CANADA
DEPARTMENT OF MINES

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BUREAU OF ECONOMIC GEOLOGY

GEOLOGICAL SURVEY



PRELIMINARY REPORT

# GROUND-WATER RESOURCES OF THE RURAL MUNICIPALITY OF MARQUIS No. 191 SASKATCHEWAN

BY

B. R. MacKay, H. N. Hainstock & J. A. Chalmers

Water Supply Paper No. 156

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# GROUND WATER RESOURCES OF THE RURAL MUNICIPALITY OF MARQUIS, NO. 191 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 fine the approximate depth to a water-bearing horizon, be 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 given 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.

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

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

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

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

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

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

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

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

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

# 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 côteau. 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 Marquis, No. 191, is a triangular-shaped area of approximately 300 square miles in the central part of southern Saskatchewan. It is bounded on the west by the Third meridian and on the northeast by Qu'Appelle river and Buffalo Pound lake. The centre of the municipality is located 9 miles west and 20 miles north of the city of Moose Jaw. The municipality consists of three full townships, described as township 19, range 27, and townships 19 and 20, range 28; parts of six townships, described as townships 19, ranges 25 and 26, townships 20, ranges 26 and 27, and townships 21, ranges 27 and 28; two fractional townships, described as townships 19 and 20, range 29; and parts of two fractional townships, described as townships 21 and 22, range 29; all west of the Second meridian. The Outlook section of the Canadian Pacific railway crosses the centre of the municipality in a northwest-southeast direction, and on it are located the villages of Tuxford, Marquis, and Keeler. The Darmody division of the Canadian National railways runs across the southwestern part of the municipality and approximately parallels the Canadian Pacific railway. The hamlet of Rowletta is located on this line.

The flood-plain of Qu'Appelle river is formed by Recent stream deposits. The thickness of these river deposits is not known. The remainder of the municipality is underlain by boulder clay or glacial till, but in an area paralleling the valley of Qu'Appelle river on the southwest the boulder clay is concealed by a deposit of glacial lake clay. In a small area in the south-western corner the glacial till is also overlain by glacial lake clay. It is doubtful if the glacial lake clay exceeds 20 feet in thickness anywhere in the municipality. The thickness of the glacial drift varies throughout the municipality. The minimum thickness occurs in an area paralleling the river in the northern part of the municipality where the Bearpaw bedrock formation outcrops.

The maximum thickness of approximately 300 feet occurs in the western part of the area.

Water-bearing Horizons in the Unconsolidated Deposits

Only one recorded well in this municipality appears to be deriving its water supply from the Recent stream deposits. The supply obtained by this well is small, but the water is used for domestic purposes and for stock, although it is slightly "alkaline". Moderate supplies of usable water should be obtained from these deposits elsewhere in the municipality. The lake clay does not yield water although it is quite sandy, particularly along the borders of the old lake basin.

Most of the wells in this municipality derive their supply from pockets of sand and gravel that occur in the glacial till. In general the glacial till or boulder clay is composed of 20 to 30 feet of weathered or yellow clay, and blue clay that extends to the bedrock. In the southwestern part of the municipality the weathered zone is apparently very thin and in some parts the blue clay comes to the surface. Pockets of water-bearing sand and gravel have been located in both the yellow and blue clays, but they are apparently more abundant in the upper zone of the drift. Consequently, it is quite difficult to locate water in the southwestern parts of the area. The water obtained from wells sunk in the upper part of the glacial till is of good quality, and that from most wells is usable for domestic purposes and stock, although some of it is slightly "alkaline". The water from most wells is hard, but that from a few, which obtain their supply by direct seepage from impounded surface water, is moderately soft. The supply from this type of well is usually intermittent, but one located in the NE.$\frac{1}{4}$, sec. 36, tp. 19, range 29, yields a permanent supply of soft water. The yield from most of the shallow wells in this municipality is small and several wells must be used or the supply supplemented by the use of dugouts.

Most of the deeper wells, sunk to depths of 30 to 90 feet, do not yield good supplies of water. The best supply is usually derived at depths of approximately 45 feet. The water is more highly mineralized than that from the shallow wells, and the water from a few wells cannot be used even for stock. In the southern part of townships 20, ranges 26 and 27, wells sunk to depths of 50 to 70 feet encounter an aquifer that yields water containing a very large amount of sodium sulphate, magnesium sulphate, and sodium chloride. The areal extent of this aquifer cannot be outlined as sufficient information is not at hand.

One well, located in the SE.¼, sec. 13, tp. 19, range 27, obtains a fairly abundant supply of usable water at a depth of 130 feet. The water-bearing deposit encountered by this well is of local occurrence.

A number of wells in the western part of the municipality derive water from an aquifer at depths of 300 to 315 feet. This aquifer is believed to be in the glacial drift, but it occurs at a low elevation and may be in the upper part of the Bearpaw formation. The aquifer is a very fine sand, and difficulty is experienced in keeping the sand from plugging the well casings and completely shutting off the supply of water. If the wells can be kept clean they should yield an adequate supply of water for farm requirements. The water is hard and in many cases slightly "alkaline", but it is usable for domestic purposes as well as for stock.

Water-bearing Horizons in the Bedrock

The only well that definitely derives water from the Bearpaw formation is the Detta Gessel well, located in the NE.¼, sec. 26, tp. 21, range 29. This well is sunk to a depth of 563 feet and encounters two water-bearing beds at depths of 433 and 465 feet. Little information is available concerning the quality and quantity of water obtained. A well located in the NE.¼, section 10, of the same township, is sunk to a depth of 640 feet, but the only water-bearing bed encountered, at a depth of 280 feet, is believed to be in the glacial drift. The lower part of this well is undoubtedly in the Bearpaw formation, and it would appear that this formation does not contain many water-bearing beds, but sufficient information is not available to outline the water-bearing possibilities of the formation in this municipality. The Bearpaw formation outcrops at many localities along Qu'Appelle valley as well as in the tributary coulées. Some of these outcrops occur at an elevation of 1,750 feet above sea-level, or somewhat higher, and if the well on the NE.$\frac{1}{4}$, section 10, derives its supply from the glacial drift the surface of the bedrock must slope to the south, as the elevation of the bedrock at the well site is less than 1,660 feet. No outcrops of the Bearpaw formation were observed in the eastern part of the municipality, but it probably occurs at elevations of 1,650 to 1,700 feet above sea-level in this area.

## GROUND WATER CONDITIONS BY TOWNSHIPS

### Township 19, Range 25

Only approximately 9 square miles of this township are in the municipality of Marquis. Glacial till or boulder clay is exposed on the banks of Buffalo Pound lake and its tributaries, and glacial lake clay overlies boulder clay elsewhere in the area under discussion. The elevation drops from 1,900 feet at plain level to 1,659 feet above sea-level at the lake. The valley slopes and some of the larger tributary coulées are covered by small poplar trees.

With the exception of four wells located in the SE.¼, section 6, no wells are recorded in this area. These wells obtain their supply chiefly by seepage from the clay, but a small amount of water may be derived from a gravelly or sandy clay aquifer. The combined supply from the wells is sufficient for the farmer's requirements. Definite information on each of these wells is not available, but the water from a 23-foot well cannot be used for domestic purposes as it contains a large amount of mineral salts in solution. It is doubtful if the lake clay will yield water, but water-bearing deposits should occur in the underlying boulder clay or glacial till. As the lake clay is not very thick, it is advisable to prospect the upper part of the drift with a small test auger. In this way water-bearing deposits may be located prior to digging a well.

### Township 19, Range 26

Only that part of this township lying southwest of Buffalo Pound lake is included in this municipality. The surface of this part of the township is quite level, being covered by glacial lake clay except in the valley that contains Buffalo Pound lake where the lake clay has been cut through and the glacial till or boulder clay is exposed along the banks. The valley is approximately 250 feet deep in this area and poplar trees are common along the valley slope.

Wells sunk to depths of 16 to 32 feet obtain water from sand or gravel pockets that occur in the upper part of the glacial drift underlying the dark-coloured lake clay. The lake clay in most of this area appears to be very thin, rarely exceeding 10 feet in thickness, and yields little or no water. The water-bearing deposits in the upper part of the underlying glacial drift are probably quite small, and they yield very limited supplies of water, only approximately one-half of the wells yielding sufficient water for local requirements. Three wells sunk in a small draw in the SW.$\frac{1}{4}$, section 17, together yield a sufficient supply of water for local needs. The water from the producing wells is suitable for stock needs and usable for drinking, although that from some wells is slightly "alkaline". The character of the lake deposits permits the excavation of dugouts to collect and retain surface water. Shallow wells sunk beside these artificial reservoirs, and connected to them by filters, yield water that is usable for domestic needs. The village of Tuxford obtains its supply from one of these "filter wells", as water-bearing beds cannot be located in the drift in this vicinity. Care must be taken to see that the water in the dugout does not become contaminated.

Six wells sunk to depths of 40 to 48 feet tap pockets of sand and gravel in the blue clay. The water obtained is more highly mineralized than that from the shallower wells in the yellow clay, and some of it is unsatisfactory for domestic use. The supply obtained, however, is fairly abundant, and only one well yields an insufficient supply. Probably the best well in the township is located in the NW.$\frac{1}{4}$, section 22. This well taps an aquifer at a depth of 48 feet, and yields approximately $1\frac{1}{2}$ tanks of water a day. The water-bearing deposits in the upper 50 feet of the drift in this township appear to be small and of infrequent occurrence. Other deposits may occur at depth, but it appears to be more economical to conserve surface water by dugouts. Wells sunk beside these artificial reservoirs and connected to them by a filter bed yield water that is usable for all domestic needs.

## Township 19, Range 27

Glacial till or boulder clay covers the western half of this township and lake clay overlies boulder clay in the eastern half. The ground surface is flat to gently undulating and the elevation increases towards the west.

The supply of water in this township is obtained from wells, sloughs, and dugouts. A few wells derive water at depths of 14 to 30 feet, and tap pockets of sand or gravel in the upper part of the glacial till or boulder clay. The glacial lake clay is not a source of water, but it is thin and wells are sunk through it and tap water-bearing deposits in the underlying boulder clay. The pockets of sand and gravel are small and rarely yield more than 1 or 2 barrels of water a day. The water, with the exception of that from a well in the SE.$\frac{1}{4}$, section 35, is hard. The water from this well is derived by direct seepage from a slough. It is not highly mineralized and is being used for domestic purposes and for stock. Approximately one-half the wells in this township obtain water from sand or gravel pockets at depths of 35 to 80 feet. The water in these wells is more highly mineralized than that from the previous group, and that from a number of them is usable only for stock. The supply is not always sufficient for local requirements, in which case dugouts are used to supplement the supply. The water may be under slight hydrostatic pressure.

A few attempts have been made to obtain water at depth in the glacial drift. One well, located in the SE.$\frac{1}{4}$, section 13, obtains water from a fine sand aquifer at a depth of 130 feet. The water is usable for domestic purposes or stock, and the supply is sufficient for at least 20 head of stock. Three wells, located in the NW.¼, section 17, NE.¼, section 31, and SW.¼, section 32, derive water at depths of 242, 240, and 240 feet, respectively. The aquifer encountered in each well is fine sand, and although it contains an abundance of water difficulty has been experienced in keeping the sand from plugging the casings; two of the wells are almost completely plugged by sand and are no longer in use. The well located in the NW.¼, section 17, yields a good supply of hard water that is usable for domestic purposes as well as for stock. A fairly continuous aquifer may exist at an elevation of approximately 1,700 feet, or at a depth of 240 feet, in the western part of the township. It does not appear advisable to tap this horizon, however, as the sand plugs the wells and renders them useless, unless this can be prevented by the use of screens in the wells.

The best supply of water is obtained at depths of 30 to 80 feet, but the aquifers are of local occurrence and dry holes may be dug. It is advisable to prospect the upper 30 to 40 feet of the drift with a small hand test auger prior to digging a shallow well. The conservation of surface water by the use of dugouts is highly recommended.

## Township 19, Range 28

This township is mantled by glacial till; the ground surface is gently rolling and is characterized by numerous undrained depressions. The northwestern part of the township is at an elevation slightly above 2,000 feet, and the elevation decreases gradually towards the east. The soil is a heavy, yellow clay loam in the eastern part of the township, but it becomes darker towards the west.

Small supplies of water are obtained from pockets of sand or gravel at depths of 20 to 22 feet. The water in these wells is not under hydrostatic pressure. Most of the wells are sunk beside sloughs and much of the water is obtained by seepage from the impounded surface water. In wet seasons when the sloughs are full some of these wells yield fairly abundant supplies, but during drought periods the supply is frequently insufficient for local needs. The quality of the water varies and depends to a great extent on the amount of water being derived directly from the sloughs. During the wet season the water from some of the wells is fairly soft, but in drought periods it becomes hard. It is, however, suitable for stock needs and is being used for domestic purposes. Three wells derive water at depths of 32 to 36 feet. The aquifers supplying these wells may be somewhat larger than those supplying the previous wells, but they are not continuous. The supply obtained is not large, but one well yields sufficient water for 40 head of stock.

A well located in the SW.$\frac{1}{4}$, section 18, encountered an aquifer at a depth of 270 feet, or an elevation of 1,760 feet above sea-level. Water was obtained but the fine sand of the aquifer plugged the casing and the well is no longer used. The water was hard and suitable for domestic purposes as well as for stock.

The supply of water from wells in this township is not abundant and it varies with the amount of precipitation. The water-bearing deposits are small and scattered, and should be located by means of a small hand auger before a well is dug. Dugouts are being used extensively to conserve surface water for stock needs. On some farms they serve as the sole source of water supply and their use is highly recommended. The information on hand appears to indicate that a fairly extensive and continuous aquifer of fine sand occurs at depths of 240 to 270 feet. It contains a considerable amount of water, but the sand often plugs the casings and shuts off the supply. This difficulty, and the expense of drilling, are factors to be considered before drilling wells to this aquifer.

Township 19, Range 29

This fractional township is mantled by glacial till, which in the southwestern corner is overlain by a thin deposit of glacial lake clay. The surface is gently rolling and the elevation gradually decreases towards the south. The soil is a heavy, black clay loam.

Pockets of water-bearing sand and gravel are very scarce in the upper part of the glacial drift, and shallow wells in this area derive water mainly by direct seepage from sloughs or dugouts, although some of them may have encountered small pockets of sand or gravel. Five wells sunk to depths of 8 to 18 feet are recorded and three of them yield insufficient supplies, not exceeding 5 or 6 barrels of water a day. The water, with the exception of that from a well located in the NE.$\frac{1}{4}$, section 36, is hard. This well is sunk to a depth of 8 feet in gravel and yields a supply of soft water sufficient for 12 head of stock. The aquifer that this well taps appears to extend in a southwest-northeast direction. Should it be encountered in other localities a good supply of water is to be expected. Water-bearing deposits should be located with a test auger before a well is dug.

A number of wells encounter a sand aquifer at a depth of approximately 300 feet, or at an elevation of 1,760 feet above sea-level. It is probably the same aquifer that occurs in the township to the east. The aquifer contains a large supply of water, but the sand is fine and it has completely plugged four wells. In two wells, located on sections 33 and 34, the aquifer is composed of a coarser sand and the wells yield sufficient water for 25 or 30 head of stock. The water is hard and that from three of the wells is slightly "alkaline", but it is usable for domestic purposes or for stock. A well in the NE.$\frac{1}{4}$, section 20, is reported to have encountered this aquifer, but it does not yield water. It is not known if the sand is dry or if it has plugged the well casing.

The main source of water supply in this area is obtained from sloughs and dugouts. The surface water from these reservoirs is used for stock, and water for domestic needs is derived from shallow wells sunk beside the impounded surface water. These shallow seepage wells are not listed in the accompanying well records or shown on the map.

Township 20, Range 26

Only the part of this township that lies to the southwest of Buffalo Pound lake and Qu'Appelle river, an area of 7 square miles, is in the municipality of Marquis. The elevation decreases gradually from less than 1,950 feet above sea-level at the western boundary to 1,900 feet at the edge of the valley, and then decreases rapidly to 1,659 feet at the lake. Glacial till or boulder clay occurs along the slope of the valley and lake clay overlies boulder clay in the remaining part of the township. The valley slope is covered with a growth of small poplar.

Dugouts are used extensively as a source of water supply on the farms in this township. Two wells obtain water at depths of 20 and 22 feet. One of these wells yields a large supply of soft water, but the nature and extent of the aquifer encountered are not known. The other well yields a small supply of soft water, and most of it is undoubtedly obtained by direct seepage from a slough. The water in both wells is usable for all farm needs. Wells have been sunk to a depth of 70 feet in the NW.$\frac{1}{4}$, section 6, but they obtained only a small supply of salty, unusable water. It is advisable to prospect the upper part of the drift with a small hand auger prior to digging wells. Should water-bearing pockets of sand and gravel not be encountered, it is not recommended to sink wells to great depth. Coulées leading into the lake are good locations for shallow wells. The use of dugouts to retain surface water is highly recommended.

Township 20, Range 27

Parts of sections 25 and 35, and all of section 36, lie to the northeast of Qu'Appelle river and are not in the municipality of Marquis. The river valley is over 200 feet deep and more than a mile wide. The flood-plain of the river is formed by Recent stream deposits, and the remainder of the area is covered in part by glacial lake clay and in part by boulder clay. In a large area in the central part of the township approximately 10 feet of non-water-bearing glacial lake clay overlies boulder clay.

A number of wells obtain water from pockets of sand and gravel in the upper part of the boulder clay at depths of 15 to 30 feet. In the central part of the area these wells are sunk through the lake clay into the underlying boulder clay. Most of the shallow wells yield only 2 or 3 barrels of water a day, but a few appear to have encountered aquifers of larger areal extent, and one well in the NE.$\frac{1}{4}$, section 5, yields approximately 40 barrels of water a day. The water from three of these wells is "alkaline" and has a slight laxative effect on humans, but only one well is not being used for domestic purposes.

A number of wells tap pockets of sand or gravel at depths of 32 to 65 feet, and the water-bearing deposits occur in the unweathered, blue boulder clay. The water from these wells is frequently under slight hydrostatic pressure. It is more highly mineralized than that from the previous group of wells, and that from approximately half of them cannot be used for domestic purposes. The water from a 65-foot well in the NE.$\frac{1}{4}$, section 1, cannot be used for domestic purposes or for stock. The yield from these deeper wells is more abundant than that from the shallower wells, but two of them yield insufficient water for local needs. A 45-foot well located in the NE.$\frac{1}{4}$, section 7, is described as yielding sufficient water for at least 100 head of stock.

When there is a shortage of water from wells in this township, dugouts are used extensively. On some farms dugouts and "filter wells" dug beside them are the only sources of water supply. Water-bearing deposits may be encountered at depths of 35 or 40 feet, but the deposits are not numerous or continuous and dry holes may be dug. Any water that may be derived at depth in this township will probably be very highly mineralized. The use of dugouts to conserve surface water is the best method of obtaining water in this township.

Township 20, Range 28

Glacial till or boulder clay mantles this township except in the northeastern part where glacial till is overlain by glacial lake clay to a depth of approximately 10 feet. The lake clay is rather sandy, especially along the edge of the basin. The elevation decreases from approximately 2,000 feet above sea-level at the southwestern corner to 1,900 feet in the north and northeastern sections.

Wells, springs, dugouts, and sloughs are used to obtain supplies of water in this township. Dugouts are not used as extensively as in the townships previously discussed in this report. At least sixteen wells obtain water from pockets of sand and gravel in the glacial till at depths of 10 to 30 feet. In the lake clay-covered area the wells are sunk through the lake clay into the underlying boulder clay. The sand and gravel aquifers encountered by the shallow wells are frequently 8 to 10 feet thick, and water is obtained in the lower part of this water-bearing deposit. The quantity of water obtained from wells, even on the same section, varies considerably, and it is doubtful if any of the water-bearing beds are continuous over a larger area. Many of the wells yield only 1 to 3 barrels of water a day, and two or three wells are used to supply sufficient water for farm needs. A few wells yield sufficient water for 30 to 50 head of stock, and one located in the SE.$\frac{1}{4}$, section 18, yields approximately 15 tanks of water a day. The water from most of the wells is hard and sometimes slightly "alkaline", but is usable for domestic purposes or for stock. A number of wells yield soft water, and most of them are located a short distance east and north of the village of Keeler.

Approximately half of the wells in the township obtain water at depths of 31 to 90 feet. The aquifers are thought to be formed by pockets of sand or gravel rather than by continuous layers. The water in several of these deeper wells is under slight hydrostatic pressure, and it is probable that the aquifers supplying these wells are located in the nearly impervious, blue boulder clay. Several deeper wells do not yield sufficient water for local requirements, whereas others yield 4 or 5 tanks of water a day. The water as a rule is usable for domestic needs as well as for stock, although that from a 90-foot well located in the SE.$\frac{1}{4}$, section 30, cannot be used for drinking. The water is hard and quite highly mineralized.

Before digging wells in this township it appears advisable to prospect the upper 20 to 30 feet of the drift with a small test auger. Water can be located below these depths, but it does not appear to be more abundant, and no wells deeper than 60 feet yield a sufficient supply for local needs. When the subsoil is sufficiently impervious to prevent the downward seepage of water, dugouts can be excavated to retain surface water for stock needs. Shallow wells dug beside these artificial reservoirs and connected to them by a filter channel should yield sufficient water for domestic needs.

Township 20, Range 29

This fractional township is mantled by glacial till or boulder clay, except in parts of sections35 and 36 where the boulder clay is concealed by a thin deposit of glacial lake clay. The surface is gently undulating, and the elevation decreases from approximately 2,035 feet above sea-level in the southwestern corner.

Deposits of water-bearing sand or gravel appear to be very scarce in the upper part of the drift, and dugouts and sloughs supply most of the water for the farms in this township. A few wells obtain water at depths of 14 to 30 feet, but they are readily affected by the amount of precipitation and become completely dry during drought periods; none of them yield sufficient water for local needs even during years of normal rainfall. The water is in most cases hard, but that from the wells that are sunk beside sloughs is often relatively soft.

Two wells, located in the SW.$\frac{1}{4}$, section 2, and the NE.$\frac{1}{4}$, section 12, derive water at depths of 48 and 45 feet, but the supply is insufficient for local needs and the water is of very poor quality. The water from the well in section 2 is slightly salty and is not usable for domestic purposes. The water from the other well is "alkaline", and although used for domestic needs and stock, it would probably have a laxative effect on persons unaccustomed to its use. Dry holes have been sunk in this township to a maximum depth of 110 feet.

Two wells, located in sections 16 and 18, are sunk to depths of 315 and 313 feet, and their aquifers are thought to occur at or near the contact of the drift and the underlying bedrock, but they may be in the upper part of the bedrock. The water is obtained from fine sand which has completely plugged the casing in the well in section 18, and the supply of water is sealed off. The sand aquifer in the other well is much coarser and an abundant supply of water is obtained. The water is hard and "alkaline", and is suitable for stock. It is used for drinking, but it may act as a laxative.

The use of dugouts is highly recommended in this area to conserve surface water. They should be located in depressions and should be at least 12 feet deep. It does not appear advisable to sink wells to great depths in this area.

Township 21, Range 27

Approximately 4 square miles of this township are in the municipality of Marquis. The greater part of this area lies on the south slope of Qu'Appelle river and is deeply dissected by coulées. Recent stream deposits form the flood-plain of the river, and the remainder of the area is covered by glacial till or boulder clay, except in a small area in the SW.$\frac{1}{4}$, section 6, where the boulder clay is overlain by a thin deposit of glacial lake clay.

The area is not suitable for cultivation and no wells have been dug. Little is known concerning the water-bearing deposits in this area, but it is possible that small supplies of water could be obtained at shallow depth in the glacial till or boulder clay. Small supplies of usable water should also be derived from the Recent stream deposits.

The Bearpaw formation outcrops in section 6, but the exact elevation of the contact of the drift and bedrock is not known. The bedrock in this area is not thought to be a good source of water.

## Township 21, Range 28

Only the part of this township that lies to the south of Qu'Appelle river is discussed in this report. A large part of this area is deeply dissected by tributary coulées of the river, and the ground surface is very irregular. Recent stream deposits occur on the flood-plain of the river, and the remainder of the area is mantled by boulder clay or glacial till. In a few small areas along the southern boundary the boulder clay is overlain by glacial lake clay.

This township is sparsely settled and many of the farms were abandoned during the drought period. Consequently, the information regarding the water conditions is small and the records of four wells only were obtained. One of these wells is dug in the Recent stream deposits and yields only a few pails of water a day, but the supply is sufficient for domestic needs. The water is hard and slightly "alkaline", but is usable for drinking as well as for stock.

Two wells obtain water from pockets of sand and gravel in the glacial drift at depths of 28 and 30 feet. Both wells yield sufficient water for local needs, but the supply is not abundant. The water is hard and that from one well is under slight hydrostatic pressure. It is of good quality and is usable for domestic purposes or for stock. A 65-foot well in the NE.$\frac{1}{4}$, section 6, taps 5 feet of gravel at its base and yields 6 barrels of water a day. The water is hard and "alkaline", and although it is usable for stock it is not suitable for domestic needs.

The Bearpaw bedrock formation is exposed in a number of localities in this township, but no wells have been sunk into it. It is doubtful if a large supply of water can be derived from this bedrock formation. The contact of the drift and bedrock is thought to occur at an elevation between 1,750 and 1,800 feet above sea-level.

### Township 21, Range 29

Qu'Appelle river flows across the northeastern corner of this fractional township in a southeasterly direction, and that part of the township to the north of the river is not included in the municipality of Marquis. The valley is steep and is approximately 200 feet deep. Recent stream deposits form the flood-plain of the river, and glacial till or boulder clay covers the uplands except in the central part of the township where glacial till is overlain by glacial lake clay. The surface elevation decreases gradually from 2,000 feet above sea-level at the southwestern corner to 1,850 feet at the edge of the valley.

Wells sunk to depths of 14 to 34 feet obtain water from pockets of sand and gravel that are thought to occur in the weathered or yellow boulder clay, but some of the deeper wells may tap aquifers in the blue boulder clay. The lake clay does not contain water, but wells sunk in the area covered by lake clay encounter water-bearing beds in the underlying glacial clay till. A well located in the SE.$\frac{1}{4}$, section 3, passed through 2 feet of sandy lake clay and 12 feet of yellow boulder clay in which a 1-foot layer of gravel was encountered at a depth of 11 feet. The shallow wells in this township are dependant upon the amount of annual precipitation for their supply, and during winters and drought periods most of them yield insufficient water, and several go completely dry. A fairly abundant supply of water, however, is found in a sand aquifer at a depth of 15 feet in the SW.$\frac{1}{4}$, section 22. The water from all the shallow wells is hard and often highly mineralized, but with the exception of that from a 34-foot well in section 2 it is usable for domestic purposes. The water from the well in section 2 is very "alkaline" and cannot be used even for stock.

One well located in the NE.$\frac{1}{4}$, section 16, obtains a good supply of water at a depth of 60 feet. The water is under hydrostatic pressure and rises to a point 22 feet below the surface. It is "alkaline" and has a laxative effect on humams, but is usable for stock.

Three wells obtain water from a fine sand aquifer at depths of 200, 220, and 280 feet, the wells increasing in depth towards the southern part of the township. The aquifer is probably continuous and undoubtedly contains an abundant supply of water, but great difficulty has been experienced in keeping the sand from clogging the casings and shutting off the supply. The stratigraphic position of the aquifer is not known, but it is believed to occur at or near the contact of the glacial drift and the Bearpaw formation. A well in the NE.$\frac{1}{4}$, section 10, is sunk to a depth of 640 feet and undoubtedly is drilled into the bedrock, but the aquifer is encountered in the glacial drift at a depth of 280 feet. The water obtained from the deep drift wells is hard, and that from one well is usable for domestic purposes. Sodium chloride (common salt) is reported in the water from the 200-foot well in the NE.$\frac{1}{4}$, section 28, and it is probable that some of the water is derived from the bedrock.

A 563-foot well drilled by the Detta Gessel Oil Company in the NE.$\frac{1}{4}$, section 26, encountered two water-bearing horizons at depths of 433 and 465 feet. These two water-bearing horizons are undoubtedly located in the Bearpaw formation, but little is known concerning the quality and quantity of the water obtained. The water at the 433-foot level is under sufficient pressure to cause it to rise to a point 363 feet below the surface.

Bedrock outcrops along Qu'Appelle valley but the exact elevation of the contact of the drift and bedrock is not known; it is thought to be approximately 1,750 feet above sea-level.

Considerable difficulty is experienced in obtaining adequate supplies of water in this fractional township. Shallow wells are almost entirely dependant on the amount of rainfall, and deep wells become plugged by sand. However, a fairly abundant supply of water might be obtained from pockets of sand and gravel at an approximate depth of 60 feet. The best method of increasing the water supply is by the conservation of surface water. Dugouts could be excavated in most sections, and small dams could be constructed on the coulées tributary to Qu'Appelle river.

Township 22, Range 29

Approximately 6 square miles of this township lie to the south of Qu'Appelle river and are in the municipality of Marquis. The flood-plain of Qu'Appelle river is formed by Recent stream deposits and the remainder of the area is covered by boulder clay or glacial till, except in a small area in the southwestern corner where the till is overlain by glacial lake clay. The elevation decreases from approximately 1,910 feet above sea-level in the southwestern corner to 1,850 feet at the edge of the valley.

The soil in most of the area under discussion is sandy and is not well suited for farming, and during the drought years many of the farms were deserted. Information on the water conditions of this area are not available, but it is probable that a small amount of water can be derived from shallow wells dug into the Recent stream deposits and the boulder clay. Water-bearing deposits should be located with a small test auger before the wells are dug, as this eliminates the chance of digging dry holes. The Bearpaw formation outcrops along the river valley, but drilling into it in search of water is not advised.

## STATISTICAL SUMMARY OF WELL INFORMATION IN RURAL MUNICIPALITY OF MARQUIS, NO. 191, SASKATCHEWAN

| West of 2nd mer. — Township / Range | 19 / 25 | 19 / 26 | 19 / 27 | 19 / 28 | 19 / 29 | 20 / 26 | 20 / 27 | 20 / 28 | 20 / 29 | 21 / 27 | 21 / 28 | 21 / 29 | 22 / 29 | Total No. in Municipality |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total No. of Wells in Township | 4 | 28 | 19 | 9 | 12 | 4 | 21 | 41 | 18 | 0 | 4 | 20 | 0 | 180 |
| No. of wells in bedrock | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| No. of wells in glacial drift | 4 | 28 | 19 | 9 | 12 | 4 | 21 | 41 | 18 | 0 | 3 | 19 | 0 | 178 |
| No. of wells in alluvium | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| Permanency of Water Supply | | | | | | | | | | | | | | |
| No. with permanent supply | 4 | 28 | 19 | 9 | 11 | 4 | 21 | 37 | 8 | 0 | 4 | 14 | 0 | 159 |
| No. with intermittent supply | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 3 | 0 | 8 |
| No. dry holes | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 4 | 5 | 0 | 0 | 3 | 0 | 13 |
| Types of Wells | | | | | | | | | | | | | | |
| No. of flowing artesian wells | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| No. of non-flowing artesian wells | 0 | 6 | 8 | 2 | 6 | 0 | 11 | 8 | 1 | 0 | 1 | 7 | 0 | 50 |
| No. of non-artesian wells | 4 | 22 | 11 | 7 | 5 | 4 | 10 | 29 | 12 | 0 | 3 | 10 | 0 | 117 |
| Quality of Water | | | | | | | | | | | | | | |
| No. with hard water | 4 | 28 | 18 | 8 | 10 | 4 | 21 | 32 | 12 | 0 | 4 | 17 | 0 | 158 |
| No. with soft water | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 5 | 1 | 0 | 0 | 0 | 0 | 9 |
| No. with salty water | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 5 |
| No. with "alkaline" water | 1 | 8 | 6 | 1 | 7 | 0 | 6 | 5 | 4 | 0 | 2 | 5 | 0 | 45 |
| Depths of Wells | | | | | | | | | | | | | | |
| No. from 0 to 50 feet deep | 3 | 28 | 12 | 8 | 5 | 2 | 19 | 33 | 14 | 0 | 3 | 15 | 0 | 142 |
| No. from 51 to 100 feet deep | 1 | 0 | 3 | 0 | 0 | 2 | 2 | 8 | 1 | 0 | 1 | 1 | 0 | 19 |
| No. from 101 to 150 feet deep | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 |
| No. from 151 to 200 feet deep | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| No. from 201 to 500 feet deep | 0 | 0 | 3 | 1 | 7 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 0 | 15 |
| No. from 501 to 1,000 feet deep | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 |
| No. over 1,000 feet deep | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| How the Water is Used | | | | | | | | | | | | | | |
| No. usable for domestic purposes | 3 | 24 | 15 | 9 | 9 | 2 | 17 | 34 | 12 | 0 | 3 | 12 | 0 | 140 |
| No. not usable for domestic purposes | 1 | 4 | 4 | 0 | 2 | 2 | 4 | 3 | 1 | 0 | 1 | 5 | 0 | 27 |
| No. usable for stock | 4 | 28 | 19 | 9 | 10 | 2 | 21 | 37 | 13 | 0 | 4 | 16 | 0 | 163 |
| No. not usable for stock | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 4 |
| Sufficiency of Water Supply | | | | | | | | | | | | | | |
| No. sufficient for domestic needs | 4 | 28 | 19 | 9 | 8 | 4 | 21 | 37 | 7 | 0 | 4 | 11 | 0 | 152 |
| No. insufficient for domestic needs | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 6 | 0 | 0 | 6 | 0 | 15 |
| No. sufficient for stock needs | 0 | 11 | 8 | 7 | 5 | 1 | 11 | 13 | 3 | 0 | 4 | 5 | 0 | 73 |
| No. insufficient for stock needs | 4 | 17 | 11 | 2 | 6 | 3 | 10 | 19 | 10 | 0 | 0 | 12 | 0 | 94 |

# 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 differance between the total hardness and the permanent hardness and represents the amount of mineral salts that ban be removed by boiling. Temporary hardness is due mainly to the bicarbonates of calcium and magnesium and iron, and permanent hardness 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 excesss 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 Marquis, No. 191, 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. | Alkalinity | CaO | MgO | $SO_4$ | $Na_2O$ | Solids | $CaCO_3$ | $CaSO_4$ | $MgCO_3$ | $MgSO_4$ | $Na_2CO_3$ | $Na_2SO_4$ | NaCl | $CaCl_2$ | |
| 1 | NW. | 5 | 19 | 26 | 2 | 28 | 414 | | | | | | | | | | | (3) | (1) | | (2) | | (4) | | (5) | x 1 |
| 2 | | 20 | 19 | 27 | 2 | | 297 | | | | | | | | | | | (1) | | (3) | | | | | (2) | x 1 |
| 3 | W.½ | 12 | 19 | 28 | 2 | 25 | 520 | | | | | | | | | | | (3) | (1) | | (2) | | | | (4) | x 1 |
| 4 | | 12 | 20 | 27 | 2 | 14 | 231 | | | | | | | | | | | (1) | | (2) | | | | | (3) | x 1 |
| 5 | SW. | 7 | 20 | 28 | 2 | 47 | 2,008 | | | | | | | | | | | | (1) | | (2) | (3) | | (4) | | x 1 |
| 6 | | 27 | 20 | 29 | 2 | | 280 | | | | | | | | | | | (1) | | (2) | | | | | (3) | Slough |
| 7 | | 27 | 20 | 29 | 2 | | 374 | | | | | | | | | | | (3) | (1) | | (2) | | | | (4) | Cistern |
| 8 | SW. | 2 | 21 | 29 | 2 | 34 | 4,391 | | | | | | | | | | | (4) | (1) | | (2) | | (3) | | (5) | x 1 |

Water samples indicated thus, x 1, are from glacial drift or other unconsolidated deposits.
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.
Analyses Nos. 1, 2, 3, 4, 6, 7, and 8, by Provincial Analyst, Regina; Analysis No. 5, by Dr. L. M. Hanna; Brownlee, Sask.
For interpretation of this table read the section on Analyses and Quality of Water.

Water from the Unconsolidated Deposits

Six samples of water obtained from wells, one from a slough, and one from a cistern were analysed, and the results are given in the accompanying table. The wells derive water from aquifers located at shallow depth in the glacial drift. The water from shallow depths in this municipality is generally not highly mineralized, but that from some of the wells in the central part of the municipality, which are sunk to depths of approximately 50 or 60 feet, is relatively highly mineralized and in several instances cannot be used for domestic purposes, and that from a few wells is unsuitable for stock. It will be observed in the accompanying table of water analyses that the sulphates of calcium and magnesium are the two most abundant mineral salts present in samples 1, 3, 5, 7, and 8. Samples 5 and 8 contain a considerable amount of total dissolved solids, 2,068 and 4,391 parts per million, respectively, and they may act as a slight laxative on those not accustomed to the use of highly mineralized waters. The water from the other shallow wells is not highly mineralized and is suitable for all farm needs.

The water from depth in the drift will contain more mineral salts in solution, and the sodium sulphate and magnesium sulphate content may be large enough to make the water unfit for drinking. Most of it, however, should be suitable for stock.

The surface water, samples 6 and 7, from the slough and cistern is slightly mineralized and is suitable for stock needs. If it is not contaminated by surface pollution it should be usable for domestic needs.

Water from the Bedrock

Only one well, located in the NE.¼, sec. 26, tp. 21, range 29, obtains water from the Bearpaw formation. The water was not analysed. Water obtained from sandy deposits in the Bearpaw formation is frequently slightly salty and quite highly mineralized, but it is suitable for stock and may be usable for drinking and other domestic purposes.

# WELL RECORDS—Rural Municipality of MARQUIS, NO. 191, SASKATCHEWAN.

| WELL No. | LOCATION ¼ | Sec. | Tp. | Rge. | Mer. | TYPE OF WELL | DEPTH OF WELL | ALTITUDE WELL (above sea level) | HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface | Elev. | PRINCIPAL WATER-BEARING BED Depth | Elev. | Geological Horizon | CHARACTER OF WATER | TEMP. OF WATER (in °F.) | USE TO WHICH WATER IS PUT | YIELD AND REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SE. | 6 | 19 | 26 | 2 | Bored | 23 | 1,920 | - 13 | 1,907 | 13 | 1,907 | Glacial drift | Hard, clear, "alkaline" | 41 | S | Insufficient for local needs; also two seepage wells 18 and 30 feet deep and an 80-foot well. |
| 2 | SW. | 4 | " | " | " | Bored | 40 | 1,955 | - 12 | 1,943 | 40 | 1,915 | Glacial drift | Hard, clear, "alkaline" | | S | Yields 3 barrels a day. |
| 3 | SW. | 4 | " | " | " | Dug | 18 | 1,945 | - 13 | 1,932 | 13 | 1,932 | Glacial sand | Hard, clear | | D, S | Yields 1 barrel a day. |
| 4 | NW. | 5 | " | " | " | Dug | 20 | 1,955 | - 15 | 1,940 | 15 | 1,940 | Glacial gravel | Hard, clear | 43 | D, S | Yields 1 barrel a day. |
| 5 | NE. | 5 | " | " | " | Dug | 20 | 1,945 | - 2 | 1,943 | 19 | 1,926 | Glacial sand | Hard, clear, " alkaline" | | D, S | Yields 2 barrels a day; also a seepage well. |
| 6 | NE. | 9 | " | " | " | Dug | 25 | 1,930 | - 10 | 1,920 | 24 | 1,906 | Glacial drift | Hard, clear | | D, S | Usually sufficient for local needs; also a similar well. |
| 7 | SW. | 14 | " | " | " | Bored | 30 | 1,955 | - 16 | 1,939 | 16 | 1,939 | Glacial sand | Hard, clear | | D, S | Yields 10 barrels a day. |
| 8 | NW. | 14 | " | " | " | Dug | 16 | 1,910 | - 8 | 1,902 | 8 | 1,902 | Glacial gravel | Hard, clear | 42 | D, S | Yields 1 barrel a day. |
| 9 | NW. | 15 | " | " | " | Bored | 30 | 1,930 | - 24 | 1,906 | 24 | 1,906 | Glacial gravel | Hard, clear | | D, S | Yields 4 barrels a day; also a similar well. |
| 10 | NW. | 16 | " | " | " | Bored | 45 | 1,945 | - 25 | 1,920 | 45 | 1,900 | Glacial drift | Hard, clear, "alkaline" | | S | Sufficient for local needs; also a seepage well. |
| 11 | NE. | 16 | " | " | " | Dug | 22 | 1,935 | - 9 | 1,926 | 19 | 1,916 | Glacial sand | Hard, clear | | D, S | Sufficient for local needs. |
| 12 | SW. | 17 | " | " | " | Dug | 18 | 1,955 | - 13 | 1,942 | 13 | 1,942 | Glacial sand and gravel | Hard, clear | 44 | D, S | Yields about 5 barrels a day; also two similar wells. |
| 13 | NW. | 20 | " | " | " | Dug | 20 | 1,940 | - 11 | 1,929 | 18 | 1,922 | Glacial sand and gravel | Hard, clear | | D, S | Yields about 5 barrels a day. |
| 14 | NE. | 21 | " | " | " | Bored | 30 | 1,925 | - 16 | 1,909 | 16 | 1,909 | Glacial gravel | Hard, clear | 40 | D, S | Yields about 1 barrel a day. |
| 15 | SE. | 22 | " | " | " | | 40 | 1,950 | - 35 | 1,915 | 35 | 1,915 | Glacial drift | Hard, clear | 44 | D, S | Sufficient for local needs. |
| 16 | NW. | 22 | " | " | " | Bored | 48 | 1,925 | - 20 | 1,905 | 48 | 1,877 | Glacial drift | Hard, clear, "alkaline" | 43 | S | Will produce about 20 barrels a day; also a similar 30-foot well. |
| 17 | NW. | 28 | " | " | " | Bored | 40 | 1,945 | - 22 | 1,923 | | | Glacial drift | Hard, clear, "alkaline" | | S | Insufficient for local needs; also a seepage well. |
| 18 | SE. | 29 | " | " | " | Bored | 32 | 1,925 | - 20 | 1,905 | | | Glacial drift | Hard, clear, "alkaline" | | D, S | Yields about 3 barrels a day. |
| 19 | NE. | 30 | " | " | " | Dug | 32 | 1,955 | - 20 | 1,935 | 28 | 1,927 | Glacial drift | Hard, clear, "alkaline" | | D, S | Yields about 8 barrels a day. |
| 20 | SE. | 32 | " | " | " | Dug | 47 | 1,925 | - 41 | 1,884 | 41 | 1,884 | Glacial drift | Hard, clear, "alkaline" | | S | Yields about 4 barrels a day; also a 20-foot well for domestic use. |
| 1 | SE. | 2 | 19 | 27 | 2 | Dug | 24 | 1,950 | - 12 | 1,938 | 12 | 1,938 | Glacial drift | Hard, clear | | D, S | Insufficient for local needs. |
| 2 | NE. | 3 | " | " | " | Bored | 80 | 1,950 | - 70 | 1,880 | 80 | 1,800 | Glacial drift | Hard, clear, "alkaline" | | S | Yields about 10 barrels a day; also a 20-foot well with good supply. |
| 3 | SW. | 4 | " | " | " | Dug | 18 | 1,960 | - 11 | 1,949 | | | Glacial sand | Hard, clear | | | |
| 4 | SE. | 13 | " | " | " | Dug | 130 | 1,960 | -125 | 1,835 | 125 | 1,835 | Glacial sand | Hard, clear | | D, S | Sufficient for 20 head stock; also a dugout. |
| 5 | NW. | 16 | " | " | " | Dug | 14 | 1,970 | - 4 | 1,966 | 10 | 1,960 | Glacial drift | Hard, clear | 42 | D, S | Yields about 3 pails a day. |
| 6 | NW. | 17 | " | " | " | Drilled | 242 | 1,970 | - 29 | 1,941 | 242 | 1,728 | Glacial drift | Hard, iron, clear | | D, S | Yields large supply. |
| 7 | SW. | 22 | " | " | " | Bored | 40 | 1,945 | - 30 | 1,915 | 38 | 1,907 | Glacial gravel | Hard, clear | | D, S | Yields about 5 barrels a day. |

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 MARQUIS, NO. 191, SASKATCHEWAN.

| WELL No. | LOCATION ¼ | Sec. | Tp. | Rge. | Mer. | TYPE OF WELL | DEPTH OF WELL | ALTITUDE WELL (above sea level) | HEIGHT TO WHICH WATER WILL RISE: Above (+) Below (−) Surface | HEIGHT TO WHICH WATER WILL RISE: Elev. | PRINCIPAL WATER-BEARING BED: Depth | PRINCIPAL WATER-BEARING BED: Elev. | PRINCIPAL WATER-BEARING BED: Geological Horizon | CHARACTER OF WATER | TEMP. OF WATER (in °F.) | USE TO WHICH WATER IS PUT | YIELD AND REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | NE. | 23 | 19 | 27 | 2 | Bored | 60 | 1,950 | - 45 | 1,905 | 60 | 1,890 | Glacial sand | Hard, clear, "alkaline" | | S | Sufficient for 30 head stock. |
| 9 | SE. | 26 | " | " | " | Bored | 55 | 1,945 | - 20 | 1,925 | 55 | 1,890 | Glacial drift | Hard, clear, "alkaline" | | S | Yields about 20 pails a day. |
| 10 | SW. | 26 | " | " | " | Bored | 35 | 1,960 | - 20 | 1,940 | 35 | 1,905 | Glacial gravel and sand | Hard, clear, sulphur | | S | Yields about 2 barrels a day. |
| 11 | NW. | 27 | " | " | " | Bored | 12 | 1,960 | - 4 | 1,956 | 11 | 1,949 | Glacial sand | Hard, clear | 41 | D, S | Yields about 3 barrels a day. |
| 12 | SW. | 31 | " | " | " | Bored | 38 | 1,960 | - 31 | 1,929 | | | Glacial sand | Hard, clear, "alkaline" | | D, S | Yields about 1 barrel a day. |
| 13 | NE. | 31 | " | " | " | Drilled | 240 | 1,950 | -210 | 1,740 | 240 | 1,710 | Glacial sand | Hard | | | Yields half a gallon a minute. |
| 14 | SW. | 32 | " | " | " | Drilled | 240 | 1,950 | -235 | 1,715 | 235 | 1,715 | Glacial sand | Hard, clear, "alkaline" | | D, S | Sufficient to supply 50 head stock. |
| 15 | SE. | 33 | " | " | " | Dug | 16 | 1,950 | - 8 | 1,942 | | | Glacial drift | Hard, clear | 40 | D, S | Yields 1½ barrels a day. |
| 16 | SE. | 35 | " | " | " | Dug | 16 | 1,965 | - 10 | 1,955 | 10 | 1,955 | Glacial drift | Soft, clear | | D, S | Flooded by pond in wet weather. |
| 17 | SW. | 35 | " | " | " | Bored | 40 | 1,900 | - 10 | 1,950 | | | Glacial drift | Hard | | D, S | Yields 4 barrels a day. |
| 18 | NE. | 36 | " | " | " | Dug | 30 | 1,945 | | | 23 | 1,922 | Glacial sand | Hard, clear, "alkaline" | | | Yields one pail a day. |
| 1 | SE. | 2 | 19 | 28 | 2 | Bored | 36 | 1,955 | - 6 | 1,949 | | | Glacial drift | Hard, clear | 42 | D, S | Sufficient for 5 head stock; also a seepage well and a dugout. |
| 2 | SE | 10 | " | " | " | Dug | 35 | 1,970 | - 28 | 1,942 | 28 | 1,942 | Glacial drift | Hard | 44 | D, S | Sufficient for local needs; also a dugout. |
| 3 | NW. | 11 | " | " | " | Dug | 20 | 1,965 | - 17 | 1,948 | 17 | 1,948 | Glacial sand | Hard, clear | | D, S | Sufficient for 30 head stock. |
| 4 | NE. | 13 | " | " | " | Bored | 32 | 1,970 | | | 30 | 1,940 | Glacial sand | Hard, clear | | | Sufficient for 40 head stock; other similar wells. |
| 5 | SW. | 18 | " | " | " | Drilled | 270 | 2,000 | -240 | 1,760 | 240 | 1,760 | Glacial sand | Hard, clear | | D, S | Was sufficient for 50 head stock; now sanded up. |
| 6 | SE. | 22 | " | " | " | Dug | 20 | 1,975 | - 4 | 1,971 | | | Glacial drift | Soft, clear, "alkaline" | 44 | D, S | Sufficient for household only; also a dugout. |
| 7 | NW. | 34 | " | " | " | Dug | 22 | 1,980 | - 14 | 1,966 | 21 | 1,959 | Glacial sand | Hard, clear | | D, S | Sufficient for 16 head stock; also a dugout. |
| 1 | NE. | 4 | 19 | 29 | 2 | Dug | 14 | 1,975 | - 13 | 1,962 | 13 | 1,962 | Glacial sand | Hard, clear | | N | Yields one barrel a day; poor quality. |
| 2 | NE. | " | " | " | " | Dug | 14 | 1,975 | - 12 | 1,963 | | | Glacial drift | Hard, clear | 46 | D, S | Yields 3 barrels a day. |
| 3 | SW. | 12 | " | " | " | Drilled | 300 | 1,990 | -230 | 1,760 | 285 | 1,705 | Glacial sand | Hard, clear, "alkaline" | | D, S | Was sufficient for 50 head stock; now plugged by sand; also a dugout. |
| 4 | NE? | 18 | " | " | " | Dug | 13 | 1,990 | - 7 | 1,983 | | | Glacial drift | Hard, clear | 45 | D | Yields 4 barrels a day. |
| 5 | SW. | 20 | " | " | " | Dug | 18 | 1,990 | - 10 | 1,980 | | | Glacial sand | Hard, clear, "alkaline" | 46 | S | Yields 3 barrels a day; deep dry hole on NE.¼. |
| 6 | SE. | 22 | " | " | " | Drilled | 300 | 2,030 | | | | | Glacial sand | Hard, clear, "alkaline" | | | Plugged with sand; also a dry hole; uses a dugout. |
| 7 | SW. | 26 | " | " | " | Drilled | 300 | 2,030 | -260 | 1,770 | 285 | 1,745 | Glacial sand | Hard, clear, iron, "alkaline" | | D, S | Was sufficient for 50 head stock; trouble keeping out sand; use a slough |
| 8 | SE. | 27 | " | " | " | Drilled | 300 | 2,035 | | | | | Glacial sand | Hard, clear, "alkaline" | | D, S | Blocked with sand and not in use; use sloughs. |
| 9 | NE. | 33 | " | " | " | Drilled | 300 | 2,035 | -260 | 1,775 | 285 | 1,750 | Glacial sand | Hard, clear, "alkaline" | 41 | D, S | Sufficient for 25 head stock; also use a slough. |

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 MARQUIS, NO. 191, 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 | NE. | 34 | 19 | 29 | 2 | Drilled | 300 | 2,035 | -270 | 1,765 | 285 | 1,750 | Glacial sand | Hard, clear, "alkaline" | 43 | D, S | Sufficient for 30 head stock; also uses sloughs. |
| 11 | NE. | 36 | " | " | " | Dug | 8 | 2,010 | - 4 | 2,006 | 4 | 2,006 | Glacial sand | Soft, clear | 51 | D, S | Sufficient for 12 head stock. |
| 1 | SW. | 6 | 20 | 26 | 2 | Dug | 20 | 1,935 | - 5 | 1,930 | | | Glacial drift | Soft, clear | | D, S | Yields 2 barrels a day. |
| 2 | NW. | 6 | " | " | " | Dug | 18 | 1,925 | 4 | 1,921 | 4 | 1,921 | Glacial drift | Soft, clear | | D, S | Sufficient for local needs; 70-foot wells not usable. |
| 1 | NE. | 1 | 20 | 27 | | Bored | 65 | 1,920 | - 49 | 1,871 | 61 | 1,859 | Glacial sand | Hard, clear, "alkaline" | | N | Not usable. |
| 2 | NW. | 2 | " | " | " | Dug | 24 | 1,940 | - 6 | 1,934 | 24 | 1,916 | Glacial sand | Hard, clear | | D, S | Sufficient for 25 head stock; also a dugout. |
| 3 | SE. | 3 | " | " | " | Dug | 20 | 1,950 | - 17 | 1,933 | 18 | 1,932 | Glacial drift | Hard, clear | 48 | D | Yields 2 pails a day; use sloughs for stock. |
| 4 | SW. | 4 | " | " | " | Dug | 55 | 1,960 | - 30 | 1,930 | 55 | 1,905 | Glacial sand | Hard, salty, "alkaline", clear | | S | |
| 5 | NE. | 5 | " | " | " | Dug | 24 | 1,900 | - 4 | 1,956 | 24 | 1,936 | Glacial sand | Hard, clear | | D, S | Yields 1 tank a day; uses cistern also. |
| 6 | NE. | 7 | " | " | " | Bored | 45 | 1,955 | - 25 | 1,930 | 45 | 1,910 | Glacial gravel | Hard, clear | | D, S | Sufficient for 100 head stock; also a 22-foot well; small supply, and a slough. |
| 7 | NE. | 9 | " | " | " | Dug | 19 | 1,940 | - 14 | 1,926 | 14 | 1,926 | Glacial gravel | Hard, clear, "alkaline" | | D, S | Yields 16 barrels a day; similar well now caved in. |
| 8 | SW. | 10 | " | " | " | Bored | 30 | 1,950 | | | | | Glacial sand | Hard, clear, "alkaline" | | S | Sufficient for 30 head stock. |
| 9 | NE. | 10 | " | " | " | Dug | 45 | 1,940 | - 25 | 1,915 | 45 | 1,895 | Glacial drift | Hard, clear, "alkaline" | | D, S | Sufficient for 50 head stock. |
| 10 | NW. | 14 | " | " | " | Bored | 22 | 1,900 | - 12 | 1,948 | 12 | 1,948 | Glacial drift | Hard, clear | | D, S | Yields 2 barrels a day; also uses a dugout. |
| 11 | NE. | 14 | " | " | " | Dug | 12 | 1,945 | - 10 | 1,935 | 10 | 1,935 | Glacial sand | Hard, clear | | D, [illegible] | Yields ½ barrel a day. |
| 12 | SE. | 15 | " | " | " | Dug | 32 | 1,940 | - 10 | 1,930 | 27 | 1,913 | Glacial sand | Hard, clear, iron | 45 | D, S | |
| 13 | SW. | 15 | " | " | " | Bored | 45 | 1,945 | - 33 | 1,912 | 45 | 1,900 | Glacial sand | Hard, clear | | D, S | Sufficient for 8 head stock; also a similar well and a dugout. |
| 14 | SE. | 21 | " | " | " | Dug | 15 | 1,945 | - 9 | 1,936 | 13 | 1,932 | Glacial gravel | Hard, clear | | D, S | Yields 3 barrels a day; high water-level due to seepage from nearby slough. |
| 15 | NW. | 22 | " | " | " | Bored | 38 | 1,950 | | | 38 | 1,912 | Glacial drift | Hard, clear, "alkaline", iron | | | Sufficient for 20 head stock. |
| 16 | SW. | 23 | " | " | " | Dug | 21 | 1,900 | - 15 | 1,945 | 21 | 1,939 | Glacial gravel | Hard, clear, iron | 41 | D, S | Yields 1½ barrels a day; stock watered at slough. |
| 17 | NW. | 30 | " | " | " | Bored | 40 | 1,940 | - 33 | 1,907 | 40 | 1,900 | Glacial gravel | Hard, clear | 43 | D, S | Yields 6 to 7 tanks a day. |
| 18 | NW. | 30 | " | " | " | Dug | 33 | 1,940 | - 28 | 1,912 | 28 | 1,912 | Glacial sand | Hard, clear | 46 | D, S | Yields 5 barrels a day; 32-foot similar well. |
| 19 | SE. | 33 | " | " | " | Bored | 40 | 1,950 | - 25 | 1,925 | 40 | 1,910 | Glacial drift | Hard, iron, yellow | | S | Yields 2 barrels a day. |
| 1 | NE. | 2 | 20 | 28 | 2 | Dug | 22 | 1,975 | - 16 | 1,959 | 16 | 1,959 | Glacial drift | Hard, clear | | D, S | Sufficient for local needs. |
| 2 | NW. | 4 | " | " | " | Dug | 60 | 1,980 | - 55 | 1,925 | 60 | 1,920 | Glacial sand | Hard, clear, "alkaline" | | D, S | Yields 15 barrels a day. |
| 3 | NW. | 6 | " | " | " | Dug | 20 | 2,000 | - 18 | 1,982 | 18 | 1,982 | Glacial sand | Hard, clear, "alkaline" | | D | Yields 5 pails a day; other wells used for stock. |

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

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

# WELL RECORDS—Rural Municipality of MARQUIS, NO. 191, SASKATCHEWAN.

| WELL No. | LOCATION ¼ | Sec. | Tp. | Rge. | Mer. | TYPE OF WELL | DEPTH OF WELL | ALTITUDE WELL (above sea level) | HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface | Elev. | PRINCIPAL WATER-BEARING BED Depth | Elev. | Geological Horizon | CHARACTER OF WATER | TEMP. OF WATER (in °F.) | USE TO WHICH WATER IS PUT | YIELD AND REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | SW. | 7 | 20 | 28 | 2 | Bored | 47 | 2,007 | - 20 | 1,987 | | | Glacial sand | Hard, clear | | D, S | |
| 5 | SW. | 7 | " | " | " | Bored | 47 | 2,007 | - 25 | 1,982 | | | Glacial sand | Hard, clear | | N | Good supply but not usable. |
| 6 | SW. | 8 | " | " | " | Bored | 30 | 2,015 | - 25 | 1,990 | 27 | 1,988 | Glacial sand | Hard, clear | 42 | D, S | Yields 2 barrels a day. |
| 7 | NW. | 8 | " | " | " | Dug | 34 | 2,020 | - 30 | 1,990 | 30 | 1,990 | Glacial sand | Soft, clear | 45 | D | Yields 1 barrel a day; another 31-foot well near by yields water suitable for stock. |
| 8 | SW. | 9 | " | " | " | Dug | 18 | 1,980 | - 14 | 1,966 | 14 | 1,966 | Glacial sand and gravel | Soft, clear | | D, S | Yields 2 barrels a day. |
| 9 | NE. | 13 | " | " | " | Dug | 31 | 1,960 | - 24 | 1,936 | 24 | 1,936 | Glacial gravel | Hard, clear | 40 | D, S | Yields 2 barrels a day; also a 7-foot well. |
| 10 | SW. | 15 | " | " | " | Dug | 65 | 1,975 | - 20 | 1,955 | | | Glacial drift | Hard, clear, iron | 46 | D, S | Yields 2 barrels a day. |
| 11 | NW. | 15 | " | " | " | Bored | 28 | 1,960 | - 25 | 1,935 | 25 | 1,935 | Glacial drift | Hard, clear, iron | 43 | D, S | Sufficient for 50 head stock. |
| 12 | SE. | 16 | " | " | " | Dug | 30 | 1,975 | - 25 | 1,950 | 25 | 1,950 | Glacial sand | Soft, clear | 43 | D, S | Yields 10 barrels a day. |
| 13 | SW. | 17 | " | " | " | Dug | 16 | 1,985 | - 12 | 1,973 | 15 | 1,970 | Glacial sand | Hard, clear | 50 | D, S | Yields 2 barrels a day. |
| 14 | SE. | 18 | " | " | " | Dug | 10 | 2,000 | - 4 | 1,996 | 4 | 1,996 | Glacial sand and gravel | Soft, clear | | D, S | Yields 15 tanks a day. |
| 15 | SW. | 18 | " | " | " | Bored | 20 | 1,990 | - 10 | 1,980 | 10 | 1,980 | Glacial gravel | Soft | | D, S | Yields 20 barrels a day. |
| 16 | SE. | 19 | " | " | " | Bored | 60 | 1,980 | - 35 | 1,945 | 60 | 1,920 | Glacial sand | Hard, clear | | D, S | Yields 15 barrels a day. |
| 17 | SW. | 20 | " | " | " | Bored | 64 | 1,979 | - 62 | 1,917 | 62 | 1,917 | Glacial sand | Hard, clear | 43 | D, S | Yields 8 barrels a day. |
| 18 | SE. | 21 | " | " | " | Dug | 45 | 1,965 | - 43 | 1,922 | 43 | 1,922 | Glacial gravel | Hard, clear | | D | Yields 2 barrels a day. |
| 19 | NE. | 21 | " | " | " | Bored | 30 | 1,970 | - 29 | 1,941 | 29 | 1,941 | Glacial gravel and sand | Hard, clear | | D | Also a 35-foot well and two dry holes 45 and 99 feet deep. |
| 20 | SE. | 22 | " | " | " | Bored | 35 | 1,960 | - 29 | 1,931 | 29 | 1,931 | Glacial sand | Hard, clear | | D, S | Sufficient for local needs; also a dugout; dry holes on section 23. |
| 21 | SW. | 26 | " | " | " | Bored | 75 | 1,960 | - 69 | 1,891 | 69 | 1,891 | Glacial sand | Hard, clear | 45 | D, S | Yields 2 barrels a day; also a spring. |
| 22 | NW. | 26 | " | " | " | Dug | 28 | 1,945 | - 24 | 1,921 | 26 | 1,919 | Glacial sand and gravel | Hard, clear | | D, S | Yields 10 barrels a day. |
| 23 | SW. | 27 | " | " | " | Dug | 38 | 1,960 | - 10 | 1,950 | 34 | 1,926 | Glacial drift | Hard, clear, "alkaline" | 43 | D, S | Yields 8 barrels a day. |
| 24 | SE. | 28 | " | " | " | Bored | 80 | 1,970 | - 30 | 1,940 | | | Glacial sand | Hard, clear | | D | Yields 6 barrels a day. |
| 25 | SE. | 29 | " | " | " | Dug | 14 | 1,955 | - 9 | 1,946 | 10 | 1,945 | Glacial sand | Hard, clear | | D, S | Sufficient for 25 head stock; trouble keeping sand out. |
| 26 | SE. | 30 | " | " | " | Bored | 90 | 1,960 | - 20 | 1,940 | | | Glacial drift | Hard, clear, "alkaline" | | S | |
| 27 | SE. | 32 | " | " | " | Dug | 30 | 1,940 | - 18 | 1,922 | | | Glacial drift | Hard, clear, "alkaline" | | S | Yields 3 tanks a day; also a similar well. |
| 28 | SE. | 32 | " | " | " | Bored | 35 | 1,940 | - 15 | 1,925 | | | Glacial drift | Hard, clear | | D, S | Yields 3 tanks a day. |
| 29 | NW. | 34 | " | " | " | Dug | 20 | 1,940 | - 16 | 1,924 | 16 | 1,924 | Glacial drift | Hard, clear | | D, S | Yields 16 barrels a day; also a 25-foot well. |
| 1 | SW. | 20 | 20 | 29 | 2 | Bored | 52 | 2,015 | - 48 | 1,967 | 48 | 1,967 | Glacial drift | Salty, hard, clear | | | Well caved in and not now in use. |

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.

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# WELL RECORDS—Rural Municipality of MARQUIS, NO. 191, 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | SW. | 2 | 20 | 29 | 2 | Dug | 11 | 2,015 | − 7 | 2,008 | 7 | 2,008 | Glacial drift | Hard, clear | 48 | D | Yields 1 barrel a day; stock water from slough. |
| 3 | NE. | 4 | " | " | " | Dug | 24 | 2,020 | − 14 | 2,006 | | | Glacial drift | Soft, clear | 42 | D, S | Sufficient for 5 head stock in wet year, but dry when arid conditions exist; also a similar well. |
| 4 | SW. | 5 | " | " | " | Dug | 28 | 2,035 | − 26 | 2,009 | 26 | 2,009 | Glacial drift | Hard, clear | 42 | D, S | Sufficient for 10 head stock in wet season; dependant on rainfall for supply. |
| 5 | SE. | 10 | " | " | " | Dug | 14 | 2,020 | − 8 | 2,012 | 8 | 2,012 | Glacial sand | Hard, clear | 48 | D | Used for house only; chiefly seepage; several dry holes, deepest 110 feet. |
| 6 | NE. | 12 | " | " | " | Bored | 50 | 2,005 | − 45 | 1,960 | 45 | 1,960 | Glacial drift | Hard, clear, "alkaline" | 42 | D | Sufficient for house use only; stock water at a slough. |
| 7 | SE. | 13 | " | " | " | Bored | 31 | 1,985 | − 6 | 1,979 | 21 | 1,964 | Glacial sand | Hard, clear, "alkaline" | 50 | D | Yields 3 barrels a day; high water-level due to seepage. |
| 8 | SW. | 16 | " | " | " | Drilled | 315 | 2,025 | −255 | 1,770 | 315 | 1,710 | Glacial sand | Hard, clear, "alkaline" | 45 | D, S | Sufficient for 75 head stock. |
| 9 | NE. | 18 | " | " | " | Drilled | 313 | 2,030 | −275 | 1,755 | 275 | 1,755 | Glacial sand | Hard, clear, "alkaline" | | D, S | Large supply but now blocked by sand; use slough for stock. |
| 10 | NW. | 20 | " | " | " | Dug | 18 | 2,025 | − 15 | 2,010 | 15 | 2,010 | Glacial drift | Hard, clear | 48 | D | Sufficient for house use only; supply largely seepage; similar seepage well and two dry holes. |
| 11 | NW. | 22 | " | " | " | Dug | 20 | 2,010 | − 16 | 1,994 | 16 | 1,994 | Glacial sand | Hard, clear | 44 | D | Sufficient for house only; slough used for stock. |
| 1 | NW. | 6 | 21 | 28 | 2 | Bored | 28 | 1,900 | − 13 | 1,887 | 26 | 1,874 | Glacial gravel | Hard, clear | | D, S | Yields about 6 barrels a day. |
| 2 | NE. | 6 | " | " | " | Bored | 65 | 1,900 | − 60 | 1,840 | 61 | 1,839 | Glacial gravel | Hard, clear, "alkaline" | | S | Yields 6 barrels a day. |
| 3 | SE. | 16 | " | " | " | Bored | 28 | 1,700 | − 23 | 1,677 | 23 | 1,677 | Recent alluvial sand | Hard, clear, "alkaline" | | D | Yields 3 pails a day. |
| 4 | NE. | 17 | " | " | " | Dug | 30 | 1,710 | − 22 | 1,688 | 22 | 1,688 | Alluvial silt | Hard, clear | | D, S | Yields ½ barrel a day. |
| 1 | SW. | 2 | 21 | 29 | 2 | Bored | 34 | 1,955 | − 20 | 1,935 | 34 | 1,921 | Glacial drift | Hard, iron, "alkaline", cloudy | | | Too highly mineralized for use; #. |
| 2 | SE. | 3 | " | " | " | Dug | 14 | 1,950 | − 11 | 1,939 | 11 | 1,939 | Glacial gravel | Hard, clear | | D, S | Yields 1½ barrels a day; in wet seasons; also a similar 12-foot well. |
| 3 | SE. | 9 | " | " | " | Dug | 30 | 1,960 | − 24 | 1,936 | 24 | 1,936 | Glacial sand | Hard, cloudy, "alkaline" | 42 | D | Yields 3 pails a day; slough used for stock. |
| 4 | NE. | 10 | " | " | " | Drilled | 640 | 1,940 | − 50 | 1,890 | 280 | 1,660 | Glacial sand | Hard, "alkaline" | | S | Drilled into Bearpaw formation. |
| 5 | NE. | 16 | " | " | " | Bored | 60 | 1,940 | − 22 | 1918 | 60 | 1,880 | Glacial drift | Hard, clear, "alkaline" | | S | Yields 1 tank a day; slough used for stock. |
| 6 | SE. | 17 | " | " | " | Bored | 20 | 1,950 | − 10 | 1,940 | 10 | 1,940 | Glacial sand | Hard, clear, "alkaline" | 42 | D | Yields 6 pails a day. |
| 7 | NE. | 20 | " | " | " | Bored | 32 | 1,950 | − 22 | 1,928 | 22 | 1,928 | Glacial gravel and sand | Hard, clear | | D, S | Sufficient for 6 head stock in wet year; several 40-foot dry holes. |
| 8 | SW. | 21 | " | " | " | Bored | 35 | 1,925 | − 20 | 1,905 | 27 | 1,998 | Glacial sand | Hard, clear, iron | 42 | N | Yielded 4 to 5 barrels a day; now filled with sand; use sloughs and haul water. |
| 9 | SW. | 22 | " | " | " | Dug | 15 | 1,950 | − 10 | 1,940 | 10 | 1,940 | Glacial sand | Hard, clear | | D, S | Sufficient for 30 head stock; other similar wells nearby. |
| 10 | NE. | 26 | " | " | " | Drilled | 563 | 1,860 | −363 | 1,497 | 433 | 1,427 | Bearpaw 00000 | | | | |
| 11 | SW. | 28 | " | " | " | Drilled | 220 | 1,925 | −180 | 1,745 | 220 | 1,705 | Glacial sand | Hard, clear | 45 | D, S | Yields 6 barrels a day. |
| 12 | NW. | 28 | " | " | " | Dug | 30 | 1,930 | − 10 | 1,920 | 30 | 1,900 | Glacial drift | Hard, clear | | D, S | Insufficient for local needs; dry in drought periods. |
| 13 | NE. | 28 | " | " | " | Drilled | 200 | 1,920 | −140 | 1,780 | 190 | 1,730 | Glacial sand | Hard soda, clear, salty | | S | Large supply at one time; now filled with sand. |
| 14 | NW. | 33 | " | " | " | Dug | 18 | 1,900 | − 8 | 1,892 | 8 | 1,892 | Glacial drift | Hard, clear | | D, S | Yields 1 tank a day; much of supply due to seepage from slough; sloughs also used. |

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.