MC82+8C21α

CANADA

DEPARTMENT OF MINES

AND

TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

WATER SUPPLY PAPER No. 173

PRELIMINARY REPORT

GROUND-WATER RESOURCES OF THE RURAL MUNICIPALITY OF CLINWORTH NO. 230 SASKATCHEWAN

By

B. R. MacKay, H. H. Beach and R. Johnson

DISCARD
ELIMINER
LIBRARY
NATIONAL MUSEUM
OF CANADA

OTTAWA

1936

This document was produced by scanning the original publication.

Ce document est le produit d'une numérisation par balayage de la publication originale.

CANADA

DEPARTMENT OF MINES

BUREAU OF ECONOMIC GEOLOGY

GEOLOGICAL SURVEY

GROUND WATER RESOURCES OF THE RURAL MUNICIPALITY OF CLINWORTH NO. 230 SASKATCHEWAN

BY

B.R. MacKAY, H.H. BEACH, and R. JOHNSON

WATER SUPPLY PAPER NO. 173

CONTENTS

Illustrations

GROUND WATER RESOURCES OF THE RURAL MUNICIPALITY OF CLINWORTH, NO. 230 SASKATCHEWAN

INTRODUCTION

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

Publication of Results

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

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

How to Use the Report

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

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

If one intends to sink a well and wishes to find the approximate depth to a water-bearing horizon, he must learn: (1) the elevation of the site, and (2) the probable elevation of the water-bearing bed. The elevation of the well site is obtained by marking its position on the map, Figure 2, and estimating its elevation with respect to the two contour lines between which it lies and whose elevations are 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

---

[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 age.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

WATER-BEARING HORIZONS OF THE MUNICIPALITY

The rural municipality of Clinworth covers an area of approximately 549 square miles in the western part of southern Saskatchewan. It consists of fifteen full townships and fractions of three others, described as townships 19, 20, 21, 22, and 23, ranges 22, 23, and 24, and the parts of townships 24, ranges 22, 23, and 24, south of South Saskatchewan river. The centre of the municipality lies approximately 38 miles east of the Alberta-Saskatchewan boundary, Fourth meridian and 65 miles northwest of the city of Swift Current. The Lemsford section of the Canadian Pacific railway extends in an east-west direction across the central part of the municipality, and on it are located the villages of Portreeve, Lemsford, and Sceptre.

South Saskatchewan river flows in an easterly direction along the northern boundary of the municipality. From the river bed, at an approximate elevation of 1,860 feet above sea-level, the surface rises some 400 to 500 feet along the rugged slopes of the valley sides that extend from 1 to 2 miles south from the river. A belt of steeply rolling upland, 4 to 5 miles wide in the eastern part of the municipality, and becoming narrower toward the western boundary, extends along the south edge of the river valley. The land drops off sharply from this upland to an undulating plain, 100 to 200 feet lower in elevation, which extends southward to the edge of the Great Sand Hills in the southern part of township 21. Elevations along the railway line range from slightly less than 2,200 to 2,250 feet above sea-level. The remaining six townships in the southern part of the municipality are situated within the Great Sand Hills. Surface elevations within this rolling area vary between 2,300 and 2,375 feet.

The river provides a readily accessible supply of water for stock pasturing in its valley. A few springs and sloughs in

the hills south of the river valley are also sources of water for stock. Throughout the remainder of the municipality a few scattered sloughs are the only surface supplies available, and practically all the water used is obtained from wells. Ground water is being obtained from the Recent dune sands, forming the sand hills, the glacial lake sands, the glacial till or boulder clay, and the Belly River bedrock formation. In the sand hills adequate supplies of water for range stock are generally obtained at depths of 50 feet or less, in the sand. Farther north water occurs much less plentifully at shallow depths. Deeper boring or drilling is required. The Belly River formation forms an almost certain source of supply in all parts of the municipality, at depths between 200 and 600 feet.

Water-bearing Horizons in the Unconsolidated Deposits

The unconsolidated deposits consist of Recent dune sands forming the sand hills, stream sands in the flats adjacent to the river, and glacial drift of various types covering the remainder of the area. The glacial drift was laid down by a great continental ice-sheet that many thousands of years ago advanced and retreated over Saskatchewan, and by the waters formed from the melting ice. The glacial deposits are of three types, differentiated by their method of deposition, the character of the component sediments, and the type of topographic relief they present. As the ice-sheet advanced and retreated it laid down a layer of glacial till or boulder clay, composed essentially of compact, bluish grey, unstratified clay through which are interspersed irregular beds and pockets of sands and gravels that are usually water bearing. The till presents a flat or regularly rolling land surface as indicated on Figure 1 of the map accompanying this report. A large area of till occurs in the

northern part of this municipality. Throughout the greater part of the area, however, the till is covered by more recent lake clay and sand. In areas where the retreating ice front remained stationary for any considerable length of time a more porous type of drift known as moraine was deposited. The moraine is also comprised mostly of sandy boulder clay interspersed with beds and lenses of sands and gravels. The surface of the moraine is irregularly rolling, with many low knolls and intervening undrained depressions. Small areas of the hilly lands adjacent to the river are moraine covered.

Waters from the melting ice accumulated to form large lakes in the low-lying parts, and into the lake basins were washed fine, clayey silts, and coarser sands were laid down around the margins. The past areal extent of one of these glacial lakes is marked by a large area of lake clay covering the till in the plain around Sceptre, Lemsford, and Portreeve. South of this area the coarser lake sands are present. These lake sands formerly covered the entire southern part of the municipality, but wind action, in more recent times has formed the surface sands into dunes or low sand hills that now cover large parts of the area. The areal distribution of these various types of deposits is indicated on Figure 1 of the accompanying map.

Although no wells have been sunk in the stream sands adjacent to the river, adequate supplies of moderately hard, drinkable water could probably be obtained in them at shallow depths. Residents seeking water for domestic use are advised to sink wells a short distance back from the river rather than to take supplies directly from the stream.

In the southern part of the municipality, where the Recent dune and glacial lake sands occur, water is available in the sand at depths of 5 to 50 feet from the surface. Throughout

the area covered by dune sand the combined thickness of the wind-blown sand and the underlying glacial lake sand ranges between 30 and 50 feet. Surface waters percolate downward through the porous sand and collect above the impervious, underlying boulder clay. In most places fairly large supplies of water are obtained by sinking sand-points down to the base of the sand. The lower water-bearing sands are for the most part coarse, but they are overlain by quicksand, which in many places prevents the digging of wells. Sand-points can be driven through the quicksand into the coarser material. In a few places the water-table lies within 10 feet of the surface, and shallow dugouts are used to provide water for range stock. In the areas covered by lake sands, around the edges of the sand hills areas, the sands are usually thinner and less productive. Since the ground water tends to collect in the sand in depressions in the surface of the underlying boulder clay, and as this surface generally conforms to the land surface, wells sunk in valleys and depressions are more likely to be productive than those located on knolls and ridges. The water from the sand is only moderately hard, and well adapted to domestic use.

The lake sands grade into the lake clay covering the plain to the north. The clay does not exceed 20 or 30 feet in thickness and is in most places too compact to yield water, thus necessitating the sinking of deeper wells in this area.

In the rolling moraine and till-covered areas along the southern edge of the river valley residents are obtaining adequate supplies of soft or moderately hard, drinkable water at depths of 30 feet or less, from scattered pockets of sand and gravel. In the lower lying plains to the south water-bearing pockets of sand or gravel occur very sparingly at shallow depths in the boulder clay, either where it is exposed at the surface or

where it underlies the lake clay. Along the northern edge of the sand hills the land again becomes more rolling, and water-bearing pockets of sand and gravel are quite generally found in the upper part of the boulder clay underlying the glacial lake clay and sand. Many residents of the area obtain their water supplies from wells, not exceeding 40 feet in depth, tapping these pockets. In the sand hills water is obtained at shallow depths in the sand, and very little prospecting has been done in the upper part of the underlying boulder clay. However, in the northeastern part of township 19, range 22, and the southeastern part of township 20, range 22, where the lake sands are thin, a few residents obtain small supplies of water from pockets of sand and gravel in the boulder clay at depths of 45 feet or less. In places where the sands are thin, in the southern six townships of this municipality, prospecting at shallow depths in the drift is considered preferable to sinking deep wells.

At depths of 40 or more feet in the glacial drift the water-bearing beds of sand and gravel are usually of sufficient areal extent that one hole will indicate their presence or absence in any locality. Irregularly interspersed beds may be encountered at any depth in the drift. Other beds, however, seem partly continuous and occur at definite horizons over fairly large areas. In the southern six townships of the municipality only a few wells have been sunk into the glacial drift. Some of these wells reached productive sands and gravels at depths between 50 and 100 feet. These beds are probably local in extent, but similar beds may be encountered at any point. A few wells drilled to depths between 125 and 210 feet draw supplies from sands and gravels occurring at elevations between 2,175 and 2,155 feet above sea-level. These sands and gravels are believed to occur near the base of the glacial drift and will probably form the most consistently productive horizon

in the area. However, it is not a certain source of supply. Throughout the plain extending northward from the sand hills, wells between 50 and 150 feet in depth have penetrated productive sands and gravels in the glacial drift at elevations between 2,160 and 2,070 feet. These sands and gravels are not considered to extend as a continuous bed over the whole area, but they seem to occur at well-defined horizons over areas of a few sections. Many drilled wells in the area are drawing supplies from porous beds encountered at depths between 160 and 250 feet. In most places these wells are believed to have tapped sand beds in the upper part of the Belly River formation, but in many places gravel aquifers are reported, indicating that some of the wells may be drawing their supplies from the lower part of the glacial drift. The higher rolling lands adjacent to the river are some 100 to 200 feet above the plain to the south, and no wells have been sunk to sufficient depth to test the continuation of the horizons in this area, or to test the actual thickness of the glacial drift. The sand and gravel beds encountered at depths of 65 to 125 feet, in the deeper wells of the area, are probably of local occurrence. No wells have been sunk sufficiently deep in the river valley to indicate the character or thickness of the glacial drift underlying the Recent deposits. However, in most places the drift will probably be less than 50 feet thick, and water-bearing sands and gravels will probably be confined to irregularly scattered pockets in the boulder clay.

Water-bearing Horizons in the Bedrock

The Bearpaw formation underlies the glacial drift in the southern part of the municipality. The formation is not more than 150 feet thick in the southern townships, and throughout the remainder of the municipality it is either absent or very

thin. The dark grey to black, fine-grained, compact, marine shales comprising the greater part of this formation will rarely yield water.

The Belly River formation extends under the entire municipality, underlying the glacial drift in the river valley and the Bearpaw shales wherever they occur. The greater part of the formation is present in the uplands and probably is at least 500 feet thick. In the lower part of Saskatchewan River valley considerable erosion has taken place, and here the formation may be less than 400 feet thick.

The Belly River formation is made up of beds of shale, sand, soft sandstone, and thin seams of coal. Water is almost certain to be obtained from the sand beds of the formation by deep drilling in any part of the municipality. Individual porous beds may not be of large areal extent and considerable lateral variation in the character of the beds occurs from place to place. Hence, water will not necessarily be encountered at the same horizon in the formation at all places. In this municipality the wells drawing supplies from this source vary in depth from 160 to 779 feet. Most of the wells yield hard, highly mineralized waters, but they are nearly always usable for drinking. A few of the deeper wells yield soft, soda-bearing waters of better quality for household use. The water in the deeper beds of the Belly River formation is found to be under considerable hydrostatic pressure, in most places, rising to within 150 feet of the surface. The supplies obtained are usually large except where the flow is shut off by fine sands plugging the wells. In a few places the water from this source is reported to have a corrosive effect upon screens which further adds to the difficulty of keeping the deep wells free from sand.

GROUND WATER CONDITIONS BY TOWNSHIPS

Township 19, Range 22

The southern half of this township lies in the northeastern part of the Great Sand Hills, and being unsuited to farming is given over to grazing. The northeastern part forms a gently rolling plain mantled by a thin layer of glacial lake sand. The Recent dune and glacial lake sands may reach thicknesses of 50 feet in the western sections of the township, but are rarely more than 30 feet thick near the eastern boundary. The sands are underlain by bluish grey boulder clay.

In adjoining townships fairly large supplies of very moderately hard water are being obtained from wells, between 15 and 50 feet deep, sunk into these sands. In this township, however, most wells have been sunk through the sands into the boulder clay or into the underlying bedrock. In the sand hill area adequate supplies of water for range stock could probably be obtained from the sands. A few test holes may be necessary in some localities before a satisfactory supply is obtained. In the northeastern sections where it is advantageous to have wells in the close vicinity of farm dwellings, residents may be obliged to sink wells into the underlying boulder clay. Careful prospecting of the sands, at depths of 30 feet or less, in valleys and depressions is advisable, however, before sinking deep wells.

Localized pockets and small beds of sand and gravel occur interspersed in the upper part of the boulder clay underlying the sands. Wells tapping these porous pockets and beds will in some places yield adequate supplies of hard, drinkable water. Wells in the NW. $\frac{1}{4}$, sections 24 and 35, 56 and 70 feet deep, are yielding sufficient water for local requirements from gravels in the upper part of the boulder clay, but wells 50 feet

deep, in the NE. ¼, section 24, and wells 39 and 100 feet deep, in section 36, yield only small supplies from fine sands.

The most consistently productive horizon in the glacial drift will probably be in sands and gravels occurring at or near its contact with the underlying Bearpaw shales. Wells in sections 12, 22, and 24, 127, 133, and 187 feet deep, are drawing their supplies from sands probably occuring near the contact, at elevations between 2,175 and 2,155 feet. All these wells have yielded fairly large supplies of hard, highly mineralized water, but the 187-foot well in section 24 became plugged with quicksand and the yield is greatly diminished. The Bearpaw formation immediately underlying the glacial drift of the area is composed of compact, dark grey to black, marine shales, from which only small seepages of highly mineralized water can be expected. However, this formation is probably not more than 100 feet thick, and is underlain by the Belly River formation at elevations of approximately 2,000 to 2,050 feet. In section 5 a 425-foot well is yielding a fairly large supply of soft, "sulphate", and iron-bearing water from a sand bed in this formation. The individual water-bearing beds are unlikely to have any large areal extent, but they are believed to be sufficiently numerous to ensure their being penetrated at depths between 350 and 500 feet in all parts of the township. The water from the Belly River formation varies from soft and soda bearing to hard, and is highly mineralized, the degree of mineralization depending upon the amount of shale present at the locality where the formation is tapped. The thick sand beds of the lower part of the formation usually yield the softer waters. Both the hard and soft waters from this formation are nearly always drinkable.

Township 19, Range 23

This township lies almost entirely within the Great Sand Hills, and not being suited to cultivation is given over largely to grazing. There are few if any surface accumulations of water, and all supplies are obtained from wells.

The sand hills are of Recent origin, and have been formed by wind action on the glacial lake sands. Uneroded lake sands cover the surface of small areas in the northeastern corner of the township, as shown on Figure 1 of the accompanying map. The dune and lake sands extend down to depths between 40 and 50 feet, and are underlain by glacial drift composed mostly of boulder clay. Ample supplies of water for stock requirements are readily found by sinking sand-points down to depths of 35 to 45 feet in the sand. The water thus obtained is only moderately hard and could be used for household purposes as well as for watering stock.

Sinking wells into the boulder clay underlying the sand is not usually necessary in this township, as the supplies available in the sand will generally be larger and of better quality than waters obtained at greater depths in the glacial drift. A 100-foot well in section 30 is yielding a fairly large supply of water from gravel in the drift, but there is no assurance that like supplies will be obtained in other parts of the township. However, should test holes in the sands prove them unproductive in any locality, water will probably be available by sinking deeper wells into the glacial drift or through the Bearpaw formation into the Belly River formation. The most consistently productive horizon in the glacial drift will probably be near its contact with the Bearpaw shales. This contact is believed to occur at depths of 150 to 200 feet in this township. The Belly River formation is almost certain to be

productive at depths between 350 and 500 feet.

More detailed information on these horizons is given in the part of this report dealing with the municipality as a whole.

Township 19, Range 24

This township is entirely devoted to stock raising, and in the absence of any surface supplies all water for stock is obtained from wells.

The western edge of the Great Sand Hills extends over the eastern half of the area. Lake sand occurs at the surface over the gently rolling western half of the township. The sand is more than 50 feet thick in places in the sand hills, but becomes thinner toward the western boundary where the thickness rarely exceeds 30 feet.

In the eastern sections, large supplies of moderately hard water are available by sinking sand-points to depths of 30 to 50 feet in the sand. In the western sections, where the sands are thinner and less productive, more prospecting will be necessary to locate sites where suitable supplies can be obtained.

The glacial drift underlying the sands is composed mostly of bluish grey boulder clay. In places where supplies from the sand are inadequate it becomes necessary to continue wells to greater depth in the glacial drift. Pockets and small beds of sand and gravel occur irregularly interspersed in the boulder clay, and when tapped by wells they will, in some places, yield fairly large supplies of water. These water-bearing beds may be encountered at any depth in the glacial drift, as they do not generally form continuous horizons, except possibly at the contact between the glacial drift and the underlying Bearpaw shale. Wells 209, 160 and 190 feet deep, in sections 5, 32, and 34 are drawing their supplies from sands and gravels believed to be at

or near the contact, at elevations between 2,175 and 2,150 feet. Water obtained from the glacial drift is in most places hard and highly mineralized, but in the absence of supplies of better quality has been used for drinking.

If supplies in the surface sands and glacial drift prove inadequate, fairly large supplies of water should be obtainable in the sand beds of the Belly River formation at depths between 350 and 500 feet. This water will vary in quality from soft and soda bearing to hard and highly mineralized, but is expected to be suitable for domestic use.

Township 20, Range 22

Most of this township is situated in the northeastern part of the Great Sand Hills, formed by dune sands. In the plain in the southeastern part of the township lake sand occurs at the surface. In the sand hills the combined thickness of the dune and lake sands probably exceeds 40 feet in many places, but in the southeastern sections the sands are rarely more than 20 feet thick, and in places less than 5 feet. The sands are underlain by glacial drift, mostly bluish grey boulder clay.

Throughout the sand hill area water can generally be obtained by sinking sand-points to depths of 15 to 35 feet in the sand. Wells of this type yield fairly large supplies of water and have provided sufficient for local range stock requirements. The water is in most places only moderately hard and could be used for drinking. In this area the sinking of wells into the glacial drift is not considered particularly advisable as the supplies from the sand are more plentiful and of better quality than those likely to be obtained in the underlying drift.

Along the southern boundary of the township the sands are thin and will probably not be productive except in a few places in depressions and valleys. In this area most residents

have sunk wells into the underlying glacial drift. Scattered pockets of sand and gravel are present in the upper part of the boulder clay, from which small supplies of hard, drinkable water can be obtained. Most of the water supplies used in the area are derived from wells tapping pockets of this type at depths between 20 and 45 feet. In some places two or more wells are required to ensure adequate supplies for stock requirements.

Where the supplies from shallow wells prove inadequate, larger supplies are, as a rule, available from beds of sand and gravel in the lower part of the glacial drift. The porous beds occurring at depths of 50 feet or more are in most places extensive enough that one test hole will show their presence or absence in any vicinity. A well in section 5 is yielding an adequate supply of hard water from a sand bed encountered at a depth of 130 feet. As the porous sand and gravel beds are irregular in their occurrence, supplies of this type may be encountered at any depth in the drift in other parts of the township. The most consistently productive horizon in the glacial drift will probably be in the sands and gravels occurring in many places at or near its contact with the underlying Bearpaw shales. This contact is believed to lie at depths between 150 and 200 feet in this township. The waters from the porous beds in the lower part of the glacial drift may in some places be too highly mineralized to be used for drinking, but they should be suitable for stock.

The marine shales of the Bearpaw formation, which immediately underlie the glacial drift, are too compact to yield water supplies. However, this formation is not more than 100 feet thick, and the underlying Belly River formation contains sufficiently extensive beds of water-bearing sand and soft sandstone to ensure water being found in it at nearly all points

in the township. Wells between 350 and 600 feet deep are almost certain to reach productive beds in this formation. The water obtained from the Belly River formation in other parts of this municipality varies from soft and soda bearing to hard, and is highly mineralized, but is usually suitable for domestic use.

Township 20, Range 23

This township, being situated in the north-central part of the Great Sand Hills, is used entirely as grazing land for stock. No surface supplies of water are available in the area and all water for stock is obtained from wells.

The sand hills consist of Recent dune sands. Lake sands occur at the surface over a small strip along the northern boundary and over small areas in the central and southeastern parts of the township.

In most parts of the township the dune and lake sands are probably between 20 and 40 feet thick. Ample supplies of water for range stock are readily obtained by sinking sand-points to depths of 14 to 30 feet in the sand. The water is only moderately hard and, if necessary, could be used for domestic purposes.

The sands are underlain by glacial drift composed mostly of bluish grey boulder clay. Since the supplies of water available in the sand are larger and of better quality than any that could be expected in the drift, it is not considered necessary or advisable to continue wells into the boulder clay. No wells have been extended below the sands in this area, and no definite information regarding the possibilities of finding water at greater depths has been obtained. Persons finding the supplies available in the sands inadequate for local requirements and contemplating deeper drilling are referred to the part of this

report dealing with the municipality as a whole, where a general discussion is given of the possibilities of finding water at the contact of the glacial drift and the Bearpaw formation, or in the Belly River formation.

Township 20, Range 24

This township is situated in the northwestern corner of the Great Sand Hills, and is entirely covered by Recent dune sand and glacial lake sand. The dune sands or sand hills cover all but the northern third of the township, and a small area in the extreme southwestern corner, as shown on the map, Figure 1.

The sands are 20 to 50 feet thick over most of the township. Fairly large supplies of water can usually be obtained from them at depths not exceeding 40 feet. Sand-points are used advantageously in this area, where it is generally necessary to penetrate fine sands that would otherwise make the sinking of wells almost impossible. In a few places the water lies in the sand at depths of less than 10 feet, and shallow dugouts are used to provide water for stock. The water from the sand is only moderately hard, and is well adapted to household use.

The sands are underlain by glacial drift that is composed mostly of boulder clay. Should test holes in the sands prove to be unproductive in any vicinity it will be necessary to continue wells to greater depths in the glacial drift. Scattered pockets and small beds of sand and gravel occur interspersed in the boulder clay, which when tapped by wells will, in most places, yield adequate supplies of water. These porous beds may occur at any depth in the glacial drift, as they are irregular in their occurrence and do not usually form continuous horizons. In the adjoining township to the south, water-bearing beds were penetrated

at depths of 160 and 190 feet, in sections 32 and 34. These porous beds are believed to be at or near the contact of the drift and the underlying Bearpaw shales, and water might be obtained at similar depths in at least the southern part of this township.

The Bearpaw formation is thin in this area and is underlain by the Belly River formation which contains many beds of sand interbedded with shales. Large supplies of water are almost certain to be obtained if drilling is carried to sufficient depths in this formation. In the adjoining township to the north several residents are obtaining their supplies from wells between 250 and 300 feet in depth, tapping the upper sands of the Belly River beds. Similar supplies might be obtained at lake depths in some parts of this township. However, it might be necessary to drill to depths of 400 to 500 feet to ensure an adequate supply.

Township 21, Range 22

The northern edge of the Great Sand Hills extends across the southern sections of this township. To the north of the sand hills the land is rolling and slopes gently to a relatively flat plain in the northern half of the township.

The Recent dune sands forming the sand hills are underlain by glacial lake sands which extend north to cover a narrow area to the north of the hills. These sands grade into lake clay that covers most of the remainder of the township. The lake sands and clay are underlain by glacial drift composed mostly of bluish grey boulder clay. Boulder clay is exposed at the surface in a small area in the extreme northwestern corner of the township.

In most places in the sand hills adequate supplies of water will probably be available at depths of 30 feet or less in the sand. Sand-points may be necessary where quicksands prevent

digging of wells. Similar supplies can be expected in some localities covered by the lake sands, but toward the north the sand becomes thinner and interspersed with greater thicknesses of clay, and hence is less productive. The water from the sand is only moderately hard, and is well adapted to household use.

Water can rarely be obtained from the lake clay that covers the remainder of the township, but scattered water-bearing pockets of sand and gravel occur interspersed in the upper part of the underlying glacial drift. Several residents obtain their water supplies from wells, between 10 and 40 feet deep, tapping these porous pockets in the drift. The supplies from wells of this type are usually small, and in some places they are inadequate for farm requirements. The water is not excessively hard and is satisfactory for domestic use. Where the shallow wells fail to yield satisfactory supplies of water it becomes necessary to continue wells to greater depths in the glacial drift or down to the underlying bedrock. Water-bearing sands and gravels are in most places penetrated at depths of 50 to 125 feet. These porous beds do not appear to be individually continuous over large areas, except possibly in the eastern half of the township where all wells sunk to sufficient depth have reached productive beds at elevations between 2,180 and 2,150 feet. The supplies obtained at depths of 50 to 125 feet have for the most part proved adequate in this township, and the water although more highly mineralized than that from shallow wells is nearly always usable for domestic purposes.

Large supplies of water are to be expected by deep drilling in any part of the township. A 258-foot well in Portreeve, in section 32, yields a large supply of hard, drinkable water from a sand aquifer believed to occur in the upper part of

the Belly River formation. This well, and others in the adjoining townships to the north and west, reached productive sands at elevations between 2,040 and 1,970 feet, indicating a possible continuous horizon which may be productive in at least the northwestern part of this township. The depths of wells necessary to reach the level of this horizon will vary from 250 feet at sites of low surface elevation in the northern part of the township to 350 feet or more near the southern boundary. Should this horizon prove unproductive, water supplies can be expected at greater depths in the beds of sand and soft sandstone that comprise the greater part of the Belly River formation.

The individual water-bearing beds do not extend over large areas, so that the depths at which water will be obtained at any site cannot be predicted. However, water is almost certain to be obtained at depths not exceeding 500 feet. The water from the Belly River formation varies from soft and soda-bearing to hard, and is mineralized, but can generally be used for drinking.

Township 21, Range 23

The southern part of this township, bordering on the Great Sand Hills, has a rolling land surface with a gradual downward slope toward the north. The northern half of the area is a fairly level or gently rolling plain.

Most of the rolling area in the southern part of the township is covered by glacial lake sands. These sands grade into lake clay that covers the lower lying plain to the north. These lake sands and clays are seldom more than 30 feet thick and are underlain by bluish grey boulder clay.

In the southern part of the township water supplies are in most places available at depths of 20 to 40 feet in the sandy lake deposits, or in scattered pockets of sand and gravel occurring

interspersed in the upper part of the underlying bouldor clay. The waters obtained from shallow wells of this type vary from soft waters contained in the thicker sand or gravel beds to hard and highly mineralized types from the clays, but are seldom unfit for drinking. Such shallow wells provide many of the residents with adequate supplies of water for all farm requirements. Careful prospecting at depths of 40 feet or less seems advisable before considering the sinking of deeper wells.

In the northern part of the township the lake clay is too compact to yield more than small seepages of water, but water can usually be obtained at shallow depths in the localized pockets of sand and gravel in the upper part of the underlying boulder clay. A few residents have obtained adequate supplies of hard, drinkable water from wells between 10 and 45 feet deep, tapping such pockets. It is probable, however, that water will be more difficult to obtain at shallow depths in this area than in the southern part of the township.

More extensive beds of sand and gravel are of common occurrence at greater depths in the glacial drift, and when tapped by wells can be expected to yield water. These beds are irregular in their occurrence and may be encountered at any depth. In section 2 a 116-foot well yields an adequate supply of hard, drinkable water from a gravel bed in the lower part of the drift, whereas in section 7 a 64-foot well yields only a small seepage of water. Similar variations in depths of wells and quantity of water may be expected in other parts of the township. The beds of sand and gravel at depths of 50 feet or more in the drift usually have sufficient areal extent so that one hole will prove their presence or absence in any vicinity.

Several residents obtain water supplies from wells, between 250 and 315 feet in depth, tapping porous beds in the upper

part of the Belly River formation. In sections 24, 27, 28, and 33 the productive sands were encountered at elevations between 2,030 and 1,980 feet. Farther south, in sections 12 and 13, they were found to be productive at elevations of 2,105 and 2,067 feet. These wells, and wells producing from the same approximate levels in adjoining townships, indicate the presence of a fairly continuous water-bearing horizon. With the exception of the 315-foot well in section 24, all the wells deriving their supply from this source yield large supplies of hard, drinkable water.

Should this horizon prove unproductive, adequate supplies of water are almost certain to be obtained in sand beds at greater depths in the Belly River formation. These water-bearing beds do not always form continuous horizons, and the depth at which water is likely to be obtained at any site cannot be predicted. However, wells in adjoining townships indicate that productive beds are almost certain to be encountered at depths of less than 550 feet.

Township 21, Range 24

The southern sections of this township, bordering on the Great Sand Hills, are irregularly rolling, but the remainder of the area to the north is a nearly level plain. Water supplies of the township are obtained almost entirely from deep, drilled wells. Sandy, glacial lake deposits cover a narrow strip along the southern boundary of the township and grade into lake clay that extends over the remainder of the area, except where the underlying boulder clay of the drift is exposed at the surface in sections 31 and 32. In the lake sand-covered area small supplies of moderately hard, drinkable water might be obtained at depths of 30 feet or less, either in the lake sands or in localized pockets of sand and gravel in the upper part of the

underlying boulder clay. In some places shallow wells sunk in depressions and valleys would probably yield sufficient water for farm requirements. Farther north, the compact lake clay will rarely yield water, and the localized pockets of sand and gravel in the upper part of the boulder clay will be less productive on account of the impervious covering of lake clay.

In order to obtain sufficient water for stock it is usually found necessary to sink wells down to the lower part of the glacial drift or into the underlying bedrock. The deep wells in this township indicate the presence of extensive porous beds at definite horizons. Wells between 100 and 160 feet deep, in sections 8, 10, 16, 17, and 34, draw their supplies from sands and gravels in the glacial drift, at elevations between 2,200 and 2,150 feet. With the exception of the well in section 16, these wells yield adequate supplies of hard, highly mineralized, but drinkable water. Sands and gravels were reported to have been penetrated at the same approximate levels in other wells, but they were unproductive and the wells were continued to greater depths. In the south-eastern half of the township wells between 170 and 265 feet deep are yielding large supplies of water from porous beds near the top of the Belly River bedrock formation at elevations between 2,110 and 2,050 feet. In the northwestern half of the township similar supplies are obtained at slightly greater depths, between 245 and 330 feet, at elevations between 2,090 and 1,955 feet. The water obtained is usually hard, and in some places slightly mineralized, but it can nearly always be used for drinking. The water-bearing sands of this horizon are not considered to form a continuous bed, but probably represent a porous zone in the upper part of the Belly River formation, and possibly in some places basal sands and gravels of the glacial drift form the productive aquifers.

Where this horizon does not yield satisfactory water supplies it is necessary to continue to lower sand beds in the Belly River formation. The individual water-bearing beds are not expected to extend over large areas at consistent elevations, but since the formation is composed mostly of beds of sand and soft sandstone water is almost certain to be obtained if drilling is continued to sufficient depths. In the central part of the township wells between 398 and 500 feet in depth are yielding large supplies of water from sand beds in this formation. The water varies from soft and soda bearing to hard and highly mineralized, but can nearly always be used for household purposes.

Township 22, Range 22

This township is a nearly flat plain, except along the eastern boundary where the land is gently rolling. In the southeastern part of the township a thin layer of glacial lake clay covers the boulder clay. Over the greater part of the area, however, the drift occurs at the surface in the form of till plain.

The lake clay is as a rule, too compact to yield water, and porous pockets of sand and gravel occur only sparingly in the upper 30 feet of the boulder clay. For this reason water is seldom available at shallow depths, and the sinking of shallow test holes is hardly warranted unless only very small supplies are required.

Most of the water supplies used in the township are obtained from wells between 40 and 100 feet deep, drawing supplies from sands and gravels in the lower part of the glacial drift. These sands and gravels are not believed to occur in a continuous bed over the area as there is considerable variation in the elevation at which they are penetrated, but in some places individual beds may extend over areas of 2 or 3 square miles. The

supplies of water obtained are usually adequate for local farm requirements. The water is nearly always hard, and in some places highly mineralized, but can be used for drinking.

Several wells have been drilled through the glacial drift and through the thin layer of underlying shales of the Bearpaw formation into the Belly River formation. In most places water-bearing beds were encountered near the top of the formation, at depths between 186 and 300 feet. The productive sands were encountered at elevations varying from 2,035 feet to 1,890 feet, indicating that they do not form any one continuous bed. The shallower of these wells may be drawing their supplies from sands and gravels in the lower part of the glacial drift, but since the evidence gathered is not sufficiently conclusive they are recorded as drawing supplies from the Belly River formation. The water is hard and highly mineralized, but can be used for drinking.

In section 8, 17, and 27 wells have been drilled down to lower beds in the Belly River at depths of 385, 495, and 345 feet. These wells yield large supplies of water from sand beds at elevations between 1,815 and 1,715 feet. The water from the 385- and 345-foot wells is hard, and contains large concentrations of sulphate salts in solution, but the water from the 495-foot well is soft.

In general, the water-bearing beds of the Belly River formation do not occur in continuous horizons, but since the formation is composed mostly of porous beds of sand and sandstone, water is almost certain to be obtained from it at depths not exceeding 500 feet.

Township 22, Range 23

A thin deposit of glacial lake clay covers most of the southwestern half of the township. The clay is underlain by

glacial drift, which occurs at the surface to form a till plain over the remainder of the township.

Very little water can be expected at depths of 40 feet or less. The lake clay is generally too compact to yield water and only a few localized water-bearing pockets of sand and gravel occur interspersed in the upper part of the boulder clay.

Fairly extensive beds of sand and gravel occur at greater depths in the glacial drift, which when tapped by wells will in many places yield adequate supplies of hard, drinkable water. Near the eastern boundary of the township, in sections 13 and 24, productive sands were reached at depths of 80 and 65 feet, at elevations of 2,144 and 2,160 feet. Throughout the rest of the township scattered wells between 98 and 160 feet in depth are yielding adequate supplies of water for farm requirements from sands and gravels, at elevations between 2,136 and 2,085 feet. Porous beds were reported to have been penetrated at the same approximate levels in many of the deeper wells in the township, but they did not yield satisfactory supplies of water.

In the northwestern part of the township, large supplies of hard, highly mineralized, but drinkable water are being obtained from wells between 200 and 285 feet in depth. These wells are considered to be drawing their supplies from the upper sands of the Belly River formation, but some may actually be drawing at least part of the water from sands and gravels at the base of the glacial drift. The elevations at which the water-bearing beds were tapped vary from 2,050 feet to 1,950 feet, indicating that the sands probably do not form one continuous bed, but rather thin lenses of individual limited extent. In the southeastern part of the township similar supplies are obtained at slightly greater depths, between 300 and 342 feet. These wells draw their supplies from more continuous sand beds occurring at elevations between 1,955 and 1,900 feet.

In sections 15, 26, and 28, wells 535, 530, and 540 feet deep are yielding large supplies of soft water from sands deeper in the Belly River formation. The porous beds apparently do not form continuous horizons over large areas. For this reason the depth to which it will be necessary to drill at any site cannot be predicted, but ample supplies are almost certain to be obtained in this formation if drilling is carried sufficiently deep. Screens are generally necessary to prevent the fine sands from plugging wells, and even screens have not always proved effective over long periods of time due to the corrosive action of the water.

Township 22, Range 24

This township is an area of gently undulating plain covered by a thin layer of glacial lake clay. Parts of sections 18, 19, and 30 are more rolling where the lake clay is absent and the boulder clay is exposed at the surface.

The lake clay is too impervious to yield water. The part of the glacial drift that underlies the lake clay at depths rarely exceeding 20 feet is composed mostly of compact boulder clay, but a few localized pockets of sand and gravel may occur in it which would yield small supplies of hard, drinkable water at depths of 40 feet or less. However, the possibility of obtaining water at shallow depths will hardly warrant the sinking of a large number of test holes in attempts to locate productive pockets.

More extensive beds of sand and gravel occur at greater depths in the glacial drift, and will yield adequate supplies of water for farm requirements. Several wells between 95 and 150 feet in depth are drawing supplies from this source. In the northwestern part of the township these sands and gravels are generally penetrated at elevations between 2,100 and 2,050 feet.

In the southeastern part of the area they occur at slightly lower elevations, between 2,050 and 2,010 feet. These sands and gravels will probably be encountered at the same approximate elevations in most parts of the township, but they may not always be sufficiently porous or extensive to yield satisfactory supplies of water. Several of the deeper wells in the area were reported to have penetrated porous beds at this horizon, but were sunk to greater depths and obtain larger supplies. The water from wells drawing supplies from sands and gravels in the glacial drift is almost invariably hard, but is seldom so highly mineralized that it is unfit for drinking.

Large supplies of water are generally obtained in sands in the upper part of the Belly River formation, at depths between 160 and 270 feet. These water-bearing sands occur at elevations between 2,030 and 1,900 feet, and although the sands probably do not form continuous beds they are sufficiently numerous to constitute a consistent horizon in this township. The water obtained is hard, but suitable for drinking.

Should wells of these depths fail to yield satisfactory water supplies, deeper sand beds are believed to occur throughout the greater part of the Belly River formation. In sections 1, 5, 11, 12, and 27, wells sunk to depths between 325 and 411 feet are all yielding fairly large supplies of water. These wells do not necessarily indicate the presence of extensive water-bearing beds, but suggest that water is almost certain to be obtained if wells are sunk to sufficient depth. In Sceptre a well was drilled to a depth of 779 feet. Soft, salt water was obtained at a depth of 695 feet. Water-bearing sands were also penetrated at depths of 389 feet, and between 500 and 600 feet. This well is not being used. At present, water for the town is being obtained from a 198-foot well drawing its supply from the upper part of the Belly River formation.

Township 23, Range 22

From the plain along the southern boundary of the township, the surface rises to a rolling upland that extends to the southern edge of the river valley, in the northern parts. The greater part of the area is covered by glacial drift in the form of till plain but a small area of moraine occurs in the south-central sections.

A few springs, occurring in the upland south of the river, provide water for stock. Most supplies, however, are obtained from wells.

In the upland the upper 30 to 40 feet of the glacial till and moraine is of a porous nature and water-bearing pockets of sand and gravel are quite generally encountered at depths of 30 feet or less. Most of the residents of this area are obtaining adequate supplies of soft or only moderately hard water from shallow wells. This shallow horizon should be thoroughly prospected before sinking deeper wells in this area. In the plain near the southern boundary shallow wells may prove unproductive, as they have in the adjoining township to the south. On the slopes leading down to the river the most favourable sites for shallow wells are in valleys and along the bottoms of slopes where gravels and sands washed down from the uplands are most likely to occur.

South of the river valley, wells not exceeding 130 feet in depth would probably in most places reach productive sands and gravels in the glacial drift. In sections 17 and 18 water was obtained from sand in the drift at depths of 42 and 65 feet. The 42-foot well yields a small supply of soft water, and the 65-foot well yields an adequate supply of hard water. These porous beds are believed to be local in extent, but in most places similar beds will probably occur at a considerable range

of depths in the drift. Near the southern boundary of the township a 93-foot well draws its supply from a gravel aquifer at an approximate elevation of 2,114 feet. A fairly consistent water-bearing horizon occurs at the same approximate level in the northern sections of the township to the south, and it may be continuous in the southern sections of this township.

Large supplies of water are almost certain to be obtained by deep drilling in any part of this area. Water may be obtained in beds of sand and gravel in the lower part of the glacial drift, or it may be necessary to drill into the Belly River formation. The actual depths at which water can be expected at any site are difficult to predict since the productive beds both at the base of the drift and in the Belly River formation are expected to be of limited individual areal extent. Suitable supplies are not likely to be obtained in drilled wells at depths of less than 200 feet, and in some places it may be necessary to drill to depths of more than 400 feet. The water obtained from the lower sands and gravels of the glacial drift and in the upper sands of the Belly River formation will be hard and highly mineralized, but should be usable for drinking. At depths of more than 400 feet, the Belly River sands may yield soft, soda-bearing waters.

In the lowlands sloping to the river valley the thickness of the glacial drift is expected to be less and the depths necessary to reach productive beds in the Belly River formation should not exceed 300 feet.

Township 23, Range 23

The southern and southwestern sections of the township form a very gently rolling plain. The surface to the north rises some 100 to 200 feet, to form a rolling upland which extends to the south edge of the river valley in the northern part of the

township. The river bed lies in the southern part of township 24, at levels 400 to 500 feet below the uplands.

The river and springs occurring in valleys and ravines provide water for range stock in the river valley and in the rolling uplands to the south. In the plain along the southern boundary all water supplies are obtained from wells.

The southern plain is covered mostly by glacial drift in the form of till plain, which grades into irregularly rolling moraine in the uplands to the north. The slopes of the river valley are covered by glacial drift and are deeply eroded. Stream deposited sands cover the drift in the flats adjacent to the river.

In the moraine-covered upland localized pockets and beds of sand and gravel are expected to occur irregularly interspersed in the upper 30 feet of the boulder clay, from which at least small supplies of hard, drinkable water could be obtained. In many places wells tapping these pockets would probably yield adequate supplies for 20 or more head of stock. Supplies of this type will rarely be obtained in the till plain to the south. In the river valley sands and gravels washed from the steep slopes will probably be encountered at shallow depths in valleys and ravines, and along the bottoms of steep inclines. Wells penetrating this porous material might in some places yield fairly large supplies of water. Water taken directly from the river may contain considerable sediment, but shallow wells a short distance back from the channel would yield clear water.

In the moraine-covered uplands adjacent to the river only two wells have been sunk into the lower part of the glacial drift. In section 13 an 86-foot well yields a small supply of hard water from a quicksand aquifer. In section 21 a fairly large supply of soft water is being obtained from gravel at a

depth of 125 feet. Although the water-bearing beds encountered in these wells are probably not continuous over a large area, similar supplies of water can be expected at depths between 50 and 150 feet in other parts of the area. In the lower lying plains in the southern part of the area most residents obtain their water supplies from wells, between 100 and 154 feet in depth, drawing water from sands and gravels in the drift at elevations between 2,125 and 2,090 feet. These sands and gravels appear to be in a continuous bed in this area and will probably be productive at similar depths throughout the southern plain. The supplies obtained are adequate for local requirements and the water, although hard, is suitable for drinking. It was not determined whether these beds were penetrated in the 303- and 218-foot wells in sections 8 and 17. This horizon may extend under the higher lands to the north, but the depths of wells necessary to reach it would be between 200 and 300 feet.

In the deep wells on sections 8 and 17 fairly large supplies of hard, drinkable water were obtained from sands in the upper part of the Belly River formation and from gravel in the lower part of the glacial drift. Adequate supplies of water are almost certain to be obtained in any part of the township, provided drilling is carried to sufficient depth. The basal sands and gravels of the glacial drift and the upper sands of the Belly River formation may yield water at depths between 200 and 300 feet, in the southern part of township 23, and at depths of 300 to 400 feet in the higher rolling lands to the north. However, in some places the supplies from these sources may not be sufficient for all local requirements, and wells would have to be continued to lower sand beds in the Belly River formation. The water obtained from the upper part of the formation is generally hard, whereas at greater depths it is soft and soda bearing.

Township 23, Range 24

South Saskatchewan river flows along the northern boundary of this township. Near the eastern boundary, the land adjacent to the river valley is quite rolling in character. To the south and west the surface slopes downward to a gently rolling plain some 100 feet lower in elevation.

The river provides water for stock ranging in the valley and the adjacent, steeply rolling land. Farmers in the southern part of the area obtain their supplies mostly from deep, drilled wells. Glacial drift extends over the township. A thin layer of glacial lake clay overlies boulder clay in the southern sections, and Recent stream deposits occur in the river valley. The drift is in the form of till plain in the southern part of the area, and as moraine in the higher rolling lands in the east-central sections.

In the till plain, in the southern parts, water can rarely be obtained at shallow depths. The lake clay is generally too compact to yield water, and although a few localized pockets of sand and gravel may occur interspersed in the upper part of the underlying boulder clay, the possibility of obtaining any appreciable supply of water from them will hardly warrant the sinking of test holes. In the more rolling areas adjacent to the river at least small supplies of water will probably be available from pockets of sand and gravel at depths of 40 feet or less. In section 26 an adequate supply of soft water is being obtained from a sand pocket at a depth of 40 feet. In the river valley water-bearing sands and gravels may occur at shallow depths in ravines and along the bottoms of steep slopes. The stream sands adjacent to the river will probably yield water.

In adjacent townships, to the south and east, many residents have obtained adequate supplies of hard, drinkable water

from wells tapping beds of sands and gravels in the glacial drift at depths between 90 and 150 feet. These aquifers generally occur at elevations near 2,100 feet.

In this township wells 65, 150, and 100 feet deep, in sections 5, 8, and 28, are drawing supplies from sands and gravels at elevations of 2,105 2,090, and 2,125 feet. Information available on deeper drilled wells in this township does not indicate whether porous beds were penetrated at this level. However, this horizon is believed to be a possible source of water supply throughout the area to the south of the river valley. In the higher rolling lands, however, it would be necessary to sink wells to depths of 200 to 300 feet to reach the level of this horizon. The wells in sections 5, 8, and 28 yield adequate supplies of hard, drinkable water.

Fairly large supplies of water are almost certain to be obtained by deep drilling in this area. In section 7 a 184-foot well yields an adequate supply of hard, drinkable water from gravel near the base of the glacial drift. In most places, however, it is necessary to sink wells into the sand beds of the underlying Belly River formation before adequate supplies are obtained.

The Belly River formation is composed mostly of beds of sand and soft sandstone, some of which are water bearing. Since the individual beds do not generally extend over large areas, the depths at which wells reach productive beds vary considerably. In sections 2, 9, and 12, wells 210, 280, and 250 feet deep yield adequate supplies of water from sands in the upper part of the formation. All other wells have been sunk to depths between 300 and 430 feet. In most places these wells yield satisfactory supplies of water, but in a few the flow into the wells has been shut off by fine sand. The water obtained from the Belly River

formation is mostly hard, but drinkable. Soft, soda-bearing waters have been obtained from some of the deeper wells in other parts of the municipality, and similar supplies might be obtained at depths of 400 to 600 feet in this township.

No wells have been drilled in the river valley, but due to the lower surface elevations water would probably be obtained in the Belly River formation at much shallower depths than on the uplands.

Township 24, Range 22

Only the southern six sections of this township lie within this municipality. The land is steeply rolling and not suited to cultivation, and no records of any wells having been sunk in the area were obtained. The river provides water for stock in the vicinity. Residents seeking domestic supplies are well advised to sink shallow seepage wells in the coarse sediments flooring the coulées or in the stream sands a short distance from the river channel rather than to use the water directly from the river. Such surface waters often contain large amounts of sediment.

Township 24, Range 23

Only sections 1, 2, and 3 of this township lie within this municipality. The greater part of the area lies on the steep slopes of the river and is not inhabited. Stock in the vicinity are watered at the river. Should domestic supplies be required it would be advisable to sink shallow seepage wells some distance from the stream channel, so that the water will be filtered.

Township 24, Range 24

Less than a square mile of this township lies within this municipality. The area is confined to the bottom and lower slopes of the river valley and is not inhabited.

STATISTICAL SUMMARY OF WELL INFORMATION IN RURAL MUNICIPALITY OF CLINWORTH, NO. 230, SASKATCHEWAN

West of 3rd mer.	Township / Range	19 / 22	19 / 23	19 / 24	20 / 22	20 / 23	20 / 24	21 / 22	21 / 23	21 / 24	22 / 22	22 / 23	22 / 24	23 / 22	23 / 23	23 / 24	24 / 22	24 / 23	24 / 24	Total No. in municipality
Total No. of Wells in Township		10	5	5	12	7	6	47	18	29	41	29	40	17	15	18	0	0	0	299
No. of wells in bedrock		1	0	0	0	0	0	1	5	20	8	18	23	0	1	11	0	0	0	88
No. of wells in glacial drift		9	5	5	11	2	6	46	13	9	33	11	17	17	14	7	0	0	0	205
No. of wells in alluvium		0	0	0	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Permanency of Water Supply																				
No. with permanent supply		10	5	5	12	7	6	47	18	29	39	29	40	17	15	18	0	0	0	297
No. with intermittent supply		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
No. dry holes		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Types of Wells																				
No. of flowing artesian wells		0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
No. of non-flowing artesian wells		5	3	3	1	0	0	7	10	27	19	24	32	1	12	17	0	0	0	161
No. of non-artesian wells		5	2	2	11	7	6	40	8	2	21	5	8	16	2	1	0	0	0	136
Quality of Water																				
No. with hard water		9	5	5	12	7	6	36	9	26	35	25	37	11	13	17	0	0	0	253
No. with soft water		1	0	0	0	0	0	11	9	3	5	4	3	6	2	1	0	0	0	45
No. with salty water		0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	2
No. with "alkaline" water		3	0	2	0	1	1	2	1	9	3	1	5	0	0	1	0	0	0	29
Depths of Wells																				
No. from 0 to 50 feet deep		2	4	2	11	7	5	33	10	1	4	0	0	15	3	1	0	0	0	98
No. from 51 to 100 feet deep		4	1	0	0	0	1	12	1	0	24	4	3	2	1	3	0	0	0	56
No. from 101 to 150 feet deep		2	0	1	1	0	0	1	1	4	1	6	12	0	7	2	0	0	0	38
No. from 151 to 200 feet deep		1	0	0	0	0	0	0	0	4	1	2	5	0	2	1	0	0	0	16
No. from 201 to 500 feet deep		1	0	2	0	0	0	1	6	19	11	14	19	0	2	11	0	0	0	86
No. from 501 to 1,000 feet deep		0	0	0	0	0	0	0	0	1	0	3	1	0	0	0	0	0	0	5
No. over 1,000 feet deep		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
How the Water is Used																				
No. usable for domestic purposes		5	0	4	6	7	4	46	17	27	37	26	36	15	14	17	0	0	0	261
No. not usable for domestic purposes		5	5	1	6	0	2	1	1	2	3	3	4	2	1	1	0	0	0	37
No. usable for stock		10	5	5	12	7	6	46	18	28	37	26	37	17	15	17	0	0	0	286
No. not usable for stock		0	0	0	0	0	0	1	0	1	3	3	3	0	0	1	0	0	0	12
Sufficiency of Water Supply																				
No. sufficient for domestic needs		8	5	5	12	7	6	27	17	29	39	27	38	15	15	15	0	0	0	265
No. insufficient for domestic needs		2	0	0	0	0	0	20	1	0	1	2	2	2	0	3	0	0	0	33
No. sufficient for stock needs		5	5	4	10	7	5	25	15	28	39	27	38	15	14	14	0	0	0	251
No. insufficient for stock needs		5	0	1	2	0	1	22	3	1	1	2	2	2	1	4	0	0	0	47

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 boilders and tea-kettles is formed from these mineral salts.

Sodium

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

Sulphates

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

Chlorides

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

Iron

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

Hardness

Calcium and magnesium salts impart hardness to water. Hardness of water is commonly recognized by its soap-destroying powers as shown by the difficulty of obtaining lather with soap. The total hardness of a water is the hardness of the water in its original state. Total hardness is divided into "permanent hardness" and "temporary hardness". Permanent hardness is the hardness of the water remaining after the sample has been boiled and it represents the amount of mineral salts that cannot be removed by boiling. Temporary hardness is the difference between the total hardness and the permanent hardness and represents the amount of mineral salts that can be removed by boiling. Temporary hardness is due mainly to the bicarbonates of calcium and magnesium and iron, and permanent 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 excess of 300 parts per million; when the total hardness exceeded 3,000 parts per million no exact hardness determination was made. Also no determination for temporary hardness was made on waters having a total hardness less than 50 parts per million. As the determinations of the soap hardness in some cases were made after the samples had been stored for some time, the temporary hardness of some of the waters as they come from the wells probably is higher than that given in the table of analyses.

Analyses of Water Samples from the Municipality of Clinworth, No. 230, Saskatchewan

LOCATION						Depth of well, Ft.	Total dis'vd solids	HARDNESS			CONSTITUENTS AS ANALYSED						CONSTITUENTS AS CALCULATED IN ASSUMED COMBINATIONS								Source of water
No.	Qtr.	Sec.	Tp.	Rge.	Mer.			Total	Perm.	Temp.	Cl.	Alka-linity	CaO	MgO	SO_4	Na_2O	Solids	$CaCO_3$	$CaSO_4$	$MgCO_3$	$MgSO_4$	Na_2CO_3	Na_2SO_4	NaCl	$CaCl_2$	
1	SW.	15	22	23	3	535	2,217															(2)	(1)	(3)		* 1
2	NW.	9	22	24	3	206	1,190											(3)	(1)		(2)		(4)		(5)	* 1
3	NW.	9	22	24	3	389	2,823	Well drilled to 779 feet											(3)		(5)	(2)	(1)	(4)		* 1
4	SW.	13	23	24	3	402	1,280	850	550	300	21	560	190	162	500	229	1,260	340		185	217		483	35		* 1

Water samples indicated thus, * 1, are from bedrock, Belly River formation.
Analyses are reported in parts per million; where numbers (1), (2), (3), (4), and (5) are used instead of parts per million, they represent the relative amounts in which the five main constituents are present in the water.
Hardness is the soap hardness expressed as calcium carbonate ($CaCO_3$).
Analyses Nos. 1, 2, and 3, by Provincial Analyst, Regina.
For interpretation of this table read the section on Analyses and Quality of Water.

Water from the Unconsolidated Deposits

South Saskatchewan river is the only important source of surface water supply in this municipality. No analysis has been made of the water from the river along this part of its course, but analyses of the river water in the vicinity of the city of Saskatoon will probably be indicative of the general character of the water. The dissolved solid content varies seasonally within a range of 200 and 400 parts per million, and the total hardness between 100 and 250 parts per million. The permanent hardness, due to dissolved calcium and magnesium sulphates ($CaSO_4$ and $MgSO_4$), rarely exceeds 100 parts per million; the temporary hardness due to dissolved calcium and magnesium carbonates ($CaCO_3$ and $MgCO_3$) comprises the greater part of the total hardness. This water is softer and much lower in dissolved mineral salt content than waters commonly obtained from wells, and except in flood seasons when there is a large amount of sediment in the water it is well adapted to either stock or house use. Since comparatively little surface water enters the river from the uplands in this thinly populated area the danger of pollution of the water is not particularly great. A cleaner water is assured by digging a well a short distance from the river, into which water could enter after percolation through the sands and silts. No analyses have been made by the Geological Survey of water obtained from the unconsolidated Recent or glacial deposits in this municipality. The following general discussion is based on analyses of waters from similar deposits in the adjoining municipality, on observations made at the wells, and on reports of residents using the water.

Waters from shallow depths in the Recent dune and glacial lake sands, in the southern part of the municipality, are soft or only moderately hard and well adapted to domestic use. Analyses

of waters from similar deposits in other municipalities indicate that such water has total dissolved solid contents of 700 to 900 parts per million, and a total hardness of 200 to 500 parts per million. The laxative acting salts, sodium and magnesium sulphate (Na_2SO_4, Glauber's salt, and $MgSO_4$, Epsom salts), are not present in sufficient quantities to affect the quality of the water for drinking. The hardness is not excessive, and as compared with waters from the glacial drift, this water is relatively soft. More highly mineralized waters are obtained from the dune and lake sands in the close vicinity of "alkali" flats or sloughs, where continued surface evaporation has concentrated the salts present in the waters. These waters contain high concentrations of Glauber's salt and Epsom salts, and may be decidedly laxative.

The character of the glacial deposits encountered within 40 feet of the surface varies considerably within small areas. Similar variations are found in the quality of water from shallow wells sunk to the same depth, yet only short distances apart. The boulder clay and lake clay are regarded as being sources of the contaminating sulphate salts present in varying amounts in waters from the drift. Hence, beds of sands and gravels not covered by any appreciable thickness of clay yield soft or only moderately hard water which is drinkable, whereas waters from beds lying under 30 feet or more of boulder clay are likely to be hard and highly mineralized. As a rule, in this area, waters obtained from shallow wells, 40 feet or less in depth, will not contain excessive concentrations of sulphate salts and will be satisfactory for domestic use.

As would be expected, water obtained at greater depths in the glacial drift is hard and contains high concentrations of dissolved mineral salts. Many of these waters have total solid

contents between 1,000 and 2,000 parts per million and a total hardness in excess of 1,000 parts per million. In many places these waters have a laxative effect on persons unaccustomed to their use. Iron is commonly present in these waters, but not in sufficient quantities to affect the quality of the water for domestic use.

Water from the Bedrock

Little or no water is being obtained, or is likely to be obtained, from the Bearpaw formation underlying the glacial drift throughout the greater part of this municipality. Any small seepages that might be obtained from these marine shales would probably contain very high concentrations of sodium sulphate and sodium chloride (NaCl, common salt). Such water is undrinkable, and its laxative effects may tend to create scour in stock.

Water obtained from the Belly River formation varies considerably in quality. Supplies from the upper sands of the formation in the northern part of the municipality are for the most part similar to those obtained from the lower sands and gravels of the glacial drift. Analyses 2 and 3 are of waters obtained at different depths in the Belly River formation in the town of Sceptre, in the NW. $\frac{1}{4}$, sec. 9, tp. 22, range 24. Analysis 2, of water from the 206-foot well, shows a total dissolved solid content of 1,190 parts per million, made up of the following mineral salts in the decreasing order of their abundance; calcium sulphate ($CaSO_4$), magnesium sulphate ($MgSO_4$), calcium carbonate ($CaCO_3$), sodium sulphate (Na_2SO_4), and calcium chloride ($CaCl_2$). This water is very hard, but the concentrations of magnesium sulphate (Epsom salts) and sodium sulphate (Glauber's salt) are not excessive and the water is suitable for drinking.

The water obtained at 389 feet in the 779-foot well (analysis No. 3) has a total dissolved solid content of 2,823 parts per million, made up of the following salts in order of their decreasing quantities; sodium sulphate (Na_2SO_4), sodium carbonate (Na_2CO_3), calcium sulphate ($CaSO_4$), sodium chloride (NaCl), and magnesium sulphate ($MgSO_4$). It will be noted that the sodium salts predominate in this water as compared with the water from the 206-foot well, in which calcium and magnesium sulphates are present in the larger quantities. At still greater depths in the 779-foot well, analyses are reported to have shown the water to contain a very high concentration of sodium chloride (NaCl, common salt) and only traces of sodium sulphate and sodium carbonate; the calcium and magnesium salts were absent. Sulphates and carbonates of calcium and magnesium cause permanent and temporary hardness, respectively; sodium salts do not contribute to the hardness. Thus the analyses of waters from the wells indicate that waters obtained near the top of the Belly River formation will usually be hard, whereas those obtained at greater depths will be softer but will contain high concentrations of sodium salts. These waters are referred to as salty if the sodium chloride content is high, and as "soda" waters if the sodium carbonate content is high. All of these salts are objectionable in water if present in large quantities. However, nearly all the waters obtained from the Belly River formation in this municipality, at depths of 200 to 550 feet, are being used for drinking. Some of these waters would undoubtedly be harmful to vegetation, due to their high mineral content, and particularly the sodium carbonate, "black alkali", content, and should not be used for garden irrigation.

Analyses 1 and 4 bear out the above statements regarding the hardness of the waters. The latter analysis is of water from a 402-foot well in the SW. ¼, sec. 13, tp. 23, range 24. This water has a total dissolved solid content of 1,280 parts per million, made up partly of calcium and magnesium salts, and is very hard, having a total hardness of 850 parts per million. This water is typical of waters from the upper sands of the Belly River formation. Analysis 1 is of water from a 535-foot well in the SW. ¼, sec. 15, tp. 22, range 23. This water is typical of that obtained at considerable depth in the formation. It is soft, and has a total solid content of 2,217 parts per million, made up almost entirely of sodium salts.

WELL RECORDS—Rural Municipality of CLINWORTH, NO. 230, 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.	5	19	22	3	Drilled	425	2,310					Belly River sand	Soft, iron, "alkaline"		S	Sufficient supply.
2	SW.	12	"	"	"	Drilled	127	2,288					Glacial sand	Hard, clear		S	Sufficient supply.
3	NE.	22	"	"	"	Drilled	133	2,288					Glacial sand	Hard, "alkaline"		D, S	Sufficient supply.
4	NW.	24	"	"	"	Bored	56	2,325	- 36	2,289	56	2,269	Glacial gravel	Clear, fairly hard, slight iron content		D, S	Sufficient supply.
5	NE.	24	"	"	"	Drilled	187	2,355	- 47	2,308	187	2,168	Glacial drift	Hard, iron, content		S	Insufficient owing to sand plugging; several wells around 50 feet all sand plugged; water hauled.
6	SW.	25	"	"	"	Bored	69	2,325	- 44	2,281	69	2,256	Glacial gravel	Hard, "alkaline"		D, S	Barely sufficient; supply has decreased owing to cave in.
7	NW.	35	"	"	"	Bored	70	2,315	- 50	2,265	70	2,245	Glacial gravel	Hard, iron		S	Sufficient supply; another shallow well 50 yards, SW. used for cooking purposes.
8	SE.	36	"	"	"	Bored	100	2,310	- 85	2,225	85	2,225	Glacial sand	Fairly hard, clear		S	Insufficient supply.
9	SE.	36	"	"	"	Dug	39	2,300	- 34	2,266	34	2,266	Glacial sand	Hard, clear		S	Water has to be hauled.
1	SW.	4	19	23	3		40	2,345	- 15	2,330	40	2,305	Glacial sand	Fairly hard, clear		S	Abundant supply.
2	SW.	6	"	"	"		45	2,355	- 20	2,335	20	2,335	Glacial sand	Fairly hard, clear		S	Sufficient supply.
3	NW.	21	"	"	"		40	2,345	- 8	2,337	40	2,305	Glacial sand	Fairly hard, iron, clear		S	Abundant supply.
4	NW.	27	"	"	"		38	2,340	- 30	2,310	30	2,310	Glacial sand	Fairly hard, iron, clear		S	Abundant supply.
5	NW.	30	"	"	"	Drilled	100	2,350	- 20	2,330	100	2,250	Glacial gravel	Fairly hard, clear		S	Abundant supply.
1	NW.	5	19	24	3	Drilled	209	2,375	-140	2,235	209	2,166	Glacial fine sand	Hard, iron, rusty, "alkaline"		D, S	Sufficient supply.
2	SE.	16	"	"	"		30	2,340	- 10	2,330	10	2,330	Glacial sand	Fairly hard, clear		S	Abundant supply.
3	NW.	24	"	"	"	Drilled	50	2,350	- 30	2,320	30	2,320	Glacial sand	Fairly hard, iron, clear		D, S	Insufficient supply.
4	NW.	32	"	"	"	Drilled	160	2,335	- 30	2,305	160	2,175	Glacial gravel	Hard, iron, rusty		D, S	Sufficient supply.
5	SW.	34	"	"	"	Drilled	190	2,340	- 90	2,250	190	2,150	Glacial sand	Hard, clear, slightly "alkaline"		S	Sufficient supply.
1	SE.	2	20	22	3	Dug	24	2,344	-18	2,326	18	2,326	Glacial gravel	Hard, clear		D, S	Insufficient supply; another 30-foot well--hard, "alkaline", water (laxative).
2	SE.	3	"	"	"	Bored	35	2,355	- 32	2,323	32	2,323	Glacial drift	Slightly hard, clear		D, S	Insufficient supply; another 14-foot well 150 yards east furnishes extra supply.
3	SW.	4	"	"	"	Dug	18	2,360	- 8	2,352	8	2,352	Glacial sand	Hard, clear		D, S	Sufficient supply.
4	NE.	4	"	"	"	Bored	45	2,300	- 30	2,330	45	2,315	Glacial gravel	Hard, clear		D, S	Sufficient supply.
5	SW.	5	"	"	"	Drilled	130	2,350					Glacial sand	Hard, clear		S	Sufficient supply.
6	NE.	13	"	"	"	Sand-point	30	2,330	- 8	2,372	8	2,372	Glacial sand	Hard, clear		S	Sufficient 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 CLINWORTH, NO.230, SASKATCHEWAN.

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
7	SW.	17	20	22	3		30	2,335	- 31	2,304	31	2,304	Glacial sand	Hard, clear, slightly "alkaline"		S	Sufficient supply.
8	NE.	22	"	"	"	Dug	10	2,310	- 7	2,303	7	2,303	Recent sand	Fairly hard, clear		S	Sufficient supply.
9	SE.	28	"	"	"		26	2,350	- 6	2,344	6	2,344	Glacial sand	Hard, iron, clear		S	Sufficient supply.
10	NW.	30	"	"	"	Sand-point	26	2,345	- 10	2,335	10	2,335	Glacial sand	Hard, clear		S	Sufficient supply.
1	SE.	4	20	23	3	Sand-point	18	2,300	- 9	2,351	9	2,351	Recent-sand	Hard, clear, slightly "alkaline"		S	Sufficient supply.
2	NW.	7	"	"	"	Sand-point	30	2,345	- 19	2,326	19	2,326	Glacial sand	Hard, clear		S	Sufficient supply.
3	NE.	10	"	"	"	Sand-point	14	2,370	- 8	2,362	8	2,362	Recent sand	Hard, clear		S	Sufficient supply.
4	NE.	20	"	"	"	Sand-point	20	2,340	- 6	2,334	6	2,334	Recent sand	Hard, clear		S	Sufficient supply.
5	SW.	27	"	"	"	Sand-point	16	2,345	- 8	2,337	8	2,337	Recent sand	Hard, clear		S	Sufficient supply.
6	NE.	34	"	"	"	Sand-bucket	16	2,365	- 8	2,357	8	2,357	Glacial sand	Hard, clear		S	Sufficient supply.
7	SW.	36	"	"	"	Sand-bucket	15	2,355	- 8	2,347	8	2,347	Recent sand	Hard, clear		S	Sufficient supply.
1	SW.	15	"	24	3	Dug	35	2,335					Glacial sand	Hard, clear		S	Sufficient supply.
2	SE.	18	"	"	"	Dug	32	2,365					Glacial sand	Hard, clear		S	Sufficient supply.
3	SE.	25	"	"	"		30	2,360	- 15	2,345	15	2,345	Glacial sand	Hard, clear		S	Sufficient supply.
4	NE.	27	"	"	"		25	2,345	- 10	2,335	10	2,335	Glacial sand	Hard, clear, slightly "alkaline"		S	Sufficient supply.
5	SW.	31	"	"	"	Dug	25	2,380	- 20	2,360	20	2,360	Glacial fine sand	Hard, clear		D, S	Sufficient supply.
6	SW.	33	"	"	"	Dug	65	2,390	- 82	2,308	82	2,308	Glacial sand	Fairly hard		D, S	Insufficient supply.
1	NE.	9	21	22	3	Dug	55	2,280	- 48	2,232	48	2,232	Glacial sand	Soft, clear		D, S	Sufficient supply.
2	NE.	12	"	"	"	Dug	40	2,281	- 35	2,246	35	2,246	Glacial drift	Soft, clear		D, S	Sufficient supply.
3	SE.	13	"	"	"	Bored	40	2,267	- 36	2,231	36	2,231	Glacial sand	Hard, "alkaline" clear		D, S	Insufficient supply.
4	NW.	13	"	"	"	Bored	95	2,264	- 90	2,174	90	2,174	Glacial sand	Hard, clear, "alkaline"		D, S	Insufficient supply; quicksand encountered in 18 holes; very little water.
5	NE.	15	"	"	"	Dug	25	2,244	- 21	2,223	21	2,223	Glacial sand	Hard, clear		D, S	Sufficient supply.
6	SW.	16	"	"	"	Dug	45	2,350	- 41	2,309	41	2,309	Glacial sand	Soft, clear		D, S	Sufficient supply.
7	NE.	17	"	"	"	Dug	30	2,340	- 25	2,315	25	2,315	Glacial sand	Soft, clear		D, S	Sufficient supply.
8	NW.	17	"	"	"	Dug	35	2,343	- 33	2,310	33	2,310	Glacial sand	Soft, clear		D, S	Sufficient supply.
9	SE.	19	"	"	"	Dug	35	2,295	- 32	2,263	32	2,263	Glacial sand	Soft, clear		D, S	Sufficient 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 CLINWORTH, NO. 230, 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				
10	NE.	19	21	22	3	Bored	35	2,289	- 25	2,264	25	2,264	Glacial sand	Soft, clear		N	Insufficient supply; well is not used now; quicksand causes trouble.
11	NE.	20	"	"	"	Dug	18	2,265	- 16	2,249	16	2,249	Glacial drift	Soft, clear		D, S	Insufficient supply.
12	NW.	21	"	"	"	Dug	40	2,269	- 33	2,236	33	2,236	Glacial drift	Hard, clear		D, S	Sufficient supply.
13	NW.	21	"	"	"	Dug	12	2,215	- 6	2,209	6	2,209	Glacial sand	Soft, clear		D, S	Sufficient supply.
14	NE.	20	"	"	"	Dug	20	2,218	- 18	2,200	18	2,200	Glacial sand	Hard, clear		D, S	Sufficient supply.
15	SW.	23	"	"	"	Dug	35	2,240	- 27	2,213	27	2,213	Glacial sand	Hard, clear		D, S	Sufficient supply.
16	SE.	24	"	"	"	Bored	82	2,239	- 64	2,175	82	2,157	Glacial sand	Hard, clear		D, S	Sufficient supply.
17	NE.	24	"	"	"	Dug	85	2,257	- 80	2,177	80	2,177	Glacial sand	Soft, clear		D, S	Sufficient supply.
18	NE.	25	"	"	"	Bored	70	2,215	- 66	2,149	66	2,149	Glacial sand	Hard, clear		D, S	Sufficient supply.
19	SE.	27	"	"	"	Dug	62	2,218	- 45	2,173	62	2,156	Glacial sand	Hard, clear		D, S	Sufficient supply.
20	SE.	30	"	"	"	Dug	20	2,275	- 15	2,260	15	2,260	Glacial sand	Hard, clear		D, S	Sufficient supply.
21	NE.	30	"	"	"	Bored	65	2,280	- 55	2,225	55	2,225	Glacial gravel	Hard, clear		D, S	Sufficient supply.
22	SW.	30	"	"	"	Bored	70	2,282	- 60	2,222	60	2,222	Glacial drift	Hard, clear		D, S	Sufficient supply.
23	SE.	32	"	"	"	Bored & Drilled	258	2,227	-168	2,059	258	1,969	Belly River	Hard, clear		D, S	Sufficient supply; flow 5 gallons a minute.
24	NW.	33	"	"	"	Bored	100	2,217	- 70	2,147	100	2,117	Glacial drift	Hard, iron, clear		D, S	Sufficient supply.
25	NE.	33	"	"	"	Bored	126	2,215	-103	2,112	126	2,089	Glacial drift	Hard, clear		D, S	Sufficient supply.
26	NE.	34	"	"	"	Bored	82	2,210	- 62	2,148	82	2,128	Glacial sand	Hard, clear		D, S	Sufficient supply.
27	NW.	35	"	"	"	Bored	73	2,215	- 61	2,154	73	2,142	Glacial sand	Hard, clear		D, S	Sufficient supply.
28	SE.	36	"	"	"	Dug	45	2,220	- 40	2,180	40	2,180	Glacial sand	Soft, clear		D, S	Sufficient supply.
29	NE.	36	"	"	"	Dug	80	2,233	- 75	2,158	75	2,158	Glacial sand	Hard, iron, clear		D, S	Sufficient supply.
1	SE.	2	21	23	3	Drilled	38	2,345	- 6	2,339	38	2,307	Glacial fine sand	Soft, clear		S	Sufficient supply.
2	NW.	2	"	"	"	Bored	116	2,368	-113	2,255	113	2,255	Glacial gravel	Hard, cloudy		D, S	Sufficient supply.
3	NE.	3	"	"	"	Dug	32	2,351	- 22	2,329	32	2,319	Glacial sand	Soft, clear		D, S	Sufficient supply.
4	NW.	4	"	"	"	Dug	35	2,352	- 30	2,322	30	2,322	Glacial fine sand	Hard, clear, iron		D, S	Sufficient supply; unsteady.
5	SE.	6	"	"	"	Dug	30	2,395	- 27	2,368	27	2,368	Glacial fine sand	Soft, clear,		D, S	Sufficient supply.
6	SW.	7	"	"	"	Bored	64	2,368	- 55	2,313	55	2,313	Glacial fine sand	Soft, clear		D, S	Insufficient supply.
7	NE.	9	"	"	"	Dug	20	2,300	- 17	2,283	17	2,283	Glacial fine sand	Hard, "alkaline", odour, cloudy		D, S	Insufficient 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 CLINWORTH, NO. 230, SASKATCHEWAN.

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
8	NW.	10	21	23	3	Dug	30	2,302	- 26	2,276	26	2,276	Glacial fine sand	Soft, clear		D, S	Sufficient supply.
9	SW.	12	"	"	"	Drilled	265	2,370	-100	2,270	265	2,105	Glacial sand	Hard, clear		D, S	Sufficient supply.
10	SW.	13	"	"	"	Dug	30	2,328	- 20	2,308	30	2,298	Glacial fine sand	Soft, clear		D, S	Sufficient supply.
11	NW.	13	"	"	"	Bored	314	2,381			314	2,067	Belly River sand	Soft, clear		D, S	Sufficient supply.
12	NE.	19	"	"	"	Dug	36	2,327	-28	2,299	28	2,299	Glacial sand	Hard, clear		D, S	Sufficient supply.
13	NW.	23	"	"	"	Dug	46	2,390	- 38	2,352	46	2,344	Glacial fine sand	Soft, clear		D, S	Sufficient supply.
14	SE.	24	"	"	"	Dug	10	2,309	- 2	2,307	2	2,307	Glacial fine sand	Soft, clear		D, S	Sufficient supply.
15	SE.	24	"	"	"	Drilled	315	2,346	-215	2,131	315	2,031	Belly River sand	Hard, clear		D, S	Insufficient supply.
16	NE.	27	"	"	"	Drilled	290	2,320	-190	2,130	290	2,030	Belly River	Hard, clear		D, S	Sufficient supply.
17	NE.	28	"	"	"	Drilled	252	2,250	-160	2,090	252	1,998	Belly River	Hard, iron, clear		D, S	Sufficient supply.
18	NE.	33	"	"	"	Drilled	280	2,264	-116	2,148	280	1,984	Belly River	Hard, clear		D, S	Sufficient supply.
1	SE.	4	21	24	3	Drilled	250	2,300	-110	2,250	250	2,110	Belly River sand	Hard, clear		D, S	Sufficient supply.
2	SE.	7	"	"	"	Drilled	280	2,340	- 90	2,250	280	2,060	Belly River sand	Hard, clear, "alkaline"		D, S	Sufficient supply.
3	SE.	8	"	"	"	Drilled	160	2,313	- 60	2,253	160	2,153	Glacial sand	Hard, clear		D, S	Sufficient supply.
4	NW.	10	"	"	"	Drilled	108	2,305	- 78	2,227	108	2,197	Glacial sand	Hard, clear		D, S	Sufficient supply.
5	NE.	14	"	"	"	Drilled	250	2,300	-120	2,180	250	2,050	Belly River	Hard, clear		D, S	Sufficient supply.
6	NW.	14	"	"	"	Drilled	420	2,320	-185	2,135	420	1,900	Belly River	Hard, clear		S	Sufficient supply; two wells on same place--one shallow, one 265-feet abandoned.
7	NE.	15	"	"	"	Drilled	398	2,330	-150	2,180	398	1,932	Belly River	Soft, clear		D, S	Sufficient supply.
8	NW.	16	"	"	"	Drilled	146	2,306	-110	2,196	146	2,160	Glacial sand	Hard, clear, "alkaline"		D, S	Insufficient supply.
9	SE.	17	"	"	"	Drilled	140	2,309	- 60	2,249	140	2,169	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient supply.
10	SE.	18	"	"	"	Drilled	320	2,320	-220	2,100	320	2,000	Belly River	Hard, clear, slightly "alkaline"		D, S	Sufficient supply.
11	NW.	18	"	"	"	Drilled	246	2,276	-150	2,126	246	2,030	Belly River	Hard, iron, clear		D, S	Sufficient supply.
12	SW.	19	"	"	"	Drilled	280	2,255	-100	2,155	280	1,975	Belly River sand	Hard, clear, "alkaline"		D, S	Sufficient supply.
13	NW.	21	"	"	"	Drilled	300	2,334	-140	2,194	300	2,034	Belly River sand	Hard, clear, salty		S	Sufficient supply.
14	SE.	21	"	"	"	Drilled	418	2,315	-175	2,140	418	1,897	Belly River sand	Hard, clear		D, S	Sufficient supply.
15	NE.	22	"	"	"	Drilled	410	2,320	-130	2,190	410	1,910	Belly River	Hard, clear, "alkaline"		D, S	Sufficient 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 5 CLINWORTH, NO. 230, SASKATCHEWAN.

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
16	NW.	23	21	24	3	Drilled	510	2,320	-170	2,150	510	1,810	Belly River sand	Soft, clear		D, S	Sufficient supply.
17	NE.	24	"	"	"	Dug	170	2,275	- 85	2,190	170	2,105	Glacial gravel	Hard, clear		D, S	Sufficient supply.
18	SE.	25	"	"	"	Drilled	198	2,275	-110	2,165	198	2,077	Glacial gravel	Hard, clear		D,S	Sufficient supply.
19	SW.	25	"	"	"	Drilled	220	2,275	-114	2,161	220	2,055	Belly River sand	Hard, clear		D, S	Sufficient supply.
20	NE.	26	"	"	"	Drilled	199	2,270	-140	2,130	199	2,071	Glacial gravel	Hard, iron, "alkaline", clear		D, S	Sufficient supply.
21	SE.	27	"	"	"	Drilled	450	2,320	-110	2,210	450	1,870	Belly River sand	Hard, clear, "alkaline"		D, S	Sufficient supply.
22	SE.	28	"	"	"	Drilled	425	2,310	-150	2,100	425	1,885	Belly River	Soft, clear		D, S	Sufficient supply.
23	SE.	29	"	"	"	Drilled	247	2,334	-170	2,164	247	2,087	Belly River sand	Hard, clear		D, S	Sufficient supply.
24	SE.	31	"	"	"	Drilled	328	2,290	-148	2,142	328	1,962	Belly River sand	Hard, clear		D, S	Sufficient supply.
25	SE.	31	"	"	"	Drilled	330	2,285	-175	2,110	330	1,955	Belly River sand	Hard, iron, clear		D, S	Sufficient supply.
26	NW.	32	"	"	"	Drilled	330	2,270	-130	2,140	320	1,950	Belly River	Hard, clear, slightly "alkaline"		D, S	Sufficient supply.
27	NW.	34	"	"	"	Bored	103	2,256	-100	2,156	100	2,156	Glacial sand and gravel	Hard, clear		D, S	Sufficient supply.
1	SE.	1	22	22	3	Dug	40	2,102	- 36	2,126	36	2,126	Glacial sand	Hard, clear		D, S	Sufficient supply.
2	NE.	1	"	"	"	Bored	54	2,206	- 42	2,164	54	2,152	Glacial gravel	Soft, clear		D, S	Sufficient supply.
3	SE.	2	"	"	"	Dug	60	2,170	- 52	2,118	52	2,118	Glacial sand	Hard, clear		D, S	Sufficient supply.
4	SW.	3	"	"	"	Drilled	40	2,180	- 36	2,144	36	2,144	Glacial sand	Hard, clear		D, S	Sufficient supply.
5	SW.	4	"	"	"	Dug	61	2,185	- 46	2,139	46	2,139	Glacial gravel	Hard, clear		D, S	Sufficient supply; also 286-foot drilled well on farm not used.
6	SE.	5	"	"	"	Dug	100	2,190	- 88	2,102	88	2,102	Glacial sand	Hard, clear		D, S	Sufficient supply.
7	NE.	5	"	"	"	Dug	100	2,210	- 88	2,122	88	2,122	Glacial sand	Hard, clear		D, S	Sufficient supply.
8	SW.	7	"	"	"	Drilled	207	2,240	- 40	2,200	207	2,033	Glacial gravel	Hard, iron		D, S	Sufficient supply.
9	SE.	7	"	"	"	Bored	100	2,210	- 92	2,118	92	2,118	Glacial sand	Hard, clear		D, S	Sufficient supply.
10	SW.	8	"	"	"	Drilled	385	2,200	- 84	2,116	385	1,815	Belly River sand	Hard, clear		D, S	Sufficient supply.
11	SW.	9	"	"	"	Drilled	280	2,209	-100	2,109	280	1,929	Belly River sand	Hard, clear		D, S	Sufficient supply.
12	NE.	9	"	"	"	Dug	82	2,180	- 76	2,104	72	2,108	Glacial sand	Hard, clear		D, S	Sufficient supply.
13	SW.	10	"	"	"	Dug	75	2,185	- 55	2,130	55	2,130	Glacial sand	Hard, clear		D, S	Sufficient supply.
14	SE.	12	"	"	"	Bored	47	2,200	- 35	2,165	47	2,153	Glacial sand	Soft, clear		D, S	Sufficient supply.
15	NW.	15	"	"	"	Drilled	245	2,170	- 90	2,080	245	1,925	Belly River sand	Hard, clear		D, S	Sufficient supply.
16	SE.	16	"	"	"	Dug	85	2,210	- 79	2,131	79	2,131	Glacial sand	Hard, clear		D, S	Sufficient 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 CLINWORTH, NO. 230, 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				
17	SE.	17	22	22	3	Drilled	300	2,190	-100	2,090	300	1,890	Belly River sand	Hard, clear		D, S	Sufficient supply.
18	SE.	17	"	"	"	Drilled	495	2,210	-385	1,825	495	1,715	Belly River	Soft,	44	D, S	Sufficient supply.
19	SW.	17	"	"	"	Dug	62	2,230	- 42	2,188	62	2,168	Glacial sand	Hard		N	At present not in use.
20	SW.	17	"	"	"	Drilled	186	2,230	- 62	2,168	186	2,044	Glacial gravel	Hard, slightly "alkaline"	44	D, S	Sufficient supply.
21	SE.	18	"	"	"	Drilled	215	2,250	- 90	2,160	215	2,035	Belly River sand	Hard	44	D, S	Sufficient supply.
22	NW.	19	"	"	"	Dug	90	2,250	- 88	2,162	88	2,162	Glacial gravel	Hard	44	D, S	Sufficient supply.
23	SW.	20	"	"	"	Dug	90	2,245	- 82	2,163	82	2,163	Glacial sand	Hard	44	D, S	Sufficient supply.
24	SE.	21	"	"	"	Bored	74	2,165	- 72	2,093	72	2,093	Glacial sand	Hard	44	D, S	Sufficient supply.
25	NE.	25	"	"	"	Dug	48	2,215	- 42	2,173	42	2,173	Glacial sand	Soft	44	D	Sufficient supply.
26	NE.	25	"	"	"	Dug	72	2,215	- 51	2,164	72	2,143	Glacial sand	Soft	44	D, S	Sufficient supply.
27	NW.	25	"	"	"	Drilled	145	2,215					Glacial sand	Hard, cloudy	44	N	Intermittent, very poor supply.
28	SW.	26	"	"	"	Bored	90	2,148	- 85	2,063	85	2,063	Glacial drift	Hard	44	D, S	Sufficient supply.
29	NE.	27	"	"	"	Drilled	345	2,140	-200	1,940	345	1,795	Belly River sand	Hard, slightly "alkaline"	44	D, S	Sufficient for local needs.
30	NE.	27	"	"	"	Bored	90	2,140									Dry hole; base in glacial drift.
31	SW.	27	"	"	"	Bored	80	2,140	- 76	2,064	76	2,064	Glacial sand	Hard	44	D, S	Sufficient supply.
32	SE.	28	"	"	"	Dug	70	2,155	- 65	2,090	65	2,090	Glacial sand	Hard	44	D, S	Sufficient supply.
33	NE.	29	"	"	"	Bored	100	2,250	- 12	2,238	100	2,150	Glacial sand	Hard		D, S, I	Sufficient supply.
34	NE.	29	"	"	"	Bored	100	2,220	- 90	2,130	90	2,130	Glacial gravel	Hard, iron	44	D, S	Sufficient supply.
35	SE.	30	"	"	"	Drilled	270	2,220	- 90	2,130	270	1,950	Belly River sand	Hard		D, S	Sufficient supply.
36	NE.	30	"	"	"	Drilled	212	2,200	- 90	2,110	212	1,988	Belly River sand	Hard, iron, slightly "alkaline"	44	D, S	Sufficient supply.
37	SW.	32	"	"	"	Bored	74	2,200	- 70	2,130	74	2,126	Glacial gravel	Hard	44	D, S	Sufficient supply.
38	NE.	32	"	"	"	Dug	100	2,203	- 87	2,116	100	2,103	Glacial gravel	Hard	44	D, S	Sufficient supply.
39	NW.	33	"	"	"	Bored	85	2,193	- 83	2,110	83	2,110	Glacial gravel	Hard	44	D, S	Sufficient supply.
40	SE.	35	"	"	"	Bored	70	2,165	- 56	2,109	70	2,095	Glacial sand	Hard	44	D, S	Sufficient supply.
1	NW.	3	22	23	3	Drilled	336	2,240	-160	2,080	336	1,904	Belly River sand	Hard		N	In need of repair.
2	NW.	3	"	"	"	Dug	128	2,240	-122	2,118	122	2,118	Glacial sand	Hard		D, S	Sufficient 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 CLINWORTH, NO. 230, 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				
3	SE.	3	22	23	3	Drilled	310	2,250	-100	2,150	310	1,940	Belly River sand	Hard	44	D, S	Sufficient supply.
4	NW.	4	"	"	"	Dug	116	2,230	-111	2,119	111	2,119	Glacial sand	Hard, iron	44	D, S	Sufficient supply.
5	NE.	5	"	"	"	Drilled	300	2,255	-100	2,155	300	1,955	Belly River sand	Hard, iron	44	D, S	Sufficient supply.
6	SE.	6	"	"	"	Drilled	342	2,304	-142	2,162	342	1,962	Belly River sand	Hard		D, S	Sufficient supply.
7	SW.	9	"	"	"	Dug	127	2,225	-120	2,105	127	2,098	Glacial sand and gravel	Hard	44	D, S	Sufficient supply.
8	SW.	10	"	"	"	Drilled	300	2,242	-140	2,102	300	1,942	Belly River sand	Hard	44	D, S	Sufficient supply.
9	SW.	13	"	"	"	Dug	80	2,220	- 76	2,144	76	2,144	Glacial sand	Hard	44	D, S	Sufficient supply.
10	SW.	14	"	"	"	Drilled	300	2,242	-120	2,122	300	1,942	Belly River sand	Hard, iron	44	D, S	Sufficient supply.
11	NW.	14	"	"	"	Drilled	300	2,242	-120	2,122	300	1,942	Belly River sand	Hard, iron	44	D, S	Sufficient supply.
12	SW.	15	"	"	"	Drilled	535	2,287	- 70	2,217	535	1,752	Belly River sand	Soft	44	D, S	Sufficient supply; #.
13	SE.	18	"	"	"	Bored	98	2,224	- 88	2,136	98	2,126	Glacial fine sand	Hard	44	D, S	Sufficient supply.
14	SW.	18	"	"	"	Dug	100	2,224	- 90	2,134	90	2,134	Glacial gravel	Hard	44	D, S	Sufficient supply.
15	SW.	19	"	"	"	Drilled	243	2,240	-140	2,100	243	1,997	Glacial River sand	Hard	44	D, S	Sufficient supply.
16	NE.	20	"	"	"	Drilled	240	2,260	-150	2,110	240	2,020	Belly River sand	Hard	44	D, S	Sufficient supply.
17	NE.	21	"	"	"	Drilled	200	2,250	- 90	2,160	200	2,050	Belly River sand	Hard	44	D, S	Sufficient supply.
18	SW.	24	"	"	"	Dug	65	2,210	- 50	2,160	65	2,145	Glacial sand	Soft	44	D, S	Sufficient supply.
19	SW.	26	"	"	"	Drilled	530	2,225	- 75	2,150	530	1,695	Belly River sand	Soft		N	Well not used; probably plugged.
20	NE.	27	"	"	"	Drilled	273	2,215	-140	2,075	273	1,942	Belly River sand	Hard, cloudy, "alkaline"			Large supply of poor quality water.
21	NE.	27	"	"	"	Bored	125	2,215	-110	2,105	125	2,090	Glacial sand	Hard	44	D, S	Not always sufficient.
22	SE.	28	"	"	"	Bored	140	2,255	-125	2,130	140	2,115	Glacial gravel	Hard	44	D, S	Sufficient supply.
23	SW.	28	"	"	"	Drilled	540	2,260	- 70	2,190	540	1,720	Belly River sandstone	Soft, soda	44	D, S	Sufficient supply.
24	SE.	30	"	"	"	Drilled	283	2,240	-150	2,090	283	1,957	Belly River sand	Hard, iron	44	D, S	Sufficient supply.
25	SW.	30	"	"	"	Drilled	270	2,245	-110	2,135	270	1,975	Belly River sand	Hard, iron	44	D, S	Sufficient supply.
26	NW.	31	"	"	"	Drilled	265	2,270	-110	2,160	265	2,005	Belly River sand	Hard, iron	44	D, S	Not always sufficient.
27	SE.	32	"	"	"	Drilled	220	2,260	-110	2,150	220	2,040	Belly River sand	Hard	44	D, S	Sufficient supply.
28	NE.	32	"	"	"	Drilled	160	2,260	- 90	2,170	160	2,100	Glacial sand	Hard	44	D, S	Sufficient supply.
29	SW.	32	"	"	"	Drilled	115	2,200	-100	2,100	115	2,085	Glacial sand	Hard	44	D, S	Sufficient 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 8 CLINWORTH, NO. 230, 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.	1	22	24	3	Drilled	411	2,150	-110	2,040	411	1,739	Belly River sand	Hard		D, S	Sufficient supply
2	SE.	1	"	"	"	Bored	110	2,160	-105	2,055	110	2,050	Glacial sand and gravel	Hard, slightly "alkaline"		D, S	Sufficient supply.
3	SE.	2	"	"	"	Drilled	238	2,140	-178	1,962	238	1,902	Belly River sand	Hard		D, S	Sufficient; waters 13 head stock.
4	SW.	2	"	"	"	Dug	128	2,155	-108	2,047	128	2,027	Glacial gravel	Hard		D, S	Sufficient supply.
5	SE.	3	"	"	"	Drilled	271	2,165	-190	1,975	271	1,894	Belly River sand	Hard, yellowish		N	Unsuitable for use.
6	SE.	4	"	"	"	Drilled	283	2,245	- 90	2,155	283	1,962	Belly River sand	Hard	44	D, S	Sufficient supply.
7	NE.	5	"	"	"	Drilled	360	2,235	-160	2,075	360	1,875	Belly River sandstone	Hard	44	D, S	Sufficient supply.
8	NE.	6	"	"	"	Drilled	234	2,240	-110	2,130	234	2,006	Belly River	Hard	44	D, S	Sufficient supply.
9	SW.	7	"	"	"	Drilled	238	2,245	- 90	2,155	238	2,007	Belly River sand	Hard	44	D, S	Sufficient supply.
10	SE.	8	"	"	"	Drilled	208	2,150	-100	2,050	208	1,942	Belly River sand	Hard	44	D, S	Sufficient supply.
11	NW.	9	"	"	"	Drilled	206	2,205			206	1,999	Belly River sand	Hard		N	Well plugged; #.
12	NW.	9	"	"	"	Drilled	198	2,205	-100	2,105	198	2,007	Belly River sand	Hard	44	D, S	Ample; supplies 2000 gallons an hour.
13	NW.	9	"	"	"	Drilled	779	2,205			779	1,426	Belly River sand	Soft, salty		N	Also 172-foot hole; filled in; #.
14	SE.	10	"	"	"	Drilled	145	2,160	-105	2,055	145	2,015	Glacial gravel	Soft, iron		D, S	Sufficient; waters 100 head stock.
15	SW.	11	"	"	"	Drilled	408	2,170	-140	2,030	408	1,762	Belly River sand	Hard		S	Sufficient for stock needs.
16	SE.	12	"	"	"	Drilled	390	2,240	-110	2,130	390	1,850	Belly River sand	Soft	44	D, S	Sufficient supply.
17	SE.	14	"	"	"	Dug	160	2,140	-105	2,035	160	1,980	Belly River sand	Hard, iron	44	D, S	Sufficient supply.
18	SE.	15	"	"	"	Drilled	190	2,155	-115	2,040	190	1,965	Belly River sand	Hard, iron, "alkaline"		D, S	Sufficient supply.
19	NW.	15	"	"	"	Drilled	202	2,230	- 80	2,150	202	2,028	Belly River sand	Hard		D, S	Sufficient supply.
20	NE.	17	"	"	"	Dug	108	2,220	-105	2,115	105	2,115	Glacial sand	Hard, iron	44	D, S	Sufficient supply.
21	SE.	18	"	"	"	Dug	96	2,225	- 91	2,134	96	2,129	Glacial gravel	Hard	44	D, S	Sufficient supply.
22	SW.	18	"	"	"	Bored	146	2,220	-142	2,078	142	2,078	Glacial sand			N	Intermittent supply; abandoned.
23	NE.	19	"	"	"	Drilled	266	2,230	-126	2,104	266	1,964	Belly River sand	Hard	44	D, S	Sufficient supply.
24	NW.	21	"	"	"	Drilled	240	2,210	-100	2,110	240	1,970	Belly River sand	Hard	44	D, S	Sufficient supply.
25	SE.	21	"	"	"	Dug	140	2,155	-135	2,020	135	2,020	Glacial sand	Hard	44	D, S	Sufficient supply.
26	SW.	22	"	"	"	Drilled	232	2,240	-110	2,130	232	2,008	Belly River sand	Hard	44	D, S	Sufficient supply.
27	NW.	23	"	"	"	Bored	100	2,145	- 90	2,055	100	2,045	Glacial gravel	Hard		D, S	Sufficient; waters 8 head stock.

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

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

WELL RECORDS—Rural Municipality of CLINWORTH, NO. 230, SASKATCHEWAN.

B 4-4
1860—10,000

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
28	SE.	23	22	24	3	Drilled	220	2,150	-140	2,010	220	1,930	Belly River sand	Hard, cloddy		D, S	Sufficient supply.
29	NW.	24	"	"	"	Drilled	230	2,175	- 70	2,105	230	1,945	Belly River sand	Hard, cloudy, "alkaline"		D, S	Sufficient supply.
30	SE.	24	"	"	"	Dug	114	2,026	-108	1,918	108	1,918	Glacial sand	Hard, "alkaline"		D, S	Sufficient supply.
31	SE.	25	"	"	"	Dug	135	2,170	-127	2,043	135	2,035	Glacial sand	Hard, "alkaline"		D, S	Sufficient supply.
32	SE.	27	"	"	"	Drilled	218	2,160	- 60	2,100	218	1,942	Belly River sand	Hard		D, S	Sufficient supply.
33	NE.	27	"	"	"	Drilled	325	2,160	-150	2,010	325	1,835	Belly River sand	Hard	44	D, S	Sufficient supply.
34	NE.	28	"	"	"	Dug	85	2,160	- 80	2,080	80	2,080	Glacial gravel	Hard	44	D, S	Sufficient supply.
35	NE.	30	"	"	"	Dug	90	2,170	- 84	2,086	90	2,080	Glacial drift	Hard	44	D, S	Sufficient supply.
36	SE.	31	"	"	"	Bored	98	2,170	- 92	2,078	98	2,072	Glacial sand	Hard	44	D, S	Sufficient supply.
37	NE.	32	"	"	"	Drilled	140	2,190	-100	2,090	140	2,050	Glacial sand	Hard	44	D, S	Sufficient supply.
38	NW.	33	"	"	"	Drilled	100	2,190	- 80	2,110	100	2,090	Glacial gravel	Hard	44	D, S	Sufficient for local needs.
39	SW.	34	"	"	"	Drilled	120	2,150	- 88	2,062	120	2,030	Glacial sand	Hard	44	D, S	Sufficient supply.
1	NW.	3	23	22	3	Dug	28	2,325	- 25	2,300	25	2,300	Glacial sand	Soft	44	D, S	Sufficient for local needs.
2	SW.	4	"	"	"	Dug	93	2,205	- 91	2,114	91	2,114	Glacial gravel	Hard, iron	44	D, S	Sufficient supply.
3	SE.	7	"	"	"	Dug	10	2,400	- 6	2,394	6	2,394	Glacial gravel	Soft	44	D, S	Sufficient supply.
4	NW.	13	"	"	"	Dug	13	2,315	- 10	2,305	10	2,305	Glacial sand	Soft	44	D, S	Sufficient supply; also several springs.
5	NE.	17	"	"	"	Dug	42	2,420	- 39	2,381	39	2,381	Glacial sand	Soft	44	D, S	Not always sufficient.
6	NE.	18	"	"	"	Bored	65	2,425	- 50	2,375	65	2,360	Glacial sand	Hard	44	D, S	Sufficient for local needs.
7	NW.	18	"	"	"	Dug	32	2,359	- 29	2,330	29	2,330	Glacial sand	Hard		D, S	Sufficient supply.
8	NW.	18	"	"	"	Dug	12	2,349	- 6	2,343	6	2,343	Glacial drift	Hard, iron		D	Sufficient supply.
9	SW.	19	"	"	"	Dug	12	2,337	- 6	2,331	6	2,331	Glacial sand	Hard, iron, cloudy		D, S	Sufficient supply.
10	SE.	19	"	"	"	Dug	16	2,390	- 12	2,378	12	2,378	Glacial gravel	Soft		D, S	Sufficient supply.
11	NE.	21	"	"	"	Dug	10	2,370	- 12	2,358	12	2,358	Glacial sand	Hard	44	D, S	Sufficient supply.
12	SW.	22	"	"	"	Dug	16	2,310	- 9	2,301	9	2,301	Glacial sand	Soft	44	D, S	Sufficient supply.
13	NW.	28	"	"	"	Dug	10	2,400	- 6	2,394	6	2,394	Glacial sand	Soft	44	D, S	Sufficient supply.
14	SW.	30	"	"	"	Dug	12	2,347	- 6	2,341	6	2,341	Glacial sand	Hard		D, S	Not always sufficient.
1	NE.	1	23	23	3	Bored	115	2,208	- 83	2,125	115	2,093	Glacial fine sand	Hard		D, S	Sufficient 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 CLINWORTH, NO. 230, 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	23	23	3	Bored	120	2,228	- 91	2,137	120	2,108	Glacial sand	Hard		D, S, I	Sufficient supply.
3	NW.	2	"	"	"	Drilled	125	2,225	- 40	2,185	125	2,100	Glacial sand	Hard		D, S	Sufficient supply.
4	SE.	3	"	"	"	Bored	135	2,228	-123	2,105	135	2,093	Glacial sand	Hard		D, S	Sufficient supply.
5	SW.	3	"	"	"	Bored	148	2,250	-136	2,114	148	2,102	Glacial sand	Hard		D, S	Sufficient supply.
6	NW.	4	"	"	"	Drilled	154	2,230	-140	2,090	154	2,076	Glacial sand	Hard, iron		D, S	Sufficient supply.
7	SW.	5	"	"	"	Dug	160	2,276	-155	2,121	160	2,116	Glacial gravel	Hard		D, S	Sufficient supply.
8	NW.	6	"	"	"	Dug	122	2,238	-115	2,123	122	2,116	Glacial sand	Hard		D, S	Sufficient supply.
9	SW.	8	"	"	"	Drilled	303	2,226	-150	2,076	303	1,923	Belly River	Hard		D, S	Sufficient supply.
10	SE.	10	"	"	"	Dug	25	2,280	- 20	2,260	20	2,260	Glacial sand	Hard		D, S	Sufficient supply.
11	SE.	12	"	"	"	Dug	18	2,259	- 6	2,253	18	2,241	Glacial gravel	Hard		D, S	Sufficient supply.
12	SE.	13	"	"	"	Dug	86	2,414	- 82	2,332	82	2,332	Glacial fine sand	Hard		S	Limited supply; insufficient; spring completes requirements.
13	SE.	17	"	"	"	Drilled	218	2,240	-150	2,090	218	2,022	Glacial gravel	Hard		D, S	Sufficient supply.
14	NW.	17	"	"	"	Dug	7	2,310	+ 3	2,313	7	2,303	Glacial coarse sand	Soft, cloudy		D, S, I	Sufficient supply.
15	SE.	21	"	"	"	Drilled	125	2,300	- 45	2,315	125	2,235	Glacial gravel	Soft		D, S	Sufficient supply.
1	SW.	2	23	24	3	Drilled	210	2,230	-180	2,050	210	2,020	Belly River			D, S	Sufficient supply.
2	SW.	5	"	"	"	Dug	65	2,170	- 45	2,125	65	2,105	Glacial drift	Hard, "alkaline"		D, S	
3	SW.	7	"	"	"	Drilled	396	2,209	-200	2,009	396	1,813	Belly River	Hard		D, S	Insufficient supply.
4	SE.	7	"	"	"	Drilled	184	2,200	-124	2,076	184	2,016	Glacial gravel	Hard		D, S	Sufficient supply.
5	NE.	8	"	"	"	Drilled	150	2,240	- 75	2,165	150	2,090	Glacial gravel	Hard		D, S	Not in use at present.
6	SE.	9	"	"	"	Drilled	428	2,210	-300	1,910	428	1,782	Belly River sand	Hard, iron		D, S	Sufficient supply.
7	NE.	9	"	"	"	Drilled	280	2,240	-210	2,030	280	1,960	Belly River sand	Hard		D, S	Sufficient supply; secton drilled well plugged and a bored well abandoned as a result of gas.
8	SW.	12	"	"	"	Drilled	250	2,262	-150	2,112	250	2,012	Belly River	Hard		D, S	Sufficient supply.
9	SW.	13	"	"	"	Drilled	402	2,255	-150	2,105	402	1,853	Belly River sand	Hard		D, S	Sufficient supply; #.
10	SW.	14	"	"	"	Drilled	392	2,260	-150	2,110	392	1,868	Belly River sand	Hard		D, S	Sufficient supply.
11	SE.	17	"	"	"	Drilled	415	2,248	-200	2,048	415	1,833	Belly River sand	Hard, iron		D, S	Sufficient supply; a similar well plugged with sand.
12	NE.	17	"	"	"	Drilled	415						Belly River sand	Hard, iron		N	Well plugged with sand.
13	SW.	22	"	"	"	Drilled	300	2,220	-150	2,070	300	1,920	Belly River sand	Hard		D, S	Sufficient supply.
14	SW.	26	"	"	"	Dug	40	2,340	- 20	2,320	40	2,300	Glacial drift	Soft, odorous		D, S	Sufficient supply.
15	SW.	28	"	"	"	Bored	100	2,225	- 80	2,145	100	2,125	Glacial gravel	Hard		D, S	Sufficient 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.