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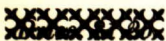
INDUSTRIAL WATER RESOURCES OF CANADA

Supplement to
WATER SURVEY REPORT No. 12

WATER QUALITY AT SOME CANADIAN MILITARY
ESTABLISHMENTS, 1959-1962

BY
J. F. J. THOMAS

ROGER DUHAMEL, F.R.S.C.
QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1963



Mines Branch Monograph 872



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Industrial Water Resources of Canada

Chemical Quality of Water Supplies at Some Canadian Military Establishments, 1959 to 1962: Supplement to Water Survey Report No. 12

At the request of the Department of National Defence (Army) a survey of the chemical quality of waters supplied to a large number of army establishments in Canada was initiated in 1956. Water quality is very important to the efficient operation in peace and war of both small and large military camps. Besides meeting health standards, these supply waters must be suitable for a variety of domestic and industrial uses; in a number of establishments they must also meet special requirements for use in hospitals, laboratories and shops.

Waters of poor chemical and physical quality may seriously lower the efficiency of Camp personnel because of problems from taste, odor, discoloration and/or hardness. Serious stability problems (corrosion or scaling) can cause costly equipment failures and replacements resulting in inefficient operation, especially at small isolated stations or camps.

In the 1956-57 survey, reported in Water Survey Report No. 12,¹ the chemical quality of waters supplied to 135 establishments was studied. Although some information on seasonal variations in water quality was obtained on most of these waters, further studies on seasonal and yearly variations were continued at the request of the Department of National Defence at 15 establishments over the period 1958 to 1961 inclusive; some data were also obtained at a few camps in 1962. *The information obtained during 1958 at these 15 establishments was included as an addendum to Table II in Water Survey Report No. 12.* This Supplement details the information obtained at the same 15 camps for the period 1959 to 1962.

As in the original survey (Water Survey Report No. 12), sampling was carried out once yearly at each establishment but during a different season each year, so that some information on seasonal changes in addition to yearly changes in quality was obtained. Special samples were also analysed from several camps in the investigation of problems of water stability, discoloration, taste and odor or to show the effect of new treatment facilities and techniques.

Table I lists the 15 establishments reported in this Supplement and tabulates general information on water sources, treatment, number of samples analysed and period of sampling.

Table II tabulates the chemical analyses of all the waters collected at army camps from 1959 to 1962 inclusive. As in previous reports of this series, information is included in this table on per cent sodium and saturation and stability indices, to assist in interpreting water quality, especially corrosive or incrustating tendencies.

The assistance of Army and civilian personnel at the various establishments, and particularly personnel of the Utilities Section, Directorate of Works, Army Headquarters, Ottawa, in facilitating the carrying out of this survey is gratefully acknowledged. Acknowledgment is also made to R.M. Gale, Scientific Officer, Industrial Waters Section for assistance in the preparation of this report. All analyses reported were carried out by the laboratory staff of the Industrial Waters Section under the direction of W.J. Traversy.

SURVEY PROCEDURE

The same program of 'quarterly' sampling begun in 1956 and outlined in Water Survey Report No. 12 was continued, i.e. each year water samples were obtained from all 15 establishments during one season of the year. The sampling dates were changed yearly so that waters were collected over the five-year period at different seasons of the year. Table I shows the rotation of sample collection over the period 1957 to 1962. In some years samples were not received when requested, and this resulted in waters being collected at the same period each year.

As in previous surveys sample containers were shipped to each establishment prior to the sampling date with the request that representative samples of all untreated and treated waters used by the establishment be collected and forwarded to the Ottawa laboratory. Usually a 2-litre sample was obtained of each water; separate samples of all well waters (150 to 250 ml) were obtained for the determination of total iron and manganese. Samples were collected by camp personnel from pumps, taps, reservoirs or direct from lakes and rivers.

ANALYTICAL PROCEDURE

The analytical methods used in this study are essentially those employed in the previous survey (Water Survey Report No. 12); these methods are for the most part standard procedures for the analyses of waters published by the American Public Health Association² and by the American Society for Testing and Materials.³

Basic methods and the interpretation of analyses are discussed in some detail in Water Survey Report No. 1, published in 1953.⁴ New methods and techniques developed since 1953 have been adopted as standard procedures

¹ Reference Appendix B, page 56

² Standard Methods for the Examination of Water, Sewage and Industrial Wastes, 11th Edition, 1960. American Public Health Association, Inc., 1790 Broadway, New York 19, N.Y.

³ Manual on Industrial Water, A.S.T.M. Special Technical Publication No. 148D, 1959. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

⁴ Industrial Water Resources of Canada, Department of Mines and Technical Surveys, Ottawa. Water Survey Report No. 1: Scope, Procedure and Interpretation of Survey Studies, Mines Branch Report No. 833, 1953.

by the Industrial Waters Section and changes in many methods are continually under way in order to improve the accuracy, precision and speed of analytical work. More recent Water Survey Reports, particularly reports Nos. 10, 12 and 13,¹ discuss in some detail the newer methods used.

DISCUSSION

The water quality at each establishment covered in this report is discussed generally but no attempt is made to interpret in detail the data of this report. Graphical presentation of the data at each plant would greatly facilitate a study of changes in quality due to season, year or other factors. Because the data will be used for different purposes by different people it is not considered feasible to attempt to present all the data of this report in graphs that would be useful to all users.

Camp Gaġetown, N.B.

The two wells at this large establishment have changed markedly in chemical quality since their development about 1955. Special studies carried out on these waters have been reported in several Mines Branch test and investigation reports. Some data from these reports are included in Water Survey Report No. 12 and in this Supplement.

Both wells increased in mineralization up to 1958, particularly in hardness and chloride content. Iron, and especially manganese contents, are high and have varied over the same period. Well No. 2 showed a lower increase in mineralization than did well No. 1 and special studies showed that by pumping well No. 1 continuously to waste, the total mineral content in well No. 2 could be lowered. However, the manganese and iron contents of well No. 2 still remained high.

This report shows little change in well No. 1 quality with season or year. Some increase in total mineralization, especially in chloride, sodium, manganese and hardness, is evident in well No. 2 in 1961. This increase persists, even when well No. 1 is being continually pumped to waste.

Continual use of these wells (well No. 2 to camp use and well No. 1 to waste) is not producing a water satisfactory for general camp use. There is some evidence that well water quality is still deteriorating.

Despite treatment the manganese content of the camp water is still higher than normally permitted and the supply does not meet municipal water quality standards in several ways.

McGivney, N.B.

Both well waters at McGivney showed little significant change in quality with season or year although, at times, some decrease in mineralization was found in March and April. Samples collected in August, 1961 showed possibly a slight increase in the iron content in both well waters and a very slight increase in mineralization (sodium bicarbonate) in the PMQ well water. Both waters are low in hardness and mineralization.

Camp Bouchard, Quebec

Well No. 1 showed little change until the 1962 spring sample was taken, when mineralization was higher than previously found. Well No. 2 showed a somewhat similar increase in 1960, mostly in sodium, chloride and sulphate content. Wells No. 1 and No. 2 and the mixed well waters showed a high ratio of magnesium to calcium. Well No. 4 showed little change over the period 1958 to 1961.

Wells No. 1 and No. 2 show relatively high contents of fluoride and phosphate; well No. 4 was low in both these constituents.

The mixed well supply after aeration showed insignificant change with season or year. More significant changes could occur owing to varying mixture of well waters. The mixed well water still showed relatively high contents of phosphate and fluoride.

Ste Foy, Quebec

The military establishment uses Ste Foy municipal well waters, which showed no significant change in quality since 1958, at which time an increase in total mineralization was noted. These waters were not considered to be of good quality, being very hard and having high sodium, calcium, sulphate, iron and manganese contents. Some indication was noted of seasonal variation, with high mineralization in January and lower mineralization in August, 1961.

Camp Valcartier, Quebec

Up to and including 1958, wells No. 1, No. 3 and No. 5 were in use and showed little change in quality; all three wells are of similar quality. Since then mixtures of wells No. 3, No. 27 and No. 28 have been used as the Camp supply. Well No. 3 showed marginal improvement in quality during this period; wells No. 27 and No. 28 showed little change.

The mixed well water supply is considered to be a good quality water, being low in mineralization and soft, although it is relatively high in silica content. Some indication of an increase in mineralization since 1958 was noted in 1961, but it is not significant so far as quality is concerned.

¹ Reference Appendix B, page 56

Camp Borden, Ontario

Five wells are available and the mixed supply, therefore, varies with the number of wells in use and the admixture of waters. In 1956 and 1957 wells No. 1, No. 2 and No. 3 were in use; since 1957 wells No. 1, No. 4, No. 5 and possibly No. 2 have been used.

Well No. 1 shows some variability in quality, with a decrease in mineralization, especially hardness salts and sulfates, although some increase in iron and fluoride contents was indicated in 1960 and 1961. Mineralization was highest in mid winter (February).

Well No. 2 is a similar water to that of well No. 1; however, in August 1961 some decrease in calcium and hardness was noted in comparison with April 1957 samples but the iron content remained high.

Wells No. 4 and No. 5 showed some increase in iron content since 1958 and well No. 4 appeared to be influenced seasonally, with mineralization being somewhat lower in the winter.

The mixed well-water supply showed severe iron pick-up owing to corrosion of the distribution system.

Camp Hagersville, Ontario

Lake Erie, the main source of supply, showed, as expected, little significant change during the period of study although the final camp water supply did show corrosion of the system, with iron being dissolved by the water.

The well water was very hard, and highly mineralized, with some increase in mineralization noted in mid summer, 1961. These well waters are of very poor quality for camp use, having high iron, sulphate, hardness and total mineralization.

Camp Petawawa, Ontario

The main source, the Ottawa River, showed changes with the season but none were significant as to final quality. Mineralization was lowest in early summer (May, June) and highest in mid winter.

The spring water showed little seasonal change except in flow; some increase in hardness and mineralization has occurred since 1957.

The mixed supply likewise showed no changes in quality that could not be accounted for by variations in the mixture of river and spring water. Usually the amount of spring water used was small compared to river water use.

The quality of the final water supply varied markedly because of iron pick-up in the system.

Fort Churchill, Manitoba

The raw water, Lake Isabelle, varied widely in quality, often being highly mineralized from March to May and low in mineralization in mid-summer. These variations in mineralization changed with the season and other factors.

The quality of the finished or treated water also varied widely, owing to the variations in the raw water and to changes in treatment.

This water supply is not altogether satisfactory for camp use because of its variable quality. At times, poor quality raw water and insufficient treatment result in unsatisfactory water entering the system.

Camp Shilo, Manitoba

A number of wells are available so that variations in the final supply depend to a considerable extent on the relative usage and admixture of wells in the system; however, these wells are all of a similar general character.

Well No. 1, a hard, bicarbonate water, showed some decrease in mineralization in the summer, but iron and manganese contents remained high. Well No. 2 is of similar chemical quality to well No. 1.

Well No. 3, also similar in quality to well No. 1, showed little change in quality with season, except that, since 1958, mineralization was lower in the February-April period and fluoride, iron and manganese contents remained high. Phosphate has increased in this well.

Well, No. 4 is highly mineralized and showed little change effecting its end use, except that phosphate also increased. Iron and manganese were also high in 1961.

Well No. 5 (Disposal Plant well) also showed little change in quality over the years or during the year. It is low in iron and manganese and much softer than the above four wells, although it is still classed as a hard water.

The Golf Course well also showed little change in quality, except for increased phosphate in 1961. It too is high in iron and manganese.

The Rifle Range well is a very hard water showing little change over the survey period except a slight increase in mineralization since 1960. It has a variable iron content (high in the late winter) and a low manganese content.

It is significant that wells No. 1, No. 3 and No. 4 as well as the Golf Course well are high in iron and manganese, while well No. 5 and the Rifle Range well are normally low in manganese and iron.

The mixed well supply is fairly consistent in quality prior to treatment, with the iron content low, but the manganese content becomes high at times. All wells and the final supply are relatively high in silica.

The softened water is quite variable, apparently due to inconsistency in the operation of the ion exchange softeners.

Camp Dundurn, Saskatchewan

The North Well water is highly mineralized and very hard, but shows little change with time, except for some increase in phosphate and variable manganese content. Iron content is very high at all times and in consequence, the wells are turbid because of precipitated and colloidal iron oxides.

West Well water is also quite highly mineralized, although considerably lower than North Well water. It also showed high iron and manganese, especially in 1960 and 1961. Some increase in hardness and fluoride was evident in 1961.

Recent treatment (aeration and filtration) of the mixed well waters, shows that although considerable iron is precipitated, both dissolved iron and manganese still remain high after aeration only. Filtration and resultant retention further decreases the iron, turbidity and total mineralization, but the manganese remains high. After such treatment the water is still hard and varied in quality, especially in sodium and bicarbonate.

The final camp water (i.e. after aeration, filtration, and ion exchange softening) usually shows satisfactory iron removal, but the manganese content, is still too high at times. Quality variation in the final water is quite wide, due no doubt to variations in well mixture and ion exchange operation.

Camp Wainwright, Alberta

The Battle River water varies very widely in quality. This variation is clearly shown in data reported in Water Survey Report No. 7, - Saskatchewan River Drainage Basin¹- published in 1956. This river water is very hard and highly mineralized with a high iron content in winter; a better quality water is obtained in late summer and early fall.

Betty Lake shows somewhat the same variations, except that it is usually lower in mineralization and hardness than the river water. Its quality, also, varies with the season and, of course, with the amount of river water added to this small lake. Attention is directed to the high magnesium-to-calcium ratio in this lake water, its low iron and manganese content and, at times, high phosphate content. The latter showed some increase in 1961. The lake water is always very hard but normally much lower in sulphate than the river water.

The final mixed water from these two sources is, because of softening treatment, much lower in mineralization and hardness. The magnesium-to-calcium ratio remains high, as does the phosphate content. The water varies somewhat in final quality depending again upon treatment and season.

Camp Chilliwack, British Columbia

Vedder River water, the principal supply, showed no changes over the year or season that are significant to its end use. Mineralization is normally higher in mid-winter (January).

The well water has very high iron and silica content and, since 1958, some manganese. The total hardness and mineralization increased somewhat in 1961 but, the water is still classed as a soft water.

Fort Nelson, British Columbia

This well provides a very poor quality water, being very high in iron and total mineralization, especially hardness salts. Manganese is also high and apparently varies with sampling; the fluoride content appears to have increased in 1961. Variations in the well water are noted, mineralization increasing in the winter.

After treatment the water still varies in quality, at times having high contents of iron, and suspended matter and it is still not considered a satisfactory municipal supply. Seasonal variations, as well as treatment and plant operation, cause the variations noted in the final water.

The Muskwa River shows some variation especially in turbidity, the poorest quality water occurring during the fall and early winter. An Investigation Report (IR 60-41), A Survey of Water Quality at Camp Muskwa, Fort Nelson, B.C. shows a year's variation in this river at Fort Nelson.

Camp Takhini, Whitehorse, Y.T.

McIntyre Creek showed little significant change in quality with year or season, although mineralization was lower in mid winter (February). The water is classed as a medium-hard to hard water, relatively hard in silica, but considered to be a satisfactory supply for municipal use.

¹ Reference Appendix B, page 56

TABLE I

Water Source, Water Treatment and Sampling Periods at Some Military Establishments

Military Establishment	Source of Water Supply	Water Treatment
<u>NEW BRUNSWICK</u>		
Camp Gagetown	Two deep wells Oromocto River St. John River	Polyphosphate addition None - not used in camp None - not used in camp
McGivney	Two deep wells	None
<u>QUEBEC</u>		
Camp Bouchard	Three deep wells	Aeration for H ₂ S removal and chlorination
Ste. Foy	Municipal wells	None
Camp Valcartier	Three deep wells	None
<u>ONTARIO</u>		
Camp Borden	Four deep wells	Chlorination
Camp Hagersville, near Hagersville	Two deep wells Lake Erie	None Chlorination
Camp Petawawa	Springs and Ottawa River	Chlorination
<u>MANITOBA</u>		
Fort Churchill	Lake Isabelle	Coagulation (lime, alum, soda ash, activated silica); pH adjustment (H ₂ SO ₄); activated carbon addition, pressure filtration and chlorination.
Camp Shilo	Seven deep wells	Ion exchange softening
<u>SASKATCHEWAN</u>		
Camp Dundurn, near Dundurn	Two deep wells	None up to and including 1959; since 1960, aeration and filtration for iron removal, ion exchange softening and chlorination.
<u>ALBERTA</u>		
Camp Wainwright, near Wainwright	Battle River and Betty Lake	Coagulation (alum), softening (lime), activated carbon addition, gravity filtration and chlorination.
<u>BRITISH COLUMBIA</u>		
Camp Chilliwack, near Chilliwack	Well Vedder River	Chlorination Chlorination
Fort Nelson	Deep well Muskwa River	Heating and aeration for iron removal, lime-soda ash softening, alum and activated carbon addition and chlorination. None - not used in Establishment
<u>YUKON TERRITORY</u>		
Camp Takini, near Whitehorse	McIntyre Creek	Chlorination
15 Establishments		

* Reported in Water Survey Report No. 12

TABLE I

Water Source, Water Treatment and Sampling Periods at Some Military Establishments

Sampling Periods						Number of Samples Reported - 1959 to 1962, inclusive
Spring, 1957*	Summer, 1958*	Autumn, 1959	Winter, 1960	Summer, 1961	Spring, 1962	
February June —	June: October — —	October — —	February: April June June	June: August — —	— — —	22 1 1
April	July	October	March	August	—	6
April	July	October	February	August	April	11
April	May	October	January	August	—	6
April	June	October	February	August	—	12
April	July	October	Feb.: Oct.	Aug. : Nov.	—	14
— April	June June	October October	February February	August August	— March: April	3 6
May	May: September	October	February	Aug.: Oct.	Jan.: May	23
March: Nov.	May	October	February	May: June Sept.: Nov.	Jan. to May, inclusive	26
April	July	October	February	August	—	19
April	June	October	Monthly from Jan. to Sept., inclusive	August	—	27
Feb.: May	July	October	February	August	—	8
{ March: April	July	October	January	August	—	6
April: June	July: Oct.	Oct.: Nov.	Jan.: Feb.	Oct.: Nov.	—	14
—	—	November	January	Oct.: Nov.	—	4
Feb.: May	June	October	February	October	—	5
		46	72	83	13	214

TABLE II
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)

PROVINCE

NEW BRUNSWICK

Camp or establishment		CAMP GAGETOWN			
No.	Source(s)	Deep wells			
		Well No. 1*			
		Raw water			
	Sampling point	At pump			
		Oct. 19/59	Feb. 8/60	April 28/60	Aug. 22/61
1	Date of sampling	Oct. 19/59	Feb. 8/60	April 28/60	Aug. 22/61
2	Storage period (days)	25:36	37:93	11	6:7
3	Sampling temperature, °C.	10.6			10.6
4	Test temperature, °C.	24.4	26.7		23.1
5	Oxygen consumed by KMnO ₄				
6	Carbon dioxide(CO ₂), (calculated)	2	3.5		2
7	pH	8.1	7.9		8.3
8	Colour	0	0		0
9	Turbidity	0	0		0
10	Suspended matter, dried at 105° C.				
11	Suspended matter, ignited at 550° C.				
12	Residue on evaporation, dried at 105° C.	1,151			1,236
13	Ignition loss at 550° C.	132			180
14	Specific conductance, micromhos at 25° C.	2,051	2,012		2,128
15	Calcium (Ca)	120	113		119
16	Magnesium (Mg)	10.6	7.8		10.0
17	Iron (Fe) Total	0.06	0.00	0.01	0.03
18	Dissolved	Trace	0.00	Trace	0.03
19	Manganese (Mn) Total	1.2	1.2	1.0	1.2
20	Dissolved	0.20	0.03		1.2
21	Aluminum (Al)	0.03	0.07		0.07
22	Copper (Cu)	0.0	0.13		0.02
23	Zinc (Zn)	0.0	0.01		0.2
24	Sodium (Na)	272	255		296
25	Potassium (K)	1.4	1.4		1.4
26	Ammonium (NH ₄)	0.0	0.0		
27	Carbonate (CO ₃)	0.0	0.0		0.0
28	Bicarbonate (HCO ₃)	182	172		217
29	Sulphate (SO ₄)	31.9	27.8		29.1
30	Chloride (Cl)	542	512	524	546
31	Fluoride (F)	0.3	0.2		0.66
32	Phosphate (PO ₄) Total	0.1	0.0		1.5
33	Dissolved				0.34
34	Nitrate (NO ₃)	0.4	0.1		0.4
35	Silica (SiO ₂), colorimetric	9.1	6.5		7.8
36	Carbonate hardness as CaCO ₃	149	142		178
37	Non-carbonate hardness as CaCO ₃	193	172		161
38	Total hardness as CaCO ₃	342	314	329	339
39	Sum of constituents	1,077	1,008		1,117
40	Per cent sodium	63	64		65
41	Saturation index at test temperature	+0.8	+0.6		+1.1
42	Stability index at test temperature	6.5	6.7		6.1
43	Redox potential (mv)				
44	Hydrogen sulphide (H ₂ S)				
45	Water level at sampling (ft)	80	112	118	88
Remarks		* Well not used in system			

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)
 NEW BRUNSWICK

C AMP GAGETOWN						No.
Deep wells						
Well No. 2						
Raw water						
At pump						
Oct. 19/59	Feb. 8/60	Apr. 28/60	June 22/61	Aug. 14/61	Aug. 22/61	
25:36	53:87	11	7:11	17:23	6:7	1
10.6			11.7		10.6	2
24.3	25.8		23.3	23.4	23.1	3
						4
						5
2	5		3	5	2	6
8.2	7.8		8.2	7.9	8.3	7
5	0		0	10	0	8
0	0		0	0	0	9
						10
						11
626						12
16.4						13
1,152	1,179		1,186	1,240	1,343	14
65.2	65.7		61.7	64.6	72.7	15
6.4	6.3		8.8	7.3	7.2	16
0.03	0.00	0.01	0.01	0.06	0.03	17
Trace	0.00	Trace	0.01		0.02	18
0.60	0.10	0.60	0.60	0.73	0.78	19
0.07	Trace			0.01	0.78	20
0.05	Trace			0.04	0.08	21
0.0	0.0			0.0	Trace	22
0.0	0.0			0.0	0.0	23
160	165		174	174	188	24
1.1	1.0		1.2	1.1	1.2	25
0.0	0.0		0.05			26
0.0	0.0		0.0	0.0	0.0	27
203	220		240	239	235	28
30.1	26.3		26.6	25.5	25.0	29
245	246	258	252	252	284	30
0.5	0.6			0.63	0.74	31
0.13	0.09			2.2	1.3	32
					0.2	33
0.4	0.0		0.7	1.2	0.5	34
9.6	6.8		7.5	7.1	8.0	35
166	180.5		190	191	193	36
22.7	9.5		0.0	0.0	18.4	37
189	190	203	190	191	211	38
618	626		650	651	704	39
65	65		66	66	66	40
+0.7	+0.4		+0.8	+0.5	+0.9	41
6.8	7.0		6.6	6.9	6.5	42
						43
			0.0	0.0		44
80	112	118	106		88	45

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)

PROVINCE NEW BRUNSWICK - (cont'd)

Camp or establishment		CAMP GAGETOWN (cont'd)			
		Oromocto River	St. John River	Deep wells*	
No.	Source(s)	Raw water		Finished water	
		Near emergency intake	Near proposed intake	At cold tap at end of system	At cold tap at Brad Townsite
Sampling point		June 1/60	June 1/60	Oct. 19/59	Feb. 8/60
1	Date of sampling	June 1/60	June 1/60	Oct. 19/59	Feb. 8/60
2	Storage period (days)	12	12	25:36	37:93
3	Sampling temperature, °C.	23.4	23.3	15.0	24.4
4	Test temperature, °C.	23.4	23.3	24.3	24.4
5	Oxygen consumed by KMnO ₄	3.4	1.5	3.4	2.5
6	Carbon dioxide (CO ₂), (calculated)	6.3	7.4	1.5	2.5
7	pH	100	50	8.3	8.1
8	Colour	2	0.4	5	0
9	Turbidity	2	0.4	0	0
10	Suspended matter, dried at 105° C.	2	0.4	0	0
11	Suspended matter, ignited at 550° C.	2	0.4	0	0
12	Residue on evaporation, dried at 105° C.	2	0.4	626	626
13	Ignition loss at 550° C.	2	0.4	18.8	18.8
14	Specific conductance, micromhos at 25° C.	30.0	116	1,149	1,136
15	Calcium (Ca)	30.0	116	65.2	51.5
16	Magnesium (Mg)	1.0	0.05	6.4	10.7
17	Iron (Fe) Total	1.0	0.05	0.18	0.04
18	Dissolved	0.10	Trace	0.02	0.00
19	Manganese (Mn) Total	0.10	Trace	0.55	0.30
20	Dissolved	0.10	Trace	0.07	0.02
21	Aluminum (Al)	0.10	Trace	0.04	0.07
22	Copper (Cu)	0.10	Trace	0.0	Trace
23	Zinc (Zn)	0.10	Trace	0.0	0.02
24	Sodium (Na)	0.10	Trace	160	160
25	Potassium (K)	0.10	Trace	1.1	1.1
26	Ammonium (NH ₄)	0.10	Trace	0.0	0.1
27	Carbonate (CO ₃)	0.10	Trace	0.0	0.0
28	Bicarbonate (HCO ₃)	0.10	Trace	202	199
29	Sulphate (SO ₄)	0.10	Trace	28.2	25.5
30	Chloride (Cl)	0.10	Trace	247	239
31	Fluoride (F)	0.10	Trace	0.5	0.2
32	Phosphate (PO ₄) Total	0.10	Trace	0.3	Trace
33	Dissolved	0.10	Trace	0.3	Trace
34	Nitrate (NO ₃)	0.10	Trace	0.4	0.1
35	Silica (SiO ₂), colorimetric	0.10	Trace	9.2	6.8
36	Carbonate hardness as CaCO ₃	8.1	36.0	166	163
37	Non-carbonate hardness as CaCO ₃	1.9	9.9	23.2	9.6
38	Total hardness as CaCO ₃	10.0	45.9	189	173
39	Sum of constituents	10.0	45.9	618	593
40	Per cent sodium	10.0	45.9	65	67
41	Saturation index at test temperature	10.0	45.9	+0.8	+0.5
42	Stability index at test temperature	10.0	45.9	6.7	7.1
43	Redox potential (mv)	10.0	45.9	6.7	7.1
44	Hydrogen sulphide (H ₂ S)	10.0	45.9	6.7	7.1
45	Water level at sampling (ft)	10.0	45.9	6.7	7.1
Remarks		* Well No. 2 or mostly well No. 2			

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)
 NEW BRUNSWICK - (cont'd)

CAMP GAGETOWN (cont'd)						No
Deep wells*						
Finished water						
At cold tap at end of system	At Anglican cold water tap	Church Hall hot water tap	At hot tap near end of system	At high school cold water tap	hot water tap	
Apr. 28/60 11	June 22/61 6	June 22/61 6	Aug. 14/61 17:23	Aug. 14/61 6	Aug. 14/61 6	1
.....	23.3	.....	.....	2
.....	3
.....	3	.....	.....	4
.....	8.1	.....	.....	5
.....	0	.....	.....	6
.....	0	.....	.....	7
.....	8
.....	9
.....	10
.....	11
.....	12
.....	1,723	.....	.....	13
.....	93.9	.....	.....	14
.....	8.7	.....	.....	15
0.21	0.87	0.45	0.12	16
.....	17
0.60	0.60	0.14	0.88	1.1	0.94	18
.....	0.34	.....	.....	19
.....	0.05	.....	.....	20
.....	0.0	.....	.....	21
.....	0.0	.....	.....	22
.....	238	.....	.....	23
.....	1.2	.....	.....	24
.....	0.1	.....	.....	25
.....	0.0	.....	.....	26
.....	221	.....	.....	27
.....	25.5	.....	.....	28
255	415	.....	.....	29
.....	0.63	.....	.....	30
.....	2.9	.....	.....	31
.....	32
.....	0.5	.....	.....	33
.....	7.4	.....	.....	34
.....	181	.....	.....	35
.....	88.7	.....	.....	36
199	270	.....	.....	37
.....	900	.....	.....	38
.....	65	.....	.....	39
.....	+0.8	.....	.....	40
.....	6.5	.....	.....	41
.....	42
118	0.0	0.9	.....	0.0	0.0	43
.....	44
.....	45

* Well No. 2 or mostly well No. 2

Sampled after continuous use

Sampled after intermittent use

Sampled after infrequent use

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)

PROVINCE

NEW BRUNSWICK (cont'd)

Camp or establishment		CAMP GAGETOWN (cont'd)			
No.	Source(s)	Deep wells*			
	Finished water				
	Sampling point	At PMQ pumping station		At Anglican Church Hall	
		cold water tap	hot water tap	cold water tap	hot water tap
1	Date of sampling	Aug. 14/61	Aug. 14/61	Aug. 14/61	Aug. 14/61
2	Storage period (days)	6	6	6	6
3	Sampling temperature, °C.				
4	Test temperature, °C.				
5	Oxygen consumed by KMnO ₄				
6	Carbon dioxide (CO ₂), (calculated)				
7	pH				
8	Colour				
9	Turbidity				
10	Suspended matter, dried at 105°C.				
11	Suspended matter, ignited at 550°C.				
12	Residue on evaporation, dried at 105°C.				
13	Ignition loss at 550°C.				
14	Specific conductance, micromhos at 25°C.				
15	Calcium (Ca)				
16	Magnesium (Mg)				
17	Iron (Fe) Total	0.04	0.50	2.7	
18	Dissolved				
19	Manganese (Mn) Total	0.72	0.97	0.70	
20	Dissolved				
21	Aluminum (Al)				
22	Copper (Cu)				
23	Zinc (Zn)				
24	Sodium (Na)				
25	Potassium (K)				
26	Ammonium (NH ₄)				
27	Carbonate (CO ₃)				
28	Bicarbonate (HCO ₃)				
29	Sulphate (SO ₄)				
30	Chloride (Cl)				
31	Fluoride (F)				
32	Phosphate (PO ₄) Total				
33	Dissolved				
34	Nitrate (NO ₃)				
35	Silica (SiO ₂), colorimetric				
36	Carbonate hardness as CaCO ₃				
37	Non-carbonate hardness as CaCO ₃				
38	Total hardness as CaCO ₃				
39	Sum of constituents				
40	Per cent sodium				
41	Saturation index at test temperature				
42	Stability index at test temperature				
43	Redox potential (mv)				
44	Hydrogen sulphide (H ₂ S)	0.0	0.0		0.0
45	Water level at sampling (ft)				
Remarks		Sampled after continuous use	Sampled after heavy and con- tinuous use		
		* Well No. 2 or mostly well No. 2			

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)
 NEW BRUNSWICK (cont'd)

CAMP GAGETOWN	Mc GIVNEY.					No.
Deep wells*	Deep wells					
	Administration Area well			PMQ Area well		
Finished water	Raw and finished water					
At cold tap, Bldg. B-18	At pumps					
	Oct. 22/59	Mar. 14/60	Aug. 29/61	Oct. 22/59	Mar. 14/60	
Aug. 22/61	Oct. 22/59	Mar. 14/60	Aug. 29/61	Oct. 22/59	Mar. 14/60	1
6.7	39:81	29:63	20:28	39:81	29:63	2
20.6	.....	4.4	5.6	.....	4.4	3
23.0	22.9	25.3	22.1	22.9	25.4	4
.....	5.0	.....	0.1	5.3	.....	5
2	3.5	3.5	8	3	3	6
8.3	7.3	7.2	6.9	7.5	7.4	7
0	0	0	0	0	0	8
0	4	0	0.8	0	0	9
.....	.....	.....	.....	.....	.....	10
876	.....	.....	101	.....	.....	11
56.0	.....	.....	29.6	.....	.....	12
1,569	114.5	93.2	102	128	108.5	13
85.2	16.9	13.5	15.0	19.6	16.7	14
8.4	1.9	0.9	1.7	1.8	1.3	15
0.12	0.76	0.04	0.28	0.06	0.08	16
0.05	0.11	0.02	.....	0.00	0.02	17
0.95	0.00	<0.05	0.00	0.00	<0.05	18
0.95	0.00	0.01	0.00	0.00	0.02	19
0.05	0.01	0.03	0.0	0.03	0.03	20
0.05	0.0	Trace	0.0	0.0	Trace	21
0.0	0.0	0.02	0.0	0.0	0.0	22
220	2.5	2.2	2.5	3.6	2.3	23
1.3	0.3	0.4	0.4	0.5	0.4	24
.....	0.0	0.5	0.0	0.0	.....	25
0.0	0.0	0.0	0.0	0.0	0.0	26
229	41.4	36.8	38.6	61.2	51.8	27
25.5	10.3	8.1	9.9	10.2	8.4	28
357	6.9	2.9	5.0	2.4	1.6	29
0.66	0.0	0.05	0.04	0.0	0.1	30
1.9	0.1	0.0	<0.1	0.02	Trace	31
1.5	.....	.....	<0.1	.....	.....	32
0.6	1.6	0.1	2.3	0.0	0.1	33
6.6	9.7	8.3	8.9	13	9.3	34
188	34.0	30.2	31.7	50.2	42.5	35
59.3	16.0	7.3	12.6	6.1	4.7	36
247	50.0	37.5	44.3	56.3	47.2	37
821	70.7	54.6	65.1	81.1	65.8	38
66	9.7	11	11	12	9.5	39
+1.0	-1.3	-1.6	-1.9	-1.0	-1.1	40
6.3	9.9	10	11	9.5	9.6	41
.....	.....	.....	.....	.....	.....	42
.....	.....	.....	.....	.....	.....	43
.....	.....	.....	.....	.....	.....	44
.....	.....	.....	Normal	.....	50	45

* Well No. 2 or mostly well No. 2

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)

PROVINCE		N.B. (concl'd)	QUEBEC		
No.	Camp or establishment	Mc GIVNEY (concl'd)	CAMP BOUCHARD, near STE. THERESE		
	Source(s)	Deep wells	Deep wells		
		PMQ Area well	Well No. 1		
		Raw and finished water	Raw water		
Sampling point	At pumps	At pumps			
		Aug. 29/61	Oct. 8/59	Feb. 10/60	Aug. 22/61
1	Date of sampling	20:28	13:35	61:96	10:15
2	Storage period (days)	5.6	7.2	7.2	7.8
3	Sampling temperature, °C.	22.2	25.3	25.9	23.0
4	Test temperature, °C.	0.0	.....	.....	8.4
5	Oxygen consumed by KMnO ₄	14	2.5	3.5	2
6	Carbon dioxide (CO ₂), (calculated)	6.9	8.3	8.2	8.4
7	pH	0	20	25	25
8	Colour	0	0	1	0
9	Turbidity .....	.....		
10	Suspended matter, dried at 105° C. ....	.....		
11	Suspended matter, ignited at 550° C. ....	.....		
12	Residue on evaporation, dried at 105° C.	111	376	.....	405
13	Ignition loss at 550° C.	20.0	36.4	.....	40.4
14	Specific conductance, micromhos at 25° C.	139	645	640	687.5
15	Calcium (Ca)	19.2	7.0	6.4	4.2
16	Magnesium (Mg)	1.6	8.4	8.6	10.9
17	Iron (Fe) Total	0.31	0.11	0.12	0.06
18	Dissolved	0.00	0.02	0.00	0.03
19	Manganese (Mn) Total	0.01	.....	<0.05	0.00
20	Dissolved	0.01	0.00	0.00	0.00
21	Aluminium (Al)	0.02	0.05	0.0	0.08
22	Copper (Cu)	0.0	Trace	0.0	0.07
23	Zinc (Zn)	0.0	0.0	0.0	0.1
24	Sodium (Na)	6.1	129	125	137
25	Potassium (K)	0.4	9.8	9.1	9.1
26	Ammonium (NH ₄)	0.0	0.3	0.1	.....
27	Carbonate (CO ₃)	0.0	0.0	0.0	2.4
28	Bicarbonate (HCO ₃)	64.6	337	334	348
29	Sulphate (SO ₄)	9.8	10.6	8.8	10.2
30	Chloride (Cl)	2.7	36.4	32.4	43.8
31	Fluoride (F)	0.18	1.1	1.0	1.5
32	Phosphate (PO ₄) Total	<0.1	2.6	2.0	2.2
33	Dissolved	<0.1	.....	.....	2.2
34	Nitrate (NO ₃)	0.7	0.9	0.1	1.2
35	Silica (SiO ₂), colorimetric	10	11	9.2	10
36	Carbonate hardness as CaCO ₃	53.0	52.0	51.5	55.4
37	Non-carbonate hardness as CaCO ₃	1.5	0.0	0.0	0.0
38	Total hardness as CaCO ₃	54.5	52.0	51.5	55.4
39	Sum of constituents	82.9	380	367	404
40	Per cent sodium	19	81	81	81
41	Saturation index at test temperature	-1.5	+0.1	0.0	0.0
42	Stability index at test temperature	9.9	8.1	8.2	8.4
43	Redox potential (mv) .....	.....		
44	Hydrogen sulphide (H ₂ S) .....	.....		
45	Water level at sampling (ft)	Normal	39	39	.....
Remarks					

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)
 QUEBEC

CAMP BOUCHARD, near STE. THERESE						No.
Deep wells						
Well No. 1	Well No. 2		Well No. 4	Mixed wells		
Raw water	Raw water			Finished water		
At pumps	At pump		At pump	At tap, Bldg. No. 29	At tap, Bldg. No. 39	
April 11/62	Oct. 8/59	Feb. 10/60	Feb. 10/60	Oct. 8/59	Oct. 7/59	1
7:13	13:35	61:96	61:96	13:35	14:36	2
.....	7.2	7.2	7.2	.....	7.8	3
24.4	25.2	25.6	25.4	25.3	25.2	4
.....	.....	.....	.....	8.0	8.0	5
4	3.5	2	3	3.5	3	6
8.2	8.2	8.5	8.1	8.2	8.2	7
25	35	40	5	30	30	8
0	1	1	0.4	0	0	9
.....	.....	.....	.....	.....	.....	10
.....	492	.....	.....	402	350	11
.....	48.8	.....	.....	42.0	45.2	12
700	845	941	410.5	726	721	13
4.2	8.0	7.5	61.7	7.2	7.6	14
11.7	10.3	10.2	9.3	9.4	9.3	15
0.24	0.04	0.12	0.21	0.05	0.14	16
0.01	Trace	0.06	0.00	0.00	0.00	17
0.01	.....	0.05	0.05	.....	.....	18
Trace	0.00	0.02	0.00	0.00	0.00	19
0.0	0.0	0.0	0.03	0.02	0.05	20
0.0	Trace	Trace	Trace	Trace	Trace	21
.....	0.0	0.05	0.0	0.05	0.0	22
135	168	190	11.0	142	144	23
9.8	11.0	10.9	2.6	10.2	10.2	24
0.5	0.3	0.2	0.1	0.1	0.1	25
0.0	0.0	7.6	0.0	0.0	0.0	26
354	385	369	241	357	354.5	27
10.4	16.1	21.0	19.1	11.6	11.9	28
47.2	75.2	98.2	1.8	52.3	52.9	29
1.4	1.2	0.5	0.05	1.2	1.2	30
2.5	2.6	2.3	0.2	2.5	2.5	31
2.3	.....	.....	.....	.....	.....	32
0.4	0.2	0.2	0.1	1.0	0.8	33
8.9	10	8.4	14.5	10	11	34
58.7	62.3	60.6	192	56.6	57.2	35
0.0	0.0	0.0	0.0	0.0	0.0	36
58.7	62.3	60.6	192	56.6	57.2	37
403	489	547.5	239	421	423	38
81	83	85	11	82	82	39
-0.2	+0.1	+0.4	+0.7	+0.1	+0.1	40
8.6	8.0	7.7	6.7	8.0	8.0	41
.....	.....	.....	.....	.....	.....	42
.....	.....	.....	.....	.....	.....	43
.....	48	.....	.....	.....	.....	44
.....	.....	.....	.....	.....	.....	45

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)

PROVINCE

QUEBEC (cont'd)

Camp or establishment		CAMP BOUCHARD, near STE. THERESE (concl'd)		PMQ AREA, STE FOY	
No.	Source(s)	Deep wells		Ste Foy Municipal Supply - wells	
		Mixed wells			
		Finished water		Finished water	
Sampling point		At tap, Bldg No. 39		At tap, 2543 Pierre Martin St.	
1	Date of sampling	Feb. 10/60	Aug. 22/61	Oct. 8/59	Jan. 19/60
2	Storage period (days)	61:96	10:15	13:24	57:107
3	Sampling temperature, °C.	8.9	8.3	.....	.....
4	Test temperature, °C.	25.3	23.2	25.2	27.2
5	Oxygen consumed by KMnO ₄ .....	.....	8.3	3.7	.....
6	Carbon dioxide (CO ₂), (calculated)	3.5	3	4	2
7	pH	8.2	8.3	7.9	8.2
8	Colour	30	25	5	0
9	Turbidity	0.4	0	4	2
10	Suspended matter, dried at 105° C. ....	.....	.....	1.8	.....
11	Suspended matter, ignited at 550° C. ....	.....	.....	0.4	.....
12	Residue on evaporation, dried at 105° C. ....	.....	443	561	.....
13	Ignition loss at 550° C. ....	.....	48.0	96.8	.....
14	Specific conductance, micromhos at 25° C.	719.5	688	893.5	1,004
15	Calcium (Ca)	7.2	4.8	84.8	85.5
16	Magnesium (Mg)	9.2	10.3	16.4	14.7
17	Iron (Fe) Total	0.11	0.17	0.79	0.17
18	Dissolved	0.02	0.05	0.09	0.00
19	Manganese (Mn) Total	<0.05	0.00	0.64	0.40
20	Dissolved	0.00	0.00	.....	0.38
21	Aluminum (Al)	0.0	0.04	0.09	0.08
22	Copper (Cu)	Trace	Trace	Trace	0.2
23	Zinc (Zn)	0.0	0.0	0.1	0.05
24	Sodium (Na)	136	137	64.0	88.0
25	Potassium (K)	9.7	9.1	1.4	1.3
26	Ammonium (NH ₄)	0.2	.....	.....	.....
27	Carbonate (CO ₃)	0.0	0.0	0.0	0.0
28	Bicarbonate (HCO ₃)	352	348	178	186
29	Sulphate (SO ₄)	10.0	10.8	34.4	37.5
30	Chloride (Cl)	49.1	45.6	174	205
31	Fluoride (F)	1.0	1.4	0.0	0.0
32	Phosphate (PO ₄) Total	2.4	2.5	0.06	Trace
33	Dissolved .....	.....	2.2	.....	.....
34	Nitrate (NO ₃)	0.4	2.2	0.9	0.2
35	Silica (SiO ₂), colorimetric	8.9	11	10	9.0
36	Carbonate hardness as CaCO ₃	55.7	54.3	146	152
37	Non-carbonate hardness as CaCO ₃	0.0	0.0	133	122
38	Total hardness as CaCO ₃	55.7	54.3	279	274
39	Sum of constituents	407	406	474	533
40	Per cent sodium	81	82	33	41
41	Saturation index at test temperature	0.0	-0.1	+0.5	+0.8
42	Stability index at test temperature	8.2	8.5	6.9	6.6
43	Redox potential (mv) .....	.....	.....	.....	.....
44	Hydrogen sulphide (H ₂ S) .....	.....	.....	.....	.....
45	Water level at sampling (ft) .....	.....	.....	.....	.....
Remarks					

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)
 QUEBEC (cont'd)

PMQ AREA, STE FOY				CAMP VALCARTIER, near QUEBEC		No.
Ste Foy Municipal Supply - wells				Deep wells		
				Well No. 3		
Finished water				Raw and finished water		
At tap, 2543 Pierre Martin St.	At tap, 274 Jean Lebarge St.			At pump		
Aug. 23/61 9:14	Oct. 8/59 13:24	Jan. 19/60 57:107	Aug. 23/61 9:14	Oct. 22/59 27:33	Feb. 10/60 55:90	
23.4	25.3	27.2	23.4	23.0	24.3	1
5.0	3.9		5.4		7.8	2
2.5	5	3.5	3	3	7	3
8.1	7.8	7.9	8.1	7.0	6.4	4
5		0	5	10	0	5
4	2	2	1.5	2	0	6
3.7						7
0.0						8
						9
						10
	593		491	50.8		11
	79.2		62.4	9.2		12
			782	59.9	32.5	13
895	952.5	973	71.5	5.5	2.7	14
73.3	85.0	82.5	13.1	1.8	0.7	15
14.9	16.6	15.1	1.2	0.39	Trace	16
2.2	0.50	0.24	0.04	0.04	0.00	17
0.25	0.02	0.00	0.47		<0.05	18
0.44	0.13	0.40	0.38	0.01	0.01	19
0.38		0.11	0.08	0.03	0.0	20
0.1	0.12	0.11	0.0	Trace	Trace	21
0.0	Trace	0.10	0.0	0.05	0.15	22
0.0	0.0	0.01	0.0	1.8	1.3	23
80.1	80.0	83.0	64.8	0.4	0.6	24
1.8	1.7	1.2	1.9	0.0	0.0	25
				0.0	0.0	26
0.0	0.0	0.0	0.0	0.0	0.0	27
189	187	177	193	19.1	11.3	28
39.0	36.6	37.3	37.0	4.8	2.8	29
161	191	192	129	3.5	0.7	30
0.14	0.0	0.0	0.14	0.0	0.1	31
0.0	0.08	Trace	0.11	0.04	0.0	32
0.0			<0.1			33
2.3	1.2	0.0	1.0	0.6	0.3	34
9.0	9.5	8.7	9.0	15	12	35
155	153	145	158	15.7	9.3	36
89.2	127	123	73.9	5.4	0.3	37
244	280	268	232	21.1	9.6	38
476	514	508	423	43.1	27.2	39
41	38	40	37	15	21	40
+0.7	+0.5	+0.5	+0.7	-2.4	-3.5	41
6.7	6.8	6.9	6.7	11	13	42
						43
						44
				44 below floor level		45

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)

PROVINCE

QUEBEC (cont'd)

Camp or establishment		CAMP VALCARTIER, near QUEBEC (cont'd)			
No.	Source(s)	Deep wells	Wells		
		Well No. 3	Well No. 27		
		Raw and finished water			
Sampling point		At pump			
		Aug. 22/61	Oct. 22/59	Feb. 10/60	Aug. 22/61
1	Date of sampling	Aug. 22/61	Oct. 22/59	Feb. 10/60	Aug. 22/61
2	Storage period (days)	6:7	27:33	55:90	6:7
3	Sampling temperature, °C.	8,9	9,6	7,8	8,9
4	Test temperature, °C.	22,9	23,0	24,2	22,8
5	Oxygen consumed by KMnO ₄ .....	.....	.....	.....	.....
6	Carbon dioxide (CO ₂), (calculated)	3	4	5	6
7	pH	6,7	6,7	6,6	6,6
8	Colour	0	0	0	0
9	Turbidity	0	0	0	0
10	Suspended matter, dried at 105° C. ....	.....	.....	.....	.....
11	Suspended matter, ignited at 550° C. ....	.....	.....	.....	.....
12	Residue on evaporation, dried at 105° C.	26,0	62,0	.....	48,0
13	Ignition loss at 550° C.	10,0	30,4	.....	20,0
14	Specific conductance, micromhos at 25° C. .	27,1	55,5	55,3	61,7
15	Calcium (Ca)	2,1	5,6	5,5	6,0
16	Magnesium (Mg)	0,8	1,3	1,4	1,7
17	Iron (Fe) Total	0,14	0,09	0,00	0,01
18	Dissolved	0,02	0,02	0,00	Trace
19	Manganese (Mn) Total	0,00	0,00	<0,05	0,00
20	Dissolved	0,00	0,00	0,02	0,00
21	Aluminium (Al)	0,02	0,06	Trace	0,02
22	Copper (Cu)	0,01	0,0	Trace	0,01
23	Zinc (Zn)	0,0	0,0	0,0	0,0
24	Sodium (Na)	1,3	1,5	1,5	1,9
25	Potassium (K)	0,6	0,5	0,6	0,7
26	Ammonium (NH ₄) .....	.....	0,0	0,0	.....
27	Carbonate (CO ₃)	0,0	0,0	0,0	0,0
28	Bicarbonate (HCO ₃)	10,2	12,4	13,8	14,9
29	Sulphate (SO ₄)	3,1	5,6	3,9	4,3
30	Chloride (Cl)	0,6	4,2	4,0	4,2
31	Fluoride (F)	0,02	0,0	0,1	0,02
32	Phosphate (PO ₄) Total	<0,1	0,01	0,0	0,19
33	Dissolved	0,1	.....	.....	0,18
34	Nitrate (NO ₃)	1,1	3,0	1,0	4,8
35	Silica (SiO ₂), colorimetric	13,5	13	13	14
36	Carbonate hardness as CaCO ₃	8,4	10,2	11,3	12,2
37	Non-carbonate hardness as CaCO ₃	0,1	9,1	8,1	9,9
38	Total hardness as CaCO ₃	8,5	19,3	19,4	22,1
39	Sum of constituents	28,1	41,3	38,0	45,3
40	Per cent sodium	23	14	14	15
41	Saturation index at test temperature	-3,4	-2,9	-3,0	-2,9
42	Stability index at test temperature	13,5	12,5	13	12
43	Redox potential (mv) .....	.....	.....	.....	.....
44	Hydrogen sulphide (H ₂ S) .....	.....	.....	.....	.....
45	Water level at sampling (ft)	42 below floor level	.....	27	36
Remarks					

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)
 QUEBEC (concl'd)

CAMP VALCAR TIER, near QUEBEC (concl'd)						No.
Wells						
Well No. 28			Mixed wells			
Raw and finished water			Finished water			
At pump			At taps		At tap, Bldg. No. 523	
Oct. 22/59	Feb. 10/60	Aug. 22/61	Oct. 22/59	Feb. 10/60	Aug. 22/61	
27:33	55:90	6:7	27:33	55:90	6:7	1
9.4	7.8	8.9	7.8	7.8	8.9	2
22.9	24.0	22.9	23.0	24.2	22.9	3
.....						4
5	6	7	4	7	8	5
6.7	6.6	6.6	6.9	6.5	6.5	6
0	0	0	0	0	0	7
0	0	0	0.8	0	0	8
.....						9
.....						10
54.8		44.0	61.2		46.8	11
28.0		18.4	23.6		24.4	12
56.5	63.8	59.8	59.0	56.6	62.6	13
5.2	5.9	6.1	6.0	5.2	5.9	14
1.1	1.2	0.8	1.7	1.3	1.8	15
0.09	Trace	0.03	0.28	0.04	0.08	16
0.01	0.00	0.02	0.00	0.00	0.03	17
.....						18
0.2	<0.05	0.00	0.00	<0.05	0.00	19
0.0	Trace	0.00	0.03	0.00	0.00	20
0.07	0.07	0.0	0.0	0.05	0.02	21
0.0	0.0	0.05	0.0	0.04	0.11	22
0.0	0.02	0.0	0.0	0.1	0.2	23
2.4	2.6	2.8	1.8	2.3	2.0	24
0.7	1.2	1.2	0.5	1.1	0.7	25
0.0	0.0		0.0	0.0		26
0.0	0.0	0.0	0.0	0.0	0.0	27
14.9	16.5	16.3	19.7	15.7	15.1	28
6.1	7.6	5.8	5.0	7.0	4.8	29
1.8	1.8	2.0	3.4	1.7	4.6	30
0.0	0.1	0.02	0.0	0.1	0.02	31
Trace	0.0	<0.1	0.03	0.0	<0.1	32
.....						33
3.0	0.0	<0.1		0.0	<0.1	34
	2.5	6.5	0.2	2.0	4.8	35
13	13	13	15	13	14	36
12.2	13.5	13.4	16.2	12.9	12.4	37
5.3	6.3	5.2	5.8	5.3	9.7	38
17.5	19.8	18.6	22.0	18.2	22.1	39
40.3	43.9	46.5	43.8	41.7	46.1	40
22	21	23	15	20	16	41
-2.9	-2.8	-2.9	-2.5	-3.0	-3.0	42
12.5	11	12	12	12.5	12.5	43
.....						44
.....						45
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.....						98
.....						99
.....						100

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)

PROVINCE

ONTARIO

Camp or establishment		CAMP BORDEN			
No.	Source(s)	Deep wells			
		Well No. 1			
		Raw water			
Sampling point		At pump			
		Oct. 19/59	Feb. 8/60	Dec. 2/60	Aug. 23/61
1	Date of sampling	Oct. 19/59	Feb. 8/60	Dec. 2/60	Aug. 23/61
2	Storage period (days)	30:36	37:87	6:11	5:6
3	Sampling temperature, °C.	10.0	9.1	8.9	9.4
4	Test temperature, °C.	23.2	27.0	22.5	23.1
5	Oxygen consumed by KMnO ₄			3.2	
6	Carbon dioxide (CO ₂), (calculated)	2.5	3	3.5	2
7	pH	8.1	8.0	7.9	8.2
8	Colour	10	0	15	0
9	Turbidity	0.5	0	0.8	0
10	Suspended matter, dried at 105° C.				
11	Suspended matter, ignited at 559° C.				
12	Residue on evaporation, dried at 105° C.	216			188
13	Ignition loss at 550° C.	44.8			24.0
14	Specific conductance, micromhos at 25° C. ...	371	390	364	334
15	Calcium (Ca)	37.8	41.0	35.0	31.6
16	Magnesium (Mg)	16.2	16.4	16.6	14.0
17	Iron (Fe) Total	0.16	0.14	0.31	0.26
18	Dissolved	0.01	0.00	0.13	0.14
19	Manganese (Mn) Total		0.05	0.05	0.00
20	Dissolved	0.00	0.00	0.02	0.00
21	Aluminum (Al)	0.04	0.04	0.0	0.03
22	Copper (Cu)	0.0	Trace	0.0	0.01
23	Zinc (Zn)	0.0	0.0	0.0	<0.05
24	Sodium (Na)	16.6	14.5	17.0	16.7
25	Potassium (K)	1.1	1.1	1.4	1.2
26	Ammonium (NH ₄)	0.1	0.0		
27	Carbonate (CO ₃)	0.0	0.0	0.0	0.0
28	Bicarbonate (HCO ₃)	203	201	203	191
29	Sulphate (SO ₄)	5.3	4.8	3.6	2.4
30	Chloride (Cl)	18.5	20.1	16.1	10.6
31	Fluoride (F)	0.0	0.0	0.2	0.2
32	Phosphate (PO ₄) Total	0.04	Trace	0.0	<0.1
33	Dissolved			0.0	0.1
34	Nitrate (NO ₃)	0.4	0.0	0.0	4.1
35	Silica (SiO ₂), colorimetric	16	16	16	16
36	Carbonate hardness as CaCO ₃	161	165	156	137
37	Non-carbonate hardness as CaCO ₃	0.0	3.6	0.0	0.0
38	Total hardness as CaCO ₃	161	169	156	137
39	Sum of constituents	212	213	206	191
40	Per cent sodium	18	16	19	21
41	Saturation index at test temperature	+0.4	+0.4	+0.2	+0.4
42	Stability index at test temperature	7.3	7.2	7.5	7.4
43	Redox potential (mv)				
44	Hydrogen sulphide (H ₂ S)				
45	Water level at sampling (ft)	16 ft drawdown	16.2 ft drawdown	34	25
Remarks					

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)
 ONTARIO

CAMP BORDEN (cont'd)						No.
Deep wells						
Well No. 2	Well No. 4			Well No. 5		
Raw water						
At pump	At pump			At pump		
Aug. 23/61	Oct. 19/59	Feb. 8/60	Aug. 23/61	Oct. 19/59	Feb. 8/60	
16:34	30:36	37:87	16:34	30:36	37:87	1
7.5	8.9	8.9	9.4	8.9	9.0	2
23.1	23.2	27.0	22.9	22.9	26.8	3
.....						4
2	2.5	3	2	2.5	3	5
8.3	8.1	8.0	8.3	8.2	8.0	6
5	10	0	5	10	0	7
.....						8
.....						9
.....						10
.....						11
225	204		225	243		12
59.6	60.8		40.0	31.6		13
399	343	360	354	410	409	14
52.6	45.9	41.2	45.6	56.9	48.7	15
16.6	13.4	13.8	15.5	15.6	15.3	16
0.55	0.12	0.28	0.87	0.20	0.22	17
0.00	0.01	0.00	0.00	0.02	0.00	18
0.01		0.05	0.07		0.05	19
Trace	0.00	0.01	0.00	0.01	Trace	20
0.1	0.06	0.06	0.09	0.07	0.06	21
0.0	0.0	0.0	0.0	0.0	0.0	22
0.0	0.0	0.0	0.0	0.0	0.0	23
6.8	8.3	6.4	7.2	6.8	5.8	24
1.4	1.0	1.0	1.2	1.3	1.2	25
.....						26
0.0	0.0	0.0	0.0	0.0	0.0	27
229	217	196	223	235	205	28
10.3	6.3	5.2	6.8	11.6	10.9	29
13.5	2.4	3.4	2.2	13.1	10.3	30
0.2	0.0	0.0	0.1	0.0	0.0	31
<0.1	0.04	Trace	<0.1	0.03	0.05	32
<0.1			<0.1			33
0.8	0.2	0.0	0.9	0.0	0.0	34
15	17	15	16	15	15	35
189	170	159	178	192	168	36
11.4	0.0	0.0	0.0	13.7	14.9	37
200	170	159	178	206	183	38
230	201	170	191	236	208	39
6.8	9.5	8.0	8.0	6.6	6.3	40
+0.8	+0.5	+0.4	+0.8	+0.7	+0.5	41
6.7	7.1	7.2	6.7	6.8	7.0	42
.....						43
.....						44
38	65 ft drawdown	30 ft drawdown	45	20 ft drawdown	5 ft drawdown	45

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES

(In parts per million)

PROVINCE

ONTARIO (cont'd)

Camp or establishment		CAMP BORDEN (concl'd)			
No.	Source(s)	Deep wells			
		Well No. 5 (concl'd)		Mixed wells	
		Raw water		Finished water	
	Sampling point			Hydrant No. 166, corner Shelot and Sask. Blvd.*	Hydrant No. 171, Sask. Blvd.*
1	Date of sampling	Dec. 2/60	Aug. 23/61	Nov. 10/61	Nov. 10/61
2	Storage period (days)	6:11	16:34	7	7
3	Sampling temperature, °C.	8.9	9.2		
4	Test temperature, °C.	22.5	23.1		
5	Oxygen consumed by KMnO ₄	2.8			
6	Carbon dioxide (CO ₂), (calculated)	4	3		
7	pH	7.9	8.2	7.8	7.5
8	Colour	15	5		
9	Turbidity	3	2		
10	Suspended matter, dried at 105° C.				
11	Suspended matter, ignited at 550° C.				
12	Residue on evaporation, dried at 105° C.		273		
13	Ignition loss at 550° C.		45.6		
14	Specific conductance, micromhos at 25° C.	412	432		
15	Calcium (Ca)	54.6	56.7	55.2	45.8
16	Magnesium (Mg)	16.6	17.0	16.2	15.1
17	Iron (Fe) Total	0.60	0.49	224	44
18	Dissolved	0.10	Trace		
19	Manganese (Mn) Total	0.05	0.03		
20	Dissolved	0.04	0.00		
21	Aluminum (Al)	0.0	0.09		
22	Copper (Cu)	0.0	0.0		
23	Zinc (Zn)	0.0	0.0		
24	Sodium (Na)	6.9	8.1		
25	Potassium (K)	1.6	1.4		
26	Ammonium (NH ₄)				
27	Carbonate (CO ₃)	0.0	0.0		
28	Bicarbonate (HCO ₃)	236	238		
29	Sulphate (SO ₄)	11.0	9.6		
30	Chloride (Cl)	13.1	19.1		
31	Fluoride (F)	0.0	0.1		
32	Phosphate (PO ₄) Total	0.0	0.13		
33	Dissolved		0.1		
34	Nitrate (NO ₃)	0.0	1.0		
35	Silica (SiO ₂), colorimetric	14	15		
36	Carbonate hardness as CaCO ₃	193	196		
37	Non-carbonate hardness as CaCO ₃	11.6	16.4		
38	Total hardness as CaCO ₃	205	212	204	177
39	Sum of constituents	234	245		
40	Per cent sodium	6.8	7.6		
41	Saturation index at test temperature	+0.5	+0.8		
42	Stability index at test temperature	6.9	6.6		
43	Redox potential (mv)				
44	Hydrogen sulphide (H ₂ S)			0	0
45	Water level at sampling (ft)	44	40		
Remarks				* After 1 min flushing	* After 10 min flushing

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)
 ONTARIO (cont'd)

CAMP HAGERSVILLE, near HAGERSVILLE						No.
Lake Erie						
Finished water						
At Camp taps			At tap, Bldg. No. 26A		At Camp tap	
Oct. 20/59	Feb. 15/60	Aug. 18/61	Mar. 20/62	Mar. 27/62*	Apr. 10/62	1
24:29	57:91	27:33	21:35	6:28	7	2
16.1	7.2	17.8	23.9	23.4	24.4	3
24.7	25.0	23.4	23.9	23.4	24.4	4
4.3	1.7	1.7	1.7	1.7	1.7	5
3	3	3.5	9	9	9	6
7.8	7.8	7.7	7.3	7.5	7.5	7
0	10	5	5	20	5	8
3	10	0.4	0.4	0.4	0.4	9
192	203	203	203	203	203	10
46.8	62.0	62.0	62.0	62.0	62.0	11
310	304	311	296	288	316	12
39.5	39.3	39.0	36.5	35.1	38.1	13
9.3	7.7	8.6	7.8	7.8	7.8	14
0.14	0.56	0.14	0.14	0.48	0.48	15
0.06	0.03	0.06	0.06	0.18	0.18	16
Trace	<0.05	0.01	0.01	0.01	0.01	17
0.06	0.01	Trace	Trace	Trace	Trace	18
0.0	0.05	0.04	0.04	0.04	0.04	19
0.0	0.0	0.0	0.0	0.00	0.00	20
0.0	0.02	0.3	0.3	0.3	0.3	21
8.7	7.6	8.8	8.0	8.0	8.0	22
1.0	1.3	1.3	1.7	1.7	1.7	23
0.0	0.0	0.0	0.1	0.15	0.0	24
0.0	0.0	0.0	0.0	0.0	0.0	25
113	113	111	104	105	113	26
23.6	22.4	21.7	22.6	22.6	22.6	27
26.2	22.5	26.6	24.0	24.0	24.0	28
0.0	0.05	0.25	0.25	0.25	0.25	29
0.0	Trace	<0.1	<0.1	<0.1	<0.1	30
0.2	0.1	0.4	0.4	0.4	0.4	31
2.4	0.6	2.2	0.3	0.3	0.3	32
92.6	92.7	91.2	85.7	86.3	93.0	33
44.2	37.3	41.7	37.6	34.2	39.0	34
137	130	133	123	120.5	132	35
167	157	164	152	152	152	36
12	11	12	12	12	12	37
-0.1	-0.1	-0.2	-0.7	-0.7	-0.7	38
8.0	8.0	8.1	8.7	8.7	8.7	39
8.0	8.0	8.1	8.7	8.7	8.7	40
8.0	8.0	8.1	8.7	8.7	8.7	41
8.0	8.0	8.1	8.7	8.7	8.7	42
8.0	8.0	8.1	8.7	8.7	8.7	43
8.0	8.0	8.1	8.7	8.7	8.7	44
8.0	8.0	8.1	8.7	8.7	8.7	45

* Unfiltered lake water

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)

PROVINCE

ONTARIO (cont'd)

No.	Camp or establishment	CAMP HAGERSVILLE, near HAGERSVILLE (concl'd)			CAMP PETAWAWA, near PETAWAWA
	Source(s)	Wells (standby supply)			Ottawa River and spring
		No. 3 well			Ottawa River
		Raw and finished water			Raw water
	Sampling point	At pump			Near pump intake
1	Date of sampling	Oct. 19/59	Feb. 15/60	Aug. 18/61	Oct. 21/59
2	Storage period (days)	25:30	57:91	27:33	35:82
3	Sampling temperature, °C.	10.0	10.0	11.1	5.6
4	Test temperature, °C.	24.7	24.7	23.2	21.7
5	Oxygen consumed by KMnO ₄ .....	.....	.....	0.2	14.2
6	Carbon dioxide (CO ₂), (calculated)	2	1.5	6	4.5
7	pH	8.2	8.2	7.7	6.8
8	Colour	5	0	5	35
9	Turbidity	8	5	4	0.8
10	Suspended matter, dried at 105° C.	13.9	.....	9.4	.....
11	Suspended matter, ignited at 550° C.	8.8	.....	7.9	.....
12	Residue on evaporation, dried at 105° C.	591	.....	737	.....
13	Ignition loss at 550° C.	113	.....	79.2	.....
14	Specific conductance, micromhos at 25° C.	817	858	969	62.8
15	Calcium (Ca)	86.2	92.6	95.2	7.1
16	Magnesium (Mg)	31.0	30.8	36.1	2.2
17	Iron (Fe) Total	0.96	0.78	1.3	0.16
18	Dissolved	0.20	0.01	0.04	0.03
19	Manganese (Mn) Total .....	.....	<0.05	0.00	0.00
20	Dissolved	Trace	0.00	0.00	0.00
21	Aluminum (Al)	0.1	0.1	0.09	0.0
22	Copper (Cu)	0.0	Trace	0.0	0.0
23	Zinc (Zn)	0.0	0.0	Trace	0.0
24	Sodium (Na)	48.5	47.5	65.5	1.4
25	Potassium (K)	2.1	2.2	2.4	0.7
26	Ammonium (NH ₄)	0.0	.....	.....	0.1
27	Carbonate (CO ₃)	0.0	0.0	0.0	0.0
28	Bicarbonate (HCO ₃)	189	168	151	17.8
29	Sulphate (SO ₄)	268	303	376	12.4
30	Chloride (Cl)	5.8	5.4	4.1	1.6
31	Fluoride (F)	0.65	0.5	1.0	0.0
32	Phosphate (PO ₄) Total	0.0	Trace	0.0	0.04
33	Dissolved .....	.....	.....	0.00	.....
34	Nitrate (NO ₃)	0.2	0.1	0.6	0.1
35	Silica (SiO ₂), colorimetric	6.2	4.6	6.2	4.3
36	Carbonate hardness as CaCO ₃	155	138	123	14.6
37	Non-carbonate hardness as CaCO ₃	187	220	263	12.2
38	Total hardness as CaCO ₃	342	358	386	26.8
39	Sum of constituents	542	570	661	38.6
40	Per cent sodium	23	22	27	9.9
41	Saturation index at test temperature	+0.8	+0.8	+0.2	-2.6
42	Stability index at test temperature	6.6	6.6	7.3	12
43	Redox potential (mv) .....	.....	.....	.....	.....
44	Hydrogen sulphide (H ₂ S) .....	.....	.....	.....	.....
45	Water level at sampling .....	.....	.....	.....	Low
Remarks					

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)
 ONTARIO (cont'd)

CAMP PETAWAWA, near PETAWAWA						No.
Ottawa River and spring						
Ottawa River						
Raw water						
Near pump intake			At approx 200 ft from intake	At pump intake		
Feb. 15/60	Feb. 8/61	Aug. 28/61	Oct. 17/61	Oct. 17/61	Dec. 11/61	
57:91	5:7	18:29	17:28	17:28	9:23	1
0.6		14.4	14.4	14.9	3.3	2
24.8	23.4	23.0	23.5	23.5	22.7	3
		2.1	10.0	10.0	9.6	4
1.5	4.6	10	6	5	5	5
7.3	6.9	6.5	6.7	6.8	6.8	6
70	50	35	40	40	40	7
5	10	0.8	5	1	0	8
	16.0					9
	6.8					10
		81.6			77.2	11
		31.6			31.6	12
		62.9	66.1	66.0	67.7	13
63.6	98.6		7.0	6.9	7.1	14
4.2	8.9		2.5	2.4	2.4	15
3.8	3.6		0.22	0.10	0.23	16
0.39	2.5*	0.17	0.01	0.01	Trace	17
0.10	0.25	0.05	0.07	0.03	0.01	18
<0.05	0.01	0.02	0.00	0.00	0.00	19
0.00	0.01	0.00			0.00	20
0.0	0.14	0.0			0.0	21
0.0	0.1	0.0	0.0	0.0	0.0	22
0.0	0.1	0.0			0.0	23
1.1	2.6	1.4	1.4	1.4	1.6	24
0.7	1.1	0.7	0.9	0.8	0.8	25
	0.1	0.1	0.2	0.3	0.2	26
0.0	0.0	0.0	0.0	0.0	0.0	27
19.7	22.1	18.7	19.1	18.9	19.5	28
10.3	14.5	10.3	12.5	11.9	11.6	29
0.5	6.7	1.0	1.5	1.7	2.6	30
0.0	0.13	0.07			0.08	31
0.1	0.03	<0.1			<0.1	32
		<0.1			<0.1	33
0.1	0.6	1.3	0.5	0.6	0.7	34
4.5	6.9	3.7	4.0	3.9	4.3	35
16.2	18.1	15.3	15.7	15.5	16.0	36
9.8	19.1	10.1	11.9	11.7	11.6	37
26.0	37.2	25.4	27.6	27.2	27.6	38
35.1	56.6	34.6	39.7	38.9	40.8	39
8.1	12	10	9.6	9.7	11	40
-2.2	-2.3	-2.9	-2.6	-2.5	-2.5	41
12	11.5	12	12	12	12	42
						43
Low		Low			Low	44
						45

* Iron pick-up

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES

(In parts per million)

PROVINCE

ONTARIO (cont'd)

Camp or establishment		CAMP PETAWAWA (cont'd)			
No.	Source(s)	Ottawa River and spring			
		Ottawa River	Spring		
		Raw water			
	Sampling point	At old pumphouse	From continuous flow to reservoir	From reservoir	
				Feb. 15/60	Aug. 25/61
1	Date of sampling	May 18/61	Oct. 21/59	Feb. 15/60	Aug. 25/61
2	Storage period (days)	12:21	35:82	57:91	20:40
3	Sampling temperature, °C.	8.9	5.0	1.1	8.9
4	Test temperature, °C.	24.5	21.7	24.4	23.0
5	Oxygen consumed by KMnO ₄		5.4		0.6
6	Carbon dioxide (CO ₂) (calculated)	5.8	1.4	0.8	14
7	pH	6.5	7.4	7.6	6.5
8	Colour	45	0	0	5
9	Turbidity	1	0	0	0
10	Suspended matter, dried at 105° C.				
11	Suspended matter, ignited at 550° C.				
12	Residue on evaporation, dried at 105° C.				152
13	Ignition loss at 550° C.				60.0
14	Specific conductance, micromhos at 25° C.	46.3	211	220	218
15	Calcium (Ca)	4.6	15.9	21.4	14.9
16	Magnesium (Mg)	2.0	8.6	5.7	9.7
17	Iron (Fe) Total		0.04	0.03	0.04
18	Dissolved		0.00	0.02	0.00
19	Manganese (Mn) Total		0.00	0.05	0.00
20	Dissolved		0.00	0.00	0.00
21	Aluminum (Al)		0.02	0.04	0.0
22	Copper (Cu)		0.0	Trace	Trace
23	Zinc (Zn)		0.0	0.0	0.0
24	Sodium (Na)	1.3	7.1	6.2	7.3
25	Potassium (K)	0.6	1.4	1.6	1.5
26	Ammonium (NH ₄)	0.2	0.0		0.0
27	Carbonate (CO ₃)	0.0	0.0	0.0	0.0
28	Bicarbonate (HCO ₃)	11.1	21.7	21.5	25.4
29	Sulphate (SO ₄)	11.5	20.9	21.9	22.1
30	Chloride (Cl)	0.9	29.1	29.7	26.1
31	Fluoride (F)		0.0	0.0	0.13
32	Phosphate (PO ₄) Total		0.0	Trace	0.5
33	Dissolved				0.0
34	Nitrate (NO ₃)	1.2	12	12	15
35	Silica (SiO ₂), colorimetric	4.8	14	14	15
36	Carbonate hardness as CaCO ₃	9.1	17.8	17.6	20.8
37	Non-carbonate hardness as CaCO ₃	10.8	57.2	59.3	56.2
38	Total hardness as CaCO ₃	19.9	75.0	76.9	77.0
39	Sum of constituents	32.9	120	123	124
40	Per cent sodium	12	17	15	17
41	Saturation index at test temperature	-3.2	-1.6	-1.3	-2.5
42	Stability index at test temperature	13	11	10	11.5
43	Redox potential (mv)				
44	Hydrogen sulphide (H ₂ S)				
45	Water level at sampling	High		High	
Remarks					

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)
 ONTARIO (cont'd)

CAMP PETAWAWA (cont'd)						No.
Ottawa River and spring						
Spring	Mixed river and spring *					
Raw water	Finished water					
From flow to reservoir	At building No. G-1		At central heating plant tap	At building No. G-1	At mixing reservoir	
Oct. 17/61	Oct. 21/59	Feb. 15/60	May 15/61	Aug. 25/61	Aug. 28/61	
17:28	35:82	57:91	10:23	20:40	18:59	1
10.6	8.9	3.3	.....	18.9	14.4	2
23.6	21.8	24.2	23.7	23.0	22.7	3
1.0	12.9	.....	.....	6.5	2.0	4
6	4	15	3	6	5	5
6.8	6.7	7.2	6.8	6.6	6.8	6
5	30	50	.....	35	35	7
0	0.8	4	.....	4	0.8	8
.....	.....	.....	.....	3.6	.....	9
.....	.....	.....	.....	3.0	.....	10
.....	.....	.....	.....	69.6	89.2	11
.....	.....	.....	.....	34.0	34.8	12
209	78.2	89.0	71.5	79.2	74.3	13
15.3	7.7	8.5	5.8	7.3	7.5	14
9.2	2.8	3.1	2.9	2.8	2.8	15
0.02	0.20	0.40	.....	0.36	0.18	16
Trace	0.06	0.13	0.13	0.12	0.03	17
0.02	0.00	<0.05	.....	0.00	0.02	18
0.02	0.00	0.00	0.00	0.00	0.00	19
.....	0.0	0.0	0.0	0.02	0.0	20
0.0	0.0	Trace	0.03	Trace	0.0	21
.....	0.0	0.05	.....	0.07	0.0	22
7.5	1.7	1.7	1.7	1.7	1.7	23
1.7	0.7	0.8	0.8	0.8	0.8	24
0.0	0.0	.....	.....	.....	0.1	25
0.0	0.0	0.0	0.0	0.0	0.0	26
23.2	15.5	18.2	12.4	15.1	19.3	27
25.5	12.2	13.4	10.8	11.4	11.7	28
25.9	5.9	5.3	5.0	5.5	3.0	29
.....	0.0	0.0	0.29	0.15	0.11	30
.....	0.04	Trace	.....	0.2	<0.1	31
.....	.....	.....	.....	<0.1	<0.1	32
12	0.8	0.2	0.4	1.9	1.5	33
15	5.3	6.5	5.3	4.8	4.6	34
19.0	12.7	14.9	10.2	12.4	15.8	35
57.2	18.0	19.1	16.1	17.5	14.4	36
76.2	30.7	34.0	26.3	29.9	30.2	37
123	44.8	48.6	39.2	43.9	42.9	38
17	10	9.5	12	11	10.5	39
-2.2	-2.7	-2.1	-2.8	-2.8	-2.5	40
11	12	11	12	12	12	41
.....	.....	.....	.....	.....	.....	42
.....	.....	.....	.....	.....	.....	43
.....	.....	.....	.....	.....	.....	44
.....	Low	Low	.....	Slightly below normal	Low	45

* Spring water not always present

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)

PROVINCE

ONTARIO (cont'd)

No.	Camp or establishment	CAMP PETAWAWA (cont'd)			
	Source(s)	Ottawa River and spring			
	Sampling point	Mixed river and spring*			
	.....	Finished water			
	.....	At mixing reservoir†	At cold water tap, RCE Bldg	At hot water tap, RCE Bldg	At mixing reservoir†
1	Date of sampling	Oct. 17/61	Oct. 16/61	Oct. 16/61	Jan. 25/62
2	Storage period (days)	17:28	29:35	21:28	8:11
3	Sampling temperature, °C.	14.3	23.0	22.8	1.1
4	Test temperature, °C.	23.2	23.0	22.8	22.4
5	Oxygen consumed by KMnO ₄	9.6	9.9	9.9	9.9
6	Carbon dioxide (CO ₂) (calculated)	7	3.5	6	7
7	pH	6.7	6.9	6.7	6.7
8	Colour	40	25	100	40
9	Turbidity	2	1	4	2.5
10	Suspended matter, dried at 105° C. ....	.....	.....	.....	.....
11	Suspended matter, ignited at 550° C. ....	.....	.....	.....	.....
12	Residue on evaporation, dried at 105° C. ....	.....	.....	.....	65.6
13	Ignition loss at 550° C. ....	.....	.....	.....	20.4
14	Specific conductance, micromhos at 25° C.	80.2	83.6	84.1	85.7
15	Calcium (Ca)	7.7	7.6	7.6	7.8
16	Magnesium (Mg)	3.1	3.3	3.3	2.9
17	Iron (Fe) Total	0.11	0.19	2.1	0.25
18	Dissolved	0.01	0.10	0.19	0.07
19	Manganese (Mn) Total	0.01	.....	.....	0.00
20	Dissolved	0.00	.....	.....	0.00
21	Aluminum (Al) .....	.....	.....	.....	0.0
22	Copper (Cu)	0.0	0.0	0.0	0.0
23	Zinc (Zn) .....	.....	.....	.....	0.0
24	Sodium (Na)	1.9	2.1	1.9	2.5
25	Potassium (K)	0.9	0.9	0.9	0.9
26	Ammonium (NH ₄)	0.1	0.2	0.5	0.2
27	Carbonate (CO ₃)	0.0	0.0	0.0	0.0
28	Bicarbonate (HCO ₃)	20.8	16.9	18.9	20.5
29	Sulphate (SO ₄)	12.7	11.7	13.5	13.9
30	Chloride (Cl)	3.5	5.0	5.8	3.2
31	Fluoride (F) .....	.....	.....	.....	0.12
32	Phosphate (PO ₄) Total .....	.....	.....	.....	<0.1
33	Dissolved .....	.....	.....	.....	<0.1
34	Nitrate (NO ₃)	1.3	1.9	0.6	1.5
35	Silica (SiO ₂), colorimetric	5.0	5.0	5.1	6.3
36	Carbonate hardness as CaCO ₃	17.1	13.9	15.5	16.8
37	Non-carbonate hardness as CaCO ₃	14.9	19.1	17.0	14.7
38	Total hardness as CaCO ₃	32.0	33.0	32.5	31.5
39	Sum of constituents	46.4	.....	48.2	49.3
40	Per cent sodium	11	12	11	14
41	Saturation index at test temperature	-2.5	.....	-2.6	-2.6
42	Stability index at test temperature	12	.....	12	12
43	Redox potential (mv) .....	.....	.....	.....	.....
44	Hydrogen sulphide (H ₂ S) .....	.....	.....	.....	.....
45	Water level at sampling .....	.....	.....	.....	Medium

Remarks

* Spring water not always present
 † Not chlorinated

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)

ONTARIO (concl'd)		MANITOBA				No.
CAMP PETAWAWA (concl'd)		FORT CHURCHILL				
Ottawa River and spring		Lake Isabelle				
Mixed river and spring*						
Finished water		Raw water				
At Bldg. No. G-1		At intake well at treatment plant				
Jan. 25/62	May 18/62	Oct. 19/59	Feb. 9/60	May 1/61	June 13/61	
8:11	12:21	32:14	59:93	24:28	13:17	1
3.3	11.1	1.1	1.1			2
22.2	24.4	25.8	24.3	24.1	23.4	3
8.9	9.6					4
9	4.5	5	11	9	8	5
6.5	6.4	7.6	7.5	7.9	7.0	6
35	35	10	15	25	5	7
3	2	2	0			8
0.0						9
0.0						10
91.2	57.6					11
15.2	27.6					12
85.8	53.7	359	643	1,129	137	13
7.9	4.7	31.8	58.3	113	11.1	14
3.3	2.1	9.5	16.8	31.2	3.7	15
0.27	0.27	0.08	0.07			16
0.11	0.13	0.00	0.00	0.11		17
0.00	0.02	0.00	<0.05			18
0.00	0.00	0.00	0.00	0.00		19
0.0	0.0	0.01	0.14	0.0		20
0.01	0.03	0.0	Trace	0.0		21
0.05	0.1	0.0	0.08	0.0		22
2.5	1.3	25.7	44.6	74.8	8.7	23
0.9	0.7	1.5	2.7	5.1	0.9	24
0.2	0.2	0.1	0.5	1.5	0.1	25
0.0	0.0	0.0	0.0	0.0	0.0	26
17.6	7.2	122	226	445	45.7	27
14.5	10.4	12.0	16.9	21.0	4.5	28
5.8	5.5	46.2	80.8	143	16.5	29
0.12	0.15	0.0	0.2			30
<0.1	0.28	0.03	0.0			31
<0.1	<0.1					32
2.0	0.8	0.1	0.3	1.2	0.8	33
6.9	4.7	4.0	4.0	2.5	0.4	34
14.4	5.9	100	186	365	37.5	35
19.1	14.4	18.4	29.3	44.6	5.5	36
33.5	20.3	118	215	410	43.0	37
70.2	33.9	191	336	610	69.1	38
13.5	11	32	31	28	30	39
-2.9	-3.5	-0.3	+0.1	+1.0	-1.8	40
12	13.	8.2	7.3	5.9	11	41
						42
						43
						44
Medium	High	51' 5"	49' 11"			45

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)
MANITOBA (cont'd)

PROVINCE

Camp or establishment		FORT CHURCHILL (cont'd)			
No.	Source(s)	Lake Isabelle			
		Raw water			
	Sampling point	At intake well at treatment plant			
		July 31/61	Sept. 26/61	Nov. 28/61	Apr. 2/62
1	Date of sampling	9:11	16:27	15:17	9:22
2	Storage period (days)	13.3	23.5	4.4	24.4
3	Sampling temperature, °C.	23.5	24.5	22.5	24.4
4	Test temperature, °C.	5.1	6	4	16
5	Oxygen consumed by KMnO ₄	3	7.4 (7.7)†	7.7	7.4 (7.2)†
6	Carbon dioxide (CO ₂), (calculated)	7.6	5	5	15
7	pH	10	0	0	0
8	Colour	0	0	0	0
9	Turbidity	0	0	0	0
10	Suspended matter, dried at 105° C.	0	0	0	0
11	Suspended matter, ignited at 550° C.	0	0	0	0
12	Residue on evaporation, dried at 105° C.	112	112	112	112
13	Ignition loss at 550° C.	56.0	56.0	56.0	56.0
14	Specific conductance, micromhos at 25° C. ...	200	251	231.5	622.5(500)
15	Calcium (Ca)	17.4	23.3	30.2	59.7
16	Magnesium (Mg)	5.3	7.4	8.9	17.3
17	Iron (Fe) Total	0.04	0.04	0.04	0.04
18	Dissolved	0.02	0.02	0.02	0.02
19	Manganese (Mn) Total	0.00	0.00	0.00	0.00
20	Dissolved	0.00	0.00	0.00	0.00
21	Aluminum (Al)	0.03	0.03	0.03	0.03
22	Copper (Cu)	0.0	0.0	0.0	0.0
23	Zinc (Zn)	0.0	0.0	0.0	0.0
24	Sodium (Na)	11.5	13.6	20.4	40.7
25	Potassium (K)	1.1	1.0	1.4	2.7
26	Ammonium (NH ₄)	0.3	0.0	0.2	0.7
27	Carbonate (CO ₃)	0.0	0.0	0.0	0.0
28	Bicarbonate (HCO ₃)	69.5	93.0	123	244
29	Sulphate (SO ₄)	5.3	6.7	6.8	13.3
30	Chloride (Cl)	20.1	26.2 (70)	37.2 (80)†	73.2 (100)
31	Fluoride (F)	0.09	0.09	0.06	0.06
32	Phosphate (PO ₄) Total	<0.1	0.0	0.0	0.0
33	Dissolved	0.0	0.0	0.0	0.0
34	Nitrate (NO ₃)	2.2	0.0	0.0	0.3
35	Silica (SiO ₂), colorimetric	0.2	0.2	1.3	0.9
36	Carbonate hardness as CaCO ₃	57.0	76.3 (90)	101 (106)	200 (220)
37	Non-carbonate hardness as CaCO ₃	8.2	12.4 (2)	11.3 (14)	20.7 (40)
38	Total hardness as CaCO ₃	65.2	88.7 (92)	112 (120)	221 (260)
39	Sum of constituents	97.4	124	167	328
40	Per cent sodium	27	25	28	28
41	Saturation index at test temperature	-0.8	-0.8	-0.3	0.0
42	Stability index at test temperature	9.2	9.0	8.3	7.4
43	Redox potential (mv)	0	0	0	0
44	Hydrogen sulphide (H ₂ S)	0	0	0	0
45	Water level at sampling	51' 3"	51' 3"	51' 5"	51' 5"
Remarks		† Values in brackets are plant tests			

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)
 MANITOBA (cont'd)

FORT CHURCHILL (cont'd)						No.
Lake Isabelle						
Raw water	Finished water					
At intake well at treatment plant	After No. 4 filter	At clearwell	At plant discharge	At cold water tap, central heating plant	At hot water tap, Bldg. L-1	
May 1/62 14:16	Oct. 19/59 32:84	Feb. 9/60 59:93	May 1/61 24:28	May 1/61 24:28	May 1/61 24:28	1
24.8	12.8	2.2	23.7	24.2	24.0	2
20	24.8	24.4	1	3	2	3
7.3 (7.1)†	2	25	8.2	7.8	7.8	4
	7.4	7.2		10		5
	5	5				6
	0.8	0				7
						8
						9
						10
						11
						12
						13
657 (500)	321	481	771	783	705	14
65.3	24.6	29.2	15.4	16.6	13.6	15
18.2	5.2	7.3	27.6	27.0	17.8	16
	0.34	0.22				17
	0.06	0.00	0.03	0.02	0.12	18
	0.00	<0.05				19
	0.00	0.00	0.00	0.00	0.00	20
	0.26	0.14	0.31	0.14	0.0	21
	0.0	Trace	0.01	0.0	0.03	22
	0.0	0.0	0.0	0.0	0.0	23
41.0	25.7	45.5	91.6	91.6	89.5	24
2.7	1.5	2.7	5.3	5.3	5.3	25
	0.0	0.3		0.0		26
0.0	0.0	0.0	0.0	0.0	0.0	27
260	28.8	26.8	116	108	58.3	28
12.7	48.5	61.5	62.5	62.3	60.2	29
74.3 (100)	48.2	83.9	146	147	147	30
	0.0	0.0		0.3		31
	Trace	0.0				32
						33
0.0	0.0	0.1	0.8	4.0	0.6	34
1.4	1.0	1.6	2.1	1.9	2.3	35
213 (222)	23.6	22.0	95.6	88.4	47.8	36
24.3 (44)	59.2	80.9	56.4	64.1	59.3	37
237 (266)	82.8	103	152	152	107	38
344	169	245	409	409	365	39
27	40	48	55	55	63	40
0.0	-1.3	-1.5	-0.1	-0.5	-0.9	41
7.3	10	10	8.4	8.8	9.6	42
						43
						44
						45
			After stabilization	Activated carbon being added		

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)
 MANITOBA (cont'd)

PROVINCE		FORT CHURCHILL (cont'd)			
No.	Source(s)	Lake Isabelle			
	Sampling point	Finished water			
		After filters*	At cold water tap, central heating plant	At hot water tank in treatment plant	At cold water tap, central heating plant
1	Date of sampling	June 13/61	June 13/61	June 13/61	July 31/61
2	Storage period (days)	13:17	13:17	13:17	9:11
3	Sampling temperature, °C.				16.7
4	Test temperature, °C.	23.3	23.4	23.4	23.2
5	Oxygen consumed by KMnO ₄				4.8
6	Carbon dioxide (CO ₂), (calculated)	2	4	1.5	3
7	pH	7.5	7.3	7.8	7.8
8	Colour	5	5	10	5
9	Turbidity				0
10	Suspended matter, dried at 105° C.				
11	Suspended matter, ignited at 550° C.				
12	Residue on evaporation, dried at 105° C.				114
13	Ignition loss at 550° C.				55.6
14	Specific conductance, micromhos at 25° C.	139	139	161	198
15	Calcium (Ca)	11.5	11.6	13.0	17.0
16	Magnesium (Mg)	4.0	3.8	5.6	5.9
17	Iron (Fe) Total				0.07
18	Dissolved				0.06
19	Manganese (Mn) Total				0.01
20	Dissolved				0.00
21	Aluminum (Al)				0.08
22	Copper (Cu)				0.0
23	Zinc (Zn)				0.1
24	Sodium (Na)	8.5	8.6	9.1	11.5
25	Potassium (K)	0.9	0.9	1.0	0.9
26	Ammonium (NH ₄)	0.1	0.1	0.1	0.0
27	Carbonate (CO ₃)	0.0	0.0	0.0	0.0
28	Bicarbonate (HCO ₃)	45.6	44.7	56.6	67.9
29	Sulphate (SO ₄)	4.6	4.6	4.8	5.1
30	Chloride (Cl)	16.6	18.4	18.1	21.8
31	Fluoride (F)				0.09
32	Phosphate (PO ₄) Total				<0.1
33	Dissolved				<0.1
34	Nitrate (NO ₃)	1.0	1.6	1.0	2.6
35	Silica (SiO ₂), colorimetric	0.4	0.4	1.1	0.2
36	Carbonate hardness as CaCO ₃	37.4	36.7	46.4	55.7
37	Non-carbonate hardness as CaCO ₃	7.6	8.1	9.1	10.9
38	Total hardness as CaCO ₃	45.0	44.8	55.5	66.6
39	Sum of constituents	70	71.9	81.5	98.7
40	Per cent sodium	29	29	26	27
41	Saturation index at test temperature	-1.3	-1.5	-0.8	-0.7
42	Stability index at test temperature	10	10	9.4	9.2
43	Redox potential (mv)				
44	Hydrogen sulphide (H ₂ S)				
45	Water level at sampling				
Remarks		† Values in brackets are plant results * Lime-soda softening discontinued, filtration and chlorination only.			

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)
 MANITOBA (cont'd)

FORT CHURCHILL (cont'd)						No.
Lake Isabelle						
Finished water						
At filter discharge *	At cold water tank in central heating plant	At hot water tank in central warehouse boiler room	At plant discharge	At cold water tap in central heating plant		
Sept. 26/61 16:27	Sept. 26/61 16:27	Sept. 26/61 16:27	Nov. 28/61 15:17	Jan. 30/62 34:41	Feb. 27/62 23:30	1
24.5	24.3	24.6	17.2 22.6	24.1	23.2	2
4.5	4.5	0	1	2	0	3
7.5	7.5 (7.6)†	9.5 (9.4)†	7.4	7.4 (8.2)†	9.4 (9.8)†	4
5	5	5	5	0	0	5
0			0			6
						7
						8
						9
						10
						11
						12
252	250.5 (220)	240	217	335 (310)	336 (290)	13
23.5	23.5	6.1	28.5	19.5	15.2	14
7.3	7.4	16.4	3.3	7.3	6.5	15
						16
						17
						18
						19
						20
						21
						22
13.7	13.5	13.6	20.9	28.5	36.0	23
1.1	1.1	1.1	1.5	1.9	2.3	24
0.0	0.0	0.0	0.2	0.0	0.3	25
0.0	0.0	19.0	0.0	0.0	4.6	26
90.8	89.1	47.2	21.1	31.8	19.9	27
6.4	6.6	5.9	58.2	43.2	32.2	28
27.6	29.4 (70)	29.0 (50)	39.2	51.8 (80)	62.1 (80)	29
			0.1			30
			0.0			31
						32
0.3	0.0	Trace	0.0	1.3	0.5	33
0.2	0.2	0.2	1.7	1.4	2.2	34
74.5	73.1 (70)	70.3 (80)	17.3	26.1 (30)	23.9 (30)	35
14.2	16.0 (20)	12.6 (0)	67.6	52.6 (50)	41.0 (36)	36
88.7	89.1 (90)	82.9 (80)	84.9	78.7 (80)	64.9 (66)	37
125	125.5	115	166	171	171	38
25	24.5	26	34	43	54	39
-0.7	-0.7	+0.7	-1.4	-1.3	+0.5	40
8.9	8.9	8.1	10	10	8.4	41
						42
						43
						44
						45

* Lime-soda softening discontinued, filtration and chlorination only

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES

(In parts per million)

PROVINCE

MANITOBA (cont'd)

No.	Camp or establishment	FORT CHURCHILL (concl'd)		CAMP SHILO	
	Source(s)	Lake Isabelle		Wells	
		Finished water		Raw water	
	Sampling point	At cold water tap, central heating plant		Well No. 1, 45' deep	
		Apr. 2/62	May 1/62	Oct. 20/59	Feb. 9/60
1	Date of sampling	Apr. 2/62	May 1/62	Oct. 20/59	Feb. 9/60
2	Storage period (days)	9:22	14:16	31:42	59:93
3	Sampling temperature, °C.			7.2	7.8
4	Test temperature, °C.	24.5	24.8	24.7	25.2
5	Oxygen consumed by KMnO ₄				
6	Carbon dioxide (CO ₂), (calculated)	0	0	6	6
7	pH	9.5 (9.0) [†]	9.1 (8.6) [†]	7.9	7.9
8	Colour	5		10	5
9	Turbidity			10	2
10	Suspended matter, dried at 105° C.			20.3	
11	Suspended matter, ignited at 550° C.			6.6	
12	Residue on evaporation, dried at 105° C.			330	
13	Ignition loss at 550° C.			48.8	
14	Specific conductance, micromhos at 25° C.	388.5 (325)	398 (325)	535	528
15	Calcium (Ca)	18.0	19.8	88.9	84.7
16	Magnesium (Mg)	6.7	6.0	17.1	17.2
17	Iron (Fe) Total			2.5	0.23
18	Dissolved			0.04	0.00
19	Manganese (Mn) Total			0.40	0.30
20	Dissolved			0.00	0.00
21	Aluminum (Al)			0.04	0.09
22	Copper (Cu)			0.0	Trace
23	Zinc (Zn)			0.0	0.0
24	Sodium (Na)	43.0	42.5	3.7	3.1
25	Potassium (K)	2.7	2.6	1.6	1.7
26	Ammonium (NH ₄)	0.5		0.0	0.0
27	Carbonate (CO ₃)	6.2	3.1	0.0	0.0
28	Bicarbonate (HCO ₃)	10.4	18.9	329	329
29	Sulphate (SO ₄)	42.2	40.9	21.9	19.4
30	Chloride (Cl)	73.7 (90)	77.9 (100)	4.0	2.0
31	Fluoride (F)			0.0	0.0
32	Phosphate (PO ₄) Total			0.03	0.0
33	Dissolved				
34	Nitrate (NO ₃)	0.2	0.0	0.0	0.1
35	Silica (SiO ₂), colorimetric	2.7	2.8	24	24
36	Carbonate hardness as CaCO ₃	18.9 (20)	20.7 (20)	270	270
37	Non-carbonate hardness as CaCO ₃	53.6 (50)	53.6 (46)	22.3	12.5
38	Total hardness as CaCO ₃	72.5 (70)	74.3 (66)	292	282.5
39	Sum of constituents	201	205	323	314
40	Per cent sodium	55	54	2.7	2.3
41	Saturation index at test temperature	+0.6	+0.3	+0.8	+0.8
42	Stability index at test temperature	8.3	8.5	6.3	6.3
43	Redox potential (mv)				
44	Hydrogen sulphide (H ₂ S)				
45	Water level at sampling			43	44
	Remarks	† Values in brackets are plant results			

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)
 MANITOBA (cont'd)

CAMP SHILO (cont'd)						No.
Wells						
Raw water						
Well No. 1, 45' deep	Well No. 3, 43' deep			Well No. 4, 42' deep		
At pump						
Aug. 18/61	Oct. 20/59	Feb. 9/60	Aug. 18/61	Oct. 20/59	Feb. 9/60	
28:39	31:42	59:93	27:33	31:42	62:97	1
7.8	7.2	7.8	5.6	7.2	7.8	2
22.8	24.8	26.2	23.4	24.4	26.1	3
0.8			0.6			4
9	6	7	6	5	8	5
7.7	7.9	7.8	7.9	8.0	7.8	6
5	5	5	5	5	5	7
0	3	2	2	5	2	8
	9.8			11.1		9
	2.9			0.7		10
						11
310	331		292	337		12
33.6	44.0		38.0	59.2		13
479	529	451	528	551	551	14
71.6	89.5	68.8	85.3	88.9	87.9	15
16.2	17.0	17.2	18.1	17.8	18.0	16
0.41	0.47	0.25	0.84	0.57	0.23	17
0.03	0.04	0.00	0.02	0.04	Trace	18
0.29	0.40	0.40	0.25	0.40	<0.05	19
0.24	0.02	0.00	0.25	0.20	Trace	20
0.05	0.05	0.08	0.09	0.04	0.02	21
0.0	0.0	0.0	0.0	0.0	0.0	22
0.0	0.0	0.0	0.0	0.0	0.0	23
8.4	2.6	2.6	3.5	4.4	4.4	24
1.6	1.6	1.6	1.8	1.7	1.6	25
0.1	0.0	0.0	0.1	0.0	0.0	26
0.0	0.0	0.0	0.0	0.0	0.0	27
275	331	275	325	331	333	28
25.3	22.1	20.0	20.0	22.2	20.3	29
5.7	2.5	1.7	2.5	6.5	6.0	30
0.2	0.0	0.0	0.2	0.0	0.0	31
<0.1	0.02	0.0	1.0	0.0	0.1	32
0.1			0.35			33
2.1	0.0	0.1	0.8	0.0	0.1	34
23	23	24	24	24	24	35
225	272	226	267	272	274	36
20.2	21.4	17.0	20.7	23.4	20.3	37
245	293	243	287	295	294	38
290	321	272	317	311	327	39
6.9	1.9	2.3	2.6	3.1	3.1	40
+0.4	+0.3	+0.5	+0.8	+0.9	+0.7	41
6.9	6.3	6.8	6.3	6.2	6.4	42
						43
						44
44	41.5	42	42	42	42	45

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)

PROVINCE

MANITOBA (cont'd)

Camp or establishment		CAMP SHILO (cont'd)			
Source(s)		Wells			
No.		Raw water			
Sampling point		Well No. 4, 42' deep	Golf Course well	Disposal Plant well No. 5, 16' deep	
		At pump		At pump	
1	Date of sampling	Aug. 18/61	Aug. 18/61	Oct. 20/59	Feb. 9/60
2	Storage period (days)	27:33	28:69	31:42	59:93
3	Sampling temperature, °C.	6.7	6.1	8.9	6.7
4	Test temperature, °C.	23.4	22.8	24.4	25.0
5	Oxygen consumed by KMnO ₄	0.7	0.8	.....	.....
6	Carbon dioxide (CO ₂), (calculated)	14	7	4	4
7	pH	7.6	7.8	7.9	7.9
8	Colour	5	5	5	5
9	Turbidity	0	1	0	0
10	Suspended matter, dried at 105° C. ....	.....	.....	.....	.....
11	Suspended matter, ignited at 550° C. ....	.....	.....	.....	.....
12	Residue on evaporation, dried at 105° C.	340	280	233	.....
13	Ignition loss at 550° C.	37.2	58.8	43.6	.....
14	Specific conductance, micromhos at 25° C.	559	454	358	356
15	Calcium (Ca)	87.1	75.7	55.3	55.1
16	Magnesium (Mg)	20.6	16.4	12.8	12.4
17	Iron (Fe) Total	1.1	1.3	0.11	0.07
18	Dissolved	0.02	0.02	0.04	0.00
19	Manganese (Mn) Total	0.25	0.26	0.00	0.05
20	Dissolved	0.07	0.08	0.00	0.00
21	Aluminum (Al)	0.09	0.04	0.05	0.08
22	Copper (Cu)	Trace	0.0	0.0	Trace
23	Zinc (Zn)	0.0	0.0	0.1	0.0
24	Sodium (Na)	4.9	1.8	0.7	0.7
25	Potassium (K)	1.8	1.3	0.8	0.9
26	Ammonium (NH ₄)	0.0	0.1	0.0	0.0
27	Carbonate (CO ₃)	0.0	0.0	0.0	0.0
28	Bicarbonate (HCO ₃)	335	289	213	212
29	Sulphate (SO ₄)	19.2	13.0	13.9	12.3
30	Chloride (Cl)	7.5	3.1	0.7	0.5
31	Fluoride (F)	0.2	0.12	0.0	0.0
32	Phosphate (PO ₄) Total	0.59	0.30	0.0	0.0
33	Dissolved	<0.1	0.13	.....	.....
34	Nitrate (NO ₃)	2.8	0.8	1.6	2.5
35	Silica (SiO ₂), colorimetric	24	24	20	21
36	Carbonate hardness as CaCO ₃	275	237	175	174
37	Non-carbonate hardness as CaCO ₃	27.3	19.5	16.2	14.9
38	Total hardness as CaCO ₃	302	256.5	191	189
39	Sum of constituents	334	278.5	211	210
40	Per cent sodium	3.4	1.4	0.9	0.8
41	Saturation index at test temperature	+0.5	+0.6	+0.4	+0.4
42	Stability index at test temperature	6.6	6.6	7.1	7.1
43	Redox potential (mv) .....	.....	.....	.....	.....
44	Hydrogen sulphide (H ₂ S) .....	.....	.....	.....	.....
45	Water level at sampling (ft)	41	40	16	16
Remarks					

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)
 MANITOBA (cont'd)

CAMP SHILO (cont'd)							No.
Wells							
Raw water				Finished water			
Disposal Plant well No. 5, 16' deep	Rifle Range well No. 6, about 16' deep			Mixed wells - camp water			
At pump	At pump			At taps			
Aug. 18/61	Oct. 20/59	Feb. 9/60	Aug. 18/61	Oct. 20/59	Feb. 9/60		
79:105	34:42	59:93	28:39	31:42	59:93	1	
7.8	8.9	4.4	8.9	8.9	8.9	2	
22.6	26.6	25.0	22.9	24.5	25.2	3	
0.4			1.0			4	
5	2	3.5	6.5	5	6	5	
7.8	8.2	8.0	7.8	8.0	7.9	6	
5	0	5	5	5	5	7	
0.4	0	0	0.4	0	0	8	
						9	
						10	
						11	
232	257		277	359		12	
38.0	50.4		42.4	34.4		13	
355	388	419	409	551	515	14	
53.5	62.1	66.5	64.4	35.3	69.3	15	
14.6	13.1	13.7	14.8	11.6	21.1	16	
0.11	0.09	0.32	Trace	0.10	0.04	17	
0.02	0.02	0.00	Trace	0.04	0.0	18	
0.17	0.00	<0.05	0.01	0.10	0.4	19	
0.05	0.00	0.00	0.00	Trace	0.03	20	
0.07	0.04	0.08	0.04	0.04	0.08	21	
0.0	0.0	Trace	0.0	0.0	Trace	22	
0.0	0.25	0.4	0.07	0.0	0.0	23	
1.0	0.9	0.7	1.0	76.0	11.0	24	
1.0	0.5	0.5	0.7	1.9	2.4	25	
0.1	0.0	0.0	0.2	0.0	0.0	26	
0.0	0.0	0.0	0.0	0.0	0.0	27	
214	223	213	239	331	322	28	
14.4	10.9	18.8	10.0	23.6	20.0	29	
1.1	1.1	1.9	1.0	7.1	2.1	30	
0.06	0.0	0.0	0.1	0.0	0.0	31	
40.1	0.01	0.09	<0.1	0.0	0.0	32	
<0.1			<0.1			33	
1.4	14	24	15	0.0	0.1	34	
20.5	22	19	22	24	25	35	
176	183	175	196	136	260	36	
17.9	25.6	47.4	25.8	0.0	0.0	37	
194	209	222	222	136	260	38	
213	235	250	246	343	309	39	
1.1	0.9	0.7	1.0	54	8.3	40	
+0.3	+0.9	+0.6	+0.4	+0.5	+0.7	41	
7.2	6.4	6.8	7.0	7.0	6.5	42	
						43	
						44	
18 in.	16	16	16			45	

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)

PROVINCE		MANITOBA (concl'd)	SASKATCHEWAN			
Camp or establishment		CAMP SHILO (concl'd)	CAMP DUNDURN, near DUNDURN			
No.	Source(s)	Wells	Two wells			
		Mixed wells — camp supply	North well			
		Finished water	Raw water			
	Sampling point	At pump	At pump			
1	Date of sampling	Aug. 18/61	Oct. 13/59	Jan 15/60	Apr. 19/60	
2	Storage period (days)	28:39	23:30	10:23	8:16	
3	Sampling temperature, °C.	10.0	6.7	6.7	6.7	
4	Test temperature, °C.	23.0	27.4	25.5	24.4	
5	Oxygen consumed by KMnO ₄	1.0	.....	.....	.....
6	Carbon dioxide (CO ₂), (calculated)	11	10	8	9	
7	pH	7.7	7.9	8.0	8.0	
8	Colour	5	10	10	25	
9	Turbidity	0.4	35	45	35	
10	Suspended matter, dried at 105° C. ....	.....	5.2	.....	.....
11	Suspended matter, ignited at 550° C. ....	.....	4.4	.....	.....
12	Residue on evaporation, dried at 105° C. ...	357	741	.....	.....
13	Ignition loss at 550° C.	42.4	105	.....	.....
14	Specific conductance, micromhos at 25° C. ...	543	1,094	1,111	1,109	
15	Calcium (Ca)	24.0	97.1	96.2	96.7	
16	Magnesium (Mg)	10.4	45.5	46.2	43.8	
17	Iron (Fe) Total	Trace	2.9	4.8	3.3	
18	Dissolved	Trace	0.11	0.00	0.03	
19	Manganese (Mn) Total	0.02	.....	Trace	0.20	
20	Dissolved	0.00	0.02	Trace	0.10	
21	Aluminum (Al)	0.02	0.10	0.03	0.09	
22	Copper (Cu)	0.0	0.0	0.0	Trace	
23	Zinc (Zn)	0.0	0.0	0.0	0.0	
24	Sodium (Na)	90.2	93.2	91.1	88.0	
25	Potassium (K)	1.9	6.1	6.3	6.0	
26	Ammonium (NH ₄)	0.1	0.1	.....	.....
27	Carbonate (CO ₃)	0.0	0.0	0.0	0.0	
28	Bicarbonate (HCO ₃)	330	541	550	545	
29	Sulphate (SO ₄)	19.5	161	167	162	
30	Chloride (Cl)	6.5	10.5	10.6	11.3	
31	Fluoride (F)	0.12	0.0	0.0	0.0	
32	Phosphate (PO ₄) Total	0.11	0.0	.....	Trace	
33	Dissolved	<0.1	0.0	.....	.....
34	Nitrate (NO ₃)	1.8	0.5	2.5	0.6	
35	Silica (SiO ₂), colorimetric	25	21	21	21	
36	Carbonate hardness as CaCO ₃	103	429	430	428	
37	Non-carbonate hardness as CaCO ₃	0.0	0.0	0.0	0.0	
38	Total hardness as CaCO ₃	103	429	430	428	
39	Sum of constituents	342	701	712	698	
40	Per cent sodium	65	32	31	31	
41	Saturation index at test temperature	0.0	+1.1	+1.1	+1.1	
42	Stability index at rest temperature	7.7	5.7	5.8	5.8	
43	Redox potential (mv) .....	.....	.....	.....	.....
44	Hydrogen sulphide (H ₂ S) .....	.....	.....	.....	.....
45	Water level at sampling (ft) .....	.....	.....	30	14	
Remarks		Drawdown	10	9	6	

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)
SASKATCHEWAN

CAMP DUNDURN, near DUNDURN						No.
Two wells						
North well	West well					
Raw water						
At pump						
July 19/60	Aug. 21/61	Oct. 13/59	Jan. 15/60	Apr. 19/60	July 19/60	1
8:14	11:16	23:30	10:23	8:16	8:14	2
6.7	6.6	6.7	6.7	6.7	6.7	3
26.0	22.9	27.5	25.5	24.5	26.0	4
.....	6.9	.....	.....	.....	.....	5
5	12	6	5	6	4	6
8.2	7.9	8.0	8.0	8.0	8.1	7
20	20	5	10	15	7	8
17	35	10	17	4	2	9
.....	5.0	0.4	.....	.....	.....	10
.....	0.0	0.4	.....	.....	.....	11
.....	817	471	.....	.....	.....	12
.....	113	50.8	.....	.....	.....	13
1,115	1,126	803	727	722.5	691	14
91.6	95.7	112	111	112	111	15
48.2	48.3	27.8	29.3	26.2	28.5	16
5.0	5.5	0.80	1.5	1.5	1.5	17
0.13	0.66	0.03	0.00	0.02	0.04	18
0.40	0.17	.....	0.10	0.60	0.70	19
0.01	0.11	0.31	0.10	0.50	0.70	20
0.12	0.19	0.11	0.06	0.04	0.15	21
Trace	0.01	0.0	0.0	0.0	0.0	22
0.05	0.0	0.0	0.0	0.0	0.02	23
96.5	92.9	6.5	6.9	6.5	6.3	24
6.3	6.1	2.1	2.4	2.2	2.3	25
.....	0.4	0.1	.....	.....	.....	26
0.0	0.0	0.0	0.0	0.0	0.0	27
530	545	368	347	347	335	28
181	173	105	110	107	121	29
12.9	10.5	4.0	3.4	4.4	4.4	30
0.0	0.39	0.0	0.0	0.0	0.0	31
0.08	<0.1	0.02	.....	Trace	0.07	32
.....	<0.1	.....	.....	.....	.....	33
1.8	2.5	0.0	2.0	0.0	2.0	34
22.5	22	16	14	16	16.5	35
425	438	301	285	285	275	36
0.0	0.0	92.6	112	109	116	37
425	438	394	397	394	391	38
722	721	455	450	446	458	39
32.5	31	3.4	3.6	3.5	3.3	40
+1.3	+1.0	+1.1	+1.0	+1.0	+1.1	41
5.6	5.9	5.8	6.0	6.0	5.9	42
.....	.....	.....	.....	.....	.....	43
.....	.....	.....	.....	.....	.....	44
15	18	.....	34	36	32	45
		12	11	14		

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)
SASKATCHEWAN (cont'd)

PROVINCE		CAMP DUNDURN, near DUNDURN (cont'd)			
No.	Camp or establishment				
	Source(s)	Wells	Mixed wells		
		West well	Aerated only - partly finished water		
	Raw water				
	Sampling point	At pump	At treatment plant		
			Jan. 15/60	Apr. 19/60	July 19/60
1	Date of sampling	Aug. 21/61			
2	Storage period (days)	11:16	10:23	8:16	8:14
3	Sampling temperature, °C.	6.6		6.7	6.7
4	Test temperature, °C.	22.8	25.5	24.8	26.0
5	Oxygen consumed by KMnO ₄	4.5			
6	Carbon dioxide (CO ₂), (calculated)	6	5.5	7	
7	pH	8.0	8.1	8.0	8.3
8	Colour	5	20	25	15
9	Turbidity	4	13	12	5
10	Suspended matter, dried at 105° C.	3.3			
11	Suspended matter, ignited at 550° C.	0.0			
12	Residue on evaporation, dried at 105° C.	558			
13	Ignition loss at 550° C.	51.2			
14	Specific conductance, micromhos at 25° C.	771	897	882	721
15	Calcium (Ca)	118	103	96.5	114
16	Magnesium (Mg)	31.6	34.1	31.0	29.2
17	Iron (Fe) Total	1.9	3.3	3.8	1.6
18	Dissolved	0.17	0.00	0.02	0.15
19	Manganese (Mn) Total	0.57	0.10	0.40	0.60
20	Dissolved	0.40	0.10	0.12	
21	Aluminum (Al)	0.16	0.01	0.10	0.12
22	Copper (Cu)	0.01	0.0	Trace	0.0
23	Zinc (Zn)	0.0	0.0	0.08	0.0
24	Sodium (Na)	7.6	46.8	57.0	6.1
25	Potassium (K)	2.3	4.2	3.7	2.4
26	Ammonium (NH ₄)				
27	Carbonate (CO ₃)	0.0	0.0	0.0	0.0
28	Bicarbonate (HCO ₃)	361	440	428	344
29	Sulphate (SO ₄)	136	138	130	120
30	Chloride (Cl)	4.0	6.6	7.8	3.2
31	Fluoride (F)	0.25	0.0	0.0	0.0
32	Phosphate (PO ₄) Total	0.58		Trace	0.05
33	Dissolved	<0.1			
34	Nitrate (NO ₃)	0.3	1.5	0.2	1.8
35	Silica (SiO ₂), colorimetric	17	18	18	17
36	Carbonate hardness as CaCO ₃	296	361	351	282
37	Non-carbonate hardness as CaCO ₃	129	37.0	22.9	118
38	Total hardness as CaCO ₃	425	398	374	400
39	Sum of constituents	495	569	555	464
40	Per cent sodium	3.7	20	25	3.1
41	Saturation index at test temperature	+1.0	+1.1	+1.0	+1.3
42	Stability index at test temperature	6.0	5.9	6.0	5.7
43	Redox potential (mv)				
44	Hydrogen sulphide (H ₂ S)				
45	Water level at sampling (ft)	34			
Remarks					

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)
 SASKATCHEWAN (cont'd)

CAMP DUNDURN, near DUNDURN (cont'd)

Mixed wells

Aerated only -- partly finished water	Aerated and filtered -- partly finished water				Final camp area water including* by-passed filtered water		No.
					Finished water		
At treatment plant				At camp taps			
Aug. 21/61	Jan. 15/60	Apr. 19/60	July 19/60	Jan. 15/60	Feb. 15/60		
11:16	10:23	8:16	12:14	10:23	9:14	1	
8.8	.....	6.7	6.7	.....	6.7	2
22.8	25.4	24.2	26.1	25.4	25.2	3	
4.8	.....	.....	.....	.....	.....	4
6	4	4.5	.....	.....	10	5
8.0	8.2	8.2	8.3	8.2	7.7	6	
10	10	15	7	0	0	7	
3	2	4	0	0	0	8	
2.5	.....	.....	.....	.....	.....	9
0.0	.....	.....	.....	.....	.....	10
543	.....	.....	.....	.....	.....	11
52	.....	.....	.....	.....	.....	12
790.5	896	882	710	784	783	13	
93.7	101	106	112	11.0	11.1	14	
28.6	36.5	33.0	29.2	2.9	4.4	15	
1.5	0.63	1.6	0.17	0.02	0.07	16	
0.19	0.00	0.05	0.00	0.00	0.00	17	
0.46	0.20	0.40	0.60	0.05	.....	18
0.16	0.20	0.29	.....	0.05	0.05	19
0.1	0.04	0.1	0.06	Trace	0.03	20	
0.0	0.0	Trace	0.0	0.0	Trace	21	
0.25	0.0	0.0	0.02	0.1	0.2	22	
43.4	47.8	41.5	6.8	167	174	23	
2.7	3.8	3.7	0.7	0.7	1.4	24	
.....	.....	.....	.....	0.0	0.0	25
0.0	0.0	0.0	0.0	0.0	0.0	26	
371	438	429	342	351	356	27	
136	137	130	120	113	116	28	
4.5	6.4	7.8	4.1	4.9	5.3	29	
0.25	0.0	0.0	0.0	0.0	0.1	30	
0.43	.....	Trace	0.05	.....	.....	31
<0.1	.....	.....	.....	.....	.....	32
0.7	1.5	0.4	0.8	0.4	0.4	33	
17	18	19	17	16	16	34	
304.5	359	352	280	39.4	45.6	35	
47.4	43.1	54.2	117	0.0	0.0	36	
352	402	406	397	39.4	45.6	37	
510	568	554	460	489	504	38	
21	20	18	3.5	90	89	39	
+0.9	+1.2	+1.3	+1.3	+0.1	-0.3	40	
6.2	5.8	5.6	5.7	8.0	8.3	41	
.....	.....	.....	.....	.....	.....	42
.....	.....	.....	.....	.....	.....	43
.....	.....	.....	.....	.....	.....	44
.....	.....	.....	.....	.....	.....	45

*Aerated, filtered
and softened

900 gallons of
filtered water by-
passed per hour

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)

PROVINCE

SASKATCHEWAN (cont'd)

No.	Camp or establishment	CAMP DUNDURN, near DUNDURN (cont'd)			
	Source(s)	Mixed wells			
		Final camp area water including by-passed filtered water*			
	Sampling point	At camp taps			
		Mar. 15/60	Apr. 19/60	May 16/60	June 13/60
1	Date of sampling				
2	Storage period (days)	13:48	8:16	14:17	8:10
3	Sampling temperature, °C.	6.7	6.7	6.7	6.7
4	Test temperature, °C.	26.7	25.0	24.6	
5	Oxygen consumed by KMnO ₄				
6	Carbon dioxide (CO ₂), (calculated)	6	8	7	11
7	pH	8.0	7.9	7.9	7.7
8	Colour	0	10	5	15
9	Turbidity	0	0	0	0
10	Suspended matter, dried at 105° C.				
11	Suspended matter, ignited at 550° C.				
12	Residue on evaporation, dried at 105° C.				
13	Ignition loss at 550° C.				
14	Specific conductance, micromhos at 25° C. ...	757	896	764	800
15	Calcium (Ca)	18.2	11.4	20.6	11.4
16	Magnesium (Mg)	16.6	5.6	35.9	3.3
17	Iron (Fe) Total	0.03	0.11	0.06	0.06
18	Dissolved	0.01	0.06	0.01	0.02
19	Manganese (Mn) Total	0.16	0.10	0.30	0.15
20	Dissolved	0.16	0.08	0.20	0.10
21	Aluminium (Al)	0.2	0.05	0.0	0.0
22	Copper (Cu)	Trace	Trace	0.0	0.0
23	Zinc (Zn)	0.2	0.2	0.2	0.07
24	Sodium (Na)	126	197	93.0	167
25	Potassium (K)	9.9	2.0	5.8	0.7
26	Ammonium (NH ₄)				0.1
27	Carbonate (CO ₃)	0.0	0.0	0.0	0.0
28	Bicarbonate (HCO ₃)	347	407	347	346
29	Sulphate (SO ₄)	113	122	113	116
30	Chloride (Cl)	4.7	8.5	3.8	5.9
31	Fluoride (F)	0.1	0.0	0.0	0.0
32	Phosphate (PO ₄) Total	0.05	Trace	0.0	0.08
33	Dissolved				
34	Nitrate (NO ₃)	0.0	0.1	0.4	0.6
35	Silica (SiO ₂), (colorimetric)	15	17	15	16
36	Carbonate hardness as CaCO ₃	113	52.3	121	41.7
37	Non-carbonate hardness as CaCO ₃	0.0	0.0	0.0	0.0
38	Total hardness as CaCO ₃	113	52.3	121	41.7
39	Sum of constituents	513	565	459	492
40	Per cent sodium	68	89	49	89
41	Saturation index at test temperature	+0.3	0.0	+0.2	-0.3
42	Stability index at test temperature	7.4	7.9	7.5	8.3
43	Redox potential (mv)				
44	Hydrogen sulphide (H ₂ S)				
45	Water level at sampling (ft)				
	Remarks	* Aerated, filtered and softened			

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)

SASKATCHEWAN (concl'd)

ALBERTA

CAMP DUNDURN, near DUNDURN (concl'd)				CAMP WAINWRIGHT, near WAINWRIGHT		No.
Mixed wells				Battle River		
Final camp area water including by-passed filtered water*				Raw water		
Finished water				At plant intake		
At camp taps				At plant intake		
July 19/60	Aug. 16/60	Sept. 13/60	Aug. 21/61	Oct. 20/59	Feb. 9/60	
8:14	8:27	15:16	11:16	36:83	58:92	1
6.7	6.7	6.7	10	3.6	1.1	2
26.0	23.4	22.7	22.9	21.8	25.4	3
		4.1	4.8	9.4		4
		7	10		10	5
4	6	7.9	7.8	8.2	8.0	6
8.1	8.0	15	5	15	15	7
7	5	0	0	4	5	8
0.5	0.8					9
						10
						11
			592			12
			48			13
			877	802	1,153	14
767	812	807	23.2	56.1	106	15
12.5	12.7	11.9	9.7	29.1	43.7	16
4.0	3.2	4.0	0.20	0.38	0.48	17
0.02	0.06	0.05	0.03	0.00	0.00	18
0.01	0.03	0.03	0.04	0.00	<0.05	19
0.01	0.10	0.10	0.04	0.00	0.00	20
0.01	0.10	0.10	0.06	0.0	0.22	21
0.03	0.0	0.05	0.0	0.0	Trace	22
Trace	Trace	0.0	0.07	0.0	0.05	23
0.1	0.1	0.02	171	83.2	100	24
171	179	178.5	2.8	6.4	8.6	25
1.1	1.0	1.7	0.0	0.1	0.0	26
0.0	0.0	0.1		0.0	0.0	27
0.0	0.0	0.0	382	365	655	28
354	359	362	138	130	128	29
121	126	131	7.1	9.6	8.8	30
5.2	8.4	6.9	0.25	0.0	0.2	31
0.0	0.0	0.0	0.2	0.06	0.0	32
0.06	0.0	0.0	<0.1			33
			0.8	0.1	0.2	34
0.4	0.2	0.0	17.5	5.6	16	35
17	17	18	97.7	260	445	36
47.2	44.4	45.7	0.0	0.0	0.0	37
0.0	0.0	0.0	97.7	260	445	38
47.2	44.4	45.7	558	500	735	39
507	524	528	78.5	40	32	40
88	89	89	+0.1	+0.8	+1.3	41
+0.2	+0.1	-0.1	7.6	6.6	5.4	42
7.7	7.8	8.1				43
						44
					4	45

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)

PROVINCE

ALBERTA (cont'd)

Camp or establishment		CAMP WAINWRIGHT, near WAINWRIGHT (cont'd)			
No.	Source(s)	Betty Lake			Battle River and Betty Lake
	Sampling point	Raw water			Finished water
		At plant intake			At Camp taps
1	Date of sampling	Oct. 20/59	Feb. 8/60	Aug. 21/61	Oct. 20/59
2	Storage period (days)	36:83	59:93	24:30	36:83
3	Sampling temperature, °C.	3.6	3.4	20.0	.....
4	Test temperature, °C. ....	.....	25.4	23.4	21.8
5	Oxygen consumed by KMnO ₄	14.0	.....	6.1	8.2
6	Carbon dioxide (CO ₂), (calculated)	6	11	1.5	.....
7	pH	8.0	7.9	8.5	9.4
8	Colour	10	15	20	0
9	Turbidity	6	2	2	2
10	Suspended matter, dried at 105° C. ....	.....	.....	.....	.....
11	Suspended matter, ignited at 550° C. ....	.....	.....	.....	.....
12	Residue on evaporation, dried at 105° C. ....	.....	.....	442	.....
13	Ignition loss at 550° C. ....	.....	.....	128	.....
14	Specific conductance, micromhos at 25° C.	713	952	685	511.5
15	Calcium (Ca)	18.1	24.9	21.6	9.3
16	Magnesium (Mg)	53.0	71.4	46.8	14.5
17	Iron (Fe) Total	0.11	0.05	0.16	0.00
18	Dissolved	0.00	0.00	Trace	0.00
19	Manganese (Mn) Total	0.00	<0.05	0.00	0.00
20	Dissolved	0.00	0.00	0.00	0.00
21	Aluminum (Al)	0.07	0.22	0.09	0.03
22	Copper (Cu)	0.0	Trace	Trace	Trace
23	Zinc (Zn)	0.0	0.0	0.0	0.0
24	Sodium (Na)	60.9	81.6	63.2	62.0
25	Potassium (K)	10.5	13.8	8.5	11.0
26	Ammonium (NH ₄)	0.0	.....	.....	0.4
27	Carbonate (CO ₃)	0.0	0.0	11.5	20.4
28	Bicarbonate (HCO ₃)	431.5	590	389	51
29	Sulphate (SO ₄)	39.6	48.7	41.4	68.0
30	Chloride (Cl)	8.9	11.5	7.3	59.2
31	Fluoride (F)	0.0	0.2	0.47	0.0
32	Phosphate (PO ₄) Total	0.19	0.0	0.6	Trace
33	Dissolved .....	.....	.....	<0.1	.....
34	Nitrate (NO ₃)	0.3	0.3	2.8	0.1
35	Silica (SiO ₂), colorimetric	3.6	5.3	9.9	3.0
36	Carbonate hardness as CaCO ₃	263	356	247	75.8
37	Non-carbonate hardness as CaCO ₃	0.0	0.0	0.0	7.0
38	Total hardness as CaCO ₃	263	356	247	82.8
39	Sum of constituents	407	548	405	273
40	Per cent sodium	32	32	35	58
41	Saturation index at test temperature	+0.3	+0.5	+0.8	+0.7
42	Stability index at test temperature	7.4	6.9	6.9	8.0
43	Redox potential (mv) .....	.....	.....	.....	.....
44	Hydrogen sulphide (H ₂ S) .....	.....	.....	.....	.....
45	Water level at sampling (ft) .....	.....	12	12	.....
Remarks					

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)

ALBERTA (concl'd)		BRITISH COLUMBIA				No.
CAMP WAINWRIGHT, near WAINWRIGHT		FORT NELSON - Mileage 295, ALASKA HIGHWAY				
Battle River and Betty Lake		Well				
Camp area supply						
Finished water		Raw water				
At plant intake	At Camp taps	At well pump		At plant	At well pump	
Feb. 9/60	Aug. 21/61	Oct. 8/59*	Nov. 13/59	Nov. 14/59	Jan. 8/60	1
59.93	24.30	25.35	20.73	19.72	17.25	2
3.3	15.6	7.8	6.7	5.0	5.6	3
25.4	23.4	25.2	26.0	25.9	25.6	4
	2.8					5
8		11	22	12	70	6
8.0	10.1	7.8	7.5	7.8	7.0	7
15	5	5	10	10	0	8
2	0.5	High**	High**	High**	High**	9
						10
						11
	267					12
	42.0					13
948	441	1,181	1,218	1,188	1,337	14
24.7	2.1	223	225	221	250	15
71.6	8.6	37.6	50.9	46.1	52.0	16
0.05	0.05	57	48	46	55	17
0.00	Trace	0.00	Trace	0.02	0.00	18
<0.05	0.00	0.41	0.50	0.40	0.80	19
0.00	0.00	0.29	Trace	Trace	0.20	20
0.22	0.08	0.17	0.08	0.05	0.14	21
Trace	Trace					22
0.0	0.0					23
80.0	68.2	5.5	5.7	5.6	6.3	24
13.4	9.6	2.1	2.2	2.2	2.6	25
	0.3					26
0.0	13.2	0.0	0.0	0.0	0.0	27
590	121	454	483	471	529	28
48.2	57.5	330	324	319	370	29
10.6	11.5	2.8	0.8	1.2	1.8	30
0.2	0.4	0.0	0.0	0.0	0.1	31
0.0	<0.1		0.04			32
	<0.1					33
0.3	0.5	0.8	1.8	0.2	5.0	34
5.7	15	7.0	8.1	7.7	7.8	35
356	40.7	373	396	386	434	36
0.0	0.0	339	373	354	403	37
356	40.7	712	769	740	837	38
546	246	833	856	835	956	39
32	73.5	1.6	1.6	1.6	1.6	40
+0.6	+1.0	+1.2	+0.9	+1.2	+0.5	41
6.8	8.1	5.4	5.7	5.4	6.0	42
						43
						44
12						45

*After 24 hours pumping
 **Due to iron oxides

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)

PROVINCE

BRITISH COLUMBIA (cont'd)

Camp or establishment		FORT NELSON - Mileage 295, Alaska Highway (cont'd)			
No.	Source(s)	Well			
		Raw water			
	Sampling point	At plant	At well pump		
		Jan 9/60	Feb. 12/60	Oct. 16/61	Nov. 7/61
1	Date of sampling	Jan 9/60	Feb. 12/60	Oct. 16/61	Nov. 7/61
2	Storage period (days)	16:24	60:94	22:29	13:19
3	Sampling temperature, °C.	6.7	5.6	5.6	5.0
4	Test temperature, °C.	25.5	25.2	21.7	23.1
5	Oxygen consumed by KMnO ₄			20.0	4.0
6	Carbon dioxide (CO ₂), (calculated)	40	42	115	31
7	pH	7.3	7.3	7.0	7.5
8	Colour	0	10	5	5
9	Turbidity	High†	High†	High†	High†
10	Suspended matter, dried at 105° C.				
11	Suspended matter, ignited at 550° C.				
12	Residue on evaporation, dried at 105° C.			1,251	1,191
13	Ignition loss at 550° C.			120	96.0
14	Specific conductance, micromhos at 25° C. .	1,323	1,378	1,646	1,419
15	Calcium (Ca)	247	269	310	293
16	Magnesium (Mg)	49.0	44.5	73.3	57.9
17	Iron (Fe) Total	52	High	67	63
18	Dissolved		Trace	0.22	0.00
19	Manganese (Mn) Total	0.80	0.80	0.94	0.63
20	Dissolved		0.20	0.31	0.43
21	Aluminum (Al)	0.2	0.02	0.22	0.03
22	Copper (Cu)		Trace	0.02	0.0
23	Zinc (Zn)		0.0	0.0	0.0
24	Sodium (Na)	6.2	6.1	7.1	6.9
25	Potassium (K)	2.6	2.4	2.8	2.6
26	Ammonium (NH ₄)				
27	Carbonate (CO ₃)	0.0	0.0	0.0	0.0
28	Bicarbonate (HCO ₃)	518	546	660	597
29	Sulphate (SO ₄)	372	392	528	455
30	Chloride (Cl)	1.0	0.9	3.0	0.2
31	Fluoride (F)		0.1	0.63	0.68
32	Phosphate (PO ₄) Total		0.2	<0.1	<0.1
33	Dissolved			<0.1	<0.1
34	Nitrate (NO ₃)	3.2	1.5	6.0	0.0
35	Silica (SiO ₂), colorimetric	6.9	9.6	8.8	10
36	Carbonate hardness as CaCO ₃	425	448	541	490
37	Non-carbonate hardness as CaCO ₃	392	408	535	480
38	Total hardness as CaCO ₃	817	856	1,076	970
39	Sum of constituents	994.5	996	1,265	1,121
40	Per cent sodium	1.6	1.5	1.4	1.5
41	Saturation index at test temperature	+0.7	+0.8	+0.6	+1.0
42	Stability index at test temperature	5.9	5.7	5.8	5.5
43	Redox potential (mv)				
44	Hydrogen sulphide (H ₂ S)				
45	Water level at sampling (ft)				
Remarks		† Due to iron oxides			

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)
 BRITISH COLUMBIA (cont'd)

FORT NELSON - Mileage 295, Alaska Highway (cont'd)						No.
Well						
Finished water						
Overflow from softener		At plant tap				
Oct. 8/59	Nov. 14/59	Jan. 9/60	Feb. 12/60	Oct. 16/61	Nov. 7/61	
25:35	19:71	16:24	60:94	22:29	13	1
23.9	23.3	24.4	24.4	14.4	15.0	2
25.0	25.7	25.5	25.0	26.5	23.7	3
1	3		1			4
7.9	7.0	10.0	7.3	7.5	7.7	5
5	5	0	5			6
0			2	0	0	7
						8
						9
						10
						11
						12
						13
750	691	899	823.5	1,304	1,104	14
106	97.7	171	128			15
30.7	25.7	0.0	26.1			16
1.5	2.7	0.69	0.12	0.24	0.31	17
0.00	Trace	0.00	0.01			18
0.14	0.02	0.00	0.05	0.10	0.05	19
0.02	0.00		0.00			20
0.38		0.15	0.05			21
			Trace			22
6.3	6.6	7.0	0.0			23
2.1	2.3	2.7	6.7			24
			2.4			25
						26
0.0	0.0	30.4	0.0			27
61.0	21.8	0.0	12.9			28
338	321	364	404			29
8.0	2.9	3.9	4.4			30
0.0		0.1	0.2			31
			0.0			32
						33
0.1	0.1	0.4	2.0			34
2.0	1.8	4.4	2.6			35
50.0	17.9	53.6	10.6			36
341	331	374	416			37
391	349	428	427	782	636	38
523	469	585	583			39
3.3	3.9	3.4	3.3			40
+0.1	+1.3	+2.4	-1.1			41
7.7	6.4	5.2	9.3			42
						43
						44
						45

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)

PROVINCE

BRITISH COLUMBIA (cont'd)

No.	Camp or establishment	FORT NELSON - Mileage 295, Alaska Highway (concl'd)			
		Muskwa River			
		Raw water			
Sampling point		800 ft south of Muskwa Bridge	100 ft south of Muskwa Bridge		
1	Date of sampling	Nov. 16/59	Jan. 11/60	Oct. 16/61	Nov. 7/61
2	Storage period (days)	17:70	10:22	22:29	13:19
3	Sampling temperature, °C.	0.6	1.1	0.0	0.0
4	Test temperature, °C.	25.9	24.8	21.6	23.0
5	Oxygen consumed by KMnO ₄	8.4	.....	3.0	2.4
6	Carbon dioxide (CO ₂), (calculated)	3.5	6	2	2.5
7	pH	8.0	7.8	8.2	8.2
8	Colour	25	0	5	5
9	Turbidity	4	5	10	14
10	Suspended matter, dried at 105° C. ....	.....	.....	12.9	11.1
11	Suspended matter, ignited at 550° C. ....	.....	.....	8.2	6.8
12	Residue on evaporation, dried at 105° C. ....	.....	.....	256	324
13	Ignition loss at 550° C. ....	.....	.....	26.4	44.8
14	Specific conductance, micromhos at 25° C.	488	508	393	485.5
15	Calcium (Ca)	72.2	74.8	55.1	70.7
16	Magnesium (Mg)	19.7	20.6	16.4	21.5
17	Iron (Fe) Total	0.23	0.15	0.32	0.31
18	Dissolved	0.03	0.00	0.09	0.00
19	Manganese (Mn) Total	0.04	0.00	0.05	0.03
20	Dissolved	0.00	.....	0.00	.....
21	Aluminum (Al)	0.05	0.07	0.11	0.02
22	Copper (Cu)	0.0	0.0	0.0	0.0
23	Zinc (Zn)	0.0	0.0	0.0	0.0
24	Sodium (Na)	5.0	5.0	3.1	4.1
25	Potassium (K)	1.0	0.9	0.8	0.9
26	Ammonium (NH ₄)	0.2	0.0	0.1	0.1
27	Carbonate (CO ₃)	0.0	0.0	0.0	0.0
28	Bicarbonate (HCO ₃)	220	231	183	233
29	Sulphate (SO ₄)	90.2	84.4	60.9	77.1
30	Chloride (Cl)	1.5	1.7	1.5	0.9
31	Fluoride (F)	0.0	0.0	0.15	0.22
32	Phosphate (PO ₄) Total	0.05	.....	<0.1	<0.1
33	Dissolved .....	.....	.....	<0.1	<0.1
34	Nitrate (NO ₃)	0.2	2.0	0.0	0.6
35	Silica (SiO ₂), colorimetric	4.3	4.0	2.9	3.8
36	Carbonate hardness as CaCO ₃	180	190	150	191
37	Non-carbonate hardness as CaCO ₃	80.7	81.5	55	73.8
38	Total hardness as CaCO ₃	261	271	205	265
39	Sum of constituents	302.5	307	231	295
40	Per cent sodium	4.0	3.8	3.2	3.2
41	Saturation index at test temperature	+0.7	+0.5	+0.6	+0.8
42	Stability index at test temperature	6.6	6.8	7.0	6.4
43	Redox potential (mv) .....	.....	.....	.....	.....
44	Hydrogen sulphide (H ₂ S) .....	.....	.....	.....	.....
45	Water level at sampling (ft) .....	.....	Low	Low	Low
Remarks					

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)
 BRITISH COLUMBIA (concl'd)

CAMP CHILLIWACK, near CHILLIWACK						No.
Vedder River			Well, Wet Bridging Area			
Raw and finished water						
At pumphouse			At well			
Oct. 13/59	Jan. 28/60	Aug. 22/61	Oct. 13/59	Jan. 28/60	Aug. 22/61	
23:30	48:98	27:35	23:30	48:98	27:35	1
8.9	4.4	15.6	10.0	10.0	12.8	2
27.4	27.1	22.3	27.4	27.1	22.3	3
4.4	.....	0.3	.....	.....	1.0	4
2	3	8	11	4	25	5
7.4	7.4	6.8	6.8	7.2	6.7	6
10	5	0	0	5	20	7
2	0.8	0.8	6	14	58	8
.....	.....	.....	13.3	.....	21.4	9
.....	.....	.....	13.0	.....	16.6	10
40.8	.....	64.4	74.0	.....	103	11
7.6	.....	17.2	19.6	.....	12.0	12
70.8	110	69.1	99.7	94.1	123	13
10.1	16.0	9.5	11.4	11.7	16.9	14
1.0	1.8	1.1	3.2	2.6	3.9	15
0.13	0.09	0.00	6.8	3.7	7.2	16
0.00	0.00	0.00	1.6	0.02	0.00	17
.....	0.05	0.00	.....	0.10	0.14	18
Trace	0.00	0.00	0.19	0.01	0.11	19
0.04	0.07	0.02	Trace	0.04	0.07	20
0.0	0.0	0.0	0.0	0.0	0.0	21
0.0	0.0	0.0	0.05	0.4	1.0	22
0.8	1.3	1.0	1.7	1.7	2.1	23
0.3	0.5	0.5	0.5	0.5	0.7	24
0.0	0.0	0.0	0.0	.....	0.0	25
0.0	0.0	0.0	0.0	0.0	0.0	26
30.4	47.2	28.2	43.6	42.8	73.4	27
7.8	8.5	6.0	6.6	5.3	1.4	28
0.5	1.0	0.3	3.5	2.3	1.4	29
0.0	0.0	0.07	0.0	0.0	0.04	30
0.0	Trace	<0.1	0.03	Trace	<0.1	31
.....	.....	<0.1	.....	.....	<0.1	32
0.0	0.2	1.2	0.0	0.0	1.3	33
4.8	6.3	5.0	15	13	14	34
24.9	38.7	23.1	35.8	35.1	58.1	35
4.4	8.5	5.1	5.8	4.8	0.0	36
29.3	47.2	28.2	41.6	39.9	58.1	37
40.3	59.0	38.6	64.9	59.0	77.7	38
5.5	5.5	7.0	7.5	8.1	7.0	39
-1.5	-1.2	-2.2	-1.9	-1.5	-1.7	40
10	9.8	11	11	10	10	41
.....	.....	.....	.....	.....	.....	42
.....	.....	.....	.....	.....	.....	43
.....	4.43	4.17	.....	.....	.....	44
.....	.....	.....	.....	.....	.....	45

TABLE II (cont'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES

(In parts per million)

PROVINCE

YUKON TERRITORY

Camp or establishment		CAMP TAKINI, near WHITEHORSE			
No.	Source(s)	McIntyre Creek			
		Raw water			Finished water
	Sampling point	At pump intake			At tap in system
1	Date of sampling	Oct. 27/59	Feb. 8/60	Oct. 12/61	Oct. 27/59
2	Storage period (days)	34:76	62:97	26:33	34:76
3	Sampling temperature, °C.	1.7	0.28	5.0	2.2
4	Test temperature, °C.	22.9	25.9	21.5	22.9
5	Oxygen consumed by KMnO ₄	7.9	.....	4.6	7.8
6	Carbon dioxide (CO ₂), (calculated)	3.5	2	8	2
7	pH	7.9	8.0	7.5	8.1
8	Colour	10	5	15	10
9	Turbidity	1	2	3	1
10	Suspended matter, dried at 105°C. ....	.....	.....	14.5	.....
11	Suspended matter, ignited at 550°C. ....	.....	.....	8.0	.....
12	Residue on evaporation, dried at 105°C. ....	.....	.....	165	.....
13	Ignition loss at 550°C. ....	.....	.....	32.0	.....
14	Specific conductance, micromhos at 25°C.	269.5	242	247	273
15	Calcium (Ca)	39.9	34.0	36.4	40.3
16	Magnesium (Mg)	9.8	8.5	8.9	10.2
17	Iron (Fe) Total	0.06	0.18	0.17	0.09
18	Dissolved	0.03	0.02	Trace	0.00
19	Manganese (Mn) Total	0.00	<0.05	0.02	0.00
20	Dissolved	0.00	0.00	0.00	0.00
21	Aluminum (Al)	0.0	0.02	0.06	0.01
22	Copper (Cu)	0.0	0.0	0.0	0.0
23	Zinc (Zn)	0.0	0.0	0.0	0.0
24	Sodium (Na)	2.9	3.1	3.5	2.9
25	Potassium (K)	0.9	0.9	1.6	0.9
26	Ammonium (NH ₄)	0.0	0.0	0.0	0.0
27	Carbonate (CO ₃)	0.0	0.0	0.0	0.0
28	Bicarbonate (HCO ₃)	162	144	150	165
29	Sulphate (SO ₄)	10.4	8.3	9.8	11.2
30	Chloride (Cl)	1.0	0.3	1.8	1.3
31	Fluoride (F)	0.0	0.1	0.17	0.0
32	Phosphate (PO ₄) Total .....	.....	0.0	<0.1	0.05
33	Dissolved .....	.....	.....	<0.1	.....
34	Nitrate (NO ₃)	0.0	0.1	0.5	0.0
35	Silica (SiO ₂), colorimetric	11	12	11	12
36	Carbonate hardness as CaCO ₃	133	118	123	135
37	Non-carbonate hardness as CaCO ₃	6.8	2.0	4.8	7.5
38	Total hardness as CaCO ₃	140	120	128	143
39	Sum of constituents	156	137	148	160
40	Per cent sodium	4.3	5.3	5.5	4.2
41	Saturation index at test temperature	+0.2	+0.2	-0.3	+0.4
42	Stability index at test temperature	7.5	7.6	8.1	7.3
43	Redox potential (mv) .....	.....	.....	.....	.....
44	Hydrogen sulphide (H ₂ S) .....	.....	.....	.....	.....
45	Water level at sampling (ft)	4	Medium to low	4	.....
Remarks					

TABLE II (concl'd)
CHEMICAL ANALYSES OF ARMY WATER SUPPLIES
(In parts per million)
 YUKON TERRITORY (concl'd)

CAMP TAKINI, near WHITEHORSE, (concl'd)		No.
McIntyre Creek		
Finished water		
At riser to reservoir		
Feb. 8/60		1
62:97		2
1.1		3
25.9		4
.....		5
3		6
7.8		7
5		8
3		9
.....		10
.....		11
.....		12
.....		13
245		14
34.7		15
8.3		16
0.18		17
0.00		18
<0.05		19
0.00		20
0.03		21
0.0		22
0.0		23
3.1		24
0.9		25
.....		26
0.0		27
144		28
10.2		29
0.8		30
0.1		31
0.2		32
.....		33
0.1		34
12		35
118		36
3.1		37
121		38
141		39
5.2		40
0.0		41
7.8		42
.....		43
.....		44
Medium to low		45

SUMMARY

The data of this report supplement those given in Water Survey Report No. 12 on water quality at 15 army establishments across Canada. These establishments are those where water supplies are classed as unsatisfactory or borderline, and where problems in use are encountered. This survey was continued at these locations mainly to obtain information to assist in future treatment to improve quality and to overcome problems in use.

A number of these camp waters show wide variations in quality either because of changing source, variability of source, changing treatment, or inadequate or variable treatment.

Few of the locations are supplied with a water meeting all chemical quality requirements for a municipal supply. A brief summary of some of the variables and a general discussion of the quality of water at each establishment is presented but, because of the many factors causing these variations including mixed supplies, varying initial quality, limited sampling frequency, variable treatment, etc. it is not feasible to attempt an interpretation of these data in detail.

It is, however, believed that sufficient data are now available on these waters to permit more detailed assessment of their role in problems of use at each location, and in future treatment requirements.

Increasing deterioration, especially increased phosphate content at some locations is noted. In some cases this resulted from the addition of phosphate to the wells in an attempt to control iron precipitation and/or corrosion.

Although this survey has been discontinued, it is believed advisable to continue periodic checks on those well sources which in 1961 appeared to be showing some deterioration in quality.

APPENDIX A

Index to Military Establishments

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<u>New Brunswick</u>		
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* See Table I, page 8

APPENDIX B

List of Published Water Survey Reports

Mines Branch Report No. 819, "Industrial Waters of Canada", a report on investigations covering the period 1934 to 1943, was the last general report published and is now out of print. Since then the Branch has published various reports on chemical quality, specific to certain drainage areas or river basins, as follows:

- Report No. 833 - Industrial Water Resources of Canada - Water Survey Report No. 1, The Aim, Scope and Method of Investigations, by J.F.J. Thomas, 1953 (\$1.00)
- Report No. 834 - Industrial Water Resources of Canada - Water Survey Report No. 2, Chemical Quality of Surface and Civic Water Supplies, Ottawa River Drainage Basin, 1947-1948, by J.F.J. Thomas, 1952 (\$1.00)
- Report No. 837 - Industrial Water Resources of Canada - Water Survey Report No. 3, Upper St. Lawrence River - Central Great Lakes Drainage Basin, by J.F.J. Thomas, 1954 (\$2.00)
- Report No. 838 - Industrial Water Resources of Canada - Water Survey Report No. 4, Columbia River Drainage Basin, 1949-1950, by J.F.J. Thomas, 1953 (\$1.00)
- Report No. 839 - Industrial Water Resources of Canada - Water Survey Report No. 5, Skeena River, Vancouver Island, and Coastal Areas of British Columbia, 1949-1951, by J.F.J. Thomas, 1953 (\$1.00)
- Report No. 842 - Industrial Water Resources of Canada - Water Survey Report No. 6, Fraser River Drainage Basin, 1950-1951, by J.F.J. Thomas, 1954 (\$1.00)
- Report No. 849 - Industrial Water Resources of Canada - Water Survey Report No. 7, Saskatchewan River Drainage Basin, 1951-1952, by J.F.J. Thomas, 1956 (\$1.00)
- Report No. 856 - Industrial Water Resources of Canada - Water Survey Report No. 8, Mackenzie River and Yukon River Drainage Basins, 1952-1953, by J.F.J. Thomas, 1957 (\$1.30)
- Report No. 858 - Industrial Water Resources of Canada - Water Survey Report No. 9, Churchill River and Mississippi River Drainage Basins, 1952-1954, by J.F.J. Thomas, 1958, (75 cents)
- Report No. 861 - Industrial Water Resources of Canada - Water Survey Report No. 10, Nelson River Drainage Basin in Canada, 1953-1956, by J.F.J. Thomas, 1959 (\$1.30)
- Report No. 864 - Industrial Water Resources of Canada - Water Survey Report No. 11, The Atlantic Provinces, and The Saint John River Drainage Basin in Canada, 1954-1956, by J.F.J. Thomas, 1959 (\$1.65)
- Report No. 865 - Industrial Water Resources of Canada - Water Survey Report No. 12, Water Quality at Some Canadian Military Establishments, 1956-1957, by J.F.J. Thomas, 1959 (\$1.65)
- Report No. 869 - Industrial Water Resources of Canada - Water Survey Report No. 13, The Lower St. Lawrence River Drainage Basin in Canada, 1955-1960, by J.F.J. Thomas, 1962 (\$2.50)
- Report No. 870 - Industrial Water Resources of Canada - Water Survey Report No. 14, The Upper Great Lakes Drainage Basin in Canada, 1957-1962, by J.F.J. Thomas (in preparation)

Memorandum

- Series No. 132 - Interim Report on Hardness of Major Canadian Water Supplies, by J.F.J. Thomas, 1956 (35 cents)

Any of the above mentioned publications are obtainable from The Queen's Printer, Ottawa or the Publications Distribution Office, Department of Mines and Technical Surveys, Ottawa, Ontario.

622(21(06) 872,c.2 C212

Canada mines branch monograph
872, industrial water resour-
ces, no. 12, supplement, 1963,
c. 2.

