GROUNDWATER SURVEY

FALMOUTH AREA - HANTS COUNTY

NOVA SCOTIA

NSDM

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November 19, 1965

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ABSTRACT

This report presents information on the nature and occurrence of groundwater in the Falmouth Area, Nova Scotia. The need for water is now critical for both the inhabitants for domestic use, and the horticultural industry. Two aquifers were mapped in the area. One, the surficial deposits of sands and gravels and the other, nearby, bedrock sandstone beds. In both aquifers there are several locations where relatively high capacity wells may be developed.

INTRODUCTION

A groundwater survey was carried out in the Falmouth Area, Hants County, in October 1965 at the request of the Nova Scotia Directorate of ARDA.

This survey was undertaken to determine the feasibility of obtaining groundwater in the immediate area of Falmouth. The primary need for groundwater is to satisfy the water requirements of the growing horticulture (Greenhouse) industry in that area. In the past, water from wells in the Falmouth area have been found to be unsuitable for both domestic purposes and for supplying enough irrigation water for the greenhouse industry. The groundwater potential, however, has never been studied in detail in the past.

The Maritime Marshland Rehabilitation Administration (M.M.R.A.) staff carried out a study earlier in the summer to investigate the feasibility of obtaining suitable surface water supplies by damming one or two small watersheds close by.

Location and Population

The Falmouth Area, Hants County, Nova Scotia, is located on the West side of the Avon River across from the town of Windsor. A map, scale 1" = 1520', outlining the groundwater geology of the immediate area under study is included (Map A). The base map for this report was compiled from 1:50,000 scale topographical maps, of the

Department of Mines and Technical Surveys, Ottawa. These being the Northwest corner of the Windsor map sheet 21-A-16 East half, and the Southwest corner of the Wolfville map sheet 21-H-1 East half.

The population of the town of Falmouth is estimated to be close to 520 in 1965, with 147 households (personnel communication, Mr. Ralph Loomer).

Climate

The climate of the Falmouth area is classified as "Maritime". The mean annual precipitation is 40.81 inches (Agricultural Research Station, Kentville, 1961, p. 29). The potential evapotranspiration calculated by the Thornthwaite formula exceeds the 45 year average precipitation only for the months of June, July and August (Agricultural Research Station, Kentville, 1961, p. 10). In other words, if groundwater is available near the surface during the months of June, July and August, more water would be evaporated from the soil and transpired from plants than would be replenished by precipitation.

Physiography and Drainage

The Falmouth area is part of the Nova Scotia lowlands. It is bordered on the West by the Gray Mountain section of the southern uplands and on the East by the Avon River estuary. The mapped area varies in altitude from less than 25 feet above sea level near the Avon River up to 600 feet on Gray Mountain. French Mill Brook, the main stream, drains about a 12 square mile area and eventually empties into the Avon River. Its average gradient being about 1 foot in 90 feet.

Water Use

At present the domestic water supply for Falmouth town residents is obtained mainly by transporting water from Windsor by tank truck and storing it in cisterns until used.

The water supply for agricultural purposes, particularly the greenhouse industry, is supplied by several drilled wells and spring fed reservoirs. Water is also obtained from French Mill Brook for irrigating crops in the greenhouses.

Estimated total water requirements for the residents of the town of Falmouth is about 25 Imperial Gallons per Minute (I.G.P.M.) or 3600 gallons per day (I.G.P.D.).

Estimated water requirements for the agricultural section, particularly the greenhouse industry, is estimated to be about 120 I.G.P.M. or (173,000 I.G.P.D.).

The domestic demand is estimated to reach 30 I.G.P.M. (43,200 I.G.P.D.) by 1975. The industrial demands by the same year are estimated to be about 210 I.G.P.M., or (300,000 I.G.P.D.).

This makes an estimated total demand of 145 I.G.P.M. (or 210,000 I.G.P.D.) at present, and an estimated 240 I.G.P.M. or (360,000 I.G.P.D.) by the year 1975.

Some thought has been given to supplying a central water distribution system for the residents of the town of Falmouth, perhaps combining this with a supply for the growing agricultural greenhouse industry. A combined water supply appears for the moment to be the most practical solution for the water needs of the area.

Previous Work

During the summer of 1965 the M.H.R.A. was approached to evaluate the surface water potential as an industrial and domestic water supply. Their work was concentrated in the upper part of the French Mill Brook watershed which is about 2 miles west of the Falmouth area.

Such a water supply would possibly necessitate the construction of a dam storage reservoir, a pipe line and a filtration - chlorination plant.

To date, the bedrock geology of the area has been mapped by Crosby, 1949 and 1950, 1 in. = 1 mile, and Taylor, 1961, 1 in. = 4 miles. Crosby's map includes the area north of 45° Latitude; Taylor's map includes that south of 45° Latitude. These two maps were mostly used to locate geologic contacts in the area.

The Pleistocene geology was mapped during October, 1965 by the Nova Scotia Department of Mines. The findings are included on Map A.

A complete soil survey was carried out in the area in 1943 by the Dominion Department of Agriculture. The results have been published with an accompanying map of the Falmouth area. (See references cited.)

Acknowledgements

The Groundwater Section, Geology Division, Nova Scotia Department of Mines, would like to acknowledge the co-operation of the inhabitants of the area for supplying information on their own water supplies. Also the co-operation of Mr. Ralph Loomer and the information which he supplied was greatly appreciated and proved very valuable in determining the consumption estimates.

GEOLOGY

Introduction

The Falmouth area is underlain by rock types of four different geological ages. In order of succession they are: 1. the slates, quartzites and siltstones of Ordovician age (Halifax Formation);

2. granites of Devonian age; 3. shales, siltstones and sandstone of Mississippian age (Horton Group); 4. gypsum, limestone and shale of Mississippian age (Windsor Group). These rock types are outlined on the accompanying Map A.

Outcrops, or exposures, of bedrock can be found along the stream valleys of the area and along the uplands.

Surficial deposits of till, sand, gravel, silt and clay of varying thickness are found in the area overlying the bedrock. These deposits being thinner near the uplands and thickest in the lowlands.

Bedrock Deposits

The slates, quartzites and siltstones of the Halifax Formation occur as a small protusion (about 3/4 square mile) in the NW corner of the map area. This structure is the nose of an anticline which plunges about 30° NE.

The granites of Devonian age occupy about a ½ square mile area on the West extremity of the map area.

Overlying the granite and slates unconformably are the shales, siltstones and sandstones of the Horton Group. These rocks occur along the West side of the map area, striking NE and dipping about 20° SE under the overlying Windsor Group.

The gypsum, limestone and shale of the Windsor Group conformably overlie the Horton Group. The rocks of the Windsor Group underlie all the map area East of the Horton sediments, the contact being slightly west of the map center and strikes about 20° East of North.

Structure

The regional structure of the area consists of a lenticular shaped body of sediments lying on the East flank of the Grey Mountain highlands. This body of sediments, of Mississippian age and younger, were deposited on older sedimentary and igneous rocks making up the highlands. The regional strike of these beds is approximately NE with the dip about 20° SE.

Surficial Deposits

Mantling the bedrock are deposits of glacial drift. Glacial drift includes unsorted till (unstratified drift) deposited during the Pleistocene Epoch (ice age), and washed material, or ice contact stratified drift, deposited by glacial meltwater. Till is composed of a mixture of silt, sand and gravel. Outwash, esker, kame and kame terrace are genetic terms applied to sand and gravel deposited by glacial meltwater.

The material found in this area was probably deposited while the remains of the glacier still occupied South Mountain. The most common surficial material is in the form of a sandy and clay till which was derived from the underlying gypsum and shales. This being predominant in the north and south parts of the area.

However, in the center of the area, trending NW - SE and roughly paralleling the lower extremity of French Mill Brook, is an area of ice contact stratified drift material. Upstream this deposit consists of sand, which grades into a gravel downstream towards the mouth of French Mill Brook. The sand begins at an elevation of about 100 feet above sea level and continues SE for about 2½ miles down to the dyke of the Avon River. Recent removal of gravel from a pit on the lower end of this deposit indicates a thickness of over 30 feet.

Recent Deposits

Since the disappearance of the glaciers, the Pleistocene deposits, as well as the bedrock in some areas, have been eroded to some extent. The presence of bottomland alluvium, which includes silt and clay, especially along French Mill Brook and the Avon River indicates recent deposition which followed the initial erosion of the stream beds.

HYDROLOGY

Introduction

The granites, slates, shales and till seldom yield more than a domestic water supply in one well. The limestones and gypsums are capable of yielding large amounts of groundwater but only with undesirable chemical characteristics. These waters are extremely hard and contain high amounts of total dissolved solids.

Two geological deposits in the area present very favourable conditions for obtaining groundwater; these are the Pleistocene sand and gravel deposits and the Horton sandstone beds. These are possible aquifers or water bearing zones. In the past, wells have not been drilled into the sand and gravel deposits because methods of screening wells in unconsolidated deposits were not known by local drillers until recently. The absence of wells drilled into the Horton sandstone may be explained by the fact that this aquifer lies west of the center of population of the area. Several well drillers have tried to drill through the Windsor Group into the Horton without knowing the local geology or the thickness of the Windsor sediments. As a result of the extreme thickness of the Windsor they have failed and discouraged further attempts to complete a well in the Horton aquifer.

Horton Aquifer

The Horton sandstone may be a very good aquifer. To date, however, there is little information available on aquifer characteristics of the Horton Formation in the Falmouth Area. In the Gaspereau Valley, a series of flowing artesian wells supply ample water for domestic and agricultural uses. The source of this water is from the Horton sandstone aquifer. A natural overflow of about 35 IGPM was measured from one 6" well drilled into this aquifer.

Surficial Aquifer

In some places Pleistocene sands and gravels are very good aquifers. For example, in 1964 a well was completed in a sand and gravel aquifer at Coldbrook. This well yielded safely 500 I.G.P.M. Information on the possible aquifer adjacent to French Mill Brook is limited.

In the Falmouth area conditions appear to be favourable for obtaining groundwater from screened wells from the sands adjacent to French Mill Brook. In addition, conditions may be favourable for induced infiltration of water from French Mill Brook into a drilled well. If the saturated thickness of the sands is limited, an infiltration gallery may be more appropriate than a vertical well.

WATER QUALITY

Surface Water

A surface water supply is available from the French Mill Brook watershed. However, before domestic use this water would require filtration and chlorination. In its present state, without treatment, this could be used only for irrigation in the agricultural industry.

Samples collected by the N.S. Water Authority during the summer indicated undesirable chemical and bacterial constituents. The total hardness results ranged from 41 - 401 parts per million (ppm). The most probable number (MPN) of coliform bacteria was greater than 240.

GROUNDWATER QUALITY

Horton Aquifer

At present nothing is known of the chemical characteristics of the water from the Horton Aquifer within the Falmouth area. However, for comparison chemical analysis of water samples collected from the Horton source area within the Gaspereau Valley are included in Table 1.

Surficial Aquifer

Three water samples were collected within the Pleistocene deposit, two being from dug wells, the other from a spring. These locations are plotted on the accompanying map of the groundwater geology (see appendix).

The analysis indicated this water to be of a fairly high quality with low total dissolved solids and a medium hardness.[1] A more complete analysis is now being carried out on these samples at the Nova Scotia Agricultural College in Truro. The completed analysis are included in Table I(a) and II.

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1. 50 ppm is taken as the boundary between hard and soft water.

Recommendations and Conclusions

It is recommended that test drilling be carried out in both the surficial deposits and the Horton sandstone area. Several test holes should be drilled into the Pleistocene sand and gravel deposits in the vicinity of French Mill Brook in order to delineate the areal extent and thickness of the aquifer and also to determine the grain size distribution of the materials encountered. At the same time temporary test wells should be installed and test pumped in order to determine the water transmitting characteristics of the aquifer.

Within the Horton aquifer area, test holes should be drilled in order to determine the depth of overburden, strike and dip of the aquifer and the depth to the aquifer. Test wells should also be drilled and test pumped in order to determine the water transmitting characteristics of that aquifer.

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TABLE I

RANGE OF CHEMICAL COMPOSITION OF GROUNDWATER FROM THE HORTON AQUIFER IN THE GASPEREAU VALLEY

Constituent	Maximum		Minimum	
Sodium (Na)	66.0	ppm	5.6	ppm
Sulphate (SO_4)	8.2	ppm	1.4	ppm
Chloride (Cl)	90.0	ppm	20.0	ppm
Iron (Fe)	0.15	ppm	0.07	ppm
Total hardness	140.0	ppm	87.0	ppm
Total Dissolved Solids	156.0	ppm	89.0	ppm
Alkalinity	128.0	ppm	55.0	ppm
Ignition Loss	42.0	ppm	5.0	ppm
Nitrates (NO_3)	$\leq$ 0.01	ppm		ppm
pH	8.4		7.6	

T A B L E I (a)

RANGE OF CHEMICAL COMPOSITION OF GROUNDWATER FROM THE PLEISTOCENE SANDS IN THE FALMOUTH AREA

Constituent	Maximum		Minimum	
Total hardness	75	ppm	65	ppm
Calcium (Ca) hardness	50	ppm	40	ppm
Magnesium (Mg) hardness	35	ppm	15	ppm
Sulphate (SO_4)	52	ppm	27	ppm
Chloride (Cl)	13.0	ppm	12.0	ppm
Iron (Fe)	0.8	ppm	0.04	ppm
pH	6.95	ppm	5.8	ppm

TABLE II

CHEMICAL ANALYSES OF WATER SAMPLES

TAKEN IN THE FALMOUTH AREA

Sample No. Wr. - D - 2

Dug well in pleistocene sand

Fe	=	0.04 ppm
Total hardness	=	75 ppm
Ca hardness	=	50 ppm
Mg hardness	=	25 ppm
pH	=	6.95
SO_4	=	32 ppm
NO_3	=	4.8 ppm
Chloride	=	12.0 ppm

Sample No. Wr - D - 1

Spring in pleistocene sand

Chloride	=	13.0 ppm
Total hardness	=	65.0 ppm
Ca hardness	=	50 ppm
Mg hardness	=	15 ppm
Fe	=	0.05 ppm
pH	=	5.8
SO_4	=	27.0 ppm

Sample No. Wr - D - 5

Dug well on contact of Sand & Till

SO_4	=	52.0 ppm
Total hardness	=	75.0 ppm
Ca hardness	=	40.0 ppm
Mg hardness	=	35.0 ppm
Fe	=	0.8 ppm
pH	=	5.8