CANADA
DEPARTMENT OF MINES

HON. T. A. CRERAR, MINISTER; CHARLES CAMSELL, DEPUTY MINISTER

BUREAU OF ECONOMIC GEOLOGY

GEOLOGICAL SURVEY

PRELIMINARY REPORT

GROUND-WATER RESOURCES OF THE RURAL MUNICIPALITY OF STORTHOAKS No. 31 SASKATCHEWAN

BY

B.R. MacKay H. N. Hainstock

Water Supply Paper No. 13

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GROUND WATER RESOURCES OF THE RURAL MUNICIPALITY OF STORTHOAKS, NO. 31, 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 purposes and the smaller supplies of ground water required for domestic and stock-raising purposes by settlers, villages, and Indian reserves. The drought conditions resulted in repeated crop failures, and in a large number of farms in the acute drought areas of Saskatchewan and Alberta being abandoned. In an effort to relieve the serious situation a number of special studies of the water problem were begun by both Federal and Provincial Governments and allied organizations. The Federal Department of Agriculture undertook among other phases of the drought problem an investigation into the existing supplies of surface water, their conservation in dug-outs, and how they could be made more generally available for irrigation. The Geological Survey of the Federal Department of Mines began an extensive study of the underground water conditions of southern Saskatchewan, this water being used principally for domestic and stock-raising purposes. For many years past the water problems in this and other provinces of Canada have engaged the attention of the Geological Survey, and considerable information had already been collected. A number of short reports dealing with the ground water conditions of special areas in Manitoba, Saskatchewan, and Alberta have been published by both the Federal and Provincial Geological Surveys, but no systematic study of the sources of the ground water, its quantity and quality as affected by the drought conditions, has, up to the present, been attempted.

Field Work

The senior author was in charge of this investigation and was instructed to cover as much of the territory as possible in the season. To effect this it was decided to maintain an

office at Regina and to have a large party consisting of twenty-six units, each to consist of three men who would cover their respective areas and visit every farm. In order that the information gathered by these different party units would be as complete and uniform as possible a questionnaire was prepared on which could be tabulated answers to all the essential questions required for a detailed study of the ground water conditions. An effort was made in the field by each party unit to fill in the questionnaire as completely as possible. In many instances, however, it was found that wells had either been abandoned, or the resident had little or no knowledge of the character of the water-bearing horizon and associated beds. When a party unit had completed the survey of a township the set of questionnaires and a report describing the characteristic features pertaining to the underground water conditions were mailed to the field office. Messrs. D.C. Maddox, F.H. Edmunds, H.H. Beach, H.N. Hainstock, R.D. MacDonald, and D.P. Goodall acted as supervisors in inspecting the work of the field units.

During the field season an area of 80,000 square miles, comprising 2,200 townships, was systematically examined, and records of approximately 60,000 wells were obtained, together with water samples for analyses obtained from 720 representative wells. These are systematically classified so that information pertaining to any well may be readily consulted. These records are supplemented by a set of 24 sectional sheets which cover all of southern Saskatchewan north to include township 32. Each sectional sheet comprises 120 townships. On these are indicated by symbol the location, type, and source of water of each of the 60,000 wells.

Publication of Results

The publication of such a great mass of detailed information is out of the question. This forms the permanent record of the Geological Survey. It is highly desirable, however, that a digest of the essential information pertaining to the ground water conditions of each municipality be furnished in convenient form to the municipality offices, to certain Provincial and Federal departments, and to allied organizations, at which centres it will be possible for any resident of the municipality or other party interested in any particular area to consult these reports. Should anyone find that he requires more detailed data than that contained in the report such additional information as the Geological Survey possesses can be procured on application to the Director, Bureau of Economic Geology, Department of Mines, Ottawa. In making such request the applicant should indicate the exact location of the area by giving the quarter section, township, range and meridian.

The reports have been prepared principally for farm residents, municipal bodies, and well drillers who are either contemplating sinking a well for the first time or considering deepening their well to a lower horizon in order to obtain a more abundant supply of water. In describing the water and geological conditions a certain number of technical terms must of necessity be used, and in case the reader should not be familiar with them their meanings have been defined in the glossary.

How to Use the Report

It is advisable that anyone desiring water information pertaining to a particular section of the municipality read over first the section dealing with the municipality as a whole, as by so doing he will be in a much better position to understand the section of the report dealing with the ground water conditions of

the area in which he is particularly interested. As he reads the text he should keep open before him for constant reference the accompanying map of the municipality on which are two figures, one showing the surface and bedrock geology of the area as they affect the ground water supply, and the other the relief and the location and type of water wells. The land relief is shown by means of lines of equal elevation, termed "contours", which lie generally at vertical intervals of 50 feet. The elevation above sea-level of each fourth line is indicated on the map. The statistical summary that follows the text gives at a glance the main characteristics of the wells in each township of the municipality and of the municipality as a whole as listed under the various sub-headings. This is followed by a section dealing with the analyses and quality of the water derived from the unconsolidated deposits and from bedrock. The table of well records gives the detailed information pertaining to each well. In this are tabulated the altitude of the well, its depth, the height to which the water will rise, and the elevation of the water horizon. The wells are grouped in the table by townships and are numbered from the lower right corner of the township westward and northward, and the location of each well by its quarter section is given. The elevations used were determined by aneroid barometer and were checked frequently by elevations on the published maps or by instrument surveys.

Where the ground surface of an area is comparatively flat every effort has been made to indicate the position of the water-bearing horizon in feet below the surface. In rolling country where there is a considerable difference of elevation within short distances a uniform figure for the water horizon is not generally possible. It then becomes necessary to indicate the position in terms of the elevation of a water-bearing bed in feet above sea-level.

Should one desire to ascertain at any location at which no well has as yet been sunk, the approximate depth at which a particular water-bearing horizon can be reached it is necessary to know two things--first, the elevation of the land surface, and second, the probable elevation of the water-bearing bed, or aquifer. The elevation of the land surface can be obtained by noting the position of the well site on the map, Figure 2, with respect to the two bounding contour lines of known elevation, and estimating either how far above the lower, or how far below the upper, control elevation line the well site lies. The approximate elevation of the water-bearing horizon at the well site can be obtained by noting on the table of well records the elevation of the horizon in the wells adjacent to the proposed location and from the range of elevations given and the relative positions of the wells shown on the map to select what appears to be its most probable elevation at the new well site. Having determined this elevation the depth that it is necessary to sink in order to tap it is the difference between its elevation and the elevation of the land surface. This method is especially applicable when the water-bearing horizon is in bedrock. In unconsolidated deposits the water horizon either conforms to the rolling land surface or occurs in isolated sand beds at various horizons that do not form a continuous water-bearing bed over a large area. Care should be taken in making any calculations for depth of water-bearing horizons to be sure that the elevations selected for the determinations occur in the same geological horizon, that is they should be either all in glacial drift or in the same bedrock formation.

The table of well records also contains notes on the temperature, quality, and quantity of the water being obtained from the various wells, and from this it is possible to draw reasonable conclusions as to the character and quantity of the water likely to be encountered at the proposed well site.

Glossary of Terms Used

Alluvium. Deposits of earth, silt, sand and gravel, and other transported material made by rivers, floods, or other causes upon land that has been submerged beneath the waters of lakes or rivers.

Aquifer. Layers or pockets of water-bearing sand or gravel that occur in unconsolidated deposits or as beds forming part of a bedrock formation.

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 deposits of gravel, sand, silt, and marl that have been laid down by the agency of water and which through a long period of time and the weight of the overlying sediments have become cemented into a solid rock.

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 section in a river valley that is 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, which were deposited by the continental ice-sheet. It is also referred to as glacial till or boulder clay.

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

Hydrostatic Pressure. The pressure exerted by the water at any given point. It is due mainly to the weight of the column of water occurring at higher levels in the same aquifer or water-bearing bed.

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

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

Potable. Drinkable.

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.

Saline. Salty, having a high content of sodium chloride.

Unconsolidated Deposits. The mantle or covering of alluvium 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.

Water-bearing Horizon. A layer in either unconsolidated deposits or in bedrock formation that is water-bearing; same as aquifer.

Zone of Saturation. An area in which the permeable rocks are saturated with water that will move under ordinary hydrostatic pressure.

Names and Descriptions of Geological Formations, Referred to in These Reports.

Wood Mountain Formation. The local name given to a series of gravel and thin sand beds which have a maximum thickness of 50 feet, and which occur as isolated patches on the higher elevations of Wood mountain. They are the youngest of the consolidated rocks and, where present, rest upon the beds of the Ravenscrag formation.

Cypress Hills Formation. The local name given to a series of conglomerates and sand beds occurring in the southwest corner of Saskatchewan, which rests upon the Ravenscrag or older formations. The thickness of this formation varies from 30 to 125 feet.

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

Whitemud Formation. The local name given to a series of white, grey, and buff coloured clays and sands that varies in thickness from 10 to 75 feet. The base of this formation grades in places into a coarse, limy sand having a maximum thickness of 40 feet.

Eastend Formation. The local 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 eastern escarpment of Missouri coteau. The thickness of the formation seldom exceeds 40 feet.

Marine Shale Formation. The general name given to the thick deposit of incoherent, dark grey to dark brownish grey, plastic shales, which weather light grey to buff in places. It forms the bedrock over

the greater part of southern and central Saskatchewan. In the eastern half of the province it has a thickness of at least 700 feet. In the western part of the province it consists of a series of dark shales averaging 700 feet in thickness, termed the Bearpaw formation. This is underlain by a series of sands, shales, and coal seams, known as the Belly River formation, which reaches a maximum thickness of 900 feet.

WATER-BEARING HORIZONS OF THE MUNICIPALITY

Water-bearing Horizons in the Unconsolidated Deposits

The rural municipality of Storthoaks is an area of 216 square miles in southeastern Saskatchewan, consisting of 6 township described as townships 4, 5, and 6, ranges 30 and 31, west of the 1st meridian. This municipality is covered by a deposit of unconsolidated glacial drift approximately 200 to 300 feet in thickness. On the uplands, the upper 10-to-30-foot zone of this deposit is composed of yellow clay with pockets of gravel and sand, but along the creek valleys and ravines, the zone consists mainly of gravel. The sand and gravel deposits of this upper part of the drift constitute the main water-bearing horizon in the municipality. All shallow wells derive their water supply from this horizon.

Underlying this upper 30-foot zone is from 150 to 250 feet of blue clay which may contain a few pockets of water-bearing sand, but any water derived from them will be small in quantity and possibly too alkaline for use.

At three locations, namely, SW. $\frac{1}{4}$, sec. 33, tp. 5, range 31; NE. $\frac{1}{4}$, sec. 27, tp. 6, range 31; and NE. $\frac{1}{4}$, sec. 17, tp. 6, range 30, a sand deposit lying between the above -mentioned blue clay and the bedrock forms a water-bearing horizon. It produces a fairly abundant supply of hard, slightly saline water, which is under sufficient pressure to rise to within 20 to 85 feet of the surface. The elevations of the horizon at these points are 1,547, 1,533 and 1,620 feet, respectively, but the horizon is not continuous throughout the municipality. As the horizon was not noted in other deep wells it would appear that in the three localities mentioned there is only a local deposit of the sand in depressions in the pre-glacial bedrock land surface.

Water-bearing Horizons in the Bedrock

The Ravenscrag formation immediately underlies the blue clay, or the sand deposits where they are present, and consists of approximately 200 feet largely of shale. In townships 4, 5, and 6, range 31, the shale contains some sandy strata, but elsewhere in the municipality they appear to be absent. These sandy layers form at least three water-bearing horizons which occur at elevations of 1,400 to 1,450 feet, 1,245 to 1,300 feet and 1,160 feet, or at depths of 250 to 320 feet, 400 to 500 feet, and 650 feet. The upper horizon yields a good supply of soft, saline water that is under sufficient pressure to rise to within 3 to 10 feet of the surface. It was reported that one of the wells deriving its water from this horizon flowed for some time after it was drilled. The water from the second horizon is harder but also saline in character, and rises to within 20 to 50 feet of the surface. The third horizon, where tapped, yielded a small supply of hard, saline water.

Should other deep wells be drilled into these three water-bearing horizons in the townships mentioned above, a fairly abundant supply of water might be expected. Elsewhere in the municipality the possibility of obtaining a satisfactory water supply from bedrock is poor.

The area in which flowing artesian wells occur, or might be expected to occur, is shown on the accompanying map.

GROUND WATER CONDITIONS BY TOWNSHIPS

Township 4, Range 30

In township 4, range 30, the pockets of sand and gravel that occur at elevations of from 1,635 to 1,700 feet, or within the upper 20 feet of the glacial drift, form its only water-bearing horizon. With the exception of the central part of the township where these pockets are absent, a supply of water sufficient for 40 to 100 head of stock can be obtained

from most shallow wells. Those wells having sand and quicksand as the aquifers give a better supply than those having gravel as aquifers. Wells dug into the yellow clay usually obtain alkaline water.

The Ravenscrag formation was struck by a well 400 feet in depth in the SW. $\frac{1}{4}$. section 31, but no water-bearing horizon was tapped. The possibilities of obtaining an abundant water supply from this formation are poor as the sandy strata are apparently very small or entirely absent.

Township 4, Range 31

The sand and gravel deposits lying above the blue clay form the only water-bearing horizon in the glacial drift of this township. All the shallow wells in the township derive their waters from this horizon at depths of from 8 to 15 feet. The top of the horizon varies in elevation from 1,700 to 1,750 feet from the southeast to the northwest. The best water supply is obtained from wells located along a narrow valley which runs in a southerly direction through sections 34, 27, 22, 15, 10, 3, and 2. This valley is underlain by a broad strip of gravel and sand 8 to 10 feet in thickness, and individual wells dug into this depcsit yield a supply of water that is sufficient for 30 to 75 head of stock. A similar deposit may occur in a small valley near the eastern edge of the township. Elsewhere, the wells are dug into pockets of gravel, and in years of normal rainfall they produce a supply of water that is sufficient for local needs. Three wells located in the western half of sections 3 and 10 yield alkaline water, but hard, potable water is obtained from the other shallow wells in the township.

Three water-bearing horizons have been tapped in the Ravenscrag formation. The upper one is formed by a sandy shale bed and it has been pierced at depths of 280,300, feet, and 320 feet, or at an elevation of 1,450, 1,410, and 1,397 feet, respectively (See wells Nos. 13, 7, and 5). The water is saline and hard in character,

and rises to within 8 feet of the surface. In the SE. ¼, section 13, a sandstone bed forming a second aquifer was pierced at a depth of 385 feet or at an elevation of 1,315 feet. It yields and abundant supply of soft, saline water which rises to within 50 feet of the surface. The third water-bearing horizon is a sandy shale bed and it has been encountered at depths of 400, 439, and 500 feet, or at an elevation of 1,280, 1,266, and 1,245 feet (See wells No. 11, 35, and 19). The water is medium hard and saline, and the hydrostatic pressure is sufficient to cause it to rise to within 25 feet of the surface, or to flow a short distance above it. Tapping of these horizons by deep wells in other parts of the township should provide an abundant supply of water under sufficient pressure to cause it to rise to within 20 to 50 feet of the surface.

Township 5, Range 30

The water supply in this township is derived entirely from the gravel and sand deposits in the upper 20 feet of the glacial drift. An abundant supply of hard, potable water, sufficient for 50 to 100 head of stock, can be obtained from the gravel deposits along Gainsborough creek and from the gravel ridges that trend in a north-south direction in various parts of the township. Where the sand and gravel occur as pockets and narrow strips, or are entirely absent, the water supply is small and water for stock use has to be hauled during the winter months and drought periods. This was the case in the following locations: NW. ¼, section 2; SW. ¼, section 11; NW. ¼, section 14; NW. ¼, section 17; SE. ¼, section 22; SE. ¼, section 33, and all of section 34.

To the writer's knowledge no deep wells have been drilled in this township. The Ravenscrag formation underlies the township and its water-bearing horizons should provide a fair supply of water if tapped. The sandy beds of this formation are thought to disappear to the eastward and if so some of the

deep wells would probably yield very little or no water.

Township 5, Range 31

There are two water-bearing horizons in the glacial drift in this township. The pockets and strips of sand and gravel lying above the blue clay at an elevation of from 1,720 to 1,800 feet, form the upper and most important water-bearing horizon. The best supply of water from this horizon can be obtained from wells dug 8 to 15 feet into the gravel flooring and bordering the valley of Lightning creek, and into similar deposits along a ravine that runs in a southerly direction through the east half of sections 22, 15, 10, and 3. These wells provide sufficient water for 50 to 100 head of stock. Elsewhere in the township the supply is poor, the gravel being in pockets or entirely absent. In the following locations -- SE. ¼, section 11; W.½, section 11; NW. ¼, section 14; SW. ¼, section 15; NW. ¼, section 19; NW. ¼, section 24; NW. ¼, section 25; SW. ¼, section 26; SE. ¼, section 27; NW. ¼, section 30, and SW. ¼, section 31 -- only a small supply of water is obtained, and water has to be hauled during the winter months and drought periods.

The blue clay has been penetrated to a depth of 160 feet in the NE. ¼, section 32, without encountering any water, and similar conditions doubtless exist throughout much of the township.

In the SW. ¼, section 33, a sand bed lying between the blue clay and the Ravenscrag formation at a depth of 265 feet, or at an elevation of 1,547 feet, constitutes the second water-bearing horizon in the glacial drift. The water is hard and saline in character, rises to within 25 feet of the surface and is abundant in quantity. This water-bearing horizon is of small areal extent as it was not encountered in the other deep wells in the township.

In the SE. ¼, section 10, water was found at a depth of 440 feet, or at an elevation of 1,320 feet, in a sandy shale bed of the Ravenscrag formation. The water rises to within 25 feet

of the surface and is soft and saline in quality and abundant in quantity. The water from this well and from one located in section 9, used to flow above the surface. In sections 23 and 27, wells were drilled to a depth of 500 feet into the Ravenscrag formation without encountering water. Apparently the water-bearing sandy strata of the formation are not continuous in this township, and should other wells be drilled some will probably not encounter any water. The possibilities of obtaining water below a depth of 500 feet are small, as at this depth a non-water-bearing Marine shale formation occurs.

Township 6, Range 30

Two water-bearing horizons exist in the glacial drift in this township. The gravel pockets lying within the upper 30 feet of the drift form the first horizon. In years of normal rainfall, a sufficient supply of water for local needs is obtained from wells tapping these pockets. In sections 31 to 36 practically no gravel is to be found, and the water that comes from wells dug into the yellow clay is not sufficient for local needs and is usually too alkaline for domestic use.

The second water-bearing horizon was encountered below the blue clay in the NE. $\frac{1}{4}$, section 17, and consists of a white sand, which extends from a depth of 130 feet to 212 feet. The water rises to within 85 feet of the surface and is hard in character, and abundant in quantity. To the writers knowledge no other deep wells have been drilled in this township, and thus the areal extent of this horizon cannot be determined.

Little information on the water-bearing horizons of the Ravenscrag formation was obtained in this township, but it is doubtful if any quantity of water will be derived from them. Two holes were drilled to depths of 420 and 690 feet in section 28 without encountering water.

Township 6, Range 31

Two water-bearing horizons occur in the glacial drift in this township. The upper horizon is formed by the sand and gravel deposits lying above the blue clay at an elevation of from 1,760 to 1,840 feet. A supply of water sufficient for 50 to 150 head of stock can be obtained from 8-to 15-foot wells dug into this horizon along Lightning and Gainsborough creeks where the gravel is extensive. In the central part of the township the gravel where present is in the form of pockets and the water supply from wells tapping these pockets is poor, and it is usually necessary to haul water for stock during the winter months and drought periods. Some farmers are using dugouts and by this method the runoff water is conserved for stock use during the summer months.

In the NE. $\frac{1}{4}$, section 27, a well 309 feet in depth, encountered a sand bed lying between the bedrock and the blue clay. This sand bed forms a second water-bearing horizon. The water from it is hard and salty, and rises to within 20 feet of the surface, but the supply is poor. Owing to the lack of information the areal extent of this horizon could not be determined.

In the SE. $\frac{1}{4}$, section 3, a well 650 feet in depth derives an abundant supply of hard, salty water from a water-bearing-horizon in the Ravenscrag formation. No further information on this horizon was obtained, but it is believed that only a small supply of water, if any, would be encountered in the bedrock throughout the township.

STATISTICAL SUMMARY OF WELL INFORMATION IN RURAL MUNICIPALITY OF STORTHOAKS, No. 31, SASKATCHEWAN

Township / West of 1st mer. Range	4 30	4 31	5 30	5 31	6 30	6 31	Total No. in Municipality
Total No. of Wells in Township	48	57	50	78	42	46	321
No. of wells in bedrock	1	11	0	4	0	1	17
No. of wells in glacial drift	47	46	50	74	42	45	304
No. of wells in alluvium	0	0	0	0	0	0	0
Permanency of Water Supply							
No. with permanent supply	32	46	28	40	18	26	190
No. with intermittent supply	5	5	13	16	12	14	65
No. dry holes	11	6	9	22	12	6	66
Types of Wells							
No. of flowing artesian wells	0	1	0	2	0	0	3
No. of non-flowing artesian wells	0	7	0	2	1	2	12
No. of non-artesian wells	37	43	41	52	29	38	240
Quality of Water							
No. with hard water	32	48	34	47	26	37	224
No. with soft water	5	3	7	9	4	3	31
No. with salty water	0	7	0	2	0	2	11
No. with alkaline water	9	8	0	3	6	1	27
Depths of Wells							
No. from 0 to 50 feet deep	47	46	50	72	41	44	300
No. from 51 to 100 feet deep	0	0	0	0	0	0	0
No. from 101 to 150 feet deep	0	0	0	0	0	0	0
No. from 151 to 200 feet deep	0	0	0	1	0	0	1
No. from 201 to 500 feet deep	1	10	0	5	1	1	18
No. from 501 to 1,000 feet deep	0	1	0	0	0	1	2
No. over 1,000 feet deep	0	0	0	0	0	0	0
Potability of Water							
No. potable for domestic use	32	42	39	52	24	37	226
No. not potable for domestic use	5	9	2	4	6	3	29
No. potable for stock use	35	51	40	51	29	39	245
No. not potable for stock use	2	0	1	5	1	1	10
Sufficiency of Water Supply							
No. sufficient for domestic needs	36	51	38	54	30	40	249
No. insufficient for domestic needs	1	0	3	2	0	0	6
No. sufficient for stock needs	27	36	23	40	22	26	174
No. insufficient for stock needs	10	15	18	16	8	14	81

ANALYSES AND QUALITY OF WATER

General Statement

Samples of water from representative wells in surface deposits and bedrock were taken for analyses. The samples were analysed in the laboratory 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 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 and calcium and unless the figure is very high it does not imply that the water is too alkaline for irrigation purposes. The analyses are given in parts per million--that is, in parts by weight of the constituents in 1,000,000 parts by volume 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 practically all rocks, but in larger amounts 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 teakettles 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 (Na_2SO_4) is usually in excess of sodium chloride (NaCl). These sodium salts are dissolved from rocks and soils. Sulphate of sodium is commonly known as "Glauber's Salts" and when there is a large amount present the water is laxative and unfit for domestic use. Sodium carbonate (Na_2CO_3) "Black Alkali", and sodium sulphate and sodium chloride "White Alkali" are injurious to vegetation, and waters that contain a large amount of them cannot be used for irrigation.

Sulphate

Sulphates (SO_4) are one of the common constituents of natural water. The sulphate salts most commonly found are sodium sulphate (Glauber's Salts, Na_2SO_4), magnesium sulphate (Epsom

Salts, ($MgSO_4$), and calcium sulphate ($CaSO_4$). Waters that contain these sulphate salts are called "sulphated waters". When the water contains large quantities of the sulphate of sodium ("White Alkali") it is injurious to vegetation and cannot be used for irrigation. According to John C. Thresh, London, "The continued use of water that contains 1,200 parts or more per million of magnesium sulphate and 500 parts or more per million of sodium sulphate causes diarrhoea and scour among stock, and one-half this quantity makes the water unfit for domestic use".

Chloride

Chloride (Cl) is a common constituent of all natural water and is dissolved in small quantities from rocks. It usually occurs as sodium chloride (common salt, NaCl) and if the quantity is much over 400 parts per million the water has a brackish taste; if the water contains much over 400 parts per million it becomes too salty to be fit for domestic use.

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. In the table of analyses given in this report, the iron content is less than 1 part per million unless otherwise noted. More than 0.1 part per million of iron in solution will settle out as a red precipitate upon exposure to the air. Water that contains not more than 0.5 part of iron per million is considered as the usual upper limit for potable water, but this amount is often exceeded. From 1 to 3 parts per million the water may be considered only fair, and in excess of 3 parts per million the water is bad. 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.

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 to the bicarbonates of calcium and magnesium, and permanent hardness to the carbonates, sulphates and chlorides of calcium and magnesium. The permanent hardness can be partly eliminated by adding natural 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. The following table taken from "The Examination of Water and Water Supplies" by John C. Thresh, London, 1925, can be used for determining the degree of hardness of a water.

Total Hardness (Total Ca and Mg content in parts per million)	Character
Less than 50	Very soft
50 - 100	Moderately soft
100 - 150	Slightly hard
150 - 200	Moderately hard
200 - 300	Hard
Over 300	Excessively hard

Many of the Saskatchewan water samp es analysed by the Geological Survey 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.

The term "alkaline" has been applied rather loosely to ground water. Its original meaning was a chemical one and it implied that the substance in question would neutralize acids. The carbonates of calcium, magnesium, and sodium are the only compounds found in ground water that would make it alkaline chemically. A later application of the term "alkaline" was to soils that contain sufficient "black alkali" or "white alkali" to make them unfit for vegetation. In the Prairie Provinces a water is usually considered to be alkaline when it contains so much dissolved solids as to be unfit for human consumption; except that water that tastes strongly of common salt is described as "salty". Many alkaline waters may be used for stock. Most alkaline waters are more correctly termed "sulphated" waters.

Analysis of Water Samples from the Municipality of Storthoaks, No. 31, Saskatchewan

LOCATION					Depth of Well, Ft.	Total dis'vd Solids	Cl.	HARDNESS			CONSTITUENTS AS ANALYSED					CONSTITUENTS AS CALCULATED IN ASSUMED COMBINATIONS									
Qtr.	Sec.	Tp.	Rg.	Mer.				Total	Perm.	Temp.	Alk'ity	CaO	MgO	SO_4	Na_2O	Solids	$CaCO_3$	$CaSO_4$	$MgCO_3$	$MgSO_4$	Na_2CO_3	Na_2SO_4	NaCl	Fe	Source
NW.	6	4	31	1	320	1,360	211	260	180	80	925	70	40	4	621	1,305	125		84		742	6	348		x 2
SW.	12	4	31	1	452	4,460	2220	1,000	400	600	575	30	18	4	2238	4,265	54		38		505	6	3,662	15	x 2

Source:

Water samples indicated thus, x 2, are from bedrock Ravenscrag formation.

x Analyses are generally reported parts per million. For interpretation of this Table read the section on Analyses and Quality of Water.

Water from the Unconsolidated Deposits

No samples of the waters from the glacial drift of this municipality were taken for analyses. The following discussion is based on the results of samples collected and analysed from surrounding municipalities.

The waters from the upper part of the glacial drift vary greatly in quality. They all contain the same mineral salts in solution, but the amounts of these salts differ greatly in the samples analysed. The total dissolved solid content ranges from 400 to 2,700 parts per million, averaging approximately 1,700 parts per million. Water that contains a total dissolved solid content exceeding 5,000 parts per million is considered to be unfit for use, but in a few cases such waters have been used without any noticeable ill effects. All of the samples of water analysed are hard to excessively hard in character, having a total hardness of from 280 to 2,000 parts per million, with an average of approximately 1,500 parts per million. The greater part of this total hardness is composed of salts that render the water permanently hard, and it cannot be softened by boiling.

Magnesium sulphate (Epsom Salts) is the most abundant mineral salt present. It ranges from 175 to 1,290 parts per million. The water having a high magnesium sulphate content may act as a laxative upon those who are not accustomed to highly mineralized water.

Sodium chloride (NaCl) and calcium carbonate ($CaCO_3$) are next in order of abundance. The sodium chloride content usually runs from 13 to 350 parts per million, with an average of 200 parts per million. This amount will not cause the water to have a salty taste. The calcium carbonate content averages 225 parts per million and imparts hardness to the water. Small amounts of magnesium carbonate also occur in the samples analysed. In general, the waters analysed contain only a small amount of

sodium sulphate or Glauber's Salts.

Unless the magnesium sulphate (Epsom Salts) and sodium sulphate (Glauber's Salts) content is very high, the water from the upper part of the glacial drift is suitable for domestic use and stock requirements. It can also be used for irrigation.

No samples were taken of the water that is being derived from the sand deposits occurring at the contact of the glacial drift and bedrock. This water is hard in character and contains the same mineral salts in solution as the water derived from the upper part of the drift. It is satisfactory for stock use and as a rule can be used for domestic purposes.

Water from the Bedrock

Two samples of water from the Ravenscrag formation were analysed and their results are listed in the accompanying table. These samples were taken from wells that are deriving their water from horizons occurring at depths of approximately 320 feet and 450 feet, and indicate the types of water that may be expected from these water-bearing horizons.

The water that was obtained from a depth of 320 feet has a total dissolved solid content of 1,360 parts per million. Approximately half of this content is composed of sodium carbonate (black alkali), and the remainder is made up of sodium chloride (common salt), calcium carbonate, magnesium carbonate, and sodium sulphate, their abundance decreasing in the order given. This water is medium hard in character, and is suitable for domestic and stock use. It cannot be used for irrigation purposes as its high sodium carbonate (black alkali) content is detrimental to vegetation.

The sample of water that was obtained from a depth of 450 feet has a total dissolved solid content of 4,265 parts per million. Sodium chloride (common salt) is the most abundant

mineral salt present, and 3,662 parts per million of the total solid content is composed of this salt. Sodium carbonate (black alkali) is next in order of abundance with 505 parts per million. Small amounts of calcium carbonate, magnesium carbonate, and sodium sulphate also occur. The water contains a large amount of iron salts, 15 parts per million, and upon exposure to the air these salts are oxidized and the iron precipitated as a brownish sediment. This water has a total hardness of 1,000 parts per million, of which 600 parts is temporary and may be destroyed by boiling. As the amounts of calcium and magnesium salts that impart hardness are low, this excessive hardness may be due to the abundance of iron and sodium chloride.

This water is not suitable for domestic purposes due to its large content of iron and common salt. When used for stock it should be allowed to stand exposed to the air for a considerable length of time. This gives the iron an opportunity to be oxidized and settle out. The water cannot be used for irrigation.

WELL RECORDS—RURAL MUNICIPALITY OF STORTHOAKS, NO. 31, SASKATCHEWAN.

WELL NO.	LOCATION					TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE		PRINCIPAL WATER-BEARING BED			CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
	¼	Sec.	Tp.	Rge.	Mer.				Above (+) Below (−) Surface	Elev.	Depth	Elev.	Geological Horizon				
1	SW.	2	4	30	1	Dug	18	1,645	- 2	1,643	10	1,635	Glacial sand	Hard, clear	44	D, S, I	Waters 60 head stock.
2	SE.	3	"	"	"	"	20	1,655	- 3	1,652	15	1,640	" gravel	Soft, bad taste	46	S	Poor supply.
3	SW.	4	"	"	"	"	10	1,670	- 9	1,661	10	1,660	Blue clay	Hard, clear	48	D	" " ; 2 pails a day. Many dry holes dug.
4	SE.	6	"	"	"	"	8	1,655	- 3	1,652	5	1,650	Glacial gravel	" "	45	D, S	Waters 40 head stock.
5	SW.	6	"	"	"	"	10	1,655	- 5	1,650	9	1,646	" sand	" "	44	D, S	Waters 60 head stock.
6	NE.	10	"	"	"	"	16	1,634	- 5	1,659	12	1,652	" gravel	" "	43	D, S, I	" 60 " " .
7	NE.	10	"	"	"	"	7	1,660	- 5	1,655	7	1,653	" sand	" "	49	D, S, I	" 100 " " ; water flows to southeast.
8	SE.	14	"	"	"	"	12	1,650	- 4	1,646	11	1,639	" "	" "	46	D, S, I	" 35 " " ; two similar wells.
9	NW.	19	"	"	"	"	10	1,685	- 5	1,680	7	1,678	" "	" "	44	D, S	" 40 " " .
10	SW.	19	"	"	"	"	12	1,675	- 7	1,668	10	1,665	" "	" "	45	D, S, I	" 40 " " .
11	NE.	20	"	"	"	"	10	1,710	- 9	1,701	9	1,701	Yellow clay	", alkaline	52	S	Poor supply; hauls water.
12	SW.	20	"	"	"	"	10	1,705	- 7	1,698	7	1,698	Glacial sand	" clear	46	D, S, I	Waters 40 head stock; two similar wells.
13	SE.	25	"	"	"	"	14	1,670	- 10	1,660	10	1,660	" "	" "	46	D, S, I	" 15 " " ; dry in drought.
14	NE.	26	"	"	"	"	13	1,650	- 10	1,640	10	1,640	Yellow clay	", alkaline	50	S	" 15 " " in ordinary years.
15	NE.	27	"	"	"	"	14	1,660	- 8	1,652	12	1,648	Glacial sand	", sulphur	41	D, S, I	" 50 " ";kills plants;laxative.
16	NW.	27	"	"	"	"	15	1,690	- 7	1,683	10	1,680	" "	", clear	43	D, S	" 100 " " .
17	SE.	30	"	"	"	"	12	1,710	- 5	1,705	6	1,704	" "	Soft, muddy	49	S	" 70 " " .
18	SE.	31	"	"	"	"	10	1,710	- 5	1,705	6	1,704	" "	Hard, clear	45	D, S, I	" 50 " " .
19	SW.	31	"	"	"	"	13	1,680	- 11	1,669	11	1,669	" gravel	" "		D, S	" 50 " " ; 400' dry hole.
20	SE.	32	"	"	"	"	18	1,725	- 9	1,716	8	1,717	" "	" "	41	S	" 50 " " .
21	NW.	33	"	"	"	"	9	1,710	- 4	1,706	6	1,704	" "	" "	44	D, S	" 20 " " .
22	SW.	34	"	"	"	"	14	1,685	- 6	1,679	9	1,676	" sand	" "	43	D, S	" 90 " " .
23	SE.	36	"	"	"	"	11	1,655	- 4	1,651	11	1,644	" "	" "	42	D, S	" 100 " " .
1	NW.	1	4	31	1	"	12	1,665	- 10	1,655	10	1,655	" "	" "		D, S	" 60 " " .
2	SW.	2	"	"	"	"	8	1,685	- 5	1,680	5	1,680	" gravel	" "		D, S	" 100 " " .
3	NW.	3	"	"	"	"	12	1,690	- 8	1,682	3	1,687	" "	" " alkaline	51	D, S	" 50 " " .

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 STORTHOAKS, NO. 31, SASKATCHEWAN.

WELL No.	LOCATION					TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE		PRINCIPAL WATER-BEARING BED			CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
	¼	Sec.	Tp.	Rge.	Mer.				Above (+) Below (−) Surface	Elev.	Depth	Elev.	Geological Horizon				
4	NW.	5	4	31	1	Dug	14	1,712			12	1,700	Glacial gravel	Hard, clear	48	D, S	Sufficient for local needs.
5	NW.	6	"	"	"	Drilled	320	1,717			320	1,397	Ravenscrag	Soft, salty		S	Not a good supply; #.
6	NE.	8	"	"	"	Dug	12	1,720	- 8	1,712	12	1,708	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
7	NE.	9	"	"	"	Drilled	472	1,710	- 8	1,702	300	1,410	Ravenscrag shale	" salty	45	S	Abundant supply.
8	SW.	10	"	"	"	Dug	10	1,700	- 4	1,696	7	1,693	Glacial sand	", alkaline		D, S	Poor supply.
9	NW.	10	"	"	"	"	8	1,710	- 6	1,704	6	1,704	" gravel	", "	45	D, S	Sufficient for local needs.
10	NE.	10	"	"	"	"	9	1,715	- 3	1,712	3	1,712	" "	", clear		D, S	Waters 75 head stock.
11	SW.	12	"	"	"	Drilled	452	1,680	- 23	1,657	400?	1,280	Ravenscrag shale	", salty	43	S	" 25 " " ;orange flocculent precipitate; #.
12	SE.	13	"	"	"	"	385	1,700	- 50	1,650	385	1,315	" sandstone	Soft, salty	46	S	Abundant supply.
13	SW.	14	"	"	"	"	400	1,710	- 3	1,707	260	1,450	" sand	Hard, salty		S	" " .
14	SW.	15	"	"	"	Dug	8	1,710	- 6	1,704	2	1,708	Glacial gravel	" , clear	45	D, S	Waters 33 head stock.
15	NE	15	"	"	"	"	9	1,725	- 5	1,720	5	1,720	" "	" "	45	D, S	Sufficient for local needs.
16	NE.	17	"	"	"	"	10	1,730	- 6	1,724	6	1,724	" sand	" "		D, S	" " " " , also flowing well.
17	SE.	18	"	"	"	"	14	1,735	- 11	1,724	12	1,723	" "	" "	40	D, S	Poor supply. three 500' wells drilled; no water.
18	NW.	18	"	"	"	"	12	1,740	- 7	1,733	7	1,733	" gravel	" "		D, S	Sufficient for local needs.
19	NE.	18	"	"	"	Drilled	520	1,745			500?	1,245	Ravenscrag shale	" salty		S	Fair supply.
20	NW.	19	"	"	"	Dug	12	1,748	- 8	1,740	8	1,740	Glacial gravel	" clear	52	D, S	Sufficient for local needs; 2 similar wells.
21	SE.	21	"	"	"	"	12	1,745	- 7	1,738	7	1,738	" sand	" "	48	D, S	" " " " .
22	NE.	21	"	"	"	"	12	1,747	- 6	1,741	9	1,738	" gravel	" "	48	D, S	" " " " .
23	NE.	22	"	"	"	"	8	1,738	- 5	1,733	5	1,733	" "	", alkaline		D, S	Poor supply
24	SW.	24	"	"	"	"	8	1,710	- 1	1,709	3	1,707	" "	", clear	46	D, S	Sufficient for local needs.
25	NE.	25	"	"	"	"	12	1,700	- 7	1,693	7	1,693	" sand	" "		D, S	Waters 50 head stock; gravel pocket.
26	NW.	26	"	"	"	"	8	1,725	- 4	1,721	6	1,719	" "	" "	45	D, S	Sufficient for local needs.
27	SW.	27	"	"	"	"	16	1,735	- 9	1,726	9	1,726	" gravel	", alkaline		D, S	Waters 60 head stock in years of normal rainfall.
28	NW.	27	"	"	"	"	10	1,745	- 7	1,738	7	1,738	" "	", clear		D, S	Sufficient for local needs.
29	SE.	28	"	"	"	"	18	1,750	- 10	1,740	10	1,740	" "	", "	48	D, S	Fair supply.
30	SE.	29	"	"	"	"	10	1,752	- 8	1,744	8	1,744	Sandy clay	", "		D, S	Poor " .

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 STORTHOAKS, NO. 31, SASKATCHEWAN.

WELL No.	LOCATION					TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE		PRINCIPAL WATER-BEARING BED			CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
	¼	Sec.	Tp.	Rge.	Mer.				Above (+) Below (−) Surface	Elev.	Depth	Elev.	Geological Horizon				
31	NW.	30	4	31	1	Dug	8	1,755	- 5	1,750	5	1,750	Glacial gravel	Hard, clear	50	D, S	Sufficient for local needs.
32	NE.	31	"	"	"	"	7	1,760	- 2	1,758	3	1,757	" "	" "		D, S	" " " " .
33	SW.	32	"	"	"	"	15	1,758	- 10	1,758	10	1,758	" "	Soft, clear	46	D, S	" " " " ; water comes from northeast.
34	NW.	35	"	"	"	"	8	1,750	- 4	1,746	4	1,746	" "	Hard, "	45	D, S,	Poor supply.
35	NE.	36	"	"	"	Drilled	439	1,705	- 18	1,687	439	1,266	Ravenscrag shale	Soft, salty	46	S,	Not a good supply; some gas in winter.
1	NW.	2	5	30	1	Dug	20	1,680	- 14	1,666	14	1,666	Glacial gravel	Hard, clear	45	D, S	Domestic use only; haul for stock in winters.
2	NW.	3	"	"	"	"	7	1,690	- 1	1,689	5	1,685	" "	" "	45	D, S	Abundant supply.
3	NE.	6	"	"	"	"	9	1,700	- 6	1,694	6	1,694	" "	" "	42	D, S	" " .
4	SE.	9	"	"	"	"	14	1,695	- 9	1,686	11	1,684	" "	" "		D, S	Waters 50 head stock.
5	SW.	11	"	"	"	"	12	1,690	- 9	1,681	9	1,681	" "	" "	46	D, S	Haul water in winter.
6	SE.	12	"	"	"	"	14	1,660	- 10	1,650	10	1,650	" sand	" "		D, S	Waters 60 head stock.
7	SE,	13	"	"	"	"	8	1,660	- 4	1,656	4	1,656	" gravel	" "	47	D, S, I	Waters 20 head stock.
8	SE.	14	"	"	"	"	11	1,695	- 2	1,693	4	1,691	" "	" "	45	D, S	Waters 50 head stock.
9	NW.	14	"	"	"	"	13	1,710	- 10	1,700	10	1,700	" sand	Soft, "		D, S	Haul water, poor supply.
10	SW.	15	"	"	"	"	10	1,697	- 5	1,692	5	1,692	" gravel	Hard, "		D,	
11	NE.	16	"	"	"	"	8	1,705	- 5	1,700	5	1,700	" sand	" "	47	D, S	Haul water, poor supply.
12	NW.	17	"	"	"	"	20	1,705	- 16	1,689	16	1,689	" gravel	" "	46	D, S	Poor supply.
13	NW.	18	"	"	"	"	12	1,702	- 10	1,692	10	1,692	" "	" "	43	D, S	Abundant supply.
14	NW.	19	"	"	"	"	7	1,715	- 3	1,712	3	1,712	" "	" "	41	D, S	" " .
15	SW.	19	"	"	"	"	20	1,705	- 12	1,693	12	1,693	" "	" "	41	D, S	Waters 100 head stock.
16	SE.	22	"	"	"	"	18	1,715	- 8	1,707	8	1,707	" sand	" "	46	N,	Haul water; dry in winters.
17	SW.	22	"	"	"	"	8	1,715	- 2	1,713	5	1,710	" gravel	" "	45	S,	Waters 40 head stock, laxative for man.
18	SE.	23	"	"	"	"	11	1,698	- 4	1,694	9	1,689	Sandy clay	" "	46	D, S	Waters 40 head stock, 2 similar wells.
19	SW.	24	"	"	"	"	8	1,680	- 2	1,678	5	1,675	Glacial sand	" "	45	D, S	Waters 50 head stock, 1 similar well.
20	NW.	25	"	"	"	"	10	1,697	- 5	1,692	8	1,689	" "	" "	44	D,	Domestic use only, 7 foor well and dugout for stock.
21	NE.	28	"	"	"	"	8	1,730	- 3	1,727	6	1,724	" gravel	" "	44	D, S, I	Abundant supply.
22	SE.	30	"	"	"	"	21	1,735	- 9	1,726	9	1,726	" "	" "	43	D, S	Abundant supply.

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

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

WELL RECORDS—RURAL MUNICIPALITY OF STORTHOAKS, NO. 31, SASKATCHEWAN

WELL No.	LOCATION					TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE		PRINCIPAL WATER-BEARING BED			CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
	¼	Sec.	Tp.	Rge.	Mer.				Above (+) Below (−) Surface	Elev.	Depth	Elev.	Geological Horizon				
23	SE.	33	5	30	1	Dug	21	1,735	- 6	1,729	11	1,724	Glacial gravel	Hard, reddish	46	D, S	Dry in winters and drought.
24	SE.	34	"	"	"	"	20	1,730	- 18	1,712	10	1,720	" "	" alkaline		N,	Hauled water for 25 years. No shallow wells.
25	SW.	35	"	"	"	"	12	1,710	- 3	1,707	3	1,707	" "	" clear		D, S,	Waters 100 head stock with similar well.
26	SW.	36	"	"	"	"	8	1,700	- 4	1,696	4	1,696	" "	" "		D, S	Abundant supply.
1	SW.	1	5	31	1	Dug	10	1,727	- 7	1,720	7	1,720	" "	" "	47	D, S	Waters 12 head stock; 1 simialr well.
2	NE.	3	"	"	"	"	24	1,760	- 18	1,742	18	1,742	" "	" iron		S,	Abundant supply, well in narrow gravel strip.
3	NW.	5	"	"	"	"	6	1,785	- 2	1,783	2	1,783	" sand	" clear	48	D,	Domestic use only.
4	NE.	6	"	"	"	"	14	1,785	- 8	1,777	8	1,777	" gravel	" "		D, S	Waters 100 head stock.
5	NE.	7	"	"	"	"	8	1,795	- 2	1,793	5	1,790	" "	" "	46	D, S	Abundant supply, several dry holes.
6	SE.	10	"	"	"	Drilled	440	1,760	- 25	1,735	440	1,320	Ravenscrag	Soft, salty		S,	Abundant supply. Used to flow. Shallow wells poor.
7	NE.	10	"	"	"	Dug	8	1,760	- 6	1,754	6	1,754	Glacial gravel	Hard, clear		D, S	Waters 15 head tock, Flowing well on SE¼ Sec 9.
8	NW.	11	"	"	"	"	28	1,760	- 24	1,736	10	1,750	" "	" "		D, S	Poor supply.
9	NE.	11	"	"	"	"	24	1,753	- 12	1,741	12	1,741	" "	" "		D, S	Waters 100 head stock.
10	SW.	13	"	"	"	"	24	1,752	-22	1,730	12	1,740	" "	" "		D, S	Waters 25 head stock.
11	NE.	13	"	"	"	"	12	1,715	- 8	1,707	8	1,707	" "	" "		D, S	Waters 50 head stock.
12	NW.	14	"	"	"	"	22	1,760					" "	" "		D, S	Depends on rainfall.
13	SW.	15	"	"	"	"	18	1,775	- 4	1,771	?	?	Sandy clay	" "		N,	Haul some water, very poor supply.
14	NE.	15	"	"	"	"	12	1,765	- 2	1,763	?	?	Glacial gravel	" "		D, S	12 bbls. a day.
15	SW.	16	"	"	"	"	8	1,786	- 4	1,781	4	1,781	" "	" "		D, S	Waters 120 head stock, dry holes south of creek.
16	SW.	16	"	"	"	"	12	1,788	- 5	1,783	5	1,783	" "	" "		B,	C. P. R. locomotives.
17	NW.	16	"	"	"	"	12	1,785	- 2	1,783	11	1,784	" sand	" "		D, S	Sufficient for local needs.
18	SW.	17	"	"	"	"	20	1,786	- 16	1,770	12	1,774	" gravel	" "		D, S	Waters 30 head stock, no water on East half of section.
19	SE.	18	"	"	"	"	16	1,798	- 8	1,790	12	1,786	" "	" "	45	D, S	Waters 35 head stock; 1 similar well.
20	NW.	19	"	"	"	"	26	1,810					Yellow clay	" alkaline		D, S	Sufficient in summer, haul water in winter.
21	SW.	20	"	"	"	"	14	1,795	- 8	1,787	8	1,787	Glacial gravel	" clear		D, S	Abundant supply.
22	NW.	20	"	"	"	"	10	1,800	- 8	1,792	8	1,792	" "	" "		D, S	Waters 25 head stock.
23	SE.	22	"	"	"	"	13	1,785	- 1	1,784	6	1,779	" "	" "	47	D, S	Abundant supply.

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

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

WELL RECORDS—RURAL MUNICIPALITY OF STORTHOAKS, NO. 31, SASKATCHEWAN.

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
24	SW.	23	5	31	1	Drilled	500	1,770									Three dry holes to 500 feet.
25	SW.	24	"	"	"	Dug	7	1,754	- 2	1,752	?	?	Glacial gravel	Hard, clear		D, S	No water on this section; fair supply along the ravine.
26	NW.	24	"	"	"	"	20	1,748	- 10	1,738			Yellow clay	" "		D, S	Very poor supply, haul water.
27	SE.	25	"	"	"	"	9	1,740	- 3	1,737	4	1,736	Glacial gravel	Soft, "		D, S	Waters 50 head stock, 2 similar wells.
28	NW.	25	"	"	"	"	17	1,795	- 2	1,793	5	1,790	Yellow clay	Hard, "		D, S,	Poor supply, haul water.
29	SW.	26	"	"	"	"	10	1,787					" "				Dry hole.
30	SE.	27	"	"	"	Drilled	490	1,790					Ravenscrag				Dry hole, no water in shallow wells.
31	SW.	29	"	"	"	Sand-point	8	1,790	- 2	1,788	3	1,787	Glacial gravel	Hard, clear	47	D, S	Waters 40 head stock; 1 similar well.
32	SE.	30	"	"	"	Dug	12	1,805	- 7	1,798	7	1,798	" "	Soft, "		D, S	Fair supply.
33	NW.	30	"	"	"	"	25	1,810	- 20	1,790	20	1,790	Yellow clay	Hard, clear		D, S	Poor supply, haul water in winter.
34	SW.	31	"	"	"	"	20	1,805	- 2	1,803	?	?	" "	" "		D, S	Haul water 10 months in year.
35	SW.	32	"	"	"	"	8	1,805	- 5	1,800	5	1,800	Glacial gravel	" "		D, S	Strong supply.
36	NW.	32	"	"	"	"	10	1,805					" sand	Soft, clear		D, S	Sufficient for local needs.
37	NE.	32	"	"	"	"	10	1,795					" sand	" "		D, S	Sufficient for local needs.
38	SW.	33	"	"	"	Drilled	265	1,812	- 25	1,787	265	1,547	Sand below blue clay	Hard, salty		D, S	Abundant supply.
39		34	"	"	"	"	464	1,800	- 10	1,790	425	1,375	Ravenscrag sand	"		D, S	Abundant supply.
40	NW.	36	"	"	"	Dug	10	1,750	- 4	1,746	6	1,744	Glacial gravel	" clear	46	D, S	Sufficient for local needs.
1	NW.	1	6	30	1	Dug	10	1,710	- 4	1,706	4	1,706	Glacial gravel	Hard, clear	44	D, S	Abundant supply.
2	NE.	1	"	"	"	"	14	1,690			14	1,676	" "	" "		D, S	Low in February.
3	SE.	4	"	"	"	"	12	1,748	- 9	1,739	9	1,739	" "	Soft, clear		D, S	Water 15 head stock in dry spells.
4	NW.	4	"	"	"	"	6	1,760	- 4	1,756	4	1,756	" sand	" "		D, S	Waters 40 head stock; freezes off in cold months.
5	SE.	10	"	"	"	"	22	1,740	- 18	1,722	10	1,730	Clay and gravel	Hard, "		D,	Sufficient for house use; haul water for stock.
6	NE.	14	"	"	"	"	8	1,705	- 4	1,701	4	1,701	Sand and gravel	"alkaline		S,	Fair supply.
7	NE.	17	"	"	"	Drilled	212	1,775	- 85	1,690	155	1,620	White sand above bedrock	"	42	D, S	Abundant supply.
8	NE.	20	"	"	"	Dug	18	1,778	- 12	1,766	12	1,766	Glacial gravel	" clear		D, S	Dry in winters.
9	SE.	21	"	"	"	"	18	1,760	- 12	1,748	12	1,748	" sand	" "		D, S	Fair supply; gravel lens only.
10	SE.	22	"	"	"	"	16	1,748	- 6	1,742	6	1,742	" gravel	" ordorous	43	D, S	Almost dry in winters; haul water then.

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 STORTHOAKS, NO. 31. 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.	27	6	30	1	Dug	11	1,755	- 9	1,746	9	1,746	Glacial gravel	Hard, clear		D, S	Good supply.
12	SW.	28	"	"	"	"	11	1,740	- 4	1,736	4	1,736	" "	" "	45	D, S	Sufficient with a similar well.
13	NE.	24	"	"	"	"	12	1,695	- 8	1,687	8	1,687	" "	" "		D, S	Waters 90 head stock. Gravel deposit extensive.
14	SE.	27	"	"	"	"	17	1,755	- 6	1,749	6	1,749	" "	" "	44	D, S	Abundant supply. *Dry holes in bedrock on Sec 28*
15	NW.	29	"	"	"	"	14	1,790	- 6	1,784	6	1,784	" sand	" "	44	D, S	Hauled water 1934-1935.
16	SW.	29	"	"	"	"	18	1,875	- 8	1,867	18	1,857	Clay and sand	"		D, S	Poor supply.
17	SE.	33	"	"	"	"	9	1,875	- 1	1,874	8	1,867	Glacial gravel	Soft, clear		D, S	Waters 50 head stock. Many dry holes dug.
18	SE.	34	"	"	"	"	26	1,815	- 3	1,812	?	?	" "	Hard, clear		D, S	Poor supply.
1	SE.	3	6	31	1	Drilled	650	1,810	- 12	1,798	?	?	Bedrock	" salty reddish		S,	Abundant supply; haul drinking water.
2	NE.	6	"	"	"	Dug	10	1,823	- 4	1,819	4	1,819	Glacial gravel	Hard, clear		D, S	Waters 150 head stock; 2 similar wells.
3	NE.	10	"	"	"	"	15	1,810	- 9	1,801	9	1,801	" "	" "		D, S	Fair supply.
4	NW.	11	"	"	"	"	30	1,805	- 24	1,781	24	1,781	" "	" alkaline		D, S	Domestic use only; uses dugout and hauls water for stock.
5	SW.	12	"	"	"	"	20	1,770	- 8	1,762	8	1,762	" sand	" clear		D, S	Use dugout.
6	SW.	14	"	"	"	"	15	1,805	- 4	1,801	4	1,801	" "	" "		D, S	Uses 3 similar wells.
7	NW.	14	"	"	"	"	16	1,805	- 8	1,797	8	1,797	" gravel	Soft, "		D, S	Waters 50 head stock.
8	NE.	14	"	"	"	"	15	1,807	- 3	1,804	14	1,793	" "	" "		D, S	Small supply; hauls in winter and drought.
9	SW.	16	"	"	"	"	12	1,840	- 3	1,837			" "	Hard, "	47	D, S	Sufficient supply from 3 wells.
10	SE.	18	"	"	"	"	8	1,840	- 3	1,837	3	1,837	" "	" "		D, S	Waters 100 head stock.
11	SW.	19	"	"	"	"	12	1,850	- 6	1,844	6	1,844	" "	" "	44	D, S	Waters 150 head stock.
12	SW.	21	"	"	"	"	16	1,855	- 11	1,844	11	1,844	Yellow clay	" "		D,	Small supply; use dugout for stock.
13	SW.	22	"	"	"	"	14	1,840	- 4	1,836	4	1,836	Glacial gravel	" "		D, S	Poor supply. Hauled water in 1931-1935.
14	SE.	24	"	"	"	"	14	1,752	- 9	1,743	9	1,743	Yellow clay	" "		D, S	Domestic supply only.
15	NE.	24	"	"	"	"	7	1,775	- 2	1,773	2	1,773	Glacial gravel	" "		D, S	Waters 100 head stock.
16	NW.	25	"	"	"	"	8	1,780	- 6	1,774	6	1,774	" "	" "	45	D, S	Waters 50 head stock.
17	NE.	25	"	"	"	"	18	1,780	- 14	1,766	14	1,766	" "	" "		D, S	Waters 50 head stock.
18	NE.	25	"	"	"	"	10	1,780	- 4	1,776	4	1,776	" "	" "	46	D, S	Abundant supply.
19	NE.	26	"	"	"	"	18	1,810	- 7	1,803	7	1,803	" sand	" "		D, S	

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

WELL RECORDS—RURAL MUNICIPALITY OF STORTHOAKS NO. 31. SASKATCHEWAN

WELL No.	LOCATION					TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE		PRINCIPAL WATER-BEARING BED			CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
	¼	Sec.	Tp.	Rge.	Mer.				Above (+) Below (−) Surface	Elev.	Depth	Elev.	Geological Horizon				
20	NE.	26	6	31	1	Drilled	309	1,842	- 20	1,822	309	1,533	Sand at base of blue clay	Hard, salty	44	D, S	Poor supply; shallow wells poor.
21	SE.	27	"	"	"	Dug	14	1,855	- 5	1,850	9	1,846	Sandy clay	" clear	47	D, S	" " ; haul water.
22	SW.	33	"	"	"	"	9	1,875	- 3	1,872	3	1,872	Glacial sand	" "		D, S	Waters 100 head stock.
23	SE.	34	"	"	"	"	14	1,842	- 2	1,840	8	1,834	" gravel	" "		D, S	Goes dry in winter.
24	NE.	34	"	"	"	"	14	1,848	- 8	1,840	8	1,840	" "	" "		D, S	Normally an abundant supply.
25	SW.	36	"	"	"	"	15	1,785	- 7	1,778	7	1,778	" "	" "		D, S	Waters 50 head stock.

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

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