MARITIME PROVINCES WATER RESOURCES STUDY

STAGE I

VOLUME FOUR

NOVA SCOTIA

BOOK 2

HALIFAX - DARTMOUTH STUDY AREA

For

ATLANTIC DEVELOPMENT BOARD

By

MONTREAL ENGINEERING COMPANY, LIMITED

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332 EXISTING SUPPLY FACILITIES

.1 Halifax

The Halifax water system dates back to the mid-1800's when the Long-Chain Lakes were developed and began supplying the City in 1848. The system was operated by the Halifax Water Company until 1861, when it was taken over by the City. The Public Service Commission of Halifax was formed during World War II as a public utility and has operated the system since 1945. In addition to serving the City of Halifax the Commission also serves a wide area of the suburbs of Armdale, Spryfield, Fairview and Rockingham.

.11 Sources of Supply The present source of supply for the City of Halifax is a series of lakes to the southwest of the city; the most important being: Long Lake, Chain Lakes, Big Indian Lake and Spruce Hill Lake as shown on Plate 3-5. These sources have been developed to produce a reliable yield of about 15.5 Mgd(Can). Long Lake, Second Chain Lake and First Chain Lake have been combined to provide a low level gravity supply. This system is augmented as required by pumping from Big Indian to Long Lake. Spruce Hill Lake provides water for both the high and low service systems in Halifax. These lakes, while providing adequately for present needs in terms of quantity, are only marginally acceptable as to colour with the present treatment facilities.

The Long-Chain system of lakes was the first to be used by Halifax. Many of the associated structures are those originally constructed and due to careful maintenance, are still in good condition. The system has a watershed of 6.4 square miles which is wholly owned by the Public Service Commission of Halifax. Long Lake is at elevation 206 and Chain Lakes at elevation 205 with a combined surface area of 500 acres. The storage volume has been estimated to be 1,070 Mg(Can)(4). On the basis of this, the reliable yield of the Long-Chain Lakes system is estimated to be 6.3 Mgd(Can). This is 0.2 Mgd(Can) less than indicated in Reference(4).

Water from Long Lake receives automatic fluoridation and chlorination treatment at the Long Lake plant and is then pumped into the Spryfield and low service systems in Halifax.

The Big Indian Lake system was brought into use during World War II to augment the Long-Chain system. The total watershed above the present dam at Big Indian is 6.9 square miles. Within the watershed are four Lakes; Big Indian, Otter, Ragged and Blueberry with a total area of about 560 acres. The elevation of Big Indian Lake is 174 ft. The total estimated storage available for use in the system is about 1400 Mg(Can). About half of the developed storage is supplied by Otter Lake with a contributing drainage area of only 1.1 square miles. The Otter Lake storage is somewhat in excess of an average year runoff and thus will be difficult to fill upon depletion. This would be of little consequence during an isolated dry period but would be more serious during a long period of low runoff. With careful operation the reliable yield of the Big Indian system is estimated to be 7.5 Mgd(Can). Ninety per cent of the watersheds of Big Indian Lake and Otter Lake are owned by the Public Service Commission of Halifax and steps are being taken to acquire ownership of the remaining area.

Spruce Hill Lake has been in use for 100 years. It has a watershed of approximately 1.55 square miles, and a lake area of 260 acres at an elevation of 362 ft. The watershed is wholly owned by the Public Service Commission of Halifax. It has an estimated storage capacity of 700 million gallons which is far in excess of that required to provide the estimated reliable yield of 1.7 Mgd(Can). However, the existing 15 in gravity supply main from Spruce to Long Lake limits the current supply to about 1.3 Mgd(Can). The water receives lime and fluoridation treatment at Spruce Hill and is chlorinated at the Chain Lake treatment plant before distribution. The existing structures although varying in age from 80 to 100 years are in good condition.

<u>.12 Quality</u> Quality is dealt with in 333.

<u>.13 Distribution</u> The water distribution system of Halifax is considered to be in three parts; the high and low service systems, and the Spryfield system. They are essentially gravity fed but are subject to booster pumping within their distribution systems.

The low service system is supplied by Chain and Long Lakes supplemented by Big Indian Lake. Water for this system is treated with fluoride and lime at the lake sources, combined and then chlorinated. The low service supply is boosted at the Dutch Village Road Station and transmitted by 341 feet of 27 in dia and 14,472 feet of 24 in dia cast iron main to the lower parts of the City. The 24 in mains were installed in 1862 and the 27 in was added in 1893. The daily output of the low service system is 10.0 Mgd(Can).

The high service system is supplied principally by Spruce Hill Lake which, although smaller than the Long-Chain-Big Indian system, is at a higher elevation. The water is treated in a similar way to that of the low service system and is transmitted by a 15 in dia cast iron main to the higher parts of the city. This system is supplemented by pumping from the Robie Street pumping station (on the low service system), to a high level reservoir of 3.64 Mg(Can) capacity. It is further supplemented by water pumped to an elevated tank pressure system (50,000 gallons), from the Windsor Street pumping station. A "super high" pumping station pumps water from the high service system to elevated storage (83,300 gallons). The daily output of the high service system is 1.3 Mgd (Can).

The capacities of most mains are impaired by tuberculation and according to reports(5) are scarcely adequate to meet demand. Some 573,000 gpd (Can) are estimated to be lost by leakage.

In 1967 the Halifax Public Service Commission completed a scheme to supply water to the communities of Spryfield, Jollimore, Armdale and Herring Cove. These communities are located to the south of Halifax. The supply is known as the Spryfield System and consists of an intake on Long Lake, pumping, treatment facilities and booster pumping plant, all of which are unattended and under automatic control. The distribution grid serves approximately 2,550 homes with a total of 0.24 Mgd (Can).

.2 Dartmouth

The City of Dartmouth owns and operates the water utility. The water supply system first came into operation in 1892 and since that date the system has been steadily developed to its present state. The present capacity of the system is 8.4 Mgd (Can) and is limited by the existing transmission system. The present requirements are, however, only 5 Mgd (Can).

.21 Sources of Supply The sources of supply are Lake Major which is located to the north-east of the City, and Lakes Topsail and Lemont which are within the City. A third source, Loon Lake, was abandoned in 1961 due to the increased residential development within its watershed and an attendant increase of pollution.

The lakes are shown on Plate 3-5.

Lake Major has a drainage area of 27 square miles and a lake area of 950 acres at an elevation of 62.0 ft. Very little of the watershed is owned by the City. Since the City took over the lake, no work has been done to increase its yield. There is a small timber crib dam 15 ft high which was originally built to serve a mill.

Lake Major is providing 4 Mgd (Can) for supply to Dartmouth. A pumping station has been built which is equipped with double sets of manual screens and two 3,750 gpm (Can) centrifugal pumps. A 15 ft dia x 72 ft high steel surge tank has been incorporated in the 24 in dia pumping main between Lakes Major and Topsail in order to reduce water hammer. The water receives no treatment whatsoever at Lake Major.

Lakes Topsail and Lemont have a drainage area of 1.3 square miles, a lake area of 170 acres at an elevation of 224 ft, and supply 1.0 Mgd (Can) to the Dartmouth system. As previously mentioned, the main function of these lakes is that of a reservoir for the 4.0 Mgd (Can) pumped from Lake Major. It is considered that this system is fully developed.

The pumping station at Lemont Lake is of modern construction and houses the following, in addition to a treatment plant:

2 mechanical travelling screens for the high service system
1 set of manually operated screens
2 centrifugal pumps, capacity 4600 gpm (Can)
2 centrifugal pumps, capacity 1500 gpm (Can).

In normal operation, a single large or small pump is used; the average pumping head is 160-170 feet.

The treatment plant was newly installed in 1965 and is highly automated and well equipped with recording and regulating devices. The treatment is of a simple nature being limited to fluoridation, chlorination and the addition of lime for pH control.

.22 Quality. Quality is dealt with in 333 of this report.

.23 Distribution. Since 1944 the City of Dartmouth Water system has functioned with a two zone distribution arrangement. The low pressure zone consists generally of that area within the old Town below the 100 ft contour. the remaining areas, i.e. above the 100 ft contour together with those areas at the extremities of the system, are known as the high pressure zone.

The low pressure zone is served by a 20 in dia cast iron main 2,340 ft in length from Lake Lemont towards the town, the flow is then divided into one 16 in dia and one 12 in dia main each approximately 10,360 ft in length. This is a gravity system.

The demand on this low service transmission system has varied greatly in recent years between 0.39 Mgd(Can) and 1.25 Mgd(Can). Very high peak demands are experienced mainly due to the watering of ships.

The service is adequate for general purposes; however, fire protection and peak industrial demand are not catered for satisfactorily.

The high service system, as it exists, was put into operation in 1952. Basically, this system consists of a 24 in dia cast iron main which extends 14,100 feet from the 5 Mg (Can) capacity high level reservoir located to the south-east of Lake Lemont. The reservoir is fed through 1300 ft of 16 in dia pipe.

Approximately seventy five percent of the water requirement is distributed by the high service system, and it is anticipated that most of the future development will be supplied by it. This distribution system also provides stand-by capacity for the low service system. That this system should depend on the single 24 in dia main is considered to be a severe limitation on the adequacy of the Dartmouth system. Failures have taken place and it is impossible to overcome the difficulties caused by such failures in the future without the installation of additional mains. The northern part of the city also suffers from an inadequate service caused by the use of a single 12 in dia pipe. About 37 percent of water is lost due to unmetered supplies and losses.

.3 Bedford-Sackville

Individual wells are the main source of supply, but the Valley View subdivision, consisting of seventy-five homes, is served by a water utility operated by the County of Halifax. The yield from the Valley View well is about 20 gpm (Can) and ground level storage of 15,000 gal (Can) is employed. There are chlorination and iron removal facilities. This system does not provide fire protection.

.4 Waverley

Waverley obtains water for domestic consumption from wells and a local brook supplies the Frame subdivision.

333 WATER QUALITY

The topography and geology of the region surrounding the Greater Halifax-Dartmouth Area have a considerable bearing on the quality of the surface waters and on their distribution. All soil deposits found in the area are of glacial origin. Their distribution is erratic, with varying depths. Bare rock outcrops are extensive throughout the area. Similarly the growth cover varies from softwood trees to extensive areas of bush and scrub.

There are three main geological substrata in the Area. Granite rocks of Devonian age are generally found south and westward of Halifax. Meguma quartzite of the Goldenville Formation extending over the remaining area is overlain by the shale of the Halifax Formation around Dartmouth and Halifax.

There are numerous areas of poor drainage resulting in extensive bogs and marshes, which have a considerable bearing on the quality' A number of lakes are shallow.

Another factor governing the quality of water is proximity to the sea. This is particularly important in the quality of groundwater.

All these factors contribute to the fact that the quality of water varies from good to very poor. Most of the surface waters exhibit colour to a varying degree, while groundwater from drilled or dug wells, depending upon the location, varies in character and is liable to have excessive amounts of iron and manganese. Total dissolved solids of surface waters are relatively low, the pH value is usually low (acidic) and the waters are considered to be aggressive. The location of good quality water is not easily predictable.

.1 Water Quality Analyses

Most of the analyses of surface waters available for the area have been examined and the chemical constituents and physical characteristics, iron, manganese, chloride, hardness, pH-value, colour and turbidity are summarized in Table 3-4. In addition, graphs in Figures 3-10 to 3-14 have been prepared showing the variation of colour, turbidity and the pH value for the lakes contributing to the present source of water supply to Halifax and of Pockwock Lake which is a potential source of supply to the system. For comparison, suggested drinking water standards and maximum allowable limits by various authorities have been summarized and shown in Table 3-5.

There is not sufficient data to prepare similar graphs for Lake Major, Topsail and Lemont of the Dartmouth supply, but comparing the available analyses with the present Halifax supply the difference between them is of little significance. This has been confirmed by discussions with local authorities.

.2 Quality of Present Supply to City of Halifax

The Long-Chain system of lakes supplies the low service area of Halifax. Water level is at 205 feet above sea level and maximum depths are about 90 feet in Long Lake and 40 feet in Chain. There are relatively few bogs and marshlands discharging into the lakes. Water from this source shows a variation of colour up to 35 units and turbidity is within permissible limits.

During the periods of drier weather in summer, the Long-Chain system is supplemented by water pumped directly from Big Indian Lake which in turn is fed by waters from Otter, Blueberry and Ragged Lakes.

TABLE 3-4

Lake Waters

Tabulation of Chemical Constituents & Physical Properties

Lake & Description	Date	Fe ppm	Mn ppm	Cl ppm	Hardness ppm	pH	Colour Units	Turbidity ppm	Ref. No.
EXISTING SOURCES OF SUPPLY TO HALIFAX									
LONG LAKE (11 D 12 A 103 H) RAW WATER	27/8/54	0.05	0.05	4.4	2.6	4.9	15	0	1
	11/4/57	0.07	0.04	7.1	5.2	5.1	25	6	
	10/6/57	T	0.02	6.9	5.3	5.3	5	0	
	10/9/57	0.06	0.04	6.4	4.9	5.3	10	0.3	
	27/11/57	0.02	0.04	7.8	5.5	5.3	25	0.3	
	24/2/58	0.06	0.05	7.3	5.7	5	30	0.3	
	23/5/58	T	0.02	T	4.6	5	25	0	
	3/9/58	0.03	0.11	6	4.5	5.4	20	0	
SPRUCE HILL (11 D 12A 80 B) RAW WATER	11/4/57	0.06	0.04	5.9	4.1	5.1	25	5	1
	10/6/57	T	0.02	6	4.7	5.4	10	0	
	10/9/57	0.02	0.04	6.3	4.6	5.8	5	0.8	
	27/11/57	0.07	0.02	6.5	4.8	5.2	25	0.3	
	24/2/58	0.11	0.04	7.8	5.1	5.3	40	0.3	
	23/5/58	0.06	0.02	5.9	3.7	4.8	30	0.8	
	3/9/58	0.02	0.11	6.2	3.5	5.3	25	0.8	
	19/5/66	0.23	0.04	10.0	14.7	6.3	10.0	2.0	2
	1/2/67	0.64	0.16	8.0	-	4.7	15	6	2
CHAIN LAKE RAW WATER	8/11/62	-	-	6.3	6.5	4.7	30	2.0	2
	5/3/63	0.13	-	9.0	6.0	4.5	35	0.5	2
	19/3/63	-	-	8.8	6.0	4.6	25	0.7	2
	1965	0.22	0.12						3
LONG LAKE & CHAIN LAKE RAW WATER	19/5/66	0.25	0.27	14.0	19.8	6.3	15.0	2.0	2
	1/2/67	0.36	0.01	10.1	-	4.6	20	2.6	2
CHAIN LAKE NO. 2 RAW WATER	12/62	-	-	-	-	-	28	0.94	2
	1/63	-	-	-	-	-	31	0.86	5
	2/63	-	-	-	-	-	28	0.84	
	3/63	-	-	-	-	-	29	0.94	
	4/63	-	-	-	-	-	24	1.03	
	5/63	-	-	-	-	-	16	1.07	
	6/63	-	-	-	-	-	15	0.96	
	7/63	-	-	-	-	-	14	0.82	
	8/63	-	-	-	-	-	13	0.97	
	9/63	-	-	-	-	-	16	0.82	
	10/63	-	-	-	-	-	22	0.98	
	11/63	-	-	-	-	-	24	0.84	

REFERENCE NO. 1. A.D.B. - "N.S. WATER RESOURCES STUDY" - April 1967 - Groundwater Section. Dept. of Mines. N.S.

REFERENCE NO. 2. PUBLIC SERVICE COMMISSION - HALIFAX

REFERENCE NO. 5. "MICROSTRAINING THE HALIFAX WATER SUPPLY" by N.S. Research Foundation. 1963

TABLE 3-4
Lake Waters
Tabulation of Chemical Constituents & Physical Properties
(Continued)

Lake & Description	Date	Fe	Mn	Cl	Hard-ness	pH	Colour	Turbi-dity	Ref. No.
		ppm	ppm	ppm	ppm		units	ppm	
EXISTING SOURCES OF SUPPLY TO HALIFAX (Cont.)									
SPRUCE HILL (FINISHED WATER)	27/8/54	0.08	0.02	6.4	9.2	7.0	15	0	1
	27/8/54	0.08	0.02	6.7	10.8	6.6	8	0	
	15/7/55	0.42	0.06	7.6	12.9	6.7	20	2	
	19/11/55	0.67	0.02	7.2	14.4	7.1	30	-	
	10/1/56	-	-	7.3	12.8	6.9	30	-	
LONG CHAIN FINISHED WATER	27/8/54	0.08	0.02	6.8	10	6.6	12	0	1
	10/4/56	0.29	0.02	6.5	14.4	6.8	35	0	
	10/5/56	0.24	0.04	6.4	11.5	6.7	20	0.2	
	3/7/56	0.07	0.02	7.4	17.3	7.9	30	0	
	18/9/56	0.07	0.05	6.2	10.6	6.8	5	0	
	24/1/57	0.12	0.04	8.8	14.4	6.6	20	0	
	25/3/57	0.06	0.02	9.5	11.0	5.9	20	3	
	6/6/57	T d	0.02	8.7	13.6	6.6	.5	0.3	
	10/9/57	0.08	0.02	8.2	13.0	6.9	10	0.9	
	24/2/58	0.12	0.02	8.8	14.5	6.9	30	0	
	23/5/58	0.06	0.01	8.6	13	6.5	20	0	
	3/9/58	0.08	0.02	8	13.6	6.9	20	0	
POTENTIAL SOURCES OF SUPPLY EXAMINED									
POCKWOCK LAKE	21/2/64			7.0	5.0	6.0	14	0.4	3
	6/3/64			7.0	6.0	5.8	17	1.15	
	1/4/64			10.0	7.0	6.0	28	0.4	
	15/4/64			7.0	5.0	6.0	18	3.0	
	6/5/64			7.0	4.0	6.4	17	0.74	
	10/6/64			7.6	6.0	5.6	19	1.0	
	15/7/64			6.0	5.0	5.9	12	5.4	
	19/8/64			9.0	5.0	5.9	10	0.72	
	17/9/64			7.0	5.0	6.15	14	2.2	
	21/10/64			6.0	5.5	6.15	14	0.62	
	28/11/64			7.0	5.5	7.10	12	3.00	
	9/12/64			6.5	6.0	5.4	14	2.75	
	27/1/65			6.5	5.5	5.5	18	0.81	
	10/2/65			9.0	5.0	5.65	15	1.1	
	10/3/65			8.5	6.5	5.60	14	1.5	
	21/4/65			6.5	5.5	6.10	14	2.0	
	23/6/65			6.5	4.5	5.61	14	1.3	
	7/7/65			11.0	6.0	5.40	13	1.4	
	12/8/65			6.0	6.0	5.60	11	2.7	
	25/8/65			4.5	6.0	5.9	9	2.0	

REFERENCE NO. 3. "REPORT ON SEVEN LAKES" by N.S. Research Foundation, October 18, 1967

TABLE 3-4

Lake Waters

Tabulation of Chemical Constituents & Physical Properties

(Continued

Lake & Description	Date	Fe	Mn	Cl	Hard-ness	pH	Colour	Turbi-dity	Ref. No.
		ppm	ppm	ppm	ppm		Units	ppm	
POTENTIAL SOURCES OF SUPPLY EXAMINED (Cont.)									
POCKWOCK LAKE (cont'd)	8/9/65			7.0	7.0	5.85	8	1.7	3
	6/10/65			6.0	5.0	5.60	6	1.8	
	13/10/65			6.0	6.0	5.55	10	1.8	
	18/11/65			6.5	6.0	5.60	8	1.6	
	6/12/65			6.0	6.0	6.25	7	1.7	
	19/1/66			6.0	6.0	5.7	9	2.3	
	10/2/66			6.0	6.0	5.4	7	2.6	
	22/3/66			6.0	6.0	5.3	6	1.3	
	1965	0.18	0.963						3
(11D 13B 19P)	21/5/65	0.06	0.03	2.7	10.0	5.9	20	-	1
TOMAHAWK LAKE	28/2/64			7.0	5.0	5.5	46	0.98	3
	25/3/64			8.0	5.0	5.7	46	0.80	
	25/4/64			6.0	5.0	6.3	42	0.61	
	27/5/64			6.0	4.0	6.1	26	8.1	
	30/6/64			6.0	5.0	6.5	23	1.43	
	22/7/64			8.0	5.0	6.2	10	0.5	
	26/8/64			6.5	5.0	6.05	54	3.6	
	24/9/64			7.5	5.5	6.25	51	2.6	
	21/10/64			6.0	6.0	5.95	15	0.92	
	18/11/64			7.0	6.0	6.61	63	2.80	
	9/12/64			6.0	5.0	5.20	13	2.20	
	20/1/65			5.5	6.0	5.50	18	0.99	
	10/2/65			7.5	5.0	5.60	15	1.13	
	10/3/65			8.0	6.5	5.60	15	1.7	
	21/4/65			6.5	5.5	5.70	16	1.8	
	19/5/65			6.0	5.0	5.40	16	2.3	
	22/7/65			6.5	5.5	5.65	21	3.9	
	1/9/65			6.0	4.0	5.40	16	15.5	
	8/9/65			7.0	10.0	5.30	21	2.8	
	6/10/65			6.0	5.0	5.40	18	3.5	
	13/10/65			6.0	4.5	5.70	20	2.2	
	18/11/65			7.0	7.0	5.50	20	2.4	
	6/12/65			7.0	6.0	5.50	36	1.8	
	25/1/66			7.0	5.0	5.10	20	2.2	
	28/2/66			8.0	7.0	4.85	52	2.0	
	27/3/66			5.0	5.0	4.70	18	1.5	
	1965	0.3	0.04						3

REFERENCE NO. 1. A.D.B. - "N.S. WATER RESOURCES STUDY" - April 1967 - Groundwater Section, Dept. of Mines.
REFERENCE NO. 3. "REPORT ON SEVEN LAKES" by N.S. Research Foundation, October 18, 1967

TABLE 3-4

Lake Waters

Tabulation of Chemical Constituents & Physical Properties

(Continued)

Lake & Description	Date	Fe	Mn	Cl	Hard-ness	pH	Colour	Turbi-dity	Ref. No.
		ppm	ppm	ppm	ppm		Units	ppm	
POTENTIAL SOURCES OF SUPPLY EXAMINED (Cont.)									
BIG INDIAN LAKE	31/1/64			9.0	5.0	6.3	20	1.04	3
	14/2/64			9.0	5.0	6.4	48	1.02	
	25/3/64			10.0	6.0	6.6	29	0.76	
	15/4/64			8.0	5.0	6.8	23	0.88	
	13/5/64			7.0	4.5	5.8	58	1.20	
	3/6/64			10.0	6.0	5.5	48	2.6	
	8/7/64			7.0	5.0	5.5	36	0.90	
	29/7/64			7.0	4.0	5.6	40	1.0	
	10/9/64			9.0	4.5	4.8	36	0.74	
	14/10/64			8.0	5.0	4.9	50	0.90	
	4/11/64			8.0	5.0	5.0	80	1.20	
	2/12/64			8.0	6.0	4.52	63	5.1	
	13/1/65			9.0	18.0	6.15	62	32.0	
	3/3/65			8.5	19.5	6.70	49	25.6	
	7/4/65			7.5	17.5	6.20	76	22.5	
	5/5/65			8.0	6.0	4.90	48	3.4	
	18/8/65			10.0	8.0	5.0	25	4.5	
	6/10/65			8.0	4.0	4.85	42	2.8	
	13/10/65			7.0	7.0	4.90	48	4.8	
	11/11/65			8.0	5.0	5.0	40	3.7	
	18/11/65			8.5	6.0	4.8	50	2.5	
	6/12/65			9.0	6.0	4.8	55	2.2	
	13/1/66			12.0	7.0	4.6	66	4.2	
	23/2/66			18.0	8.0	5.9	68	9.3	
	22/3/66			8.0	7.0	5.95	17	2.0	
	18/4/66			7.0	7.0	4.60	54	2.7	
	1965	0.25	0.05						3
GRAND LAKE	21/2/64			9.0	7.0	-	23	13	3
	6/3/64			10.0	8.0	5.9	19	2.45	
	8/4/64			10.0	10.0	5.4	23	3.80	
	29/5/64			8.0	11.0	6.3	18	1.23	
	24/6/64			7.0	6.0	6.3	14	2.40	
	22/7/64			8.0	5.0	5.8	25	3.20	
	26/8/64			9.0	13.5	5.8	11	2.10	
	17/9/64			9.0	14.0	6.6	12	1.22	
	7/10/64			7.5	13.0	6.41	14	0.43	
	11/11/64			9.0	11.0	6.0	16	0.70	
	16/12/64			12.0	10.0	6.2	21	2.40	
	20/1/65			10.0	11.5	6.0	18	2.30	
	25/2/65			10.0	11.0	5.05	14	2.40	
	17/3/65			8.0	12.0	5.9	16	1.50	

REFERENCE NO. 3. "REPORT ON SEVEN LAKES" by N.S. Research Foundation, October 18. 1967.

TABLE 3-4

Lake Waters

Tabulation of Chemical Constituents & Physical Properties

(Continued)

Lake & Description	Date	Fe	Mn	Cl	Hard-ness	pH	Colour	Turbi-dity	Ref. No.
		ppm	ppm	ppm	ppm		Units	ppm	
POTENTIAL SOURCES OF SUPPLY EXAMINED (Cont.)									
LITTLE LAKE	15/7/64	0.06	0.05	4.8	16.6	6.0	5	1.0	4
INDIAN POINT	17/7/64	0.04	0.05	4.3	11.0	5.8	5	0.9	
NICHOLS LAKE	1/10/64			5.5	9.0	4.38	60	1.25	3
	28/10/64			6.0	5.0	4.65	64	0.87	
	23/12/64			7.2	15.8	6.7	105	6.7	
	13/1/65			9.0	16.5	6.1	78	29.0	
	3/2/65			8.0	19.0	6.15	62	32	
	3/3/65			8.5	19.5	6.7	49	25.1	
	5/5/65			8.0	7.0	4.9	50	3.3	
BIG FIVE BRIDGES	7/2/64			10.0	3.0	6.4	95	1.0	3
	13/3/64			8.0	4.0	6.98	92	0.5	
	15/4/64			7.0	3.0	5.8	120	0.89	
	29/5/64			6.0	3.0	4.8	112	0.90	
	30/6/64			8.0	3.0	-	70	0.62	
	12/8/64			7.0	4.0	5.5	112	0.86	
	1/10/64			3.5	8.5	4.48	100	0.74	
	28/10/64			6.5	4.0	4.62	100	0.95	
	25/11/64			8.0	5.0	5.32	192	3.95	
	30/12/64			9.1	5.3	4.6	135	0.83	
	6/1/65			8.0	3.0	5.3	66	1.2	
	24/3/65			8.0	4.5	4.9	76	19	
McCABE LAKE	28/2/64			8.0	4.0	5.5	48	1.02	3
	20/3/64			8.0	6.0	6.2	53	0.77	
	8/4/64			9.0	7.0	5.8	50	7.9	
	29/5/64			7.0	4.0	6.5	35	2.6	
	24/6/64			7.0	6.0	5.9	32	1.3	
	15/7/64			7.0	8.0	5.8	28	2.1	
	10/9/64			7.0	5.5	5.15	54	0.97	
	7/10/64			8.5	6.0	5.70	65	1.0	
	11/11/64			7.0	6.0	5.9	80	1.49	
	16/12/64			8.0	7.0	5.9	66	3.4	
	20/1/65			8.5	7.0	5.7	64	1.06	
	25/2/65			8.0	6.5	5.2	50	2.9	
	17/3/65			8.0	9.0	5.2	57	1.6	
	31/4/65			7.5	8.0	5.2	51	2.4	

REFERENCE NO. 3. "REPORT ON SEVEN LAKES" by N.S. Research Foundation, October 18, 1967

REFERENCE NO. 4 "WATER QUALITY STUDY ON SHUBENACADIE RIVER AND WATERSHED" 1964, Dept. N.H.W.

TABLE 3-4

Lake Waters

Tabulation of Chemical Constituents & Physical Properties

(Continued)

Lake & Description	Date	Fe	Mn	Cl	Hard-ness	pH	Colour	Turbi-dity	Ref. No.
		ppm	ppm	ppm	ppm		Units	ppm	
EXISTING SOURCES OF SUPPLY TO DARTMOUTH									
MORRIS LAKE	19/2/54	N.D.	-	9.8	12	6.1	15	-	1
(11D12D24Q)	9/5/60	0.34	0.11	10	8	6.2	25	-	
(" " " J)	25/4/57	0.4	-	15	20	6.0	30	9.6	
LEMONT LAKE (11D12D50P)	11/5/60	0.07	0.23	5	4	4.9	5	-	1
LAKE MAJOR (11D12D97H)	11/5/60	0.10	0.06	5	4	5.1	30	-	1
LEMONT LAKE	27/8/54	0.02	-	4.7	10.6	6.8	.3	0	1
(OR LOON LAKE)	30/10/54	0.21	0	6	13.3	7.2	15	2	
(11D12D73B)									
(11D12D73C)	13/6/65	0.13	N.S.S.	25.7	240.5	7.7	20	-	
MISCELLANEOUS SOURCES									
LOOKOUT LAKE (11D13A49C)	3/8/64	0.05	0.03	11.0	-	4.8	80	10	1
	10/8/64	0.05	0.09	7.5	-	4.7	75	5	
	25/8/64	0.13	0.06	12.2	-	5.0	.75	5	
	8/9/64	0.18	0.09	10.6	2.9	5.0	100		
	1/10/64	0.22	0.05	14.2	2.9	5.0	85		
	8/10/64	0.22	0.05	14.2	2.9	5.0	85		
	30/7/65	0.05	0.03				80		
	7/8/65	0.05	0.09				75		
	21/8/65	0.13	0.06				75		
	3/9/65	0.18	0.09				62		
	1/10/65	0.22	0.05				85		
BENNERY LAKE (11D13D22N)	15/11/60	165	14.5	97.8		4.3			1
	" " "	2.9	1.35	7.3		4.0			
	" " "	0.08	-	4.0		6.4			
	" " "	0.16	0.25	5.2		4.9			
(11D13D22M)	28/2/61	0.30	-	4.7	10	5.85	20	0.7	
(11D13D22Q)	" " "	0.64	0.06	4.3	6.4	5.9	40	9.7	

REFERENCE NO. 1. A.D.B. - "N.S. WATER RESOURCES STUDY" - April 1967 - Groundwater Section. Dept. of Mines N.S.

TABLE 3-4

Lake Waters

Tabulation of Chemical Constituents & Physical Properties

(Continued)

Lake & Description	Date	Fe	Mn	Cl	Hardness	pH	Colour	Turbidity	Ref. No.
		ppm	ppm	ppm	ppm		Units	ppm	
MISCELLANEOUS SOURCES (Cont.)									
BENNERY BROOK	19/5/64	0.30	0.38	3.3	17.6	4.8	15	1.5	1
FAIRVIEW (11D12D31Q)	11/9/56		0.02	7.2	14.4	7.1	30		1
DUCK POND (11D12B97B)	4/1/65	0.03	0.01	10.6	4.1	4.4	40		1
LOVETT LAKE (11D12D16B)	4/1/65	0.07	0.03	14.2	8.1	4.5	30		1
MIDDLE LAKE (11D12D16E)	4/1/65	0.10	0.01	14.2	8.1	4.2	25		1
WEBBER LAKE (11D13A14P)	16/3/65	0.14	0.04	7.1	15.8	5.7	40		1
(OUTLET)	5/4/65	0.15	0.03	23.1	13.8	5.5	50		
	22/6/65	0.06	T	20.4	14.0	6.7	25		
SACKVILLE R. (11D12D104N)	22/6/65	0.05	0.03	20.4	18.0	7.0	30		1
TIMBERLEA (11D12036N)	1/2/65	0.60	0.16	42.6	99.2	6.8	< 5		1
TWO MILE L. (11D13813Q)	8/10/64	0.05	T	10.6	3.9	5.2	70		1
FLETCHER LAKE	JUN/JUL/64								
MAX.	JUNE 64	0.16	0.60			6.8	5	2.1	4
MIN.		0.02	0.38			5.2	5	0.6	
KINSAC LAKE	JUN/JUL/64								
MAX.						7.1	10	2.4	4
MIN.						6.0	5	0.1	
THOMAS LAKE	JUN/JUL/64								
MAX.		0.12	0.46			6.9	10	2.1	4
MIN.		0.08	0.30			5.7	5	0.2	
WILLIAMS LAKE	JUN/JUL/64								
MAX.						7.1	15	3.0	4
MIN.						6.2	5	0	
CHARLES LAKE	JUN/JUL/64								
MAX.		0.10	0.10			7.1	5	1.8	4
MIN.		T	<0.05			6.1	5	0.1	

REFERENCE NO. 1. A.D.B. - "N.S. WATER RESOURCES STUDY" - April 1967 - Groundwater Section, Dept. of Mines, N.S.

REFERENCE NO. 4. "WATER QUALITY STUDY ON SHUBENACADIE RIVER & WATERSHED" 1964. Dept. N.H.W.

TABLE 3-5

Comparison of Drinking Water Standards

CONSTITUENT	SUGGESTED DRINKING WATER STANDARDS			MAXIMUM ALLOWABLE LIMITS U.S. PUBLIC HEALTH SERVICE	
	ONTARIO W.R.C. 1964 (Amended 1967)	AWWA			
		IDEAL QUALITY WATER 1962	"TASK FORCE" 1967	1946	1962
Colour (Hazen Units)	5.0	3.0	<3	-	15.0
Turbidity (Units)	1.0	<0.1	<0.1	-	5.0
Alkalinity phenolphthalein (ppm)	Not more	than 1	-	-	-
Ca CO_3 - (total ppm)	-	-	1.0	15.0	-
Hardness (total ppm)	-	80.0	-	-	-
Magnesium (Mg) ppm	-	0.01	-	125	-
Iron (Fe) ppm	0.3	0.05	<0.05	0.3	0.3
Aluminum (Al) ppm	-	0.05	<0.05	-	-
Manganese (Mn) ppm	0.05	0.01	<0.01	-	0.05
Copper (Cu) ppm	1.0	0.2	<0.2	3.0	1.0
Zinc (Zn) ppm	5.0	1.0	<0.1	15.0	5.0
Lead (Pb) ppm	-	0.03	-	0.1	0.05
Sulphate (SO_4) ppm	250.0	-	-	250.0	250.0
Chloride (Cl) ppm	250.0	-	-	250.0	250.0
Nitrate (NO_3) ppm	45.0	5.0	-	-	45.0
Total dissolved solids (ppm)	500	-	-	500	500
pH	6.0 to 8.5	-	-	-	-

There are extensive marshlands extending north and north-easterly from Big Indian towards Blueberry and Ragged. The lakes are shallow and maximum depths reported are 29 feet in Big Indian, 20 feet in Blueberry and Ragged, and 40 feet in Otter. Water from this source is coloured and maximum values have been recorded of up to 80 units during the period of observations in 1964 and 1966. Corresponding figures for turbidity were up to 32 ppm, far in excess of the permissible limits by the U. S. Public Health Service. However this water is not pumped directly into the low service supply but is first discharged into Long Lake where, as a result of dilution and detention, some improvement in quality takes place.

The high service system of Halifax is fed by water from Spruce Hill Lake. The elevation of this lake is 365 feet and its maximum depth is reported to be 40 feet. There are extensive swamps north-west of the lake and water shows a color variation of up to 40 units but turbidity is within the standard U. S. Public Health Service limits. All raw waters supplied to the Halifax water system show a rather low pH value and are aggressive.

The watersheds of the Halifax water supply system are under the surveillance of the Public Service Commission. No development or activity is allowed within the catchment areas. Therefore the supply of water is considered to be free of pollution caused by any residential or industrial development.

Generally, the chemical quality of the Halifax supply is considered to be good. The water is treated by chlorination and fluorine is added. In addition, the entire supply, with the exception of the Spryfield system, has its pH value adjusted by lime treatment.

The colour of water supplied to Halifax undergoes seasonal variations. It is at its worst during winter months when the lakes are under ice. Finished water, during the winter, may show a variation between 15 and 30 Hazen Units. In the spring, a marked improvement in quality (colour) takes place and later, in the summer, despite the fact that coloured waters from Big Indian Lake are on occasions, admixed, the colour appears to be further improved. It has also been reported that certain forms of aquatic life survive the treatment and appear in customers taps as leeches, bugs, etc., naturally resulting in complaints. There have also been complaints of dirty, smelly and bad tasting water.

For many years the Commission has been concerned with the improvement of quality. In 1962 and 1963 microstraining experiments were conducted and it was found that 80% of suspended solids and 100% of plankton could be removed by this method. Nevertheless, microstraining was not successful for colour removal. A limited study was also conducted on water treatment including coagulation, filtration, chlorination for Big Indian, Pockwock and Tomahawk lakes. It was found that coagulation and filtration would effectively reduce colour but further tests were considered necessary by the Commission.

.3 Quality of Prospective Supply to City of Halifax

In their search for additional sources of supply the Commission has studied a number of watersheds in the area and arranged for a series of tests on physical and chemical qualities of the waters of some of the lakes to be carried out.

One of the more important lakes examined was Big Indian already referred to as a supplement to the Long-Chain system. A majority of the samples (about 85%) taken over a two year period were of high colour. Turbidity measurements showed erratic results and indicated that approximately half of the time the waters of Big Indian Lake would be turbid. Biological examination revealed that some larger forms of aquatic life might get through to the supply system. The predominant forms present were of the filter-clogging, taste-and odour-producing type.

Water from Big Indian Lake is soft and the pH value is low, but not as low as the water from Chain Lake. Although Big Indian Lake is used occasionally to augment the flow from Long Lake, it is not suitable for direct feed into the City supply system without additional treatment. This additional treatment would be coagulation as indicated by the initial experiments, but further tests are still required to prove the extent and type of treatment needed.

In the same area, generally west of Halifax, a large number of Lakes have been examined at one time or another. Most of them are shallow, surrounded by small lakes and ponds, with projecting rocks and flanked by bogs and marshes. In common with Big Indian they all exhibit high colour, show suspended matter and micro-forms. Some of these lakes are listed below:

- Peter Lake high colour and turbidity recorded.

- Lakes Moore and Big Five Bridges: shallow, high colour, suspended matter and micro-forms.

- Nine Mile River and Shag Bay Lake: high colour and unsewered communities in the catchment area.

- Lakes Moody and Parr: shallow and high colour observed. A spot check on April 18, 1968, revealed 70 units of colour. There is also a large number of small lakes in the area.
- Birch Cove Lake with Kearney and Paper Mill Lakes drawdown limited, high colour.
- Five Islands and Hubley Big Lakes: shallow, drawdown limited.

In order to make these waters more potable, in most of the cases, full treatment would be required.

In the north-westerly direction the lakes examined were McCabe, Pockwock and Tomahawk. The first, similarly to those listed above, was considered unsuitable. Pockwock, on the other hand, exhibits qualities comparable with those of Long-Chain Lakes. It is a large lake with reported depths from 60 to 90 feet. Bogs are limited in the area. Colour is generally within or just above the standard of the U.S. Public Health Service. Turbidity, although somewhat higher than in Long-Chain lakes, is within the U.S.P.H.S. limits except for one reading exceeding the limit by 0.4 units. The pH values, although low, are somewhat less than the raw water in the Long-Chain Lakes. The raw water in Pockwock is soft and chemically of good quality. In order to achieve the appearance and quality of the present supply this water need only be treated by chlorination, fluoridation and by lime addition to correct the pH value. However if a consistent supply of clear water is required it would have to be additionally treated by coagulation and/or filtration.

Nearby Tomahawk Lake is much smaller and shallower than Pockwock, and with greater extent of swamps. It exhibits colour in an erratic way and although there was a period of about one year when colour stayed consistently at 20 units or just below, at times the count exceeded 50 units and rather high turbidity was recorded. This water although chemically of good quality is not suitable for direct feeding into the supply system without additional treatment to reduce colour. Coagulation and filtration would be needed as an additional treatment but the correct method would have to be confirmed by experiments.

Grand Lake in the headwaters of the Shubenacadie River was also investigated. This lake in common with lakes William, Thomas, Fletcher and others in the area appears to be of good quality and is relatively clear. Nevertheless it was rejected by the Commission as a suitable source because of development and recreational activity in the area.

.4 Quality of Present Supply to City of Dartmouth

Existing sources on the Dartmouth side are Lake Major, feeding water to Topsail and Lemont Lakes, which in fact serve as two large storage reservoirs. Originally only Topsail and Lemont served as the supply source, augmented by Loon Lake. In 1960-61, Loon was abandoned and superseded by the new source, Lake Major. There are only a few chemical analysis available for the Major-Topsail-Lemont sources as shown on Table 3-4, but it is considered that the quality is good and in every respect comparable with the Halifax supply. These waters receive similar treatment to the Halifax supply, namely pH adjustment, chlorination and fluoridation.

Of other lakes in the area, Lake Albro was used for a time to supply a naval installation. Bell Lake supplied an eastern sub-division in Dartmouth while the oil refinery in Shearwater takes water from Morris and Bissett Lakes.

.5 Quality of Miscellaneous Sources

Analyses are available for a few additional lakes and water courses in the area and they all reveal generally similar water quality characteristics, i.e. - occurence of colour, occasional turbidity, aggressiveness due to the low pH value and low total dissolved solids. Iron and manganese usually show within the permissible limits although there are exceptions, for example Lookout, Bennery, Timberlea Lakes at times show an excess.

There has been a reported increase in acidity and of iron content of water in Lake Miller and subsequently in Lake Fletcher which in turn resulted in the closure of the fish culture station at Wellington. The cause was attributed to construction of the Trans-Canada Highway and the Halifax International Airport where considerable amount of pyrites was exposed.

It is also worth mentioning that there have been cases reported of water from wells changing its composition or being contaminated by the reason of local trench excavation, for instance, for new water-mains.

.6 Possible Urban Development in Catchment Areas

It has already been mentioned that the Public Service Commission of Halifax takes precautions that the watersheds supplying civic water are kept relatively free from any pollution and no domestic, recreational, agricultural or industrial activities are allowed. This policy may originate to some extent from an epidemic of typhoid in Halifax in 1913. Since then it has been considered advisable to rely only on unspoiled and unpolluted watersheds for the water supply. This consideration is one of the reasons the Commission has rejected the use of some catchments in the area and, moreover, has considered the abandonment of the Long-Chain catchments, presently used as a water supply, in favour of city development. The Long-Chain source would be replaced by another water supply scheme considered necessary in the long run. The replacement would be far removed from the city and not subject to pollution.

However, there are communities (some in Canada) which are not in such a favourable position as Halifax, i.e., located near untouched areas for thier water supply. Many areas have to rely on their supplies from watersheds already developed for habitation or are compelled to permit a planned growth expansion over these watersheds. It has been found possible to develop these sources and to give a safe civic water supply by suitable control and treatment.

When opening a water supply catchment area for partial or full urban development, the problem of maintaining the water quality unaffected and at the safe level becomes very prominent. There are two aspects to this problem. One is the temporary pollution of the water caused by the physical process of introducing the development into the watershed area. The other is contamination of a more continuous and permanent nature, generated by activities in the area. The latter form of contamination is probably much less of a nuisance nowadays. Under proper control and forward planning the sources of potential contamination are easily identifiable and may be neutralised at the source. As an additional precaution, sludge and solid waste could be disposed of outside the watershed boundaries. A system of control points established on the watersheds could assist in monitoring the pollution in ground water and watercourses, thus detecting any abnormalities. It is, therefore, envisaged that under proper control in fully developed and established areas, disinfection of water by, say, chlorination would still remain a perfectly satisfactory and necessary method of water treatment. No additional treatment would normally be required unless it is necessary to stabilize water by pH adjustments, to add fluoride for health reasons, or otherwise to make water more attractive and useful.

The first aspect, i.e., the pollution of water caused by site clearance, excavation and construction activities, will be mainly portrayed by the increase in colour, turbidity and suspended matter if there are allowed to reach the supply reservoir. These physical changes are, of course, of a temporary nature and their extent and nuisance depend upon the methods employed, the degree of supervision over the construction exercised, and on the length of time taken to complete the development. Prevailing weather, conditions intensity and frequency of rains, also contribute to the extent of pollution finding its way to the water source. By careful planning and foresight many of these adverse changes in physical quality of water may be prevented or at least minimized. For instance, setting aside a strip of land around impounding lake and prohibiting trespassing is one of the normal precautions.

Assuming adequate control and supervision during construction activities, it is quite conceivable that a deterioration in the physical quality of the water could be avoided and that the treatment outlined above would be sufficient. However, it is not certain that the danger of a temporary but severe deterioration during periods of excessive runoff could be entirely eliminated. Moreover, in Halifax there is already a problem of seasonal occurrence of high colour, and the appearance of aquatic forms of life in customers taps is known. The process of disinfection by chlorination together with the pH value adjustment and fluoridation may no longer be considered adequate and certainly no deterioration, even if only temporary, is tolerable.

Clearly there are number of factors bearing on this problem, many of which cannot be evaluated without more detailed study. The extent of treatment required will depend on the controls excercised and the type and rate of development which may take place. For the purpose of this study it has been considered prudent to assume that full treatment comprising chemical pretreatment, settling, sand filtration and chlorination will be necessary. Further study may reveal that less extensive treatment would be adequate. Certainly the use of the Long-Chain lakes and other watersheds in the area for both civic development and civic water supply is considered entirely feasible.

.7 Further Quality Studies

The present activities in the collection and assembly of water quality data in the area should be coordinated and expanded to ensure that adequate information is available for optimum planning and management of the water resources.

Such a bank of water data would facilitate the study of seasonal variations and would be useful in establishing a reference datum from which any future long term changes in quality and pollution contributed to the waters in the area, could be evaluated.

Some of the parameters to be considered are the pH value, colour, turbidity, total solids, hardness, selected chemical constituents, biochemical and biological characteristics.

3.4 GROUND-WATER RESOURCES

This section of the report describes briefly the bedrock and surficial geology of the Greater Halifax-Dartmouth Area and the influence of geological factors on ground-water potential. A review is made of the existing wells, including distribution, yields, chemical quality, and approximate cost figures. On the basis of hydrogeologic data, including information on existing wells, a projection is made to locate areas suitable for ground-water prospecting. Two areas deserve special attention and one, the Sackville River Valley, is described in detail.

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.1 Bedrock Geology

Bedrock formations in the area around Halifax consist mainly of highly folded and faulted metamorphosed Lower Ordovician sediments that were intruded by granitic rocks during Devonian times. These ancient folded sediments, truncated by erosion, are called the Halifax and Goldenville Formations of the Meguma Group. The Halifax Formation, which is the overlying one, is predominantly shale with some schist and minor quartzite, whereas the Goldenville Formation (possibly pre-Ordovician in age) is essentially quartzite with some greywacke, gneiss, and minor slate. Limestone is reported to occur in thin beds at the base of the Halifax Formation. Within the Area, the Halifax Formation has been eroded away in many places leaving the underlying Goldenville Formation exposed. Intrusive Devonian rocks include biotite granite, muscovite-biotite granite, and minor pegmatite. The thick Meguma beds were deposited in a deep geosynclinal basin.

Good water-bearing rocks, such as sandstone and limestone, occur only in poorly defined thin beds. The topography is more rugged in the areas underlain by granitic rocks than in the areas where shales and slates underlie the surface.

.2 Surficial Geology

The surficial deposits in the Area are generally thin and patchy. In Nova Scotia, glaciation did not transport large amounts of weathered bedrock materials over long distances. Therefore, areas underlain by granitic rocks are usually knobby and rough; till deposits developed from them are bouldery. Small lakes, swamps, and poorly drained depressions are commonplace. Long narrow depressions in granitic rock areas are likely to be structurally controlled. Furthermore, areas underlain by slate rocks have smoother topography and the surface soils derived from slate contain fewer stones.

There are many lakes in the Area with their natural outlets much higher than the streams or lakes to which they discharge. This indicates impermeable barriers, of rock and/or drift, controlling the flow of groundwater. Runoff is high.

.3 Ground Water in Bedrock

Sedimentary rocks in the general area have been severely folded and metamorphosed and have been intruded by granitic materials. The occurence of ground water within the bedrock depends mainly on the nature of the existing joints, fault zones, and bedding planes. Examination of existing well logs and capacities indicates a wide variation in well capacities. The capacity of wells is likely to be strongly affected by the bedrock structure in the immediate vicinity of the well. Relatively small lateral movement of ground water in the bedrock over long distances is expected. Because the capacity of wells in bedrock depends on the presence of erratic fractures and the particular number and size of fractures intersected by the drill holes, the yield of wells in bedrock is unpredictable. About the only safe extrapolation that can be made from existing bedrock well data is the location of zones of higher fracture permeability. Most existing wells in the Area are bedrock wells. No well is reported to have a screen in the overburden. The average yield of the existing wells is reported to be between 3 and 15 gpm (Can). Production of 20 gpm (Can) from wells in bedrock is very good for this Area. The extreme range in yield is indicated by two wells: a bedrock well at Westphal is reported to yield 100 gpm (Can) and in the Cole Harbour area a bedrock well yields only 1 gpm (Can).

The well at Westphal penetrates 79 feet of overburden before it strikes bedrock; it is located adjacent to Loon Lake. It is probable that under pumping conditions the lake water is influent to the well. Higher flows than those attainable from bedrock wells may be expected from wells installed in pervious, granular surficial materials.

.4 Ground Water in the Surficial Material

The low performance of existing bedrock wells indicates that the search for large capacity wells must be turned towards surficial materials. Granitic and quartzitic bedrock terrains should possess somewhat better possibilities because glacial soils derived from these rocks have relatively higher permeabilities. These soils are more likely to contain sandy and gravelly materials which, if sorted and redeposited by glacial meltwaters, could form good aquifers. The area has been strongly eroded by glacial action; the immediate local relief generally does not exceed 100 feet over a horizontal distance of 500 feet. The study of high level air photos indicates that the chances of finding buried bedrock channels filled with pervious overburden is poor.

Buried channels, however, are not always uncovered by the examination of air photos. The Sackville River Valley seems to be one such bedrock valley that has been partly filled with glacial drift and alluvial materials. The area around Loon Lake and southwards may be another where a deep overburden masks a bedrock valley.

In the Greater Halifax-Dartmouth Area the problem is to locate surficial aquifers large enough to store, and pervious enough to yield, substantial quantities of ground water. Plate 3 - 9 shows areas considered to be more favourable than other areas for ground-water prospecting.

.5 Factors Controlling Recharge

The average annual rainfall in the Area is 47 inches and the total precipitation is 55 inches. Soil materials overlying the bedrock may be assumed to be constantly wet. The principal factors affecting infiltration of precipitation into aquifers are topography and permeability of the underlying strata; precipitation is ample.

For high-production wells, local recharge conditions are of primary importance. Areas with high local recharge potential adequate for high yields seem to be limited to the Sackville River Valley and to the land south of Loon Lake towards Eastern Passage. Local pockets of saturated sand and gravel adjacent to lakes and streams may also have good recharge potential. The well adjacent to Loon Lake at Westphal is in one such area. Pollution hazard is likely to be greatest in shallow water-table aquifers. Consequently, consideration must be given to reducing the chances of pollution in any present or future development of land resources located in potential ground-water recharge areas.

342 EXISTING WELL FACILITIES

.1 Existing Wells

The number of persons dependent on ground water in the Greater Halifax-Dartmouth Area is approximately 45,000, which is about 22 per cent of the total population of 206,500 (1966). Table 3-18 shows in more detail the population using ground water.

Out of a total of 960 wells in the Area on which data was available, a representative selection was made of 59 wells. The representative wells were selected to portray the conditions of the area in which they were located; the selections were made on the basis of total depth, depth to bedrock, lithologic information, yield, and water quality.

TABLE 3-24

Groundwater - Summary of Reported Information on Water Quality

LOCALITY	AQUIFER OR GEOLOGY	TYPE OF WELLS	QUALITY
HALIFAX	Lower Ordovician Halifax Formation. Northern part: Lower or Pre-Ordovician Goldenville formation	Unknown	often unsatisfactory
DARTMOUTH	Contact between Lower Ordovician Meguma group: Goldenville formation overlain by Halifax formation	Unknown	may be inferior
PURCELLS COVE	Meguma Halifax formation	Dug into surficial deposits: some drilled into bedrock	Poor: high hardness, excessive iron, incidence of saline intrusion
BIRCH COVE	Meguma Halifax formation	Drilled	Doubtful: appreciable quantities of iron and manganese
UPPER AND MIDDLE SACKVILLE	Stratigraphically higher Halifax formation	Drilled into bedrock; some dug into surficial deposits	Excessive iron and manganese
LOWER SACKVILLE	Stratigraphically lower Goldenville formation	Drilled into bedrock; some dug into surficial deposits	Excessive iron and manganese
BEAVER BANK	Meguma Halifax formation	Drilled	Doubtful: appreciable quantities of iron and manganese.
EASTERN PASSAGE	Meguma Goldenville formation	Drilled and dug	Unknown
EAST PRESTON	Meguma Goldenville formation	Drilled and Dug	believed satisfactory
NEW ROAD	Goldenville formation metasediments	Drilled into aquifer some dug into surficial deposits	believed satisfactory
WAVERLEY	Meguma Goldenville formation	Drilled into bedrock	reported satisfactory

TABLE 3-24

Groundwater - Summary of Reported Information on Water Quality

(Continued)

LOCALITY	AQUIFER OR GEOLOGY	TYPE OF WELLS	QUALITY
WINDSOR JUNCTION	Meguma Goldenville formation	Drilled into Meguma metasediments: some dug	reported satisfactory
BEDFORD	Meguma Goldenville formation	Unknown	generally unsatisfactory excessive iron
MOUNT UNIACKE	Contact between Meguma Goldenville formation and Devonian granite	Drilled into bedrock: some dug	reported satisfactory
TIMBERLEA	Devonian granite	mainly drilled some dug	generally fair: excessive iron and manganese
LAKE SIDE	Devonian granite	drilled into bedrock some dug	believed satisfactory
HATCHET LAKE	Devonian granite	Drilled and Dug	believed satisfactory
BOUTILIER'S POINT	Devonian granite	Drilled and Dug	Doubtful
HEAD OF ST. MARGARET'S BAY	Devonian granite	Drilled and dug	Subject to saline intrusion
TERENCE BAY; WHITE LAKE; SHAD BAY	Devonian granite	Dug into surficial deposits: some drilled into bedrock	believed satisfactory
SAMBRO	Devonian granite	Dug into surficial deposits: some drilled into bedrock	Unknown
HERRING COVE	Devonian granite	Dug into surficial deposits: some drilled into bedrock	believed satisfactory

Ref. A.D.B. "N.S. WATER RESOURCES STUDY - APRIL 1967 - Groundwater Section, Dept. of Mines N.S.".