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CANADA
DEPARTMENT OF MINES
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GEOLOGICAL SURVEY OF CANADA
WATER SUPPLY PAPER No. 309

GROUND-WATER RESOURCES OF ELDON TOWNSHIP, VICTORIA COUNTY, ONTARIO

By
D. K. Erb

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Preliminary map - Eldon township, Victoria county, Ontario

Figure 1. Map showing surface deposits;

Figure 2. Map showing topography and location and types of wells

INTRODUCTION

This report deals with the ground-water conditions of a township in the province of Ontario investigated by the Geological Survey of Canada. It is one of a series of ground-water reports on individual townships of Ontario.

All available information pertaining to the water wells in the area was recorded and water samples were taken for analysis. The elevation of the surface of the water in most of the wells was measured. As the ground-water conditions are directly related to the geology, the surface deposits were also studied and mapped.

Thanks are here extended to the farmers and to the residents of communities throughout the area for their co-operation and willingness to supply information regarding their wells. Valuable assistance was also given by well drillers and municipal waterworks authorities in the area.

Publication of Results

The essential information pertaining to ground-water conditions is being issued in reports covering each township investigated in the province of Ontario. These reports, as published, will be supplied directly to the proper municipal and township authorities. In addition, pertinent data on wells investigated in each township will be kept on file at Ottawa. The well record compilation sheets will not ordinarily accompany the reports, as, for most areas, they are too numerous. However, persons interested in individual wells may receive the information upon application to the Chief Geologist, Geological Survey of Canada, Ottawa. For this information the request should specify lot, concession, owner's name, and approximate location of the well -- at house, at barn, in pasture, etc.

With each report is a map consisting of two figures. Figure 1 shows the surface deposits that will be encountered in the

area, and Figure 2 shows the positions of all wells for which records are available, together with the class of the well at each location.

GLOSSARY OF TERMS USED

Alluvium. Recent deposits of clay, silt, sand, gravel, and other material deposited in lake beds and in flood-plains of modern streams.

Aquifer. A porous bed, lens, pocket, or deposit of material that transmits water in sufficient quantity to satisfy pumping wells, flowing artesian wells, and springs.

Bedrock. Bedrock, as here used, refers to the consolidated deposits underlying the glacial drift. South of a line drawn between Midland, on Georgian Bay, and Kingston, the bedrock consists mainly of sedimentary rocks such as limestone, shale, slate, and sandstone; north of that line the bedrock consists chiefly of hard, crystalline, granitic rocks.

Contour. A line drawn on a map that passes through points that have the same elevation above mean sea-level.

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

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

Effluent Stream. A stream that receives water from a zone of saturation.

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

Glacial Drift. A general term that includes all the loose, unconsolidated materials that were deposited by the continental ice-sheet, or by waters associated with it. It includes till, deposits of stratified drift, and scattered boulders and rock fragments.

Several forms in which glacial drift occurs are as follows:

(1) End Moraine (Terminal Moraine). A more or less discontinuous ridge or series of ridges consisting of glacial drift that was laid down by the ice at the margin of a moving ice-sheet. The surface is characterized by irregular hills and undrained basins.

(2) Ground Moraine. A widely distributed moraine consisting of glacial drift deposited beneath an ice-sheet. The predominant material is till, which is clay containing stones. The topography may vary from flat to gently rolling.

(3) Kame Moraine. Assorted deposits of sandy and gravelly stratified drift laid down at or close to the ice margin. The topography is similar to that of an end moraine. Kame terraces are elongated deposits of this type laid down on the slopes of broad, flat-bottomed valleys.

(4) Drumlin. A smooth oval hill that has its long axis parallel with the direction of ice movement at that place. It is composed mainly of till.

(5) Esker. An irregular-crested ridge or series of discontinuous ridges of stratified drift deposited by a glacial stream that flowed beneath the continental ice-sheet or in deep crevasses within it. It is composed mainly of sand and gravel.

(6) Glacio-fluvial Deposits. Silt, sand, and gravel outwash deposited by streams resulting from the melting of the ice-sheet.

(7) Glacio-lacustrine Deposits. Clay, silt, and sand deposited in glacial lakes during the retreat of the ice-sheet. The clay deposits are commonly very distinctly stratified in layers a fraction of an inch to one or more feet in thickness; each layer is believed to represent deposition during one summer season and one winter season.

(8) Kame. An isolated mound or conical hill composed of stratified sand and gravel deposited in a crack or crevasse within the ice or in a depression along the ice front.

(9) Marine Deposits. Deposits laid down in the sea during the submergence that followed the withdrawal of the last ice-sheet. They consist chiefly of clay, silt, and sand, and have emerged beaches of sand and gravel associated with them.

(10) Shoreline. A discontinuous escarpment that indicates the former margin of a glacial lake or sea. It is accompanied by scattered deposits of sand and gravel located on former beaches and bars.

Ground Water. Sub-surface water in the zone of saturation below the water-table.

Hydrostatic Pressure. The pressure that causes water in a well to rise above the point at which it was first encountered.

Influent Stream. A stream that feeds water into a zone of saturation.

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

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

Porosity. The porosity of a rock is its property of containing interstices or voids.

Pre-glacial Land Surface. The surface of the land as it existed before the ice-sheet covered it with drift.

Recent Deposits. Deposits that have been laid down by the agencies of water and wind since the disappearance of the continental ice-sheet; for example, alluvium in stream valleys.

Unconsolidated Deposits. The mantle or covering of loose, uncemented material overlying the bedrock. It consists of Glacial or Recent deposits of boulders, gravel, sand, silt, and clay.

Water-table. The upper limit of the part of the ground saturated with water. This may be near the surface or many feet below it. Water may be retained above the main water-table by a zone of impervious material; such water is said to be perched and its upper limit to be a perched water-table.

Wells. Holes sunk into the ground so as to obtain a supply of water. When no water is obtained they are referred to as dry holes. Wells yielding water are divided into four classes:

(1) Flowing Artesian Wells. Wells in which the water is under sufficient hydrostatic pressure to flow above the surface of the ground at the well.

(2) Non-flowing Artesian Wells. Wells in which the water is under hydrostatic pressure sufficient to raise it above the level of the aquifer, but not above the level of the ground at the well.

(3) Non-artesian Wells. Wells in which the water does not rise above the water-table or the aquifer.

(4) Intermittent Non-artesian Wells. Wells that are generally dry for a part of each year.

Zone of Saturation. The part of the ground, below a water-table that is saturated with water.

GENERAL DISCUSSION OF GROUND WATER

Almost all the water recovered from beneath the earth's surface for both domestic and industrial uses is meteoric water, that is, water derived from the atmosphere. Most of this water reaches the surface as rain or snow. Part of it is carried off by streams; part evaporates either directly from the surface and from the upper

mantle of the soil or indirectly through transpiration of plants; the remainder infiltrates into the ground to be added to the ground-water supplies.

The proportion of the total precipitation that infiltrates from the surface into the zone of saturation will depend upon the surface topography and the type of soil or surface rock. More water will be absorbed in sandy or gravelly areas, for example, than in those covered with clay. Surface run-off will be greater in hilly areas than in those that are relatively flat. In sandy regions where relief is great, the first precipitation is absorbed and run-off only commences after continuous heavy rains. Light rains falling upon the surface of the earth during the growing season may be wholly absorbed by growing plants. The quantity of moisture lost through direct evaporation depends largely upon temperature, wind, and humidity. Ground water in areas overlain by pervious material may be recharged by influent streams carrying run-off from areas overlain by relatively impervious material.

Because of the large consumption of ground water in settled areas, it may seem surprising that precipitation can furnish and adequate supply. However, when it is borne in mind that a layer of water 1 inch deep over an area of 1 square mile amounts to approximately 14,520,000 imperial gallons, and that the annual precipitation in this region, for example, is about 30 inches, it will be seen that each year some 435,600,000 imperial gallons of water falls on each square mile. Although it would be impossible to determine the annual recharge of the ground-water supply of the area, if it were assumed that only 10 per cent of the total precipitation, namely 43,560,000 gallons, is contributed to the zone of saturation, it will be seen that the annual recharge for the entire area would be a very large volume. The annual consumption

of water in all areas investigated is not known, but an estimate for some restricted areas, based on per capita consumption, shows it to be only about one-tenth of the annual recharge as estimated above.

In most regions of the world where precipitation is effective there is an underground horizon known as the ground-water level or water-table, which is the upper surface of the zone of saturation. The water-table commonly is a subdued replica of the surface topography. The water that enters from the surface into the unconsolidated deposits and rocks of the earth is drawn down by gravity to where it reaches the zone of saturation or comes in contact with a relatively impervious layer. Such a layer may stop further downward percolation, resulting in perched water and creating a perched water-table. If a water-table is at or near the surface, there will be a lake or swamp; if it is cut by a valley, there will be a stream in the valley. The terms influent and effluent are used with reference to streams and their relation to the water-table. An influent stream flows above the water-table and feeds water into the zone of saturation; an effluent stream flows at or below the water-table and receives water from the zone of saturation. An effluent stream may become influent and eventually dry up if the water-table is lowered sufficiently. The ground water in the zone of saturation is almost constantly on the move percolating towards some point of discharge, which may be a spring or a pumping well.

All rocks and soils are to some degree porous, that is, the individual grains or particles of which they are composed are partly surrounded by minute interstices or open spaces that form the receptacles and conduits of ground water. In most rocks and soils the interstices are connected and large enough for the water to move from one opening to another. In some rocks or soils, however, they are largely isolated or too small to allow movement of water. The

porosity of a material varies directly with the size and number of its interstices, which in turn depend chiefly upon the size, shape, arrangement, and degree of assortment of the constituent particles. Horizons within the earth's crust of fine-grained rock such as shale, limestone or dolomite, or unconsolidated clay or silt, may have such small interstices that the contained water will not flow readily and wells penetrating them may derive little or no water from them. Such horizons are considered impervious. Beds of more coarse-grained materials such as sand, gravel, or sandstone have greater porosity and readily yield their waters to wells. They are called water-bearing beds or aquifers. A clean water-bearing gravel is one of the best sources of water. This is true whether the water is derived from the zone of saturation or from a bed of gravel confined above, between, or below beds of less pervious material.

Consolidated rocks usually considered to be impervious may sometimes produce water in relatively good supply from openings within them of primary or secondary origin. Those of primary origin, original interstices, were created when the rocks came into existence as a result of the processes by which they were formed; e.g. bedding planes, and intergranular spaces. Secondary interstices comprise joints and other fracture openings, solution openings, and openings produced by several processes of minor importance, such as the work of plants and animals, mechanical erosion, and recrystallization; all of these involve movement of a type that acted after the consolidation of the rock. The most important interstices with respect to water supplies are the original interstices, next to them are the fracture and solution openings.

The most common wells and those that in drift-covered areas yield the largest aggregate supply of ground water are water-table wells. These are wells that derive their water from the zone of

saturation. Many shallow wells become dry during the late summer and winter, or during periods of extreme drought. In most cases this is due to the lowering of the water-table below the bottom of the well. The grouping together of a number of water-table wells within a limited area will also lower the yield of any one of the wells. This is especially true of water-producing formations of low permeability. When a well penetrates an aquifer confined by impervious beds, water will be forced upward by hydrostatic pressure exerted at the point where the well enters the aquifer. If the hydrostatic pressure is great enough to force the water to or above the surface, a flowing well is formed.

Springs are formed where the water-table, or some water-bearing aquifer, outcrops at the surface of the ground. The water emerging from water-table springs is free-running water flowing down the gradient of the water-table. In many cases these springs occur as slow seeps along the steeper slopes of stream valleys. A large number in one area could maintain a swamp. A group of permanent springs occurring in one area could provide sufficient water to maintain a lake or form the source of a stream.

GENERAL DISCUSSION OF GROUND-WATER ANALYSIS

The mineral content of ground water is of interest to many besides those industries seeking water of specific quality. Both the kind and quantity of mineral matter dissolved in natural water depend upon the texture and chemical composition of the rocks with which the water has been in contact. Pollution is caused by contact with organic matter or its decomposition products. Analyses of well waters for mineral content are made by the Mines Branch, Department of Mines and Technical Surveys, Ottawa.

In any given area, an attempt is made to secure samples of water representative of all major aquifers. The quantities of the

various constituents for which tests are made are given as "parts per million", which refers to the proportion by weight of each constituent in 1,000,000 parts of water.

The following mineral constituents are those commonly found in natural waters in quantities sufficient to have a practical effect on the value of the waters for ordinary uses:

Silica (SiO_2) may be derived from the solution of almost any rock-forming silicate, although its chief source is the feldspars. It is commonly determined in the analysis of water for use in steam boilers, as silica is classed as an objectionable encrustant.

Calcium (Ca). The chief source of calcium dissolved in ground water is the solution of limestone, gypsum, and dolomite. The common compounds of calcium are calcium carbonate ($CaCO_3$) and calcium sulphate ($CaSO_4$), neither of which has injurious effects upon the consumer, but both of which cause hardness and, the former, boiler scale.

Magnesium (Mg). The chief source of magnesium in ground water is dolomite, a carbonate of calcium and magnesium. The sulphate of magnesium ($MgSO_4$) combines with water to form Epsom-salts ($MgSO_4.7H_2O$), and renders the water unwholesome if present in large amounts.

Sodium (Na) is found in all natural waters in various combinations, though its salts constitute only a small part of the total dissolved mineral matter in most waters in humid regions. Sodium salts may be present as a result of pollution by sewage, or of contamination by sea water either directly or by that enclosed in sediments of marine origin. Moderate quantities of these salts have little effect upon the suitability of a water for ordinary uses, but water containing sodium in excess of about 100 parts per million must be used with care in steam boilers to prevent foaming. Waters containing large quantities of sodium salts are injurious to crops and are, therefore, unfit for irrigation. The quantity of sodium salts

may be so large as to render a water unfit for nearly all uses.

Potassium (K), like sodium, is derived originally from the alkaline feldspars and micas. It is of minor significance and is sometimes included with sodium in a chemical analysis.

Iron (Fe) is almost invariably present in well waters, but rarely in large amounts. Salts, or compounds, of iron are dissolved from many rocks as well as from iron sulphide deposits with which the ground water comes in contact. It may also be dissolved from well casings, water pipes, and other fixtures in quantities large enough to be objectionable. Upon exposure of the water to the atmosphere, dissolved iron separates as the hydrated oxide that imparts a yellowish brown discoloration. Excessive iron in water causes staining on porcelain or enamelled ware and renders the water unsuitable for laundry purposes. Water is not considered drinkable if the iron content is more than 0.5 parts per million.

Sulphates (SO_4). Deposits of gypsum ($CaSO_4 \cdot 2H_2O$) are the principal source of sulphates dissolved in ground water; soluble sulphates, chiefly of magnesium and sodium, are other sources. Sulphates cause permanent hardness in water and form injurious boiler scale. Sodium and magnesium sulphates are laxative when present in quantities of more than 900 parts per million.

Chloride (Cl) is derived chiefly from organic materials or from marine rocks and sediments. It occurs usually as sodium chloride and less commonly as calcium chloride and magnesium chloride. Sodium chloride is a characteristic constituent of sewage and a locally abnormal amount suggests pollution. However, because chlorides may be derived from many sources, such abnormal quantities should not, in themselves, be taken as positive proof of pollution. Chlorides impart a salty taste to water if they are present in excess of 300 parts per million.

Nitrates (NO_3) are of minor importance in the study of ground water. Relatively large quantities in a water may represent

pollution by sewage, or drainage from barnyards, or even from fertilized fields. It is recommended that a bacteriological test be made of water showing an appreciable nitrate content if it is to be used for domestic purposes.

Carbonate (CO_3) forms a large percentage of the solid compounds held in solution by the average ground water. The two chief sources are the decomposition of feldspars and the solution of limestone by water carrying carbonic acid in solution, which is the primary agent in rock decomposition. They are indicated in the table of analyses as alkalinity. Calcium and magnesium carbonates cause hardness in water, whereas sodium carbonate causes softness.

Bicarbonate (HCO_3). Carbon dioxide dissolved in water renders the insoluble calcium and magnesium carbonates soluble as bicarbonates. Boiling reverses the process by changing the bicarbonates into insoluble carbonates, which form a coating on the sides of cooking utensils.

Total Dissolved Solids (Residue on Evaporation). The term is applied to the residue obtained when a sample of water is evaporated to dryness. Waters are considered high in dissolved mineral solids when they contain more than 500 parts per million, but may be accepted for domestic use up to that point if no better supply is available. Residents, accustomed to the waters, may use waters that carry well over 1,000 parts per million of total dissolved solids without inconvenience, although persons not used to such highly mineralized waters would find them objectionable.

Hardness is a condition imparted to waters chiefly by dissolved calcium and magnesium compounds. It here refers to the soap-destroying power of water, that is, the power of the water

first to use a certain amount of soap to precipitate the above compounds before a lather is produced. The hardness of water in its original state is its total hardness. Permanent hardness remains after the water has been boiled, and is caused by mineral salts that cannot be removed from solution by boiling. It can be reduced by treating the water with natural softeners, such as ammonia or sodium carbonate, or with many manufactured softeners. Temporary hardness can be eliminated by boiling, and is due to the presence of bicarbonates of calcium and magnesium. Waters containing larger quantities of sodium carbonate than of calcium and magnesium compounds are soft, but if the latter compounds are more abundant the water is hard. The following table[1] may be used to indicate the degree of hardness of a water:

Total Hardness

Parts per million	Character
0-50	Very soft
50-100	Moderately soft
100-150	Slightly hard
150-200	Moderately hard
200-300	Hard
300 and over	Very hard

[1] Thresh, J. C., and Beale, J. F.; The Examination of Waters and Water Supplies, p. 21, London, 1925.

ELDON TOWNSHIP, VICTORIA COUNTY, ONTARIO

Physical Features

Eldon township is in the central western part of Victoria county, and has an area of approximately 102 square miles. Woodville in the southwest and Kirkfield in the northeast are the main villages in the township, and Bolsover, Eldon Station, Argyle, Glenarm, Lorneville Junction, Hartley, and Grasshill smaller communities.

The surface of the township is fairly flat with local relief, a reflection of preglacial valleys in the bedrock, or drumlins and ice-contact deposits. The valleys trend from almost north to northeast, and have fairly steep sides. The drumlins are almost wholly confined to the southern and northeastern parts of the township. The ice-contact deposits are fairly well scattered over the area and are recognizable by hills and hollows in more or less stratified gravel and sand. Notable deposits of this type are Logan Hill, about 1½ miles southeast of Bolsover, the hills at Kirkfield, the unnamed hill about 2 miles west of Glenarm, and a hill about 2 miles northwest of Lorneville Junction.

The altitude above sea-level varies from 800 feet along Canal Lake in the northwest to over 1,000 feet on the hills around Goose Lake in the southeast corner.

A topographic feature worthy of note in this township is the shoreline of glacial Lake Algonquin.[1] In the north, this shoreline is marked by steep, wave-cut bluffs and terraces, wave-built

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[1] Goldthwait, J. W.: An Instrumental Survey of the Shorelines of the Extinct Lakes Algonquin and Nipissing in Southwestern Ontario; Geol. Surv., Canada, Mem. 10, 1910.

Johnston, W. A.: The Trent Valley Outlet of Lake Algonquin and the Deformation of the Algonquin Water Plane in the Lake Simcoe district, Ontario; Geol. Surv., Canada, Mus. Bull. No. 23, Geol. Series No. 32, 1916.

gravel bars and ridges, and wave-washed terraces. On the west side of the township these features are less pronounced and on the east side the beach is not at all distinct but can be seen here and there between the 860 and 880 foot contours.

A large shallow embayment of Lake Algonquin can be traced just east of Logan Hill. This embayment opens to the west just north of this hill, where a strong, bay-mouth bar was built by the waves of the main lake. The opening to the east was through a fairly narrow valley about 2 miles south of Kirkfield.

Geology and Water Supply

Bedrock Formations and Their Water-bearing Properties.

Eldon township is underlain by Trenton limestone of Ordovician age. This formation outcrops over a considerable part of the township and dips gently to the southwest. This dip accounts for the numerous northeast-facing scarps in the area. Bedrock immediately under the drift is, in many places, much weathered and broken into small pieces and is locally called "shell" rock.

Bedrock in this township appears to carry a fair amount of water. In many places the solid rock prevents the downward flow of the ground water and its fractured surface acts as a reservoir. In other places the water is collected in deeper fractures and fissures in the rock and possibly even in underground streams.[1]

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[1]Mr. M. Finn, lot 34, South Portage road, con. VI, reported that the windmill on his well had pumped up numerous small fish 6 to 8 inches long. He also reported that running water could be heard in the drill-hole. This well is dug a measured 12 feet and drilled an estimated 12 feet. The dug part is cribbed with stone and is 4 feet in diameter. The drill-hole has a 5-inch casing. The well is approximately 1½ miles from Canal Lake, the nearest body of water.

Of the 475 wells in the township, 35 are drilled and 48 are dug and drilled, giving a total of 83 that may be classed roughly as drilled wells in bedrock. Of this 83, 24 have medium to good supplies, 15 poor supplies, 25 are gassy, salty, or have a mineral taste, and the supplies of the remaining 18 are unknown.

Unconsolidated Deposits and Their Water-bearing Properties.

The greater part of the drift covering Eldon township is ground moraine. This is made up of a somewhat clayey to sandy till that nowhere reaches a very great thickness, and whose thickness decreases to zero where the gently dipping bedrock reaches the surface.

Glacio-fluvial or ice-contact deposits are fairly numerous in this township. A line of such deposits extends from northeast of Victoria Road village southwest through Kirkfield to Logan Hill. Two well-defined eskers, one north and one south of Victoria Road village, coalesce about 1 mile southwest of the village and the continuation can be traced intermittently southwest through Kirkfield until it terminates at Logan Hill. Logan Hill itself is probably a kame or possibly a deltaic deposit.

In the central part of the township, ice-contact deposits of sand and gravel form the south side of the wide Grass Creek valley. This deposit extends southwestward through Argyle and terminates in a kame 2 miles west of Lorneville Junction.

Another similar deposit extends southwest from the edge of the township and terminates in a kame hill about 2 miles west of Glenarm. An esker ridge can be easily traced along this deposit.

Still another ice-contact deposit surrounds Goose Lake in the extreme southeast corner of the township and extends northeast into Fenelon township and southwest into Mariposa township.

These ice-contact deposits provide the principal supply of sand and gravel for the township. Other sources of gravel are the

numerous beach ridges and bars formed by glacial Lake Algonquin along its shore, or in shallow water in the northwest corner of the township.

Drumlins are numerous in the south, southeast, and northeast of the township. These hills, elongated in the direction of ice flow, are composed mainly of sandy till containing many boulders and pebbles. Some of those in the northeast corner were islands in Lake Algonquin, and beach deposits of stratified sand and gravel occur along their lower slopes.

There are a few small occurrences of similar material above this level, evidently deposited in small, temporary lakes formed during the melting away of the ice.

A white to cream or brown coloured, calcareous marl is also found beneath 3 to 4 feet of muck in the swampy bottoms of the main valleys in the township, but as yet has no economic importance.

The main water-carrying beds or aquifers in Eldon township occur in unconsolidated material. Sand and gravel pockets, lenses, and beds scattered through the drift or on the surface of the bedrock, ice-contact deposits of sand and gravel, and glacial lake deposits of sand, gravel, and silt are most likely to supply water in sufficient quantities for local use. It was reported that water in some wells was obtained from clay or clay till. However, clay and clay till normally yield water very slowly to a well, and it is more probable that the wells are in small lenses of sand or silt or possibly sandy till. In some places there are known to be holes or passages in clay or clay till $\frac{1}{4}$ inch to several inches in diameter that may yield considerable quantities of water.

Many wells in the townships can be pumped dry, but fill again in a relatively short time. These wells are probably dug in

clayey till or sandy clay till through which water passes very slowly. The water supply from such wells might be improved by enlarging them, thus increasing the reserve of water.

One flowing artesian well was reported in the township, but is plugged, supposedly to keep the well from overflowing, and the claim could not be substantiated.

Over 18 springs occur in the area, but little can be learned of their source from their location and depth. Most of them, as is to be expected, are on the sides of hills in sandy material. Outcropping lenses of sand or gravel overlying impervious clay strata may channel the water to the surface at these points. Springs in low-lying areas may be seepage from a water-table at the surface. Glacio-lacustrine sand, gravel, and silt beneath the muck in swampy areas form good reservoirs for ground water. Most springs are used to form open ponds or tanks for watering stock, and are not very important sources of water in this township.

All the villages in the township obtain their supplies from privately owned wells in glacial deposits. Bolsover obtains its supply from glacio-lacustrine sands, Kirkfield from glacio-fluvial sands and gravels, Woodville, Argyle, and Lorneville Junction from lenses of sand and gravel in till, and Hartley and Glenarm from gravel and fractured rock on top of bedrock.

Analysis of Water Samples

Twenty-eight representative samples of water were analysed for their mineral content in the laboratory of the Mines Branch, Department of Mines and Technical Surveys. The table of analyses summarizes the results.

Conclusions

This investigation warrants the following conclusions.

1. The ground-water supply in Eldon township is normally sufficient for domestic, stock, and municipal use.
2. Exceptionally dry seasons will result in a lowering of the ground-water table and a drying up of the shallower or poorer quality wells.
3. The only measures available to counteract such occurrences are:
   (a) To deepen the existing wells;
   (b) To avoid excessive use of water;
   (c) To refrain from cutting off the forest cover and draining the swamps, which act as natural reservoirs for ground water.
4. The water-bearing beds in the ground moraine deposits are composed of irregular pockets or lenses of sand, gravel, and sandy clay.
5. Glacio-fluvial and glacio-lacustrine deposits form the most important aquifers in the township.
6. The quality of water obtained from the glacial drift is quite suitable for domestic use.
7. The amount of water obtainable from any well depends on the thickness, extent, and porosity of the aquifer penetrated.
8. The bedrock in the area supplies considerable water, but much of it is salty, gassy, or has a mineral taste and is not suitable for human consumption.
9. The depth at which water may be expected can be estimated for any point in the township, but whether or not an aquifer will be found at that point cannot be predicted.

ELDON TOWNSHIP

Wells and Springs	CONCESSIONS I	II	III	IV	V	VI	VII	VIII	IX	X	XI	Total No. in Township	Percentage of Total
Total number	33	56	50	56	37	40	39	48	31	53	29	472	100
Dug	29	47	38	40	32	32	35	41	26	47	26	393	83.3
Dug and drilled	3	3	7	12	5	5	0	4	2	2	1	44	9.3
Drilled	1	6	5	4	0	3	4	3	3	4	2	35	7.4
Wells 0 - 20 feet deep	6	8	5	3	6	5	2	2	1	2	0	40	8.5
21 - 40	2	1	0	2	0	1	2	1	2	0	0	11	2.3
41 - 80	1	0	1	0	0	1	0	1	0	0	0	4	.8
Depth unknown	24	47	44	51	31	33	35	44	28	51	29	417	88.4
Wells that yield hard water	32	52	47	53	37	40	39	46	31	52	25	454	36.1
soft water	1	2	0	0	0	0	0	1	0	0	4	8	1.7
sulphur odor	0	0	1	2	0	0	0	1	0	1	0	5	1.1
unknown	0	2	2	1	0	0	0	0	0	0	0	5	1.1
Wells with aquifer in sand	5	7	5	3	4	0	1	2	4	2	3	36	7.6
in gravel	4	4	3	4	0	0	0	7	3	4	3	32	6.8
in clay	6	1	2	3	3	0	3	2	1	1	1	23	4.9
in glacial drift	2	4	2	5	4	1	1	6	2	7	5	39	8.3
in limestone	10	21	24	32	23	35	24	22	16	23	14	244	51.7
unknown	6	19	14	9	3	4	10	9	5	16	3	98	20.7
Springs (including one flowing well)	1	1	2	2	2	2	1	0	0	3	2	16	3.4
Non-flowing artesian wells	7	8	7	5	2	3	3	3	1	4	1	44	9.3
Non-artesian wells	21	40	37	46	31	32	31	42	26	45	23	374	79.3
Wells with non-permanent supply	4	5	4	3	2	3	4	3	4	1	3	36	7.6
Supply unknown	0	2	0	0	0	0	0	0	0	0	0	2	.4
Wells not used	1	3	0	3	0	2	1	3	2	5	3	23	4.9

ANALYSES OF WELL WATERS FROM..[illegible]..... [illegible]..... COUNTY,

	Sample Number	Owner	Lot	Concession	Depth of well (Feet)	Aquifer	Total dissolved solids parts per million	Constituents as Analysed (parts per million): Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Alkalis (as Na)	Sulphate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Bicarbonate (HCO_3)	Alkalinity (as $CaCO_3$)	Hardness as $CaCO_3$ (pts. per million): Ca hardness (as $CaCO_3$)	Mg hardness (as $CaCO_3$)	Total hardness (as $CaCO_3$)
4318	1	H. Veale	4	I	16	T	756	13.4		141.3	53.5	24.2	149.0	74.9	2.7	439.2	360.0	352.0	220.2	572.7
4319	2	J. McLeung	14	I	22	T	310	7.8		39.9	22.8	18.5	32.5	39.2	1.2	158.4	146.2	99.6	93.8	193.4
4320	3	A.J. McFaden	1 SPR	I	15	C	272	20.8		67.0	15.7	6.1	24.7	9.1	0.7	236.7	194.0	167.2	64.6	231.8
4322	4	G. Douglas	9W	II	140	Ls	454	10.4		114.2	12.7	9.7	50.2	8.4	42.1	235.7	235.6	284.9	52.3	337.2
4321	5	H.C.Nichols	22W	II	60	Ls	14,356	19.6		882.3	437.9	3226.0	78.1	7308.0	27.7	246.9	202.4	2201.3	1802.0	4003.3
4323	6	P. Hill	2W	III	40	Ls	370	9.8		97.2	15.5	9.[illegible]	34.2	4.2	22.2	305.5	250.4	242.5	63.8	306.3
4324	7	Doling Ross	12	III	40	?Ls	1,942	8.8		161.7	68.2	396.4	159.7	739.2	0.0	288.5	232.4	483.4	280.6	684.0
4262	8	J. Thomas	4E	III	63	Ls	484	9.2		95.0	23.8	37.5	31.3	22.8	52.7	329.6	270.2	237.0	97.9	334.9
4325	9	J.R.McEachern	1SW	III	19	Ls	942	13.6		168.3	14.6	38.7	111.5	39.2	179.4	283.0	232.0	419.9	60.1	480.0
4326	10	J.R.McEachern	1SW	III	10	G	588	14.0		115.7	9.4	39.8	50.6	81.8	62.0	283.0	232.0	288.7	38.7	327.4
4327	11	R. Hurren	13 SPR	III	15	Ls	278	9.4		49.3	9.6	21.2	18.1	1.5	3.3	106.2	127.0	123.0	39.5	162.5
4263	12	O. Smith	5W	IV	75	Ls	528	11.2		67.0	23.0	68.1	24.7	101.4	1.7	327.0	268.0	237.0	97.9	334.9
4264	13	W. Mitchell	19W	IV	20	Ls	700	7.0		123.0	18.1	19.6	44.9	28.1	115.2	219.4	179.8	306.9	74.5	381.4
4266	14	J.H.Gillespie	11W	V	10	Ls	460	8.8		108.1	24.5	7.2	97.1	8.2	39.0	276.9	227.0	269.7	100.8	370.5
4265	15	Wm.MacLean	25 SPR	V	20	?	726	12.0		116.1	48.1	32.0	150.2	39.1	106.3	250.3	205.2	289.7	197.9	487.6
4267	16	J. Wilson	3W	VI	30	Ls	472	20.2		62.6	37.4	23.9	68.3	60.5	40.8	182.3	149.4	156.2	153.9	310.1
4328	17	H.MacLachlan	11W	VI	15	Ls	684	19.2		91.8	35.8	42.3	158.4	80.0	8.9	131.8	118.0	229.0	147.3	376.3
4329	18	M. Finn	34 SPR	VI	29	Ls	658	13.6		45.7	21.9	109.2	67.1	82.3	97.5	150.5	139.0	114.0	90.1	204.1
4331	19	V. Smith	IE	VII	38	?	242			27.5	23.0	9.3	7.8	4.7	5.3	172.0	159.0	62.6	94.6	163.2

T -- Till, C -- Clay, G -- Gravel, Ls -- Limestone.

	Sample Number	Owner	Lot	Concession	Depth of well (Feet)	Aquifer	Total dissolved solids parts per million	Constituents as Analysed (parts per million) Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Alkalis (as Na)	Sulphate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Bicarbonate (HCO_3)	Alkalinity (as $CaCO_3$)	Hardness as $CaCO_3$ (pts. per million) Ca hardness (as $CaCO_3$)	Mg hardness (as $CaCO_3$)	Total hardness (as $CaCO_3$)
4330	20	D.MacArthur	15W	VII	21	Ls	312	6.0		87.8	6.8	4.8	27.0	5.8	3.5	258.6	159.0	219.1	28.0	247.1
4332	21	A. McFadyen	12W	VIII	20	T	390	11.4		87.0	13.1	30.3	54.3	18.9	44.3	209.4	187.6	217.1	53.9	271.0
4333	22	R. Southern	23W	VIII	78	Ls	754	7.4		38.3	21.2	187.0	102.5	266.0	0.0	86.9	82.4	145.5	87.2	232.7
4336	23	B.Blatchford	4E	IX	23	G	418	12.0		75.5	22.9	35.3	85.2	19.6	14.2	251.8	218.0	188.4	94.2	282.6
4335	24	J.O. McMillan	15E	IX	31	Ls	966	11.4		168.2	25.8	40.0	97.5	47.6	210.9	256.9	234.6	419.7	106.2	525.9
4334	25	Kirkfield crushed stone	31 NPR	IX	29	Ls.	692	6.4		123.5	20.1	64.4	358.4	38.5	14.2	94.7	77.6	308.1	82.7	390.8
4337	26	C. Roberts	53 SPR	X	22	G.	420	11.4		60.6	31.0	13.0	107.4	12.6	64.9	134.2	114.0	151.2	127.6	278.8
4339	27	A.E.Thornbury	9E	XI	15	?	262	14.4		43.9	20.8	8.0	47.7	4.2	28.4	148.8	129.2	109.5	85.6	195.1
4338	28	W. Newman	32E	XI	32	?	116	7.8		57.6	7.2	4.7	11.9	3.5	1.8	164.5	158.8	143.7	29.6	173.3

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