D, S	Oversufficient for 50 head stock.
9	NE.	18	"	"	"	Dug	5	2,290	0	2,290	0	2,290	Glacial drift	Hard, clear	43	D, S	Sufficient for local needs.

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(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of HILLSBURGH NO.289, 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
10	SW.	22	28	21	3	Bored	123	2,400	- 95	2,305	123	2,277	Belly River? blue sand	Hard, clear, "alkaline"	42	D, S	Sufficient for 50 head stock.
11	SW.	23	"	"	"	Bored	120	2,390	- 90	2,300	120	2,270	Belly River blue sand	Hard, clear, "alkaline"	43	S	Sufficient for local needs.
12	SE.	24	"	"	"	Dug	20	2,310	- 14	2,296	20	2,290	Glacial sand	Soft, clear	42	D, S	Sufficient for 15 head stock.
13	NW.	24	"	"	"	Bored	69	2,340	- 50	2,290	69	2,271	Belly River? sand	Hard, clear, "alkaline"	42	D, S	Sufficient for 35 head stock.
14	SW.	26	"	"	"	Bored	115	2,395	- 97	2,298	115	2,280	Belly River blue sand	Hard, clear	43	D, S	Sufficient for 50 head stock.
15	SE.	27	"	"	"	Bored	115	2,400	- 95	2,305	95	2,305	Belly River blue sand	Hard, clear, "alkaline"	43	D, S	Sufficient for 50 head stock.
16	NE.	27	"	"	"	Bored	148	2,420	-130	2,290	148	2,272	Belly River blue sand	Hard, clear, "alkaline" iron	43	D, S	Sufficient for 50 head stock.
17	SE.	36	"	"	"	Dug	118	2,385	-114	2,271	114	2,271	Belly River sand	Hard, clear	43	D, S	Sufficient for 35 head stock.
18	NE.	36	"	"	"	Bored	80	2,400	- 50	2,350	80	2,320	Glacial sand and gravel	Hard, clear	43	D, S	Sufficient for 40 head stock.
1	NE.	3	29	19	3	Bored	80	2,315	- 65	2,250	75	2,240	Glacial gravel	Hard, cloudy, "alkaline" iron	42	D, S	Sufficient for local needs; also a 16-foot seepage well.
2	SW.	7	"	"	"	Drilled	188	2,400	-120	2,280	188	2,212	Glacial sand	Hard, clear, iron, "alkaline"		D, S	Sufficient for local needs.
3	NE.	9	"	"	"	Bored	105	2,410	- 65	2,345	102	2,308	Glacial sand	Hard, clear, iron	42	D, S	Sufficient for local needs.
4	SE.	11	"	"	"	Bored	85	2,310	- 75	2,235	75	2,235	Glacial clay	Hard, clear, "alkaline" iron		S	Insufficient for local needs.
5	SE.	12	"	"	"	Dug	20	2,286	- 17	2,269	17	2,269	Glacial sand	Hard, clear, iron		D, S	Sufficient for local needs.
6	SE.	15	"	"	"	Bored	160	2,395	- 80	2,315	160	2,235	Glacial drift	Hard, cloudy, iron, "alkaline"	42	D, S	Sufficient for local needs.
7	SW.	15	"	"	"	Bored	110	2,405	- 80	2,325	110	2,295	Glacial sandy gravel	Hard, clear, iron		D, S	Sufficient for local needs.
8	SE.	16	"	"	"	Bored	130	2,400	- 85	2,315	125	2,275	Glacial sand	Hard, clear, iron		D, S	Sufficient for local needs.
9	SW.	16	"	"	"	Bored	120	2,440	-115	2,325	120	2,320	Glacial sand	Hard, cloudy, "alkaline"	42	D, S	Insufficient for local needs.
10	SE.	18	"	"	"	Drilled	225	2,415	- 90	2,325	225	2,190	Glacial sand	Hard, cloudy, iron, "alkaline"		D, S	Sufficient for local needs.
11	NW.	18	"	"	"	Bored	45	2,390	- 33	2,357	45	2,345	Glacial sand	Hard, clear, iron		D, S	Sufficient for local needs.
12	SW.	19	"	"	"	Bored	142	2,340	-107	2,233	142	2,198	Glacial sand	Hard, cloudy, iron, "alkaline"		D, S	Insufficient for local needs.
13	N½.	20	"	"	"	Dug	25	2,375	- 19	2,356	25	2,350	Glacial sand	Hard, clear		D, S	Sufficient for local needs.
14	SW.	21	"	"	"	Dug	25	2,415	- 18	2,397	25	2,390	Glacial gravel	Hard, clear	42	D, S	Sufficient for local needs.
15	NE.	23	"	"	"	Bored	85	2,390	- 75	2,315	85	2,305	Glacial gravel	Hard, clear	42	D, S	Sufficient for local needs; also an 18-foot seepage well.

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(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of HILLSBURGH NO.289, 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
16	SW.	24	29	19	3	Drilled	220	2,410	-100	2,310	210	2,200	Glacial sand	Hard, clear, iron	42	D, S	Sufficient for local needs.
17	SE.	27	"	"	"	Bored	74	2,390	- 66	2,324	66	2,324	Glacial gravel	Hard, clear, iron	42	D, S	Sufficient for 12 head stock.
18	NE.	28	"	"	"	Dug & Bored	60	2,420	- 50	2,370	60	2,360	Glacial gravel	Hard, clear, iron	42	D, S	Sufficient for local needs.
19	NW.	31	"	"	"	Bored	75	2,370	- 50	2,320	75	2,295	Glacial sand	Hard, clear		D, S	
20	NW.	32	"	"	"	Dug	62	2,390	- 52	2,338	57	2,333	Glacial sand	Hard, clear, iron	42	D, S	Sufficient for local needs.
21	SE.	34	"	"	"	Dug	30	2,340	- 27	2,313	27	2,313	Glacial gravel	Hard, clear		D, S	Sufficient for 20 head stock.
22	SE.	35	"	"	"	Dug	30	2,385	- 22	2,363	26	2,359	Glacial sand	Soft, clear	42	D, S	Sufficient for local needs; also a similar well nearby.
23	SW.	36	"	"	"	Dug	30	2,380	- 26	2,354	26	2,354	Glacial sand	Hard, clear, iron	42	D, S	Insufficient for local needs.
1	SE.	2	29	20	3	Bored	30	2,290	- 27	2,263	27	2,263	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
2	W½.	2	"	"	"	Bored	72	2,290	- 32	2,258	72	2,218	Glacial drift	Hard, cloudy, iron, "alkaline"	42	D, S	2 tanks a day.
3	SW.	5	"	"	"	Bored	100	2,380	- 90	2,290	90	2,290	Glacial sandy clay	Hard, "alkaline"	42	S	Sufficient for local needs.
4	SE.	6	"	"	"	Bored	120	2,380	-113	2,267	120	2,260	Belly River? sand	Hard, clear iron, "alkaline"	42	S	Sufficient only for stock.
5	E½.	7	"	"	"	Bored	104	2,330	- 70	2,260	104	2,226	Belly River? sand	Hard, clear, "alkaline"	42	D, S	Sufficient for local needs.
6	SE.	9	"	"	"	Bored	60	2,260	- 45	2,215	60	2,200	Glacial sand	Hard, clear, iron	42	D, S	Sufficient for local needs.
7	NE.	9	"	"	"	Bored	40	2,285	- 24	2,261	40	2,245	Glacial sand	Soft, clear	42	D, S	Sufficient for local needs.
8	SW.	10	"	"	"	Bored	60	2,265	- 35	2,230	60	2,205	Glacial sand	Hard, cloudy, iron	42	D, S	Sufficient for local needs. #
9	NW.	11	"	"	"	Dug	58	2,300	- 50	2,250	58	2,242	Glacial sand	Hard, clear	42	D, S	Sufficient for local needs.
10	NW.	11	"	"	"	Bored	116	2,300									Dry hole, base in glacial drift.
11	SE.	13	"	"	"	Drilled	354	2,390	-229	2,161	350	2,040	Belly River black sand	Hard, clear, "alkaline" iron	42	D, S	Sufficient for local needs.
12	NW.	14	"	"	"	Bored	140	2,330									Dry hole, base in glacial drift.
13	SE.	15	"	"	"	Bored	100	2,305	- 50	2,255	100	2,205	Glacial drift	Hard, clear, iron	42	S	Insufficient for local needs.
14	E½.	16	"	"	"	Bored	45	2,295	- 37	2,258	45	2,250	Glacial sand	Hard, clear	42	D, S	Sufficient for local needs.
15	NW.	17	"	"	"	Dug & Bored	60	2,280	- 40	2,240	55	2,225	Glacial sand	Hard, clear, iron, "alkaline"	42	D, S	Sufficient for local needs. #
16	SE.	18	"	"	"	Bored	100	2,325	- 60	2,265	100	2,225	Belly River grey sand	Hard, clear, "alkaline"	42	D, S	Sufficient for local needs.
17	SW.	18	"	"	"	Bored	128	2,340	- 78	2,262	125	2,215	Belly River sand	Hard, cloudy, "alkaline"	42	S	Sufficient for local needs.

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(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of HILLSBURGH NO.289, 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
18	SE.	20	29	20	3	Bored	40	2,290	- 20	2,270	40	2,250	Glacial sand	Hard, clear, iron, "alkaline"	42	D, S	Sufficient for local needs.
19	SW.	20	"	"	"	Drilled	305	2,400	-125	2,275	290	2,110	Glacial sand	Hard, clear, "alkaline"	42	D, S	Sufficient for local needs.
20	E½.	22	"	"	"	Spring		2,280	0	2,280	0	2,280	Glacial drift	Hard, clear	44	D, S	Sufficient for local needs.
21	NW.	23	"	"	"	Bored	55	2,300	- 25	2,275	55	2,245	Glacial sand	Hard, clear, iron	42	D, S	Sufficient for local needs.
22	NE.	24	"	"	"	Bored	40	2,360	- 20	2,340	40	2,320	Glacial gravel	Hard, clear		D, S	Insufficient for local needs.
23	SE.	24	"	"	"	Bored	125	2,340	- 60	2,280	115	2,225	Glacial sand	Hard, clear, "alkaline" iron	42	D, S	Sufficient for local needs.
24	NE.	28	"	"	"	Bored	78	2,300	- 38	2,262	70	2,230	Glacial drift	Hard, clear, iron	42	D, S	Sufficient for local needs.
25	NE.	30	"	"	"	Bored	60	2,260	- 30	2,230	55	2,205	Glacial sand	Hard, clear, "alkaline" iron	42	D, S	Sufficient for local needs.
26	NW.	31	"	"	"	Bored	60	2,215	- 20	2,195	60	2,155	Glacial drift	Hard, clear, "alkaline"	42	D, S	Sufficient for local needs.
27	NE.	33	"	"	"	Bored	62	2,310	- 54	2,256	60	2,250	Glacial gravel	Hard, clear, iron	42	D, S	Sufficient for local needs.
28	SW.	34	"	"	"	Bored	80	2,305	- 50	2,255	76	2,229	Glacial drift	Hard, clear, "alkaline" iron	42	D, S	Sufficient for local needs.
29	NE.	34	"	"	"	Dug	53	2,305	- 47	2,258	51	2,254	Glacial sand	Hard, clear, iron	42	D, S	Sufficient for local needs.
30	NW.	35	"	"	"	Bored	90	2,340	- 60	2,280	80	2,260	Glacial sand	Hard, clear, "alkaline" iron	42	D, S	Sufficient for local needs.
31	NE.	35	"	"	"	Bored	60	2,345	- 40	2,305	40	2,305	Glacial sand	Hard, clear, iron	42	D, S	Sufficient for local needs.
1	SW.	2	29	21	3	Bored		2,370					Glacial drift	Hard, clear	40	D, S	Sufficient for 9 head stock.
2	SE.	4	"	"	"	Bored	80	2,380					Glacial drift	Hard, clear, "alkaline"	40	S	Sufficient for 70 head stock.
3	NE.	4	"	"	"	Bored	95	2,360	- 75	2,285	95	2,265	Belly River ? sand	Hard, clear, "alkaline" iron	40	D, S	Sufficient for 30 head stock.
4	NE.	10	"	"	"	Bored	64	2,340	- 60	2,280	60	2,280	Belly River sand	Soft		N	Good supply.
5	NE.	10	"	"	"	Drilled	690	2,340	- 40	2,300	115	2,225	Belly River sand	Hard, clear	40	S	Oversufficient for local needs.
6	SW.	12	"	"	"	Bored	100	2,365			100	2,265	Glacial sand	Hard, clear, iron	40	D, S	Sufficient for 20 head stock.
7	SW.	13	"	"	"	Bored	98	2,345	- 86	2,259	98	2,247	Belly River sand	Hard, clear, "alkaline" iron	40	D, S	Sufficient for 15 head stock.
8	SE.	14	"	"	"	Bored	108	2,355	- 68	2,287	108	2,247	Belly River sand	Hard, clear, "alkaline" iron	40	D, S	Sufficient for 10 head stock.
9	SW.	14	"	"	"	Bored	90	2,340	- 70	2,270	76	2,264	Belly River black sand	Hard, clear, "alkaline" iron	40	D, S	Sufficient for local needs.

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(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of HILLSBURGH NO. 289, 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
10	SE.	15	29	21	3	Bored	94	2,335	- 74	2,261	94	2,241	Belly River sand	Hard, clear, iron, "alkaline"	40	D, S	Sufficient for 15 head stock.
11	NW.	18	"	"	"	Bored	45	2,315	- 30	2,285	45	2,270	Glacial sand	Hard, clear, "alkaline" iron	40	S	Sufficient for local needs.
12	NE.	20	"	"	"	Dug	80	2,295					Glacial drift	Hard, clear	40	D, S	Oversufficient for 13 head stock.
13	SE.	21	"	"	"	Bored	85	2,310			85	2,225	Glacial sand	Hard, clear, iron	40	D, S	Sufficient for 25 head stock.
14	SW.	22	"	"	"	Bored	106	2,310	- 56	2,254	56	2,254	Glacial drift	Hard, clear, "alkaline"	40	D, S	Insufficient for 24 head stock- 56-foot well used for house.
15	NE.	22	"	"	"	Bored	150	2,310			150	2,160	Belly River sand	Hard, clear, "alkaline"	40	D, S	Sufficient for local needs.
16	SW.	24	"	"	"	Bored	85	2,305	- 58	2,247	85	2,220	Glacial sand	Hard, clear	40	D, S	Sufficient for 45 head stock.
17	NE.	24	"	"	"	Bored	52	2,260	- 46	2,214	52	2,208	Glacial drift	Hard, clear, "alkaline"	40	D, S	Sufficient for 10 head stock.
18	NW.	26	"	"	"	Bored	62	2,260	- 54	2,206	62	2,198	Glacial sand	Hard, clear,	40	D, S	Sufficient for 200 head stock.
19	SW.	27	"	"	"	Drilled	260	2,270			260	2,010	Belly River sand	Hard, clear, "alkaline"	40	D, S	Sufficient for local needs.
20	SW.	28	"	"	"	Dug	80	2,280			80	2,200	Glacial sand	Hard, clear, "alkaline"	40	S	Sufficient for local needs.
21	NE.	28	"	"	"		80	2,275					Glacial drift				Good supply of good quality water but well is now filled in.
22	SE.	29	"	"	"	Bored	110	2,280									Dry hole in glacial drift; water obtained from municipal dam.
23	SE.	30	"	"	"	Bored	32	2,290	- 25	2,265	25	2,265	Glacial sand	Hard, clear, "alkaline"	40	D, S	Sufficient for 30 head stock.
24	NE.	30	"	"	"	Bored	260	2,292	-100	2,192	260	2,032	Belly River blue sand	Hard, clear		N	Large supply. #
25	SE.	31	"	"	"	Bored	40	2,292	- 38	2,254	38	2,254	Glacial sand	Hard, clear, "alkaline"		S	Insufficient for local needs.
26	NE.	33	"	"	"	Bored	80	2,220	- 40	2,180	80	2,140	Glacial drift	Hard, clear, "alkaline"	42	S	Insufficient for local needs. Several similar wells not used.
27	SW.	34	"	"	"	Bored	78	2,263	- 60	2,203	78	2,185	Glacial gravel	Hard, clear, "alkaline"	40	D, S	Oversufficient for local needs.
28	SE.	34	"	"	"	Bored	104	2,245	- 40	2,205	104	2,141	Glacial gravel	Hard, clear	40	D, S	Sufficient for 25 head stock.
29	NW.	36	"	"	"	Bored	55	2,260	- 40	2,220	55	2,205	Glacial sand seams in clay	Soft, clear, iron	42	D, S	Insufficient for local needs; two wells 90 and 120 feet deep, not used.
1	NE.	1	30	19	3	Dug	20	2,400	- 12	2,388	15	2,385	Glacial sand	Hard, clear	42	D, S	Sufficient for local needs; have two similar wells.
2	NW.	2	"	"	"	Bored	50	2,400	- 38	2,362	50	2,350	Glacial gravel	Hard, clear, iron	42	D, S	Sufficient for local needs.
3	SE.	6	"	"	"	Bored	50	2,385	- 40	2,345	40	2,345	Glacial gravel	Hard, clear		D, S	Insufficient for local needs.
4	NE.	8	"	"	"	Bored	145	2,400	-120	2,280	145	2,255	Glacial gravel and sand	Hard, clear, "alkaline" iron		D, S	Sufficient for local needs.
5	NE.	12	"	"	"	Dug	20	2,450	- 17	2,433	17	2,433	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
6	SE.	13	"	"	"	Dug	19	2,425	- 15	2,410	15	2,410	Glacial sand	Soft, clear		D, S	Sufficient for 18 head stock.

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(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of HILLSBURGH NO.289, 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
7	SE.	14	30	19	3	Bored	25	2,480	- 5	2,475	25	2,455	Glacial gravel	Hard, clear	42	D, S	Sufficient for local needs.
8	NE.	14	"	"	"	Dug	14	2,470	- 11	2,459	11	2,459	Glacial sand	Soft, clear		D, S	Sufficient for local needs.
9	NW.	16	"	"	"	Bored	50	2,390	- 30	2,360	50	2,340	Glacial sand	Hard, clear, iron, "alkaline"		D, S	Sufficient for local needs.
10	SE.	20	"	"	"	Bored	50	2,360	- 30	2,330	50	2,310	Glacial sand	Hard, clear, iron, "alkaline"		D, S	Sufficient for local needs.
11	NW.	22	"	"	"	Bored	125	2,390	- 65	2,325	125	2,265	Glacial gravel	Hard, clear, iron, "alkaline"	42	S	Sufficient for local needs.
12	SE.	23	"	"	"	Bored	60	2,425	- 30	2,395	60	2,365	Glacial drift	Hard, clear	42	D, S	Sufficient for local needs.
13	NW.	24	"	"	"	Bored	111	2,415	- 81	2,334	81	2,334	Glacial sand	Hard, clear	42	D, S	Sufficient for local needs.
14	SE.	25	"	"	"	Bored	60	2,400	- 12	2,388	50	2,350	Glacial sand	Hard, clear, iron	42	D, S	Sufficient for local needs.
15	SE.	27	"	"	"	Bored	80	2,400	- 50	2,350	76	2,324	Glacial gravel and sand	Hard, clear, iron, "alkaline"	42	D, S	Sufficient for local needs.
16	SE.	28	"	"	"	Dug	50	2,390	- 45	2,345	50	2,340	Glacial gravel and sand	Hard, clear, "alkaline"	42	S	Sufficient for 12 head stock.
17	NE.	30	"	"	"	Bored	85	2,340	- 50	2,290	80	2,260	Glacial sand	Hard, clear, "alkaline" iron	42	D, S	Sufficient for local needs.
18	NW.	31	"	"	"	Bored	52	2,325	- 49	2,276	49	2,276	Glacial gravel	Hard, clear	42	D, S	Sufficient for local needs.
19	NE.	31	"	"	"	Bored	65	2,320	- 55	2,265	65	2,255	Glacial gravel and sand	Hard, clear, "alkaline" iron	42	D, S	Sufficient for local needs.
20	NE.	32	"	"	"	Bored	65	2,355	- 55	2,300	60	2,295	Glacial gravel and sand	Hard, clear,	42	D, S	Sufficient for local needs.
21	SW.	33	"	"	"	Bored	127	2,360	- 57	2,303	127	2,233	Glacial gravel	Hard, clear, iron	42	D, S	Sufficient for local needs.
22	SE.	35	"	"	"	Dug	20	2,385	- 8	2,377	20	2,365	Glacial gravel and sand	Hard, clear, iron	42	D, S	Sufficient for local needs.
1	SE.	1	30	20	3	Bored	85	2,380	- 65	2,315	75	2,305	Glacial gravel	Hard, clear	42	D, S	Insufficient for local needs.
2	SE.	2	"	"	"	Drilled	85	2,350	- 55	2,295	75	2,275	Glacial sand	Hard, clear, iron, "alkaline"	42	D, S	Sufficient for local needs.
3	SW.	6	"	"	"	Bored	45	2,210	- 15	2,195	38	2,172	Belly River black sand	Hard, clear, iron	42	D, S	Sufficient for local needs; also two springs.
4	SW.	6	"	"	"	Spring		2,200	0	2,200	0	2,200	Glacial drift	Hard, cloudy, "alkaline"			
5	NW.	6	"	"	"	Bored	62	2,220	- 25	2,195	62	2,158	Belly River sand	Hard, cloudy, iron, "alkaline"	42	S	Sufficient for local needs.
6	NE.	7	"	"	"	Bored	126	2,290	- 55	2,235	126	2,164	Belly River black sand	Hard, clear, iron, "alkaline"	42	S	Sufficient for local needs.
7	SW.	10	"	"	"	Bored	110	2,300	- 30	2,270	110	2,190	Belly River sand	Hard, clear, iron	42	D, S	Sufficient for local needs.

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WELL RECORDS—Rural Municipality of HILLSBURGH NO. 289, 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
8	SW.	12	30	20	3	Bored	78	2,330	- 60	2,270	78	2,252	Glacial ?black sand	Hard, clear	42	D, S	Insufficient for local needs.
9	NE.	12	"	"	"	Bored	85	2,330	- 65	2,265	75	2,255	Glacial ? black sand	Hard, clear	42	D, S	Insufficient for local needs.
10	N½.	14	"	"	"	Dug	30	2,305	- 6	2,299	30	2,275	Glacial drift	Hard, clear	42	D, S	Sufficient for local needs.
11	SE.	16	"	"	"	Dug	35	2,308	- 32	2,276	32	2,276	Glacial gravel	Hard, clear	42	D, S	Sufficient for local needs.
12	SE.	18	"	"	"	Bored	65	2,290	- 62	2,228	65	2,225	Glacial sand	Hard, clear, "alkaline"	42	D, S	Insufficient for local needs.
13	NE.	22	"	"	"	Bored	75	2,300	- 35	2,265	75	2,225	Glacial gravel	Hard, cloudy, "alkaline" iron	42	D, S	Insufficient for local needs.
14	SW.	24	"	"	"	Bored	44	2,310	- 26	2,284	44	2,266	Glacial sand	Hard, clear, "alkaline"	42	D, S	Sufficient for local needs. #
15	SE.	28	"	"	"	Dug	35	2,310	- 25	2,285	35	2,275	Glacial sand	Hard, clear	43	D, S	Sufficient for local needs.
16	SE.	29	"	"	"	Bored	28	2,280	- 18	2,262	28	2,252	Glacial sand	Soft, clear	42	D, S	Sufficient for local needs.
17	SW.	29	"	"	"	Bored	28	2,275	- 18	2,257	28	2,247	Glacial sand	Soft, clear	42	D, S	Sufficient for local needs.
18	SW.	30	"	"	"	Dug	35	2,260	- 27	2,233	27	2,233	Glacial drift	Hard, clear	42	D, S	Sufficient for local needs.
19	NW.	30	"	"	"	Dug	34	2,250	- 31	2,219	31	2,219	Glacial sand	Hard, clear	42	S	Sufficient for local needs.
20	N½.	34	"	"	"	Dug	60	2,315	- 52	2,263	60	2,255	Glacial sand	Hard, clear	42	D, S	Sufficient for local needs.
21	SW.	36	"	"	"	Bored	65	2,315	- 30	2,285	60	2,255	Glacial sand	Hard, clear, iron	42	D, S	Sufficient for local needs.
1	SW.	4	30	21	3	Bored	100	2,250	- 60	2,190	100	2,150	Belly River formation	Hard, clear, salty "alkaline"	42	D, S	Sufficient for 15 head stock.
2	SE.	5	"	"	"	Bored	60	2,240	- 40	2,200	60	2,180	Belly River formation	Hard, clear, "alkaline" iron	42	S	Sufficient for 18 head stock.
3	NW.	6	"	"	"	Bored	125	2,265	- 65	2,200	125	2,140	Belly River sand	Hard, clear, "alkaline" iron	42	D, S	Insufficient for 30 head stock.
4	NW.	11	"	"	"	Drilled	150	2,240	- 20	2,220	150	2,090	Belly River ? blue sand	Hard, clear, "alkaline"	42	D, S	Sufficient for 12 head stock.
5	NW.	12	"	"	"	Bored	100	2,240	- 96	2,144	96	2,144	Glacial drift	Hard, clear, iron	41	S	Insufficient supply; waters 8 head stock.
6	SW.	13	"	"	"	Bored	40	2,215	- 20	2,195	20	2,195	Glacial gravel	Hard, clear, iron	42	D, S	Insufficient for local needs. Municipal dam here with good supply.
7	NE.	14	"	"	"	Bored	82	2,250	- 52	2,198	82	2,168	Glacial sand	Hard, clear	42	D, S	Sufficient for 10 head stock.
8	SE.	15	"	"	"	Drilled	180	2,240	- 20	2,220	180	2,060	Belly River? sand	Hard, clear "alkaline" iron	40	S	Oversufficient for 5 head stock.
9	NW.	16	"	"	"	Dug	20	2,200	- 10	2,190	10	2,190	Glacial drift	Hard, clear	40	D, S	Insufficient for local needs.
10	NE.	18	"	"	"	Bored	91	2,240	- 40	2,200	91	2,149	Belly River? blue sand	Hard, clear, iron	42	D, S	Oversufficient for 30 head stock.

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(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of HILLSBURGH NO.289, SASKATCHEWAN

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
11	NW.	18	30	21	3	Bored	40	2,265			40	2,225	Glacial gravel	Hard, clear	42	D, S	Sufficient for 20 head stock.
12	NW.	22	"	"	"	Bored	60	2,200	- 40	2,160	60	2,140	Glacial sand	Hard, clear, "alkaline"	42	S	Sufficient for 30 head stock.
13	NE.	22	"	"	"	Bored	50	2,230	- 25	2,205	50	2,180	Glacial sand	Hard, clear	42	D, S	Oversufficient for local needs.
14	SE.	22	"	"	"	Bored	45	2,235	- 15	2,220	45	2,190	Glacial drift	Hard, clear, "alkaline"	42	S	Sufficient for 14 head stock; seepage well for domestic use.
15	SW.	23	"	"	"	Bored	75	2,230									Dry hole base in glacial drift.
16	NE.	24	"	"	"	Dug	22	2,260	- 16	2,244	22	2,238	Glacial sand	Soft, clear	43	D, S	Sufficient for 25 head stock.
17	SE.	25	"	"	"	Dug	18	2,250	- 10	2,240	18	2,232	Glacial sand	Hard, clear, iron	43	D, S	Sufficient for 20 head stock.
18	SE.	36	"	"	"	Dug	37	2,275	- 33	2,242	33	2,242	Glacial sand	Hard, clear	42	D, S	Oversufficient for 12 head stock.

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(#) Sample taken for analysis.